Economic Growth and The Quality of Environment: Evidence of The Environmental Kuznets Curve (EKC) in Indonesia

Idris[1], Yollit Permata Sari[2]

[1, 2] *Fakultas Ekonomi, Universitas Negeri Padang, Padang, Indonesia*

ABSTRACT

This study proved the EKC hypothesis results of the trade-off between economic growth and environmental degradation in Indonesia. The researchers used the non-linear quadratic regression estimation. This study found that the EKC hypothesis was almost valid in all islands in Indonesia, such as Sumatra Island, Sulawesi Island, Borneo Island, and Small Island in the Eastern Region of Indonesia. Thus, the economic growth causes the environmental gradation while the trade-off did not apply in Java and Bali. Government policies regarding the environment and globalization played an important role in generating and transferring production technology that saved resources and used cleaner technology from developed countries to developing countries so the EKC hypothesis does not apply in Indonesia.

Pertumbuhan Ekonomi dan Kualitas Lingkungan: Pembuktian Kurva Environmental Kuznets Curve (EKC) di Indonesia

ABSTRAK

Penelitian ini bertujuan untuk membuktikan apakah hypothesis EKC yang menyatakan bahwa adanya trade off antara pertumbuhan ekonomi dan degradasi lingkungan berlaku di Indonesia. Dengan menggunakan estimasi regresi non linear kuadratik, penelitian ini menemukan bahwa hipotesis EKC hampir berlaku di semua pulau di Indonesia seperti Pulau Sumatra, Pulau Sulawesi, Pulau Kalimantan dan Pulai kecil di Wilayah Timur indonesia yang artinya pertumbuhna ekonomi menyebabkan lingkungan semakin terdegradasi di pulau tersebut, sedangkan trade off tidak berlaku di Pulau Jawa dan Bali. Kebijakan pemerintah mengenai lingkungan dan globalisasi memainkan peran penting dalam menghasilkan dan mentransfer teknologi produksi yang hemat sumber daya dan pemakaian teknologi yang lebih bersih dari negara maju ke negara berkembang sehingga hipotesis EKC tidak berlaku di Indonesia.

Energy consumption is the economic determinant (Ozturk & Acaravci, 2010). Energy is equally important as labor and capital to increase economic growth. Several studies suggest that energy consumption plays an important role in determining economic growth (Cassim et al., 2004; Apergis et al., 2010). Jiang & Chen (2020) explain that energy can increase economic growth because of economic activities. However, the consumption of low-cost, dirty energy and imperfect technology causes environmental damage and threatens the economy. This matter becomes a tradeoff between economic growth and the environment (Shahiduzzaman & Alam, 2012). This fact creates a dilemma between economic growth and environmental quality that currently receives widespread attention nationally and globally.

The debate between economic growth and the environment was started in the early 1990s by Grossman & Krueger (1991). They found a correlation between economic growth and changes in environmental quality, such as an "inverted U" curve. In the early stages of economic development, the environment will only be slightly polluted, but when economic growth continues to increase, the quality of the environment will be worse. In conditions of the peak of economic growth reaching, environmental degradation will be slower and will return to the initial condition. The correlation between these two variables is familiar with the EKC hypothesis or the environmental Kuznets curve (EKC).

Grossman & Krueger (1991) explain that the impact of economic development on environmental quality depends on the stages of development that the country goes through. These stages are also known as scale effects, composition effects, and technical effects. The scale effect is experienced by a country that changes its structure from an agricultural country to an industrial country. At this stage, a country uses natural resources on a large scale. Thus, the exploitation of natural resources cannot be avoided so it is very vulnerable to environmental degradation (Panayotou, 1994). Thus, a negative correlation between economic growth and environmental degradation existed. Economic growth refers to the causes of the depletion of natural resources and poor environmental quality. The second stage is the composition effect. At this stage, the economic growth of a country improves, so the desire to improve the environment will be also higher and change the economic structure of a country from a resource-intensive economy to a service- and knowledge-based, natural resource-intensive economy to a technology-intensive economy based on science (Dinda, 2004). The last stage is the technical effect. At this stage, many countries have carried out research and development (Komen et al., 1997). At this stage, many innovations use green technology that promotes new and cleaner technologies. In this last stage, a positive correlation between economic growth and environmental quality is observable. In the end, the results of these three stages of economic development will produce an inverse-U correlation between economic growth and environmental quality

Some empirical evidence examined the correlation between economic growth and environmental degradation. Shahbaz et al. (2015), Hossain (2012), and Chandran & Tang (2013) explain that economic growth and energy consumption are the causes of environmental damage. Liddle (2015) conducted research in 107 countries. Saidi & Hammami (2015) studied 75 countries. Farhadi (2015) studied 18 randomly selected OECD countries. Apergis et al. (2010) studied 16 industrialized and growing countries. They found a negative correlation between economic growth and energy consumption that caused the environmental quality to deteriorate. Nasreen et al. (2020) found that a 1%

increase in energy consumption would worsen environmental quality by about 0.57% and 0.46% in Asian countries, respectively. Dogan & Turkekul (2016) used panel data analysis in E7 countries (Brazil, China, Indonesia, India, Mexico, Russia, and Turkey) and showed that an increase in the economic growth of 1% led to an increase in carbon emissions of 0.243% which led to environmental degradation.

However, if the research period is distinguished, many researchers found a long-term correlation between the two variables, and no observable correlation in the short term (Liddle, 2015; Ozturk & Acaravci, 2010; Arouri et al., 2012). Ssali, Du, Mensah and Hongo (2019) examined the cointegration and the causal correlation between economic growth and carbon emissions in sub-Sharan Africa countries. By using panel cointegration, the researchers found that the correlation between the two variables only occurred in the short term while in the long term the relationship was positive. Yang et al. (2006) also support the research conducted by Ssali et al (2018) and Khan et al (2018) that economic growth did not cause environmental degradation. So that economic growth was beneficial for the environment and even these two variables supported each other (Beckerman, 1992)

In Indonesia, the environmental quality index (EQI) is calculated using three indicators, namely water quality index, air quality index, and land cover quality index. In 2018, the environmental quality index in Indonesia was 71.76. This figure is the highest value for the last 10 years. However, in 2019, the EQI decreased by 67.20. The water quality index gave the largest contribution to the decline in the EQI from 77.07 to 52.25, while the other two indices only experienced slight changes, namely the air quality index. The air quality increased from 89.36 to 89.83, while the land cover quality index decreased from 75.05 to 77.30 from 2018 to 2019. The comparison of economic growth data in the same year proves the validity of the EKC hypothesis in Indonesia. The result means that the increased economic growth from 5.02% to 5.17% from 2018 to 2019 would decrease the environmental quality from 71.76 to 67.20.

Previous research proved that the EKC hypothesis had an inverse-U correlation between economic growth and environmental quality. These studies focused on different countries, periods, proxy variables, and different methodologies to describe the correlation between economic growth and environmental degradation. Thus, the results of these studies are different. First, most of the previous studies on the EKC hypothesis focused on one variable as a proxy to describe environmental degradation by ignoring other variables (Al-Mulali et al., 2015; Jha & Murthy, 2003; Kurniawan et al., 2021). Second, predictions regarding the EKC hypothesis are still unclear thus the prediction needs a more comprehensive study that addresses the limitations of previous studies. From the above phenomenon, several previous debatable studies become more prominent. The fact shows the conflict between economic growth and the environment is more complex. Thus, the authors are interested in researching the further correlation between economic growth and environmental quality on the islands in Indonesia with quadratic regression.

METHOD

Data Analysis

This study proved the EKC hypothesis about the trade-off between economic growth and environmental degradation in Indonesia. Theoretically, economic growth causes excessive consumption of natural resources which causes a degraded environment. In this

study, the researchers used GDP as an indicator to represent economic growth. The researchers also used the Environmental Quality Index as an indicator to describe the condition of environmental degradation. The EQI consists of three components: Water Quality Indicators, Air Quality Indicators, and Land cover Quality Indicators. The researchers obtained the data from the Central Bureau of Statistics, the Ministry of Environment and Forestry of the Republic of Indonesia, and the World Bank from 2009-2019.

Research Model

This quadratic regression model study examines the tradeoff between economic growth and environmental degradation in Indonesia. The underlying assumption was the evidence of the trade-off in developing countries. The use of quadratic regression could estimate the correlation between dependent and independent variables in a non-linear form. This approach provided better accuracy in estimating the model due to the algorithm iteration (Gujarati, 2009).

In general, regression analysis is a statistical analysis method to examine the effect of two or more variables. The correlation is expressed in a mathematical model (Steel, 1980). Regression analysis is divided into linear and non-linear regression analysis (Walpole, 1993). Quadratic regression analysis is an example of non-linear regression analysis. Non-linear regression is a regression model in which the parameters are nonlinear. Thus, if the value is lower, the obtained results are still in the form of parameters (Gujarati, 2009). This regression analysis does not follow a straight line but in the form of a curve. The form of the quadratic regression equation in this study is

$$Y_1 = \beta_{1e}\beta_2 x_1 + \mu_1 \ \text{...............}(1)$$
With:

$\beta 1$: constant
$\beta 2$: regression coefficient
Xi : GDP
Y : Environmental Quality Index
μ_1 : error

RESULTS AND DISCUSSIONS

Descriptive Analysis

Economic growth contributed to improving the standard of living and quality of life of a country. On the other hand, economic growth also depleted the natural resources and degraded the ecosystems. The increased CO_2 levels on earth occur due to human activities. Thus, humans encounter climate change in the world.

Currently, many scholars are debating about achieving economic growth without damaging the environment. The correlation between environmental protection and economic development has been a controversial issue. In 1970, growth limit became a popular term at the time. The term emphasized that a country had to lower the economic growth rate to protect the environment.

In Indonesia, the measurement of environmental quality applies an index known as the Environmental Quality Index (EQI). The indexing measurement uses 3 indicators: the Water Quality Index (WQI), Air Quality Index (AQI), and the Land Cover Quality Index (LCQI). The measurement results of these indicators are divided into 5 classifications. If the IKLH value is higher than 80, the category will be very good, 70-80 is categorized as good, 60-70 is categorized as moderate, 50-60 is categorized as low; and less than 50 is categorized as poor. The environmental quality index is useful to inform and support the policy-making process related to environmental protection and management in Indonesia.

The measurement results of the environmental quality index in 2009 are observable in Figure 1. The Air Quality Index

is in the very good category, while the Water Quality index is in the poor category. Then, from year to year, the value fluctuated with the highest quality reaching 77.77. However, in 2019, a significant decrease reached the level of 55.55 (poor category). Low Water Quality Index was closely related to waste disposal in rivers. Meanwhile, the Land Cover Quality Index Trend also showed a low level due to illegal logging and unsuccessful forest rehabilitation efforts. Generally, the Environmental Quality Index in Indonesia indicates an insignificant increased level in the category of the excellent category.

Figure 1. Environmental Quality Index
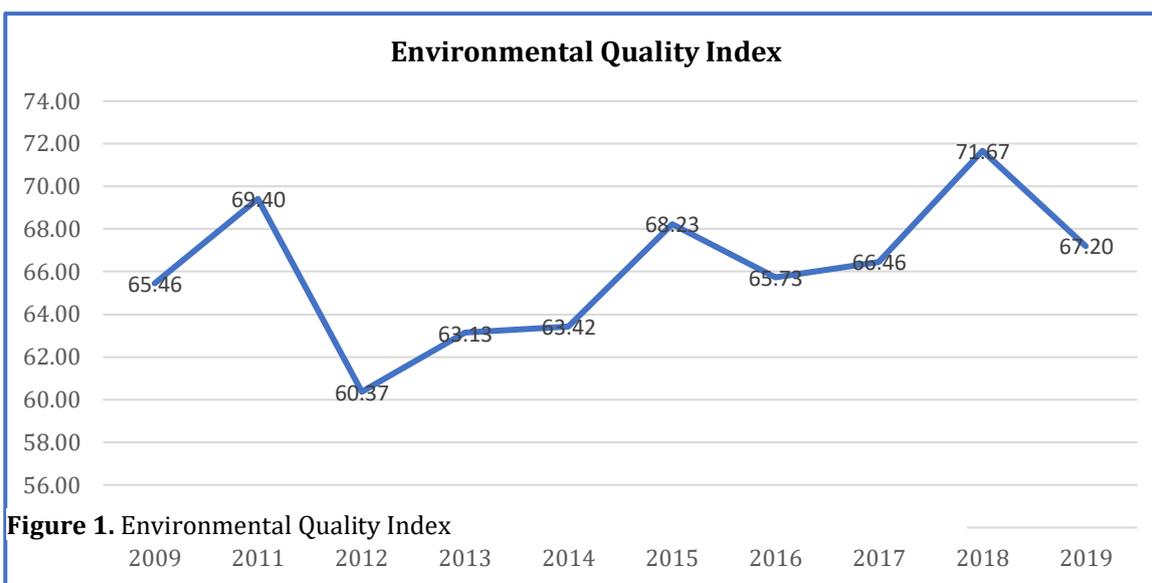
Sources: BPS, 2019

Estimation Results using Quadratic Regression

The researchers divided the territory of Indonesia into islands to observe the correlation between economic growth and the EQI. The territories were Sumatra, Java and Bali, Sulawesi, Borneo, and Small Islands in Eastern Indonesia. Figure 2 shows the EKC hypothesis results are almost valid on all islands in Indonesia, starting from Sumatra Island, Sulawesi Island, Borneo Island, and Small Island in the Eastern Region. The result shows a negative correlation between economic growth and the environmental quality index in Indonesia. On the other hand, the EKC hypothesis did not apply in Java and Bali. The result indicates that economic growth does not cause environmental degradation on these islands.

The existence of a negative correlation between economic growth and the environment in several islands in Indonesia showed that economic growth was not optimal in supporting environmental sustainability. Thus, the economic growth seemed to experience environmental degradation. These findings support Sasana& Aminata (2019) research that found the stage of economic growth in Indonesia did not reach a turning point to support economic growth. The complete results of these relations between economic growth and the environmental quality index in some islands in Indonesia are shown in Table 1, Table 2, Table 3, Table 4 and Table 5.

In Sumatra, the domination was from the agricultural sector. Dinda (2004) found that the acceleration of economic development in agriculture-dominated by

Figure 2. Estimation Results using Quadratic Regression

Relationship Between Economic Growth and Environmental
Quality Index in Sumatra Island

The Relationship Between Economic Growth And The
Environmental Quality Index In Java And Bali

Relationship Between Economic Growth and
Environmental Quality Index in Sulawesi Island

The Relationship Between Economic Growth And
Environmental Quality Index In Kalimantan Island

Relationship Between Economic Growth and Environmental
Quality Index in Small Islands in the Eastern Region

Source: Data Processed, 2020

Table 1. Relationship Between Economic Growth and The EQI on Sumatra Island

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	89.363	2	44.363	.677	.632
Residual	406.366	7	58.052		
Total	495.528	9			

Source: Data Processed, 2020

Table 2. The Relationship Between Economic Growth and The EQI in Java and Bali

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	17.982	2	8.991	.791	.490
Residual	79.527	7	11.361		
Total	97.509	9			

Source: Data Processed, 2020

Table 3. The Relationship Between Economic Growth and The EQI in Sulawesi

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	16.786	2	8.393	.201	.822
Residual	292.162	7	41.737		
Total	308.948	9			

Source: Data Processed, 2020

Table 4. The Relationship Between Economic Growth and The EQI in Kalimantan

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	144.104	2	72.052	5.563	.036
Residual	90.670	7	12.953		
Total	234.774	9			

Source: Data Processed, 2020

Table 5. The Relationship Between Economic Growth and The EQI in Small Islands in the Eastern Region

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	13.908	2	6.954	.658	.547
Residual	73.966	7	10.567		
Total	87.874	9			

Source: Data Processed, 2020

applied some processes of economic development, such as agricultural intensification and resource extraction. These processes depleted the resources rapidly. On the other hand, the regeneration rate of new resources was slow so pollution would emerge in large numbers. This condition led to the environmental quality problem due to the economic growth in Sumatra.

An area requires higher inputs to achieve higher growth rates. Thus, this area would have increased waste and emission production due to economic activities. Economic growth in Sulawesi, Borneo, and small islands in the Eastern Region was dominated by the mining sector. Thus, land clearing activities and cleaning of new min-

ing sites would impact the air quality, water quality, and land cover quality. Apergis et al. (2010) and Jahangir Alam et al. (2012) found that excessive use of energy disrupted the environmental quality. The island also did not rely on non-renewable and environmentally friendly energy sources to increase economic growth. Aye & Edoja (2017) found that an industrialized country would have increased pollution that harmed the environment.

The evidence in Java and Bali found a positive correlation between economic growth and the environment. The result indicated an increased income and environmental quality. The finding was contradictory to the EKC theory about a negative relationship between economic growth and the environmental index.

Al-Mulali et al. (2015) explain that regions with low incomes are in the early stages of economic development so when economic growth increases, environmental damage will also increase. However, countries with relatively high-income levels will tend to use renewable energy or the latest and most efficient technology to prevent environmental damage. This action is difficult to apply in regions with low incomes because the technology takes a high cost.

In Java and Bali, the economic growth rate is higher than in other islands. The Central Bureau of Statistics in 2020 showed that Java was an island with a major contribution to economic growth in Indonesia. Thus, the economic growth and the environment had a positive correlation on this island. Komen et al. (1997) explain that structural change in an industrial sector based on technology and knowledge causes an area capable of carrying out Research and Development. Thus, the environmental quality will not be disturbed. This can only be carried out in an area that has a fairly high economic growth, high education level of humans, and high implementation research and development.

The EKC hypothesis also emphasizes the positive correlation between economic growth and environmental quality with the implementation of appropriate policies for environmental protection. Many regions in Java and Bali have made various environmental preservation policies, such as providing free water pumps for residents. Thus, the annual flash flood management in Solo can be resolved. The other policy is the tree planting policy in Surabaya. The city has 30 parks in Surabaya with a plan to add 5 parks every year. In Java, the governments applied various policies. Thus, the EKC hypothesis about reducing economic activity was not suitable for Java and Bali because these areas had a positive correlation between economic growth and the environment (Charfeddine et al., 2018). Moreover, in these areas (Java and Bali Island), its people rely more on other industries based on services and creative economy (Juariyah, 2015; 2018) that do not over-exploit the environment and instead support environmental sustainability.

CONCLUSION AND SUGGESTION

The environment plays a very vital role to support the economy. Thus, economic and environmental performance should go hand in hand. The environment contributes to providing natural resources for the process of producing goods and services. In addition, the environment through its ecosystem is also useful for carbon sequestration, water purification, and flood risk management. Therefore, the environment is very important to promote economic growth and development in both present and future eras.

This study examined the correlation between economic growth and the environment in the islands of Indonesia. Economic growth could protect the environment from damage or vice versa. From the estimation results using quadratic regression, the researchers found a negative correlation between economic growth and the environment on almost all islands in Indonesia, such as Sumatra Island, Sulawesi Island, Borneo Island, and small islands in the Eastern Region. The

existence of economic growth made the environment on the island degraded. Meanwhile, in Java and Bali, the researchers found a positive correlation between the two variables. The result indicated economic growth did not degrade the environment. It is probably because the use of environmentally friendly technology and society is more concern with environment sustainability.

The existence of a negative correlation between economic growth and the environment does not mean that a bad environment is only caused by the process of economic development. Many factors influence the quality of the environment, such as social, natural, and the role of environmental law enforcement. A clear policy is important to overcome this problem, especially on islands with proven EKC hypotheses, such as Sumatra, Sulawesi, Borneo, and Small Islands in the Eastern Region of Indonesia.

The government can create a legal draft of the environment as a short-term effort to overcome the negative impacts of economic growth and the environment, such as by imposing an emission tax. The government can also educate the public about an environmentally friendly culture. Meanwhile, in the long term, the government can encourage companies to innovate with more environmentally friendly technologies. In this context, globalization can play an important role in generating and transferring resource-efficient production technologies from developed countries to developing countries.

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