Environmental Quality in Emerging Markets: EKC Hypothesis and Bond Test Perspective

Firsty Ramadhona Amalia Lubis[1*], Nurul Anwar[2], Arintoko[3]

[1*] Jendral Soedirman University / Ahmad Dahlan University, firsty.ramadhona@ep.uad.ac.id , Indonesia
[2] Jendral Soedirman University, nurul.anwar@unsoed.ac.id , Indonesia
[3] Jendral Soedirman University, arintoko@unsoed.ac.id , Indonesia
*firsty.ramadhona@ep.uad.ac.id

ABSTRACT

Emerging markets is a term that refers to economies whose economic growth is rapidly increasing and have some characteristics like developed countries. Concentration of greenhouse gases in the earth's atmosphere caused by rising global temperatures leading to warming. The EKC hypothesis was conducted by Grosman & Krueger in 1991, which supports the EKC claim that environmental degradation and economic growth are interrelated. This study aims to examine the effect of GDP variables, renewable energy consumption, forest area, and population urbanization on emissions. This study uses the Generalized Method of Moments panel model with Bond Test analysis, with research locations in Indonesia, Malaysia, the Philippines, and Thailand. The results show that the EKC hypothesis is not proven in ASEAN emerging market countries, renewable energy consumption has a significant effect on emissions, forest land area has a significant effect on emissions, and urbanization has no significant effect on emissions.

**Keywords: EKC, emissions, renewable energy, GDP, Forest**

1. Introduction

Simon Kuznets' theory in the book (Economic Growth and Income Inequality) explains the relationship of the inverted U-curve between income per capita income and income inequality, it can be said that there is a correlation between income inequality and income inequality. if income inequality increases followed by an increase in income per capita. In addition, the inverted U-curve results from non-inclusive growth where economic growth focuses on growth, where economic growth focuses on one particular profitable sector, while other sector, while other sectors remain stagnant. With a non-diverse economic structure, this can lead to inequality (Kuznet, 1995).

The global economy emerging markets are significant players As Cristina Lagarde has said, during the economic crisis that occurred in 2008, 80% of world economic growth was generated by emerging market countries. The market for goods and capital in emerging market countries are undergoing development, this is what the has the potential to attract investors, which results in the country having Emerging markets is a term that refers to economies where economic growth has increased considerably. The emerging market is a term that refers to an economy

where economic growth has increased considerably and has some attributes like developed economies. Emerging market countries are experiencing a transition from the developing phase to the extended stage (Corporate Finance Institute, 2020).

One of the region's most vulnerable to the impacts of climate change is ASEAN. According to the 2018 Global Climate Risk Index (CRI), countries such as Myanmar, the Philippines, Vietnam and Thailand are in the top 10 most affected by extreme climate events during 1999-2018 (Eckstein, Kunzel, Schafer, & Winges, 2019). ASEAN is a region with the majority of developing countries. There are 4 countries that are categorized as emerging markets, namely Indonesia, Malaysia, the Philippines, and Thailand. Emerging market is a term that refers to an economy where economic growth has increased considerably and has several characteristics such as developed economies (Corporate Finance Institute, 2020). Based on data from Bloomberg, IMF, and World Bank, a country categorized as an emerging market is measured using economic indicators including GDP, inflation, government debt, and investor concerns such as ease of doing business, level of corruption, and economic freedom.
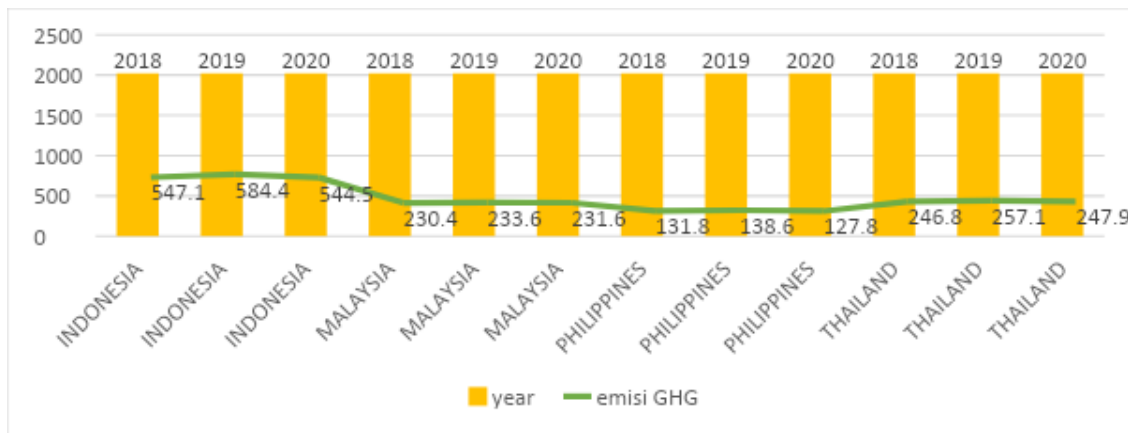
Source: IEA data processed

Chart 1.1
CO2 Emission Data Chart (CHG)

CO_2 greenhouse gas emissions measured in metric tons in four Emerging Market countries from 2018 to 2020 experienced significant growth. The growth of CO_2 emissions in emerging market countries fluctuates and tends to increase in 2018-2020 This increase is due to the increasing demand or use of fossil fuels. International Energy Agency (IEA) data also shows an increasing trend in CO_2 emissions in Indonesia and Thailand. According to the International Energy Agency (IEA), Indonesia is the country with the largest CO_2 gas emissions in the ASEAN region.

Economic development with the aim of developing the quality of human life is actually the biggest contributor to environmental damage. This is based on economic development that does not pay attention to the preservation of the surrounding environment. Development that is brought to life with the mission of improving people's welfare has an unfavorable impact on the quality of the environment. Damage to environmental quality is strongly related to the consumption of energy that is not environmentally friendly when carrying out the economic development process. (Carfora, Pansini, & Scandurra, 2019). In research Nikensari, Destilawati, & Nurjanah (2019), decreased health, decreased happiness and decreased subjective health and

well-being are also discussed as effects of low environmental quality, especially air pollution (Zhang, Liu, & Bae, 2017). To preserve the environment in the present and future, the government must carry out sustainable development, particularly through limiting CO_2 emissions (OECD, 2015). Therefore, this study aims to examine the Environment Kuznets Curve (EKC) hypothesis on economic growth renewable energy consumption, forest area, and urbanization on emissions.

2. Literature Review

According to the Environmental Kuznets Curve theory, (Harris & Roach, 2021), a country's initial economic boom may cause its environmental effects to decline after reaching a certain level of wealth. In the 1950s, economist Simon Kuznets originally proposed the EKC theory. This theory explains the inverted U-shaped relationship between the level of environmental damage and per capita income. According to the EKC hypothesis, for economic progress to take place, there must first be a period of environmental degradation. However, due to changes in economic structure, when economic expansion reaches its peak, environmental degradation will decline (Galeotti, 2007).

Energy is a very important component in carrying out production tasks. The amount of energy used or required per unit of output is referred to as energy intensity. Reduced energy intensity is a sign of increased energy efficiency (Fitriyanti & Iskandar, 2019). Several factors, including population growth, lifestyle changes, increased output, and economic competitiveness, contribute to increased energy demand. Using too much fossil fuel results in an increase in carbon dioxide (CO_2), which has a negative impact on the environment including global warming (Eren, Taspinar, & Gokmenoglu, 2019). Bilgili, Kocak, & Bulut (2016) found that factors related to the use of renewable energy have a negative influence on CO_2 emissions. The negative impact of environmental destruction that damages living things will be reduced by the use of renewable energy.

People tend to urbanise due to reduced costs and maximum accessibility to urban services and can eliminate transport costs (Alonso, 1964). Antrop (2004) agrees with the idea that, from a technical point of view, transport distance and costs are important with respect to the spatial diffusion of urban land use. Empirical studies conducted to determine the impact of urbanisation on environmental degradation have confirmed that this impact is more or less significant and can be both positive and negative (Xin, Zhang, Zhao, Xu, & Wang, 2017). Wang, Liu, Zhaou, Hu, & Ou (2017) confirmed the impact of urbanisation on CO_2 emissions in four major cities in China. Yuan, Rodrigues, Wang, Tukker, & Behrens (2022), found that urbanisation increases the household gas footprint in developing regions of China. The significant and positive impact of urbanisation on environmental degradation is also confirmed by other studies (Wang, Liu, Zhaou, Hu, & Ou, 2017). Yuan, Rodrigues, Wang, Tukker, & Behrens (2022), The economic growth driven by urbanisation also increases carbon dioxide emissions, which means it contributes to environmental degradation.

Harris & Roach (2021) forests are included in biological systems that can be compromised if overexploited. Increasing the area of forest area can increase carbon storage so that it can remove CO_2 gas emissions from the earth's atmosphere. According to the research of Kurniarahma, Laut, & Prasetyanto (2020); Begum, Raihan, & Said (2020), there is a significant negative effect in the short term between the variables of the comparison of forest area. variable Carbon dioxide emissions from forest degradation cause the smaller the percentage of forest area to the size of a country will have a destructive impact and increase carbon dioxide emissions.

3. Research Methodology

This study uses quantitative data, renewable energy consumption, forest area, urbanisation, and gross domestic product. The dependent variable of this study is emissions in ASEAN emerging market countries, which include Indonesia, the Philippines, Malaysia, and Thailand, from 2011-2020. This study uses the Arellano Bond dynamic panel model. Research variables Emissions are gases formed through various combustion processes with units of metric tonnes, data obtained from the International Energy Agency. Renewable energy consumption is the amount of renewable energy consumed by society with units of per cent, data obtained from the World Bank. Forest area is the total amount of tree cover in the forest with units of percent, data obtained from the World Bank. Urbanisation rate is the percentage of the population living in urban areas with units of percent, data obtained from the World Bank. GDP is a measure of the growth of living standards and per capita income in per cent, data obtained from the World Bank. According to Baltagi, a common problem in dynamic panels is the correlation between explanatory variables, resulting in biased GLS estimates. This problem can be solved by the GMM Arellano and Bond methods which produce more constant parameters.

Arellano and Bond is a technique that can see the correlation between explanatory variables and lagged values. Because the number N is greater than the number T of observations. The form Arellano Bond suggests is first diff The estimator in the optimal GMM model of ($\delta 1$) according to Hansen for N $\rightarrow \infty$ and T. The GMM estimator δ is obtained by minimizing the weighted quadratic function J(δ) as an equation (Baltagi, 2005)

$$y_{it} = \delta y_{1,t-1} + \beta x'_{it} + \mu_{it} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(1)$$

Blundell & Bond (1998) attributed the bias and poor precision of the FD-GMM estimator to the weak instruments, which are characterized by their parameter concentration FD- GMM as δ à 1 and ($\frac{\sigma_\mu^2}{\sigma_u^2}$) increases (Baltagi, 2005).

Equation:

(Emisi)it = α + δ (Em) it-1 + β1(G)it + β2(G²)it + β3(Cnre) it + β4(For) it + β5ln(Urban) it + εit

Description :
- Emissions: Emission Co2
- G   : Economic Growth
- CnRe   : Consumption Renewable Energy
- For   : Forest Area
- Urban   : Urbanisation

Arellano Bond (Baltagi, 2005), to test the hypothesis of the absence of second order serial correlation in the error term in the first diff. The hypothesis can be stated to be true when the vit is not correlated. Arellano Bond proposes to perform the Sargan test to avoid over identifying restriction. Arellano Bond proposes a stage of hypothesis testing that there is no second order

serial correlation in the first derivative. First derivative. Thus, this model does not have overidentifying restriction, which makes the data stable and unbiased. Using the Sargan test and the consistency of the instruments used using the Arellano Bond test. Sargan test to identify the validity of all instrument variables whose number exceeds the estimated parameters (over-identifying condition) with the null hypothesis that the instrument is valid. identifying conditions with the null hypothesis that the instrument is valid over-identifying. (restrictions are valid, and instrument variables are not correlated with error).

4. Results

Analysing data requires descriptive statistics to describe or describe the data as it is without making conclusions from the data.The type of data used in this research is secondary data where the data obtained through other trusted parties. The data used is panel data for 4 emerging market countries with 12 years, namely 2011-2021. The following is a recapitulation of the descriptive analysis of each variable data.

Table Descriptive Data

Variabel	Mean	Std. Deviasi	Min	Max
Emisi	264.922	147.510	79.1	584.4
GDP	2.76	3.47	-11	6,6
GDP^2	19,4442	19,357	1,34	0.181
Cnre	21,007	10,706	2,16	34,06
Forest	42,996	13,342	23,05	59,24
Urban	55,64	11,46	44,69	77,16

Source: Stata.14 data processing results

The table above is a description of each variable used in this study. Observations or observations refer to the total amount of data used in the study. The max value is the maximum or highest value in each variable, while the min value or minimum value is the lowest in each variable. Mean is the average value of each data in the study. In determining the data distribution in a sample and how close each data is to the mean value using standard deviation. At this stage, the dynamic panel data regression model is estimated using the first-difference GMM approach.

Table 2. Result of FD-GMM

Variabel	Coefficient	Std. Error	Z-Statistic	Prob.
L. Emisi	0,312	0,054	5,72	0.000
GDP	-19,46	4,44	-4,38	0.000
GDP^2	2,36	0,52	4,54	0.000

Cnre	-6,482	0,950	-6,82	0.000
Forest	-10,15	3,63	-2,79	0.005
Urban	2,420	1,911	1,27	0.205
Cons	662,336	177,632	3,73	0,005

Source: Stata.14 data processing results

Result Interpretation

$(Emisi)it = \alpha + \delta$ **Emisi** $(0.312)it$-**1** $+ \beta1$ **G**$(-19,461)$ $it + \beta2G^2(2,36)it + \beta3$**CnRE**$(-6,48)$ $it + \beta4$**Forest**$(-10,15)it +$

$\beta5$**urban**$(2,42)it + \varepsilon it$ ....**(1)**

Description:
Emissi (0.312)=> Carbon dioxide emissions increase by 1 Metric ton in the previous period, it will increase the greenhouse gas emissions emerging market countries by 0,312 Metric tons.
GDP (-19,46)   => Economic growth increases by 1 percent, it will reduce greenhouse gas emissions   emerging market countries by 19,46 Metric tons.
GDP2 (2.36) => Economic growth increases by 1 percent, it will increase greenhouse gas emissions   emerging market countries by 2,36 Metric tons
CnRE (-6,48)=> Renewable energy consumption increases by one percent, it will reduce greenhouse gas emissions in emerging market countries by 6,48 Metric tons.
Forest (-10,15) => Forest land area increases by one percent, it will reduce greenhouse gas emissions in emerging market countries by 10,15 Metric tons
Urban (2,42) => urbanisation variable has no significant effect on greenhouse as emissions emerging market countries

Result Arellano-Bond Test
The Arellano-Bond test is used to determine the consistency obtained from the Difference Generalised Method of Moments (GMM) process Table 3.

Table 3. Result Bond Test

	First Difference	
Arellano Bond -Test		
	Chi-Sq.Statistic	Prob>Chi2
	AR (1) = -1,15	0,2568
	AR (2) = 0,43	0,6661

Source: Stata.14 data processing results
The opinion (Arellano & Bond, 1991) that mathematically Δvit is correlated with Δvit-1, where each element contains Δvit-1 so that the autocorrelation test in AR (1) and AR (2) autocorrelation test is applied to order 2. The probability value in AR (1) and AR (2) in the

model is more significant than alpha (1%, 5%, 10%), so there is no autocorrelation in the residuals. So, it can be concluded that the estimation is consistent, and there is no autocorrelation in the second-order first-difference error.

Result Sargan Test
The Sargan test is used to determine the validity of using data that exceeds the number of parameters estimated. Resulting in a high/considerable cross-section value, means that to determine the validity of using instrument variables whose number exceeds the number of estimated parameters (overidentifying conditions). The test in Table 4 serves to determine whether the dynamic panel model used is valid. The probability value of the Sargan test can be used to determine the validity of the dynamic panel model.

Table 4. Result Sargan Test

	First Difference	
Sargan -Test	Chi-Sq.Statistic	Prob>Chi2
	18,1708	0,6382

Source: Stata.14 data processing results

The test results show that the probability of the Sargan test is 0.6382, while the significance level of the study is 0.050, or 5%. The results show that the Sargan test probability of 0.6382 is more significant than 0.050. to ensure that the dynamic panel model used in this study is accurate and can be used correctly.

5. Discussion

The results show that EKC theory cannot be proven in emerging market countries. Economic growth in the short term has a positive and significant effect on greenhouse gas emissions variables. While in the long run, it has a negative impact on greenhouse gas emissions. Thus, the Kuznets curve theory does not apply to this study. This result is in line with Ugur and Abdullah's research (Pata & Caglar, 2021) which states that the EKC hypothesis is not valid in China, where the GDP per capita and GDP per capita squared variables have positive values - reinforced by research (Leal & Marques, 2020) where the results show that in countries with low globalisation the EKC hypothesis is not proven. Kasimu, Opoku, & Lambon (2017) published a related study in Ghana which showed that there is a short-run equilibrium, but the EKC has not been proven and has no real impact. Ali, Khatoon, Ather, & Akhtar (2015), conducted a similar study in Pakistan, which showed that there is a short-run equilibrium but did not support EKC. As CO2 greenhouse gas emissions are a type of global pollution that can go up or down and is expected to take a very long time.

Second, the research variable of renewable energy consumption significantly negatively affects emissions. Renewable energy consumption increases by one per cent, it will reduce emissions in emerging market countries by 6.48 Metric tonnes. This analysis found that the use of renewable energy can reduce CO2 emissions. This finding is supported by research by Bilgili et al. (2016) which states that factors related to the use of renewable energy can reduce CO2 emissions. Various negative impacts of environmental destruction that damage living things will be reduced

by using renewable energy. Renewable energy consumption is negatively related to CO2 emissions, which means that when renewable energy consumption increases, CO2 emissions decrease. Renewable energy is clean and environmentally friendly because it produces far fewer pollutants than fossil fuels, so it negatively impacts CO2 emissions (Lubis, Suharno, & Arintoko, 2023).

Third, the forest area variable is known to have a significant negative impact on emissions. This means that every 1% increase in a country's forest area will be able to reduce the value of CO2 emissions by 42.99 metric tonnes. Since the coefficient is negative, an increase in the percentage value of one variable will decrease the dependent variable's value. Thus, slowing deforestation and/or maintaining forest areas will have a positive impact by reducing the amount of CO2 emissions in a country (Krisnawati, Imanuddin, Adinugroho, & Hutabara, 2015). The research is accordance with the results of Begum et al. (2020) there is a significant negative effect in the short term between the variables of forest area comparison. The variable of carbon dioxide emissions from forest degradation causes the smaller the percentage of forest area to the area of a country will have a destructive impact and increase carbon dioxide emissions.

The last study looked at the influence of urbanization variables on emissions in emerging market countries. The results show that urbanization has no effect on emissions in 4 emerging market countries: Indonesia, Malaysia, Philippines, and Thailand. The research aligns with Ali, Law, & Zannah (2016) study looked at the dynamic impact of urbanization on CO2 emissions in Nigeria based on autoregressive distributed lags (ARDL) approach for the period 1971-2011. The results showed that the long-run coefficient showed that urbanization has no significant impact on CO2 emissions in Nigeria.

6. Conclusion

Based on the results of the study, it was found that the EKC theory was not proven in the study. renewable energy consumption variables and forest land area have a negative and significant effect on emissions. policy implications that can be done by the government are to issue supporting policies to improve governance in order to accelerate renewable energy projects. This is realised, among others, in the form of ease of licensing, improvement of data and information, implementation of monitoring and evaluation and facilitation of problem solving for geothermal projects. Then, the government can increase the area of forest land as efforts to reduce emissions from Deforestation and Forest Degradation in Developing Countries (REDD) emerge as a key component of climate change mitigation efforts. REDD hopes to stabilise atmospheric CO2 concentrations at the lowest possible level through a system of payments to countries that reduce or halt deforestation.

Reference

Ali, A., Khatoon, S., Ather, M., & Akhtar, N. (2015). Modeling Energy Consumption, Carbon Emission and Economic Growth. *International Journal of Energy Economics and Policy, 5*(2), 624-630.

Ali, H. S., Law, S. H., & Zannah, T. I. (2016). Dynamic Impact of Urbanisation, Economic Growth, Energi Consumption, and Trade Openness on CO2 Emissions in Nigeria. *Environment Sicence Pollution Research, 23*, 12435-12443. doi:https://doi.org/10.1007/s11356-016-6437-3

Alonso, W. (1964). *Location and Land Use: Toward a General Theory of Land Rent.* Amerika Serikat: Harvard University Press. doi:https://doi.org/10.4159/harvard.9780674730854

Antrop, M. (2004). Landscape Change and The Urbanization Process in Europe. *Landscape and Urban Planning, 67*(1-4), 9-26. doi:https://doi.org/10.1016/S0169-2046(03)00026-4

Arista, T. R., & Amar, S. (2019). Analisis Kausalitas Emisi CO2, Konsumsi Energi, Pertumbuhan Ekonomi dan Modal Manusia di ASEAN. *Universitas Negeri Padang*.

Baltagi, B. H. (2005). *Econometric Analysis of Panel Data.* England: John Wiley & Sons, Ltd.

Begum, R. A., Raihan, A., & Said, M. N. (2020). Dynamic Impacts of Economic Growth and Forested Area on Carbon Dioxide Emissions in Malaysia. *Sustainability, 12*(22), 9375. doi:https://doi.org/10.3390/su12229375

Bilgili, F., Kocak, E., & Bulut, U. (2016). The Dynamic Impact of Renewable Energy Consumption on CO2 Emissions: A Revisited Environmental Kuznets Curve Approach. *Renewable and Sustainable Energy Reviews, 54*, 838-845. doi:https://doi.org/10.1016/j.rser.2015.10.080

Blundell, R., & Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics, 87*, 115-143.

Carfora, A., Pansini, R. V., & Scandurra, G. (2019). The Causal Relationship Between Energy Consumption, Energy Prices and Economic Growth in Asian Developing Countries: A Replication. *Journal of Energy Strategy Reviews, 23*, 81-85. doi:https://doi.org/10.1016/j.esr.2018.12.004

Corporate Finance Institute, C. (2020, January 30). *Emerging Markets.* Diambil kembali dari CFI: https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=0CDcQw7AJahcKEwiYhOScr82BAxUAAAAAHQAAAAAQAw&url=https%3A%2F%2Fcorporatefinanceinstitute.com%2Fresources%2Feconomics%2Femerging-markets%2F&psig=AOvVaw1VR0pHfHaJtqpz1KNR_lSn&u

Eckstein, D., Kunzel, V., Schafer, L., & Winges, M. (2019). Who Suffers Most from Extreme Weather Events? Weather-Related Loss Events in 2018 and 1999 to 2018. *Global Climate Risk Index 2020*, 1-42. doi:https://germanwatch.org/sites/germanwatch.org/files/20-2-01e%20Global%20Climate%20Risk%20Index%202020_10.pdf

Eren, B. M., Taspinar, N., & Gokmenoglu, K. K. (2019). The Impact of Financial Development and Economic Growth on Renewable Energy Consumption: Empirical Analysis of India. *Science of The Total Environment, 663*, 189-197. doi:https://doi.org/10.1016/j.scitotenv.2019.01.323

Fitriyanti, F., & Iskandar, D. D. (2019). An Analysis on Determinants of Energu Intensity in ASEAN Countries. *Jurnal Ekonomi dan Studi Pembangunan, 11*(1), 90-103. doi:http://dx.doi.org/10.17977/um002v11i12019p090

Galeotti, M. (2007). Economics Growth and The Quality of The Environment: Taking Stick. *Environment, Development, and Sustainability, 9*(4), 427-454. doi:http://dx.doi.org/10.1007/s10668-006-9030-y

Harris, J. M., & Roach, B. (2021). *Environmental and Natural Resource Economics: A Contemporary Approach.* Britania Raya: Routledge.

Kasimu, O., Opoku, G., & Lambon, S. (2017). Factors Affecting The Performance of Small and Medium-scale Enterprises in The East Mamprusi District of The Northern Region of Ghana. *International Journal of Engineering, Business and Enterprise Applications, 22*(1), 11-17.

Krisnawati, H., Imanuddin, R., Adinugroho, W. C., & Hutabara, S. (2015). *Metode Standar untuk Pendugaan Emisi Gas Rumah Kaca dari Hutan dan Lahan Gambut di Indonesia.* Jakarta: Kementerian Lingkungan Hidup dan Kehutanan.

Kurniarahma, L., Laut, L. T., & Prasetyanto, P. K. (2020). Analisis Faktor-faktor Yang Mempengaruhi Emisi CO2 di Indonesia. *DINAMIC: Directory Journal of Economic, 2*(2), 368-385. doi:https://dx.doi.org/10.31002/dinamic.v2i2.1429

Kuznet, S. (1995). Economic Growth and Income Inequality. *The American Economic Review, 45*, 1-28.

Leal, P. H., & Marques, A. (2020). Rediscovering The EKC Hypothesis for The 20 Highest CO2 Emitters Among OECD Countries by Level of Globalization. *International Economics, 164*(C), 36-47. doi:10.1016/j.inteco.2020.07.001

Lubis, F. R., Suharno, S., & Arintoko, A. (2023). Sectoral Analysis Of Carbon Emissions And Economic Factors: Dinamis Model. *MYIC, 2*, 34-44.

Nikensari, S. I., Destilawati, S., & Nurjanah, S. (2019). Studi Environmental Kuznets Curve Di Asia: Sebelum dan Setelah Millenium Development Goals. *Jurnal Ekonomi dan Pembangunan, 27*(2), 11-25. doi:https://doi.org/10.14203/JEP.27.2.2019.11-25

OECD. (2015). *Better Policies for Development 2015: Policy Coherence and Green Growth.* Paris: OECD. doi:http://dx.doi.org/10.1787/9789264236813-en

Pata, U. K., & Caglar, A. E. (2021). Investigasting The EKC Hypothesis with Renewable Energy Consumption. Human Capital, Globalization and Trade Openness for China: Evidence from Augmented ARDL Approach with a Structural Break. *Energy, 216*, 119220. doi:https://doi.org/10.1016/j.energy.2020.119220

Wang, S., Liu, X., Zhaou, C., Hu, J., & Ou, J. (2017). Examining The Impacts of Socioeconomic Factors, Urban Form, and Transportation Networks on CO2 Emissions in China's Megacities. *Applied Energy, 185*(1), 189-200. doi:https://doi.org/10.1016/j.apenergy.2016.10.052

Xin, Zhang, i., Zhao, Y., Xu, X., & Wang, C. (2017). Urbanisation Effect on Energy-Related Carbon Emissions in Jiangsu Province from The Perspective of Resident Consumption. *Polish Journal of Environmental Studies, 26*(4), 1875-1884. doi:https://doi.org/10.15244/pjoes/68953

Yuan, R., Rodrigues, J. F., Wang, J., Tukker, A., & Behrens, P. (2022). A Global Overview of Developments of Urban and Rural Household GHG Footprints from 2005-2015. *Science of The Total Environment, 806*(2), 150695. doi:https://doi.org/10.1016/j.scitotenv.2021.150695

Zhang, S., Liu, X., & Bae, J. (2017). Does Trade Openness Affect CO2 Emissions: Evidance From Ten Newly Industrialized Countries? *Environmenyal Science and Pollution Research, 24*(21), 17616-17625. doi:10.1007/s11356-017-9392-8