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Factors affecting CO2 emissions in Indonesia 1985-2021

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Abstract

This study aims to determine and analyze the effect of urban population, per capita income, per capita income2, oil consumption and natural gas consumption on CO2 emissions in Indonesia in 1985-2021.This study uses the Autoregressive Distributed Lag (ARDL) method. The results show that the variables of urban population, per capita income, per capita income2, oil consumption, natural gas consumption have a positive effect on CO2 emissions in the short term, while in the long term the variables of urban population, per capita income and natural gas consumption have no effect on CO2 emissions in the long term. The Environmental Kuznets Curve Hypothesis (EKC) is proven in Indonesia.

Keywords: Urban Population, Per Capita Income, Per Capita Income2, Oil Consumption, Natural Gas Consumption

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INTRODUCTION

The world is becoming increasingly concerned about climate. Climate change and global warming are caused by the increase of greenhouse gases in the atmosphere. Greenhouse gases are 12 kilometers from the earth's surface (Mukono, 2018). The content of greenhouse gases is CO2 gas, CH4, and N2O gas, the amount of which exceeds the limit, causing the earth's temperature to get hotter, and over time it will be dangerous for humans.

The urgency of climate change and global warming in the international world, the United Nations (UN) formed the United Nations Framework Convention on Climate Change (UNFCCC) as a response or answer to overcome

these global problems. Reducing CO2 emissions in the world is one of the main programs of the United Nations Framework Convention on Climate Change (UNFCCC). UNFCCC implemented an agreement with the world known as the Paris Agreement in 2015.

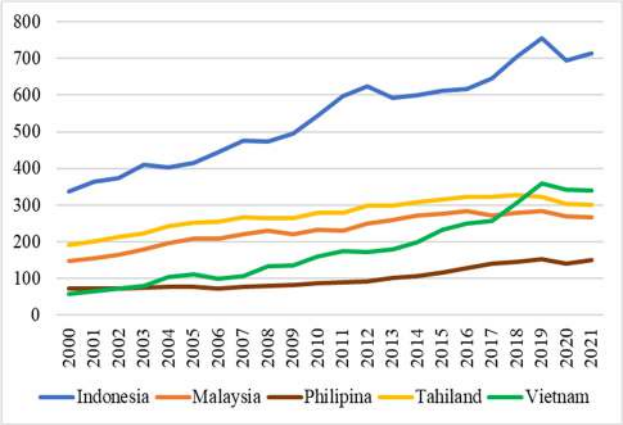

Figure 1. CO2 Emissions Development in 5 ASEAN (Metriks ton Per Kapita)
Source: BP Statistical Review of World Energy, 2023

The 197 countries are official members of the United Nations Framework Convention on Climate Change (UNFCCC). These countries are divided into 2, namely Annex 1 countries consisting of countries that provide several funds, and non-Annex 1 countries, namely countries that are obliged to tackle climate change problems.

Indonesia's commitment to reduce CO2 emissions has been contained in the Paris Agreement, then to be more optimal, Indonesia 2017 established Low Carbon Development Indonesia (LCDI) by the Ministry of National Development Planning (Rustam et al., 2023). According to the 2022 Emissions Gap Report, G-20 countries accounted for more than 75% of the total global emissions in 2020, namely China, the United States, the European Union, India, Brazil, Russia. Less developed countries contribute 2.3 tCO2e per capita per year.

Figure 1 shows that the first largest contributor to CO2 emissions in Indonesia, which in 2021 is valued at 713.1 metric tons per capita, Indonesia has experienced a decrease in CO2 emissions in 2020, namely from 2019 valued at 756.1 metric tons per capita down to 694.3 metric tons per capita. The trend in the 5 ASEAN countries tends to fluctuate. This is followed by Vietnam in 2021 with a CO2 emission level of 339.8 metric tons per capita. The third country is Thailand with a value of 301.8 metric tons per capita.

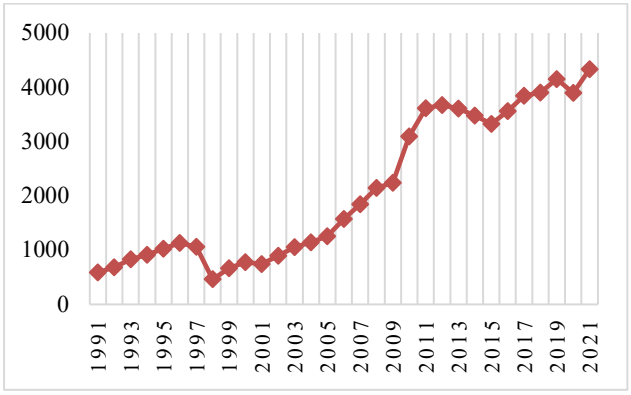

Figure 2. Indonesia Per Capita Income 1991-2021.
Source: World Bank, 2023

Then Malaysia with a value of 266.7 metric tons per capita, and the country with the lowest level of CO2 emissions is the Philippines with a value of 149.5 metric tons per capita. Studies on the problem of CO2 emissions show that developing countries in the world contribute 76.7% of CO2 emissions (Ullah et al., 2022).

The impact of increased CO2 emissions will disrupt the health of living things, especially humans, and is a major threat to the environment in the world (Ngong et al., 2022). Environmental problems are currently being discussed, not only domestically but this issue or

problem is busy in the international world (Fauzi, 2017).

According to the 2022 Environmental Performance Index (EPI) report in terms of global environmental health, Indonesia is ranked 134th with a value of 25.3 out of 180 countries in the world, it can be concluded that Indonesia still has low environmental health quality. The increase in population and human economic activity greatly affects the increase in environmental damage.

With economic activity, it automatically increases economic development. Economic development and the environment grow inversely, this happens because the more the economy grows, it will increase pollution as a result of production activities whose management uses energy that is not environmentally friendly and imperfect waste management so that it has an impact on the environment (Maulidina and Maulana, 2022).

Indicators of a country's economic growth can be seen from the amount of income per capita. The World Bank has categorized a country based on its per capita income, namely countries with low income (per capita income <$1,025), while for countries with lower middle income (per capita income between $1,026 and $4,035), countries with upper middle income (per capita income> $12,476) (World Bank, 2016).

Figure 2 Indonesia experienced a very sharp decline in per capita income in 1997-1998 when Indonesia was during an economic crisis. Starting in 2000, Indonesia's per capita income slowly began to rise again, accompanied by an increase in Indonesia's economic growth of 4.92% in 2000. However, per capita income declined again due to instability in the government at that time. From 2008 to 2019, Indonesia's per capita income tended to fluctuate. Until finally there was a major outbreak in the world, namely CoviD-19, which attacked all economies in the world, thus becoming a major threat to the international economy.

The relationship between environmental damage and per capita income can be described through the EKC (Environmental Kuznetz Curve) hypothesis, where environmental damage occurs in developing countries with low per capita income, which are characterized by urban-focused economic development, thus attracting rural migrants to move to cities. If this continues, it will lead to an increase in urban population.

The high level of human activity will increase consumption to meet the needs of human life, one of which is energy consumption. Increased energy consumption illustrates an increase in economic activity. This can be explained if there is an increase in the number of urban residents, supported by the vast industrial sector and the household sector (Prima et al., 2017).

Indonesia's dependence on energy consumption is still very high, this is evidenced by the majority of the national primary energy supply comes from coal, oil and natural gas, which amounted to 90.7% in 2019 according to the Indonesian Energy Outlook Report, (2021). Increasing energy consumption results in depletion of foreign exchange because it is used to import materials and generate greenhouse gases sourced from fossil energy through hydrocarbon combustion.

Energy demand can increase due to changes in culture, culture and habits of urban residents resulting in increased mobility and infrastructure. If this is fulfilled, it will change the lifestyle of a person who becomes wasteful of

energy because of the ease of technology today (Prima et al., 2017). Crude oil production over the last 10 years has experienced a downward trend.

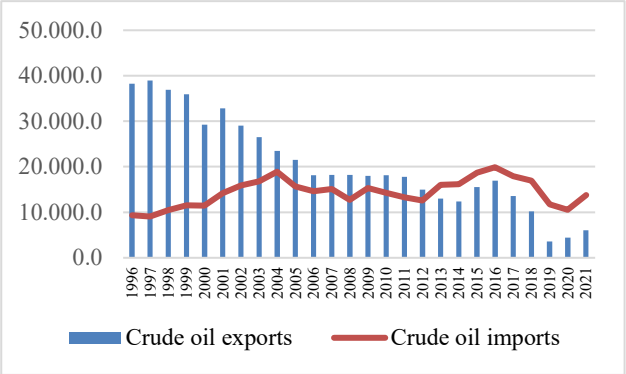

Figure 3. Indonesia's Crude Oil Exports and Imports 1996-2021.
Source: Badan Pusat Statistik Indonesia, 2023

In 2011 crude oil production in Indonesia of 32,9249.30 million barrels, to 24,0324.50 million barrels. This decline in crude oil production according to a report from Outlok Energy Indonesia 2019 is due to the aging of the main oil production wells, while the number of new wells is still very limited.

The decline in oil production has an impact on oil exports in Indonesia, this can be seen in Figure 3 the trend of Indonesia's oil exports from year to year has a downward trend. To meet domestic oil needs, Indonesia tries to import oil from abroad. The countries that become import destinations are countries that are famous for crude oil production, namely countries in the Middle East.

Oil and natural gas are among the products produced by fossil energy. Based on Figure 4, the consumption of fossil energy, namely oil and natural gas, has an upward trend from year to year. This means that there has been an increase in fossil energy consumption. The impact of increased fossil energy consumption is the increase in earth's temperature and sea level which over time will cause greenhouse gas emissions (Setyono and Kiono, 2021).

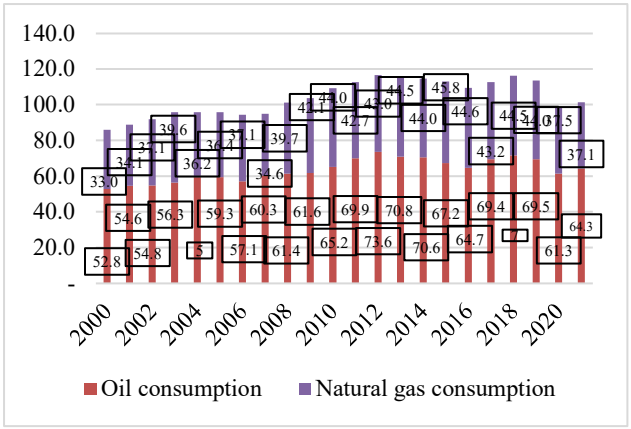

Figure 4. Oil Consumption and Natural Gas Consumption in Indonesia 2000-2021.
Source: bp Statistical review of world energy, 2023

The role of oil still dominates because it supports the transportation sector. According to data from the Handbook of Energy & Economic Statistics of Indonesia in 2021, the transportation sector has the largest share, namely 45.76%, which is used as fuel oil (BBM), followed by the industrial sector, which is 31.11%. The household sector has a share of 16.89% and the commercial sector has a share of 4.97%.

The continuous use of energy is used to achieve economic targets so that it is hoped that with an increase in the economy will be able to create community welfare. However, the increasing use of energy and the increasing population in Indonesia will have a negative externality impact on the environment, for this reason there is a need for public awareness about the importance of protecting the environment, to live safely and peacefully.

RESEARCH METHODS

The type of research used is quantitative research, namely research that uses numerical data or with data whose units can be calculated, starting from data collection, defining to drawing conclusions. Quantitative research can be called discovery research, because this research can bring up new ideas and knowledge (Machali, 2021). The type of data used is an annual time series from 1985 to 2021.

Table 1. Variable Operational Definitions

Variable	Description	Source
Y : CO_2 emissions Metriks ton per kapita	Combustion exhaust gases resulting from the consumption of each type of energy in an area within one year.	BP Statistical Review of World Energy
X1 : Urban Population (%)	People who live, work and conduct economic activities in urban areas.	Word Bank
X2 : Income Per capita (USD)	Per capita income is the total income in a country divided by the total population.	Word Bank
X3: Income Per capita2	Per capita income2 is used to test the hypothesis of an inverted "U" shaped environmental Kuznets curve.	Word Bank
X4 : Oil Consumtion (Million tonnes.)	The total use of petroleum-derived energy in a region over a certain period of time.	BP Statistical Review of World Energy
X5 : Natural Gas Consumtion (Billion cubic metres.)	Natural gas consumption is the total use of natural gas energy in a region over a certain period of time.	BP Statistical Review of World Energy

Source: Researchers, 2023

This research uses secondary data. The type of data used is an annual time series from 1985 to 2021. So it can be called this research examines data within a period of 36 years. The data in this study were obtained through the BP Statistical Review of World Energy, Word Bank and Our Word In Data websites.

This research was conducted within this period because it will look at the impact of the increase in urban population, per capita income, per capita income2, oil consumption and natural gas consumption which will affect the quality of the environment in Indonesia. The advantage of Autoregressive distributed lag (ARDL) is that it is not concerned with the stationary level of the data, even so in the analysis of Autoregressive distributed lag (ARDL) data cannot be used if the data is stationary at the 2nd diference level.

Autoregressive distributed lag (ARDL) is not concerned that the variables are integrated at the same order, but the data must be stationary at the 1st difference level. This research uses quantitative methods with Autoregressive distributed lag (ARDL) analysis techniques. Autoregressive distributed lag (ARDL) is a model that includes not only present values but also past values. This research uses the eviews 12 application to process data.

The model in the Autoregressive distributed lag (ARDL) analysis is generally as follows:

$$\Delta LogCO2_t = \beta_\theta + \sum_{i=1}^{k} \beta_1 \Delta LogCO2_{t-1} + \sum_{i=1}^{k} \beta_2 \Delta JPP_{t-1} + \sum_{i=1}^{k} \beta_3 \Delta LogPP_{t-1} + \sum_{i=1}^{k} \beta_4 \Delta LogPP^2_{t-1} + \sum_{i=1}^{k} \beta_5 \Delta LogKOIL_{t-1} + \sum_{i=1}^{k} \beta_6 \Delta LogKGA_{t-1} + \varepsilon_{3t1}$$

The long-term effects in this study are as follows:

$$\Delta LogCO2_t = \beta_\theta + \theta_1 CO2_{t-1} + \theta_2 JPP_{t-1} + \theta_3 LogPP_{t-1} + \theta_4 LogPP^2_{t-1} + \theta_5 LogKOIL_{t-1} + \theta_6 LogKGA_{t-1} + \varepsilon_{4t1}$$

While the short-term effects in this study are as follows:

$$\Delta LogCO2_t = \beta_\theta + \sum_{i=1}^{k} \beta_1 \Delta LogCO2_{t-i} + \sum_{i=1}^{k} \beta_2 \Delta JPP_{t-1} + \sum_{i=1}^{k} \beta_3 \Delta LogPP_{t-1} + \sum_{i=1}^{k} \beta_4 \Delta LogPP^2_{t-1} + \sum_{i=1}^{k} \beta_5 \Delta LogKOIL_{t-1} + \sum_{i=1}^{k} \beta_6 \Delta LogKGA_{t-1} + \delta ECT_{t-1} + \varepsilon_{5t-1}$$

The variables used in this study are CO2 emissions as the dependent variable, and urban population, per capita income, per capita income2, oil consumption, natural gas consumption as independent variables. Specifically, Table 1 shows the operational definitions for the variables used in this study.

RESULTS AND DISCUSSION

The initial stage carried out in the research of the Autoregressive distributed lag (ARDL) analysis method is data testing. Data testing in this method is a stationarity test or unit root test. In the Autoregressive distributed lag (ARDL) method, testing is done through two stages, namely the level stage and the 1st difference stage. The probability value on each variable used in the study has a value smaller than 0.1 (α = 10%). This means that all data used in the study are stationary at the 1st difference level.

Table 2. Stationarity Test

Variable	Level	1st difference
LCO2	1.0000	0,0001
JPP	0.7193	0,0000
LPP	0.8844	0,0000
LKOIL	0.9988	0,0006
LKGA	0.9945	0,0005

Source: Eviews 12 Output, 2023

So the conclusion in the stationarity test is that all data can be used in research and does not have a runaway regression problem so that it can use the Autoregressive Distributed Lag (ARDL). Based on Table 3, the resulting value is 51.36408 when compared to the value of I(0) and the value of I(1) at the 10%, 2.5% and 1% significance levels, it has a much greater f-statistic value. So the conclusion is that all variables used in the study have cointegration and have a long-term relationship.

Table 3. Cointegration Test

Bound Testing Approch	Value	Significant	I(0)	I(1)
F-Statistik		10%	2.08	3
	51.36408	5%	2.39	3.38
		2,5%	2.7	3.73
		1%	3.06	4.15

Source: Eviews 12 output, data processed, 2023

Based on Figure 5, it can be seen that the optimum lag lies on the longest or maximum line with model number 1, so it has an ARDL model (4,4,4,4,4), which has the smallest error results. This means that the variables used in the

study have an influence on each other. Based on Table 4, it explains that the income per capita variable has a positive coefficient value with a probability value of 0.0713 and income per capita2 has a negative coefficient with a probability value of 0.0808 smaller than 0.1 (α = 10%) which means significant.

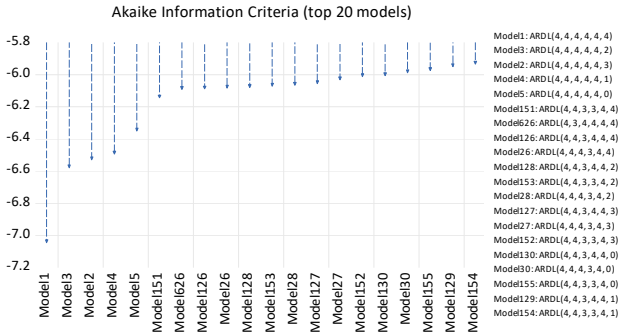

Figure 5. Lag Length Criteria
Source: Eviews 12 Output, 2023

So, it can be concluded that this study fulfills the conditions for the EKC hypothesis to be proven in Indonesia. Based on Table 5 shows that there are Autoregressive Distributed Lag (ARDL) model selection results, namely (4,4,4,44,4). Meanwhile, the R-squared value in this test is 0.999962. The F-statistic value is 2750.675 while the probability value of the f-statistic is 0.000010.

Table 4. Results of EKC Hypothesis Testing in Indonesia

Variable	Coeficcient	Prob.	Information
LOGPP	1.001219	0.0713	Negative
LOGPP2	-0.076805	0.0808	Positive

Source: Eviews 12 Output, 2023

Table 6 shows that the results of the ECM model estimation in the short term can be describe as follows : The residual value of the Eror Correction Term (ECT) generated in the test has a coefficient value of 0.752726 and a probability value of 0.0001. So that it has met the model requirements because it is statistically significant and the model is considered valid and can be used in research.

The JPP or urban population variable has a coefficient value of 1.27E-06 (0.00000127%) and a probability value of 0.0010. The resulting probability value is smaller than 0.1 (α = 10%). So the conclusion is that changes in urban population have a positive effect on CO2 emissions in the short term under the assumption of ceteris paribus.

The LPP or income per capita variable has a coefficient value of 1.001219 and a probability value of 0.0063. The resulting probability value is smaller than 0.1 (α = 10%). So the conclusion is that changes in per capita income affect CO2 emissions in the short term under the assumption of ceteris paribus.

The variable LPP2 or income per capita2 has a coefficient value of -0.076805 and a probability value of 0.0067. The resulting probability value is smaller than 0.1 (α = 10%). So the conclusion is that changes in per capita income2 negatively affect CO2 emissions in the short term under the assumption of ceteris paribus.

The variable LKOIL or oil consumption has a coefficient value of 0.799528 and a probability value of 0.0002. The resulting probability value is smaller than 0.1 (α = 10%). So the conclusion is that changes in oil consumption have a positive effect on CO2 emissions in the short term under the assumption of ceteris paribus.

The variable LKGA or natural gas consumption has a coefficient value of 0.236059 and a probability value of 0.0054. The resulting probability value is smaller than 0.1 (α = 10%). So the conclusion is that changes in natural gas

consumption have a positive effect on CO_2 emissions in the short term under the assumption of ceteris paribus.

Table 5. Method Autoregressive Distributed Lag (ARDL)

Variable	Coeficcient	Std. Error	t-statistik	Probability
LOGCO2(-1)	0.118829	0.107034	1.110200	0.3479
LOGCO2(-2)	0.005107	0.143729	3.566789	0.9739
LOGCO2(-3)	0.421946	0.147099	2.868452*	0.0641
LOGCO2(-4)	1.206843	0.138412	8.719204***	0.0032
JPP	1.27E-06	4.51E-07	2.804270*	0.0676
JPP(-1)	2.93E-07	3.30E-07	0.885643	0.4410
JPP(-2)	1.56E-06	5.27E-07	2.959693*	0.0596
JPP(-3)	-6.81E-09	6.73E-07	-0.010125	0.9926
JPP(-4)	1.12E-06	4.89E-07	2.296418	0.1053
LOGPP	1.001219	0.365414	2.739954*	0.0713
LOGPP(-1)	-1.079940	0.533271	-2.025125	0.1360
LOGPP(-2)	-1.119984	0.562906	-1.989649	0.1407
LOGPP(-3)	2.717386	0.564371	4.814892**	0.0171
LOGPP(-4)	-1.059129	0.459889	-2.303008	0.1047
LOGPP^2	-0.076805	0.029607	-2.594102*	0.0808
LOGPP(-1)2	0.084115	0.042377	1.984926	0.1414
LOGPP(-2)2	0.076810	0.042478	1.808237	0.1683
LOGPP(-3)2	-0.206284	0.040763	5.060568**	0.0149
LOGPP(-4)2	0.081235	0.035147	2.311311	0.1039
LOGKOIL	0.799528	0.137147	5.829706**	0.0101
LOGKOIL(-1)	-0.771241	0.280313	-2.751360	0.0707
LOGKOIL(-2)	0.502600	0.350439	1.434198	0.2470
LOGKOIL(-3)	-0.978223	0.301789	3.241412**	0.0478
LOGKOIL(-4)	-0.949757	0.242160	3.922025**	0.0295
LOGKGA	0.236059	0.095976	2.459564*	0.0909
LOGKGA(-1)	-0.054244	0.135603	-0.400020	0.7159
LOGKGA(-2)	0.185736	0.147884	1.255960	0.2980
LOGKGA(-3)	-0.133066	0.208914	-0.636941	0.5694
LOGKGA(-4)	0.141150	0.092203	1.530867	0.2233
C	-1.260102	0.924401	-1.363155	0.2661
R-Squared	0.999962			
Adjusted R squared	0,999599			
F-statistik	2750.675			
Prob (F-Statistik)	0,000010			

Signification * = Significance 10%

**= Significance 5%

*** = Significance 1%

Source: Eviews 12 Output, 2023

The variable LOGPP2 or income per capita2 has a coefficient value of 0.054373 and a probability value of 0.0742. The resulting probability value is smaller than 0.1 (α = 10%). So the conclusion is that every 1% increase in per capita income2 affects CO2 emissions in the long run under the assumption of ceteris paribus.

Table 6. Short Term

Variable	Coeficcient	Std. Error	t-statistik	Probability
D(JPP)	1.27E-06	9.77E-08	12.95974	0.0010
D(LPP)	1.001219	0.145998	6.857774	0.0063
D(LPP2)	-0.076805	0.011407	-6.733087	0.0067
D(LKOIL)	0.799528	0.034424	23.22623	0.0002
D(LKGA)	0.236059	0.032544	7.253538	0.0054
ECT(-1)	0.752726	0.022919	32.84274	0.0001

Source: Eviews 12 Output, 2023

The LOGKOIL variable or oil consumption variable has a coefficient value of 1.856046 and a probability value of 0.0055. The resulting probability value is smaller than 0.1 (α = 10%). So the conclusion is that every 1% increase in oil consumption affects CO2 emissions in the long run under the assumption of ceteris paribus.

The variable LOGKGA or natural gas consumption variable has a coefficient value of -0.499033 and a probability value of 0.1112. The resulting probability value is greater than 0.1 (α = 10%). So the conclusion is that every 1% increase in natural gas consumption has no effect on CO2 emissions in the long run under the assumption of ceteris paribus.

Table 7. Long Term

Variable	Coeficcient	Std. Error	t-statistik	Probability
JPP	-5.62E-06	3.14E-06	-1.789249	0.1715
LOGPP	-0.610518	0.284366	-2.146940	0.1211
LOGPP2	0.054373	0.020184	2.693871	0.0742
LOGKOIL	1.856046	0.257006	7.221812	0.0055
LOGKGA	-0.499033	0.223054	-2.237278	0.1112
C	1.674053	1.132374	1.478357	0.2358

Source: Eviews 12 Output, 2023

Based on the analysis results in the short term and long term, the results of this study are in line with research conducted by Sasana and Setiawan (2017) in their study using the Ordinary Least Square (OLS) method in the period 1990-2014, which found that an increase in population has a positive and significant effect on CO2 emissions in Indonesia

An increase in urban population will contribute to an increase in CO2 emissions, because there are various activities that contribute to CO2 emissions such as

transportation, industry, energy use and others. These activities cause fossil fuel consumption to increase, which in turn increases CO2 emissions and results in faster environmental degradation. However, this research is not in line with research conducted by Wada and Faizulayev (2021) in their study in Brazil from 1971-2016 which found that in the long run, population increase has a positive effect on CO2 emissions in Brazil.

The existence of a positive and significant effect shows that the increase in urban population in Indonesia will be detrimental to humans. This condition needs to be handled or prevented to reduce the harm caused by CO2 emissions, considering that Indonesia has a high population of productive age so that it will continue to increase CO2 emissions.

Based on the analysis results in the short term and long term, the results of this study are in line with Kasman and Duman (2015) who state that per capita income affects CO2 emissions in member countries and prospective members of the European Union during the period 1992-2010. Supported by Wada and Isah (2021) in their study in Brazil using the Autoregressive Distributed Lag (ARDL) method, explaining that in the short-term per capita income in Brazil affects CO2 emissions, causing a decrease in environmental quality.

The influence of per capita income variables in the short term indicates that an increase in per capita income affects CO2 emissions. This means that in a society where per capita income rises, it is possible to increase CO2 emissions in Indonesia, or in other words, environmental conditions in Indonesia are getting worse because of various economic activities that occur. However, at a certain point, an increase in per capita income causes a decrease in CO2 emissions, or in other words, environmental conditions in Indonesia are increasingly maintained.

Based on the analysis results in the short term and long term, The existence of the effect of changes in per capita income in the long term of this study is in line with the Environmental Kuznets Curve (EKC) hypothesis which explains that if there is an increase in per capita income, it will control environmental damage.

However, the validation of the Environmental Kuznets Curve Hypothesis (EKC) is proven in Indonesia, this is evidenced by the results of the Autoregressive Distributed Lag (ARDL) regression that the per capita income variable has a significant positive effect on CO2 emissions and the per capita income variable2 has a significant negative effect on CO2 emissions, so it can form an inverted U curve.

The proof of the EKC hypothesis in this study explains that an increase in per capita income can make people aware of the importance of protecting the environment. This will be done if the government is more assertive in making economic policies that prioritize the environment. Indonesia has built or launched renewable energy and the use of electric transportation as one of the solutions to save energy.

Not only the role of the community must be accompanied by an increased role of the government, so that there is no inequality. Based on the analysis results in the short term and long term, the results of this study are in line with Imran (2018) in his study in Sub-Saharan Africa with the generalized method of moment (GMM) method explaining that oil consumption included in fossil fuel consumption has a significant effect on CO2 emissions, on the one hand it will cause air pollution.

The estimation results that have a significant effect on CO_2 emissions are not surprising because in developing countries such as Indonesia, fuel oil is used continuously to meet energy needs, which is expected when energy needs are met to increase economic growth. The significant influence on CO_2 emissions proves that Indonesia is still dependent on oil consumption. Oil consumption in Indonesia is dominated by fuel and LPG consumption with an average increase of 3% for fuel and 5% for LPG (Setyono and Kiono, 2021).

Based on the analysis results in the short term and long term, The results of this study are in line with Ahmed and Rehmanet (2017) in their study in 5 South Asian countries the results show that energy consumption (natural gas consumption) has an influence on CO_2 emissions in 5 South Asian countries, natural gas consumption will increase and cause environmental damage in the region. Gas consumption in society tends to increase due to increased public income, and vice versa if public income decreases, natural gas consumption also decreases.

CONCLUSION

From the results of the research that has been done, the following conclusions can be drawn: Urban population has an influence on CO_2 emissions in the short term, while in the long term it has no influence on CO_2 emissions. Per capita income has an influence on CO_2 emissions in the short term, while in the long term it has no influence on CO_2 emissions.

Per capita income2 has an influence on CO_2 emissions in the short and long term. Changes in per capita income2 will affect CO_2 emissions in the short and long term. The Environmental Kuznetz Curve (EKC) hypothesis is proven in Indonesia. Oil consumption has an influence on CO_2 emissions in the short and long term. Natural gas consumption has an influence on CO_2 emissions in the short term, while in the long term it has no influence on CO_2 emissions.

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