Original Research Article

ANALYSIS OF ECONOMIC GROWTH ON CARBON DIOXIDE GAS EMISSIONS IN G20 COUNTRIES

ABSTRACT

Aims: The purpose of this research is to analyze the effect of GDP, GFCF, and urban population on carbon dioxide gas emissions. In this case, the member countries of the G20 are the group of countries responsible for 75% of the greenhouse gas emissions produced. The role of the G20 countries is needed in reducing the resulting carbon dioxide gas emissions, to prevent global warming or climate change.

Study design: This study used a quantitative descriptive method.

Place and Duration of Study: The scope of this research is the member countries of the G20 such as Indonesia, South Africa, United States, Saudi Arabia, Argentina, Australia, Brazil, China, India, United Kingdom, Italy, Japan, Germany, Canada, South Korea, Mexico, France, Russia, and Turkey, with Time Period 2000-2019.

Methodology: This study uses a descriptive method with a quantitative approach, namely to analyze and determine the effect of Gross Domestic Product (GDP), Gross Fixed Capital Formation (GFCF), and urban population (URB) on carbon dioxide gas emissions in the G20 countries. Furthermore, the data used is secondary data with a panel data regression model, namely a combination of time series data and cross sections starting from 2000-2019.

Results: The results of this study indicate that GDP, GFCF and urban population have a positive and significant effect on increasing carbon dioxide gas emissions in G20 member countries.

Conclusion: Based on the calculation results, it is found that the Gross Domestic Product (GDP), Gross Fixed Capital Formation (GFCF), and urban population (URB) in G20 member countries have a positive and significant effect on increasing carbon dioxide gas emissions, both in partial and simultaneous tests. So that the government's role in this case is needed to maintain a healthy environment with increasing economic growth, or in the sense of creating Sustainable Development Goals.

Keywords: Carbon Dioxide Emissions, GDP, GFCF, Urban Population, Panel Data.

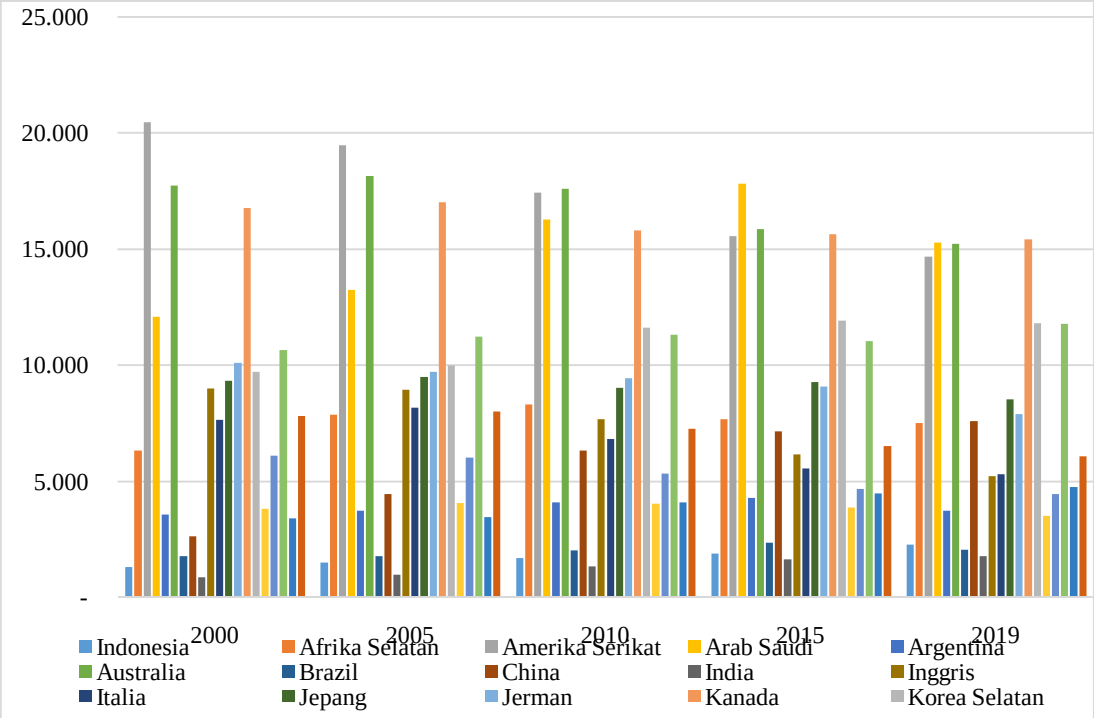
1. INTRODUCTION

Economic growth is a continuous increase in production volume in a country [1]. An increase in output in an economy indicates an increase in national income or an increase in Gross Domestic Product (GDP) in that country. Economic growth is inseparable from the existence of an externality that occurs, whether it is a positive externality or a negative externality. Increasing industrial activity in an economy will certainly increase economic growth. However, increased activity in an industry will cause negative externalities, such as industrial waste that is not properly managed and residual or exhaust gases that are not filtered before spreading into the air, which will cause environmental degradation. The occurrence of environmental degradation is one of the causes of climate change or global warming.

Global warming is one of the many environmental issues that has received serious attention not only from one country, but has become the focus of study in many countries. Overall, carbon dioxide (CO2) is the largest contributor to greenhouse gas emissions with a percentage of 74%, followed by methane, nitrogen dioxide and other foliated gases, where this figure is expected to continue to increase every year, if there are no effective policies implemented. conducted [2]. Data related to carbon dioxide gas emissions produced by the G20 countries in 2000-2019 is presented. Based on Figure 1, it can be seen that the highest levels of carbon dioxide gas emissions generally occur in developed countries such as the United States, Canada and Australia. In 2019 the largest producer of carbon dioxide gas emissions was Canada (15.43 metric tons/capita), followed by Australia (15.23 metric tons/capita).

Then Saudi Arabia (15.28 metric tons/capita), and the United States (14.67 metric tons/capita). While the smallest emitters of carbon dioxide gas in the G20 countries are countries (India 1.79 metric tons/capita), Brazil (2.05 metric tons/capita), Indonesia (2.29 metric tons/capita), Mexico (3.52 metric tons/capita) tons/capita), Argentina (3.74 metric tons/capita), France (4.46 metric tons/capita), Turkey (4.75 metric tons/capita). Then followed by the United Kingdom (5.22 metric tons/capita), Italy (5.31 metric tons/capita), the European Union (6.09 metric tons/capita), South Africa (7.50 metric tons/capita), China (7.60 metric tons/capita), Germany (7.91 metric tons/capita), Japan (8.54 metric tons/capita), Russia (11.79 metric tons/capita), and South Korea (11.79 metric ton/capita).

Overall, during the 2000-2019 period, carbon dioxide emissions in the G20 countries were divided into two, in which developed countries had a negative emission growth rate, while developing countries had a positive growth rate. In developing countries, this is triggered by industrialization activities which, along with an increase in Gross Domestic Product (GDP), will also increase the carbon dioxide gas emissions produced.

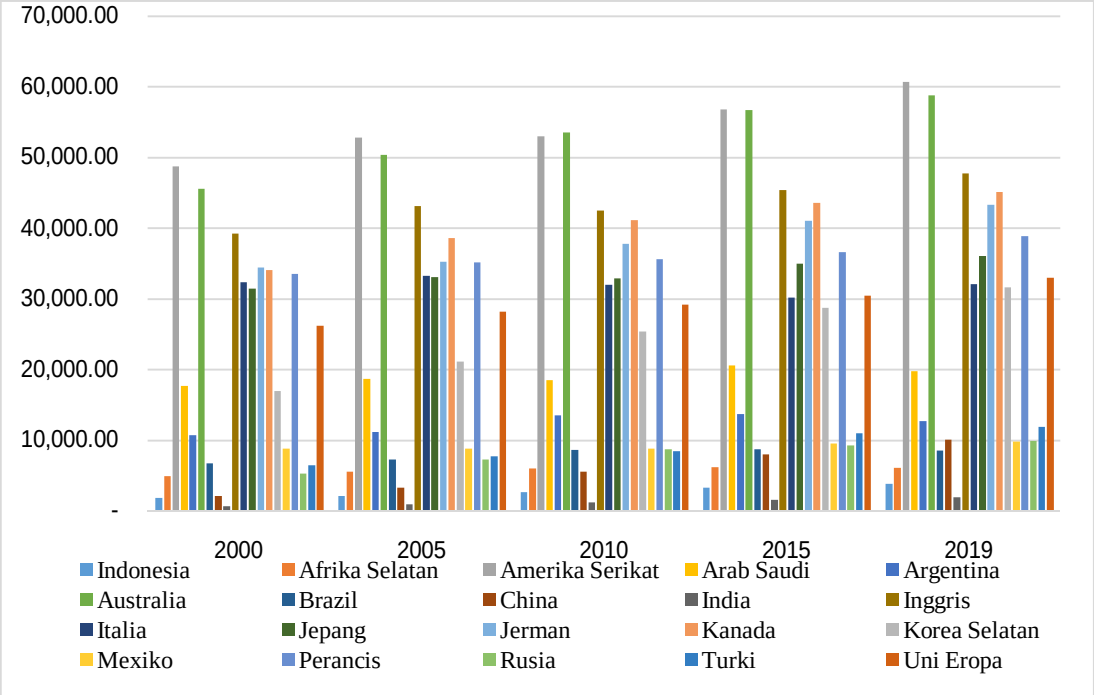


Source : World Bank, 2022

Figure 1. Carbon Dioxide (CO_2) Emissions from G20 Countries

The greater the level of Gross Domestic Product (GDP) of a country, the greater the level of income and development in that country. Gross Domestic Product (GDP) is used to measure the level of development and prosperity nationally. The graph shows the Gross Domestic Product (GDP) per capita of the G20 countries in 2000-2019. Based on Figure 2, it can be seen that the largest per capita Gross Domestic Product (GDP) in the G20 countries is the United States of America (US$ 60,687) in 2019. Followed by Australia (US$ 58,781), England (US$ 47,750)), Canada (US$ 45,109), and Germany (US$ 43,329).

Then France (US$ 38,912), Japan (US$ 36,081), the European Union (US$ 33,032), Italy (US$ 32,119), and South Korea (US$ 31,640). While the country that has the smallest per capita Gross Domestic Product (GDP) in the G20 countries is India (US$ 1,965), followed by Indonesia (US$ 3,877), South Africa (US$ 6,125), and Brazil (US$ 8,622). . Then Mexico (US$ 9,819), Russia (US$ 9,958), China (US$ 10,155), Turkey (US$ 11,955), Argentina (US$ 12,712), and Saudi Arabia (US$ 19,817). Overall, the growth of the Gross Domestic Product (GDP) per capita in the G20 countries has a positive trend during the 2000-2019 period.



Source : World Bank, 2022
Figure 2. GDP per Capita of G20 Countries.

Gross Fixed Capital Formation (GFCF) is expenditure in the form of capital goods that have a useful life of more than one year, and are not consumption goods [3]. Gross Fixed Capital Formation (GFCF) is one of the components in the preparation of the Gross Domestic Product (GDP) in a country. Gross Fixed Capital Formation (GFCF) is the main key in economic growth which makes demand for goods and services more effective, efficient with technological advances [4].

Furthermore, in this study another factor that is no less important in environmental problems is the population size. With the rapid population growth, the need for fuel, clothing and food needs, as well as the waste produced will quickly affect environmental [5]. The following are some reference materials to support this research. First, research conducted by [7] related to the determinants of carbon dioxide gas emissions using panel data, showed the results that GDP per capita, urban population, and gross fixed capital formation have a significant effect on carbon dioxide gas emissions.

Furthermore, research by [5] related to the relationship between economic growth, urban population and carbon dioxide gas emissions using a simultaneous equation model in 33 OECD countries 1992-2011. Shows that economic growth and urban population have a positive and significant effect on carbon dioxide emissions in all OECD member countries. The member countries of the G20 are the group of countries responsible for 75% of the greenhouse gas emissions produced. The role of the G20 countries is needed in reducing the resulting carbon dioxide gas emissions, to prevent global warming or climate change. Therefore, this study aims to analyze the effect of GDP, GFCF, and urban population on carbon dioxide gas emissions in the G20 countries.

2. METHODOLOGY

This study uses a descriptive method with a quantitative approach, to analyze and determine the effect of Gross Domestic Product (GDP), Gross Fixed Capital Formation (GFCF), and urban population (URB) on carbon dioxide gas emissions in the G20 countries. The scope of this research is the member countries of the G20 such as Indonesia, SouthAfrica, United States, Saudi Arabia, Argentina, Australia, Brazil, China, India, United Kingdom, Italy, Japan, Germany, Canada, South Korea, Mexico, France, Russia, and Turkey (19 countries), using the 2000-2019 time period. Furthermore, the data used is combined data between cross section data and time series data which is also known as panel data. This study uses secondary data sourced from the World Bank.

Table 1. Variables, Symbols, Units, and Data Sources

Variables	Symbols	Units	Data Sources
Carbon Dioxide Emissions	CO2	Metric Tonnes Per Capita	World Bank
Gross Domestic Product (GDP) Per Capita	GDP	*Konstan US$*	World Bank
Gross Fixed Capital Formation	GFCF	*Konstan US$*	World Bank
Urban Population	URB	Persentase (%)	World Bank

The model of this research analysis, as follows;

$$logCO2_{it} = \beta_0 + \beta_1 logGDP_{it} + \beta_2 logGFCF_{it} + \beta_3 logURB_{it} + \varepsilon_{it}$$

Explanation
CO2it = Carbon Dioxide Emissions
GDPit = Gross domestic product
GFCFit = Gross Fixed Capital Formation
URBit = Urban Population
β0 = Constant
β1,2,3, = Coefficients
ε = Residual (error term)
i = Member Countries of the G20
t = Time
log = Logarithmic transformation

In estimating panel data, there are three approaches to selecting the best model, namely: Common Effect Model, Fixed Effect Model and Random Effect Model. Therefore, to determine the best model of the three models, the Chow test, Hausman test, and Lagrange multiplier test were carried out.

3. RESULTS AND DISCUSSION

3.1 RESULTS

a) Chow Test

Chow test was conducted to see a comparison between the Common Effect Model and the Fixed Effect Model which one is more appropriate to use.

Table 2. *Chow Test*

Effects Test	Statistic	d.f.	Prob.
Cross-section F	961.794079	(18,358)	0.0000

Based on the chow test that has been carried out in Table 2, it is obtained that the p – value of chow between the Common Effect Model and the Fixed Effect Model at the 5% level of significance (0.05) is 0.0000. Because the p-value is smaller than the 5% (0.05) significance level, it can be concluded that the Fixed Effect Model is more appropriate to use than the Common Effect Model.

b) Hausman Test

The Hausman test was conducted to see which random effect model and fixed effect model is more appropriate to use.

Table 3. *Hausman Test*

Effects Test	Statistic	d.f.	Prob.
Cross-section random	1.665771	3	0.0446

Based on the Hausman test performed in Table 3, it was obtained that the Hausman p-value between the Random Effect Model and the Fixed Effect Model at a significant level of 5% (0.05) was 0.0446. Because the p-value is smaller than the 5% (0.05) significance level, it can be concluded that the Fixed Effect Model is more appropriate to use to analyze the research model than the Random Effect Model.

c) Lagrange Multiplier Test

Lagrange multiplier test was conducted to see a comparison between the Common Effect Model and Random Effect Model which one is more appropriate to use.

Table 4. *Lagrange Multiplier Test*

	Cross-section	Time	Both
Breusch-Pagan	3276.356	4.309238	3280.666
	(0.0000)	(0.0379)	(0.0000)

Based on the lagrange multiplier test performed in Table 4, it is obtained that the Breusch-Pagan probability between the Common Effect Model and the Random Effect Model at the 5% level of significance (0.05) is 0.0000. Because the p-value is smaller than the 5% significance level (0.05). So it can be concluded that the Random Effect Model is more appropriate to use to analyze the research model than the Common Effect Model. So it can

be concluded that, of the three model specification tests carried out, the Fixed Effect Model is the best model as evidenced by the results of the Chow test and the Hausman test. So the conclusion is that the regression model used in this study is the Fixed Effect Model.

Table 5. *Panel Data Estimation Results Using the Fixed Effect Model Approach*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.827801	0.332218	-8.511894	0.0000
LOG(GDP)	0.167890	0.052463	3.200196	0.0015
LOG(GFCF)	0.244666	0.023775	10.29094	0.0000
LOG(URB)	0.255644	0.118679	2.154087	0.0319
R-squared	0.993680	Mean dependent var		2.618327
Adjusted R-squared	0.993309	S.D. dependent var		1.609777
S.E. of regression	0.097560	Sum squared resid		3.407397
F-statistic	2680.270	Durbin-Watson stat		0.320462
Prob(F-statistic)	0.000000			

Based on the estimation results in Table 5, the regression equation can be written as follows:

$$logCO2_{it} = -2.827 + 0.167\,(logPDB_{it}) + 0.244\,(logPMTB_{it}) + 0.255\,(logURB_{it}) + \varepsilon_{it}$$

3.2 DISCUSSION

Based on the regression results, it was found that the Gross Domestic Product (GDP) of the G20 member countries had a positive and significant effect with a figure of 0.167 on carbon dioxide gas emissions. In this case, it means that if there is an increase in the Gross Domestic Product (GDP) of the G20 member countries by one percent. This will cause an increase in carbon dioxide gas emissions of 0.167 percent assuming ceteris paribus. Furthermore, based on the regression results, it was found that the Gross Fixed Capital Formation (GFCF) of the G20 member countries had a positive and significant effect with a figure of 0.244 on carbon dioxide gas emissions. In this case, it means that if there is an increase in the Gross Fixed Capital Formation (GFCF) of the G20 member countries by one percent. This will cause an increase in carbon dioxide emissions of 0.244 percent assuming ceteris paribus.

Then based on the regression results, it was found that the urban population of G20 member countries had a positive and significant effect with a number of 0.255 on carbon dioxide gas emissions. In this case, it means that if there is an increase in the urban population of G20 member countries by one percent. Then it will cause an increase in carbon dioxide gas emissions by 0.255 percent assuming ceteris paribus. The results of this study are in accordance with those conducted by [7] which states that per capita GDP, urban population, and gross fixed capital formation have a significant effect on carbon dioxide gas emissions. According to [5] economic growth and urban population have a positive and significant effect on carbon dioxide gas emissions in all OECD member countries.

So that an increase in GDP, GFCF and urban population from year to year will have an impact on increasing carbon dioxide gas emissions produced in G20 member countries. This

is the main factor for the increase in emissions is the ever-increasing population, so that the demand for goods and services that must be met to meet the needs of life will also increase. Then the exploitation of natural resources which is carried out on a large scale will have an impact on environmental degradation.

4. CONCLUSION

Based on the calculation results, it is found that the Gross Domestic Product (GDP), Gross Fixed Capital Formation (GFCF), and urban population (URB) in G20 member countries have a positive and significant effect on increasing carbon dioxide gas emissions, both in partial and simultaneous tests. So that the role of the government in this case is needed to maintain a healthy environment with increasing economic growth, or in the sense of creating Sustainable Development Goals.

DISCLAIMER

The products used in this study are widely available and commonly used in the countries and regions where the research is being conducted. Since we don't want to use this product as a tool of argument but for intellectual gain.The authors contributed exclusively to finance in this research.

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