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ANALYSIS OF POLLUTION HAVEN HYPOTHESIS IN WORLD TRADE ORGANIZATION MEMBER COUNTRIES

ABSTRACT

The threat of climate change, justice and also inequality are subjective proxies in the Sustainable Development Goals (SDGs). Likewise with free trade carried out by every country in the world to meet the needs of society. Free trade began to appear when the rounds at the World Trade Organization (WTO) in Dohaaimed to remove trade distortions in the international trade regime, so as to encourage an increase in world trade. The race of countries in the world to pursuewealth and prosperity has several impacts on the environment, one of which is global warming caused by greenhouse gases. The main greenhouse gas thatcontinues to increase is carbon dioxide. The purpose of this study is to analyze the Pollution Haven Hypothesis (PHH) model in explaining the relationship between foreign investment, trade openness, income per capita, renewable energy consumption, non-renewable energy consumption and urban population on the environmental quality of WTO member countries. This research is an associative quantitative research conductedon WTO members with a sample size of 108 countries. Data collection was obtainedthrough the World Bank Index which was then analyzed using the Autoregressive Distributed Lag (ARDL) method. The results of the study show that the Pollution Haven Hypothesis model notoccurs in WTO member. However, in the long run the investment has a reduced emission impact on the host country. This is proof of the existence of the Halo Pollution Hypothesis.

Keywords*: pollution haven hypothesis, foreign investment, trade openness, incomeper capita, renewable energy consumption, non-renewable energy consumption, urban population growth. .*
JEL Classification : Q0, Q2, Q3, Q4, Q5

INTRODUCTION

Predicting the future of life on earth and the next generation is a challenge for every researcher in the world. The civilization that was once glorified as one of the advanced and modern civilizations brought negative impacts that were not realized by humans. Changes to the earth are one of the world's concerns at this time. Given the history of the earth has existed since 4.6 billion years ago and has given the apocalypse to various species. The paradigm of economic thought then developed over time until now. Followed by the emergence of developed and developing countries. In the era of mercantilism, it emerged due to the surplus of agricultural products, trade began to be introduced both domestically and abroad (Deliarnov, 2010). At this time, history emerged for the world starting from European nations who traded to colonizing other nations to gain wealth. At that time the era of mercantilism in Europe was marked by the industrial revolution that occurred in the 18th century. In the 1990s globalization was present and became a major problem for the economic dimension. Advances in technology, communication and telecommunications and transportation increasingly support the flow of globalization so that economic relations between countries and regions become very easy (Cahyandito, 2006). Government support through ease of customs further encourages free trade (Enquete Commission, 2002). The presence of globalization creates a world that seems without barriers or boundaries, including in trade. Globalization is certainly supported by population growth which is also very rapid. Especially in developing countries, there is high population growth, urbanization and uneven population distribution. According to (Pisson, 2019) the largest total representing the largest population in the world is China, India, the United States, Indonesia, Pakistan, Brazil and Nigeria. The problems that arise when the population is very large include poverty and environmental problems. According to (Peacock, 2018) the increasing population strengthens the damage to every biological ecosystem. Thus, the increasing population

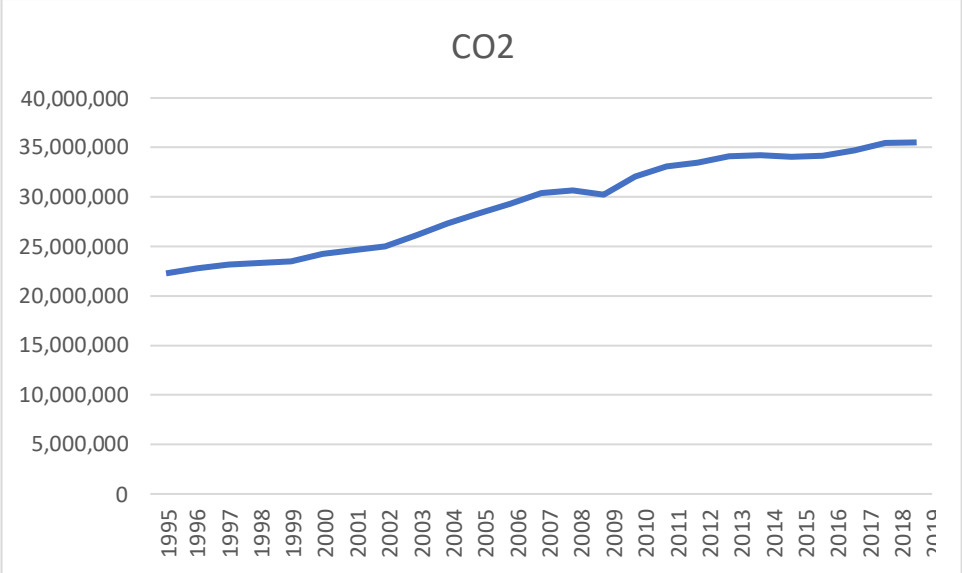
will experience strong pressure on the available natural resources. It is also explained by (Suparmoko, 2014) that natural resource goods are not free so that to obtain them requires sacrifice, for example by increasing the need for food, clean water, clean air, housing and so on. The same view is also obtained from (Akinsola et al., 2022) who studied industrial development, urbanization and pollution in Africa with the results obtained that increased urbanization and industrialization caused increased environmental degradation in the panel data period, namely from 1990 to 2019. Urbanization is often associated with industrialization. This is due to the movement of human resources towards labor-intensive sources or areas with high job needs. Free trade began to emerge when the round at the World Trade Organization (WTO) in Doha aimed to eliminate trade distortions in the international trade regime, so that it could encourage increased world trade (Sabbarudin, 2013). This became a milestone and basis for calculating that international policies regarding trade in the world began to be formed. The discourse on the world trade organization became a new beginning for the evolution of the global trade regime that had not existed before. There are at least two benefits that can be taken from international trade cooperation so that trade liberalization can be implemented. First, mutually beneficial negotiations will support the achievement of freer trade. Second, negotiated agreements will help governments avoid trade wars that can be detrimental, Krugman and Maurice (2005:235).

The World Trade Organization (WTO) is now the only international body that specifically regulates trade issues between countries. History records that the system and guidelines for carrying out multilateral trade activities officially only occurred since January 1, 1995 as the world trade organization that succeeded GATT (The General Agreement on Tariffs and Trade) 1947. That date is the early history of the inauguration of the World Trade Organization which is now called the World Trade Organization (WTO) (Sulistyo, 2007).

The global economic order seems to have no limits, spurring each country to compete to pursue high income and economic growth through trade in order to meet the needs of the population in each country. The development of environmental damage issues, indirectly raises new obstacles concerning environmental standards in international trade, such as taxes, subsidies and ecolabelling which are sometimes discriminatory (Andriani, 2012).

Acceleration of economic growth and The needs of the population in a country also have a serious impact on energy demand. The energy currently used by most of the world's population is NRE (Non Renewable Energy. When compared to the use of clean energy or REC (Renewable Energy). Serious threats to the sustainability of the Earth in the future greatly affect the needs or demand for energy for the world's population today. So that countries in the world are competing to meet the demand for energy by finding alternative energy sources with the aim of the welfare of its population. The race of countries in the world to pursue wealth and prosperity has several impacts on the environment, one of which is global warming caused by greenhouse gases. The main greenhouse gas that continues to increase is carbon dioxide (UNDP, 2007). Countries around the world are relentlessly releasing large amounts of these gases into the atmosphere. Developed countries emit more per capita, mainly because they have more vehicles or generally burn more fossil fuels, but once developing countries start building, they also catch up in contributing to emissions of these gases. Regardless of who produces the gas, all citizens of the world are affected. There is only one earth and atmosphere, therefore each country's emissions worsen the world crisis (UNDP, 2007).

Figure 1. Fluctuations in Carbon Dioxide Emissions in the World 1995-2019



Source: *World Development Indicators*

The preceding data shows that every year there is an increase in carbon dioxide levels in the world, the increasing trend began in 1995 to 2019. Based on the data above, the formation of the world trade organization in 1995, the increase in carbon dioxide in the world also increased until 2019.

Lately, there have been many hypotheses regarding the relationship between economic activities and the environment. One of them is the Environmental Kuznet Curve (EKC) which provides an analytical framework to test the relationship between the economy and environmental problems. This analytical framework presents the existence of an inverted U-shaped relationship between per capita income and pollution (Grosman and Krueger, 1995). However, on the other hand, the inverted U-shaped relationship better known as the EKC is a little fragile in explaining the paradigm of economic and environmental change.

The Pollution Haven Hypothesis (PHH) emerged as a refinement of the shortcomings of the EKC. PHH claims that the difference in the stringency of environmental regulations between the North and South or developed and developing countries will provide the final result regarding the comparative advantage of pollution production. If PHH applies, then EKC may not imply a net reduction in pollution, but only a transfer of pollution from developed to developing countries (Copeland and Taylor, 1994). According to Bu (2013) that basically the emission reductions achieved in developed countries are partly the result of shifting gross production to developing countries with weak environmental standards. When income and environmental degradation increase substantially, more severe environmental regulations will be imposed in an economy, encouraging the relocation of pollution-intensive industries to developing countries and countries with weaker environmental laws. This will result in a race where developing countries lower their environmental and social standards to gain a competitive advantage. This debate will take into account the right model of the relationship between trade and the environment among WTO members. Based on the main problems and literature review that

have been described, the hypotheses to be tested can be formulated, namely: H1: Foreign Investment has a positive effect on the amount of carbon dioxide (CO2) emissions. H2: Trade Openness has a positive effect on the amount of carbon dioxide (CO2) emissions. H3: Per capita income has a positive effect on the amount of carbon dioxide (CO2) emissions. H4: Renewable Energy has a negative effect on the amount of carbon dioxide (CO2) emissions. H5: Non Renewable Energy has a positive effect on the amount of carbon dioxide (CO2) emissions. H6: Urban Population has a positive effect on the amount of carbon dioxide (CO2) emissions.

RESEARCH METHODOLOGY

The research design used in this study is a quantitative research design in the form of associative. This research was conducted in WTO member countries. This location was chosen because WTO members are still registered in the WTO organization and implement all forms of WTO policies as part of the largest trade organization in the world. This study focuses on the study of foreign investment variables, trade openness, per capita income, renewable energy consumption, non-renewable energy consumption and urban population on the environmental quality of WTO member countries during 1995-2019. The study uses secondary data obtained from the World Indicator Index. The number of samples used in this study was determined based on the country category based on the World Bank, which is 108 countries. With the category of High Income Countries, there are 72 countries and the category of Low and Middle Income Countries, there are 36 countries. The independent variables used in this study are foreign investment, trade openness, per capita income, renewable energy consumption, non-renewable energy consumption and urban population. In this study, the dependent variable is the amount of carbon dioxide. This study uses a panel data model processed using Eviews.

RESULT AND DISCUSSION

The panel data model used in this study uses two model options, namely the common effect model (CEM) or the random effect model (REM). In order to see the best model between the two models, the Lagrangge Multiplier (LM) Test is carried out. The LM test tests by comparing the calculated LM value to be compared with the Chi Squared value. However, in this study the researcher used the common effect model (CEM). This selection was considered because in the random effect model (REM), namely: 1) REM requires that the number of cross sections must be greater than the number of explanatory variables in the model. 2) REM cannot show differences in intercepts for each country due to variations between countries, but in REM the variation is placed on the error component and is assumed to be uncorrelated with the explanatory variables. 3) If the REM model experiences problems with the classical assumption test, namely heteroscedasticity and autocorrelation, the SUR cross-section method cannot be used because REM uses the General Least Square (GLS) approach. The next consideration is also used in determining the best model, namely the Lagrangge Multiplier (LM) Test. The following are the results of the LM test*:*

Table 1. Lagrangge Multiplier (LM) Test

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	2.434586	4.858811	7.293397
	(0.1187)	(0.0275)	(0.0069)

Source: Processed data, 2023

Berdasarkan hasil uji LM test pada tabel 1 diperoleh *cross section Breusch-Pagan* > 0.05 yaitu 0,1187 > 0,05 maka model terbaik dalam penelitian ini adalah *common effect model* (CEM).

Table 2. Lagrange Multiplier Test

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	2.434586	4.858811	7.293397
	(0.1187)	(0.0275)	(0.0069)

Source: Processed data, 2023

The results of the Breusch-Godfrey Lagrange Multiplier (LM) test show 0.1187 and an alpha value of 0.05. So it is obtained 0.1187>0.05 so that the hypothesis H_0 is accepted. It can be concluded that there is no autocorrelation problem in the panel data structure

Table 3. Likelihood Ratio Test

Panel Cross-section Heteroskedasticity LR Test
Equation: UNTITLED
Specification: CO2 CO2(-1) CO2(-2) CO2(-3) CO2(-4) CO2(-5) CO2(-6) CO2(-7) FDI FDI(-1) TRD TRD(-1) GDP GDP(-1) REC REC(-1) NREC NREC(-1) UB UB(-1) DUMMY C

Null hypothesis: Residuals are homoskedastic

	Value	df	Probability
Likelihood ratio	**8105.752**	108	0.0000

LR test summary:

	Value	df
Restricted LogL	-16956.49	1405
Unrestricted LogL	-12903.62	1405

Source: Processed data, 2023

From the test results in the Likelihood ratio, it shows that the p-value> α, namely 8105.752> 0.05 so that the hypothesis H_0 is accepted. It can be concluded that the panel data is homoscedastic.

Table 4. Results of WTO Member Analysis

	CO2
CO2(-1)	1.458003***
CO2(-2)	-0.287956***
CO2(-3)	0.037698
CO2(-4)	-0.297841***
CO2(-5)	-0.003194
CO2(-6)	0.341198***
CO2(-7)	-0.248273***
FDI	16.51955
FDI(-1)	-24.97342
TRD	257.1162**
TRD(-1)	-260.9711**
GDP	0.122107
GDP(-1)	-0.191198
REC	-1002.756*
REC(-1)	1067.184*
NREC	687.5074
NREC(-1)	-615.1822
UB	-208.1032
UB(-1)	1123.564
Dummy	**3782.34**
Constant	-9116.95
F-Statistic	51898.09
R2	0.998648
Adj R-square	0.998629
Observation	1426
λ	0.999635
Kecepatan Penyesuaian	0.000365

Note : *p<10%, **p<5%, ***p<1%

Source: Processed data, 2023

The effect of FDI on CO2 shows insignificant results at the 5% and 1% levels. The effect of TRD on CO2 shows significant results at the 5% level. The effect of GDP per capita on CO2 shows insignificant results in CO2 conditions. The effect of REC on CO2 shows significant results in CO2 conditions. The effect of NREC on CO2 shows insignificant results. The effect of UB on CO2 shows insignificant results. The effect of dummy or two groups of countries 1 for High Income countries and 2 for developing countries shows significant results at the 5% level in the first CO2 condition. The R-square value in the first CO2 condition is 0.998648 which means that 99% of the variation in CO2 production can be predicted from the variables FDI, TRD, GDP, REC, NREC, and UB. In the F test in the three CO2 conditions, the calculated F value has a significance of 0.000 which is less than 0.05. Thus, it can be concluded that the above model is feasible to

use and the independent variables have a simultaneous effect on the dependent variable. The positive Adj R-square result means that the independent variable is able to explain the variance of the dependent variable..

Table 5. Analysis of All WTO Members With Interaction Terms

	CO2
CO2(-1)	1.457897***
CO2(-2)	-0.287833***
CO2(-3)	0.037606
CO2(-4)	-0.297755***
CO2(-5)	-0.003217
CO2(-6)	0.341213***
CO2(-7)	-0.248255***
FDI	-103.8981
FDI(-1)	-23.71331
TRD	260.8174*
TRD(-1)	-263.5336*
GDP	0.121283
GDP(-1)	-0.191245
REC	-1014.377*
REC(-1)	1077.558*
NREC	680.4011
NREC(-1)	-609.3796
UB	-204.3771
UB(-1)	1127.174
Dummy	3293.278
Dummy*FDI	**124.1761**
Constant	-8635.655
F-Statistic	49396.42***
R2	0.998648
Adj R-square	0.998628
Observation	1426
λ	0.999656
Adjustment Speed	0.000344

Note: *p<10%, **p<5%, ***p<1%
Source: Processed data, 2023

The effect of FDI on CO2 shows insignificant results at the 10%, 5% and 1% levels. The effect of TRD on CO2 shows significant results at the 10% level. The effect of GDP per capita on CO2 shows insignificant results in the first CO2 condition. The effect of REC on CO2 shows significant results. The effect of UB and NREC on CO2 shows insignificant results. The

effect of dummy or two groups of countries 1 for High Income countries and 2 for developing countries shows insignificant results in the CO2 condition. The effect of dummy variables interacted with FDI shows insignificant results in the first CO2 condition. The R-square value in the first CO2 condition is 0.998648 which means that 99% of the variation in CO2 production can be predicted from the variables FDI, TRD, GDP, REC, NREC, and UB. In the F Test in the CO2 condition, the calculated F value has a significance of 0.000 which is less than 0.05. Thus, it can be concluded that the above model is suitable for use and the independent variables have a simultaneous influence on the dependent variable. The positive Adj R-square result means that the independent variables are able to explain the variance of the dependent variable..

Table 6. Short-term and Long-term Effects of CO2 Without Changes in the Dummy Variable Model

Depvar: CO2	Short Term Coefficient	Long Term Coefficient
FDI	16.51955	-23168.54
TRD	257.1162**	-10564.64
GDP	0.122107	-189.3495
REC	-1002.756*	176570.3
NREC	687.5074	198213.2
UB	-208.1032	2508895

Sumber: Data diolah, 2023

The short-term and long-term results of the influence of independent variables on the dependent variables are shown in Table 6. The influence of foreign investment (FDI) entering both groups of countries shows that investment has a negative impact on the environment or increases CO2 production in both groups of countries in the short term. The results of this short-term impact are in accordance with the Pollution Haven Hypothesis which states that the entry of FDI will contribute to an increase in CO2 in the host country (Tang and Tan, 2015). The long-term impact of foreign investment is that if there is a 1% increase in foreign investment, it will reduce CO2 emissions by -23,168.5 kilotons. This indicates that investment or the movement of the world economy is slowly moving towards improvement or concern for the environment. This is in accordance with the Halo Pollution Hypothesis theory which states that multinational companies involved in FDI can contribute to reducing local pollutant emissions, if they use high-standard production patterns and advanced technology in the host country (Yirong, 2022). Reducing CO2 emissions or environmental degradation through FDI will depend on increasing the efficiency of energy use and the adoption of clean technology. The results of trade openness also show the same results as foreign investment in both groups of WTO member countries. The short-term impact shows that trade openness has a negative impact on the environment, then in the long term it has an impact on improving environmental quality with a decrease of 10,564.6 kilotons of CO2 emissions. This is certainly very significant if you look at the short-term impacts that result if there is a 1% increase in trade openness between countries, it will cause an increase of 257.1162 kilotons of CO2. The impacts related to trade and CO2 emissions have been previously studied and found the same thing

that trade has an effect on increasing CO2 (Sharma, 2011). The explanation of the reduction in CO2 emissions in the long term is explained by (Antweiler et al., 2001), the effect of trade openness on the environment can be decomposed into three effects, namely the scale effect, the technique effect, and the composition effect. The technique effect better reflects the long-term impact of trade openness on WTO member countries. In response, the government will implement stricter regulations regarding more environmentally friendly production standards (Grossman & Krueger, 1991). The per capita income between developed and developing countries certainly has a very large difference when viewed from the previous descriptive results. However, in the short term, this together has an effect on decreasing environmental quality. If there is an increase in per capita income of 1 $, it will increase the decline in environmental quality by 0.122 kilotons. Although the results are relatively small compared to the influence of other variables, they cannot be ignored either. Slowly in the long term it will reach the stage of increasing environmental quality due to an increase of 1 $ per capita income, namely by decreasing CO2 emissions by 189.3 kilotons. The difference between the income of people in developed and developing countries is often referred to as income inequality which is a determining factor in environmental degradation (Baloch et al., 2018). The existence of income inequality is certainly an obstacle to sustainable economic development because it is not in line (Galor and Moav, 2004). This is because if income inequality is higher, public attention to the environment will decrease (Magnani, 2000). However, if a fairer distribution of income will result in better environmental quality (Baek and Gweisah, 2013). Along with technological advances and awareness of the threat of climate change. Therefore, every country is looking for alternatives to reduce emissions produced. One of them is by using environmentally friendly energy. Both short-term and long-term impacts of Renewable Energy Consumption have a positive impact on the environment. If every country is able to use or consume renewable energy by 1% of the total national energy, it will reduce CO2 emissions by 1,002.7 kilotons in the short term. This result is also supported by research from (Dogan and Seker, 2016), (Jebly et al., 2016), (Liu et al., 2017) that high consumption of Renewable Energy will improve environmental quality by reducing CO2 emissions. Meanwhile (Boluk and Mert, 2014) found that energy used from renewable sources contributes 50% to reducing emissions compared to conventional energy. The long-term results of each country being able to use environmentally friendly energy by 1% then will increase CO2 emissions by 176,570.3 kilotons. The view on the negative impacts of renewable energy was put forward by (Ebube and Akan, 2021) who said that renewable energy recycling technology is a step in the right direction, but the cost of recycling is five times the cost of mining. The results will affect the price of energy produced in the long term. Another negative impact of renewable energy is the use of bioenergy that uses trees or tree derivatives requires a large area of land so that large land clearing is needed so that topical changes occur (Tajne, 2015). Currently, the world's largest consumption, both developed and developing countries, is still dominated by fossil fuels or non-renewable energy. The short-term and long-term impacts of non-renewable energy consumption are increasing environmental degradation. If there is a 1% increase in consumption of non-renewable energy in each WTO member country, it will increase CO2 emissions by 687.50 kilotons, as well as the long-term impacts resulting from non-renewable energy consumption will increase emissions by 198,213 kilotons. The main cause of air pollution is the combustion of fossil fuels which produces residual particles and is harmful to health (Guttikunda and Jawahar, 2014); (Khan et al., 2017); (Lelieveld

et al., 2020). Research from (Khan et al., 2020); (Shaari et al., 2017) shows that fossil energy consumption is the cause of increased carbon emissions. Fossil energy that has been proven to have an impact on environmental degradation is the consumption of coal, oil and natural gas (Martins et al., 2021).

Urban population growth in each country changes from year to year, especially in developing countries. The impact of changes or increases in urban population growth in the short term will result in a decrease in emissions of 208.1 kilotons. However, in the long term, urban population growth will actually result in an increase in CO2 emissions or a decrease in environmental quality of 2,508,895 kilotons. Support for these results is explained by (Peacock, 2018) the increasing population strengthens the occurrence of damage in every biological ecosystem. The same view is also obtained from (Akinsola et al., 2022) who studied industrial development, urbanization and pollution in Africa with the results obtained that increased urbanization and industrialization caused increased environmental degradation in the panel data period from 1990 to 2019. Urbanization is often associated with industrialization. This is due to the movement of human resources towards labor-intensive sources or areas with high job needs. After looking at the short-term and long-term impacts of each variable. So the acceleration of the adjustment of CO2 emissions towards its long-term equilibrium cannot be ignored. Based on the test results above, it shows that the coefficient of the lag of the dependent variable in this case is not in accordance with expectations, located $0 < \lambda < 1$ which indicates that the short-term model will converge towards the long term. This value is related to the speed of adjustment obtained by means of $(1-\lambda)$. The adjustment speed value is 0.000365 which indicates the short-term imbalance of CO2 emissions produced by WTO member countries due to changes in independent variables will slowly move towards long-term equilibrium with the adjustment speed showing 0.0365% of the gap between CO2 emissions produced by WTO members and their long-term equilibrium and will be closed within one period. The speed value below 0.50 indicates that the adjustment of CO2 emissions produced by WTO member countries towards their long-term equilibrium is relatively slow. Proof of the direction of the relationship between the presence or absence of the Pollution Haven Hypothesis in WTO members on the dummy results. The dummy variables included in this analysis with categories 0 as developing countries and 1 as high-income countries show positive results. The dummy coefficient value of 3782.34 means that High Income Countries produce more CO2 emissions.

Table 7. Short-term and Long-term Effects of CO2 Changes in Dummy Variable Interaction Model

Depvar: CO2	Short Term Coefficient	Lomg Term Coefficient
FDI	-103.8981	-370708.2
TRD	260.8174*	-7890.519
GDP	0.121283	-203.2393
REC	-1014.377*	183538.5
NREC	680.4011	206315.8
UB	-204.3771	2680704

Source: Processed data, 2023

The long-term and short-term results of the influence of independent variables on their dependent variables in the second model are changes in CO2. The influence of incoming foreign investment (FDI) shows that foreign investment has an impact on reducing CO2 emissions in the short term. If FDI enters by 1%, it will result in a decrease in CO2 emissions of 103.89 kilotons. The same thing also happens in the long term, if FDI enters by 1%, it will result in a decrease in CO2 emissions of 370,708 kilotons. This result is not in accordance with the hypothesis that FDI has a positive effect on CO2 emissions. Similar results are also supported by research from In the short term, the trade openness variable (TRD) shows results in accordance with the hypothesis. If in the short term each WTO member country opens its international trade by 1%, it will cause an increase in CO2 emissions of 260.81 kilotons. This result is supported by . The impact related to trade and CO2 emissions has been previously studied and found the same thing that trade has an effect on increasing CO2 (Sharma, 2011). However, much earlier research from (Grossman and Krueger, 1991) stated that the more widespread market expansion, the greater the intensity of trade and will encourage the use of fossil fuels, and will exploit natural resources massively and ultimately have an impact on increasing pollution. However, a different thing is shown in the long-term impact of trade openness, if each WTO member country opens 1% of its international trade, it will cause a reduction or decrease in CO2 emissions by 7,890.5 kilotons. The explanation of the reduction in CO2 emissions in the long term is explained by (Antweiler et al., 2001), the effect of trade openness on the environment can be decomposed into three effects, namely the scale effect, the technique effect, and the composition effect. The technique effect better reflects the long-term impact of trade openness on WTO member countries. This effect describes the amount of pollutants produced for each unit of output. There is an assumption that pollutants per unit of output will decrease as a country becomes more advanced. The underlying reasons are, first, trade openness stimulates the transfer of more environmentally friendly modern technology as a form of foreign investment. Second, with increasing income as a result of trade openness, it will also encourage demand for a cleaner environment. In response, the government will implement stricter regulations regarding more environmentally friendly production standards (Grossman & Krueger, 1991).

Per capita income between groups in WTO member countries shows that if there is an increase in income of 1 USD, it will cause an increase in CO2 emissions of 0.121283 kilotons in the short term. However, in the long term if there is an increase in income of 1 USD, it will reduce CO2 emissions by 203.23 kilotons. This result is also supported by research

In the short term, the use or consumption of Renewable Energy Consumption (REC) has an impact on reducing CO2 emissions. If Renewable Energy Consumption (REC) increases by 1%, it will cause a decrease in CO2 emissions of 1,014.3 kilotons. However, the opposite occurs in the long term, if Renewable Energy Consumption (REC) increases by 1%, it will increase CO2 emissions by 183,538.5 kilotons. Support for these results was also expressed by

Other energy consumption used by each country is non-renewable energy. The short-term impact of non-renewable energy consumption if it increases by 1% will increase CO2 emissions by 680.4 kilotons. In the long term it also shows the same results if there is an increase in non-renewable energy consumption by 1% it will increase CO2 emissions by 206,315.8 kilotons.

The last variable is Urban Population which shows the results of emission reductions

in the short term if there is a 1% increase in the urban population. However, in the long term the urban population will increase CO2 emissions at a 1% increase in urban population growth. by (Peacock, 2018) the increasing population strengthens the damage to every biological ecosystem. The same view is also obtained from (Akinsola et al., 2022) who studied industrial development, urbanization and pollution in Africa with the results obtained that increased urbanization and industrialization caused increased environmental degradation in the panel data period, namely from 1990 to 2019. Urbanization is often associated with industrialization. This is due to the movement of human resources towards labor-intensive sources or areas with high job needs.

Based on the test in Figure 5.6, the results show that the coefficient of the dependent variable lag in this is not in accordance with expectations, located $0 < \lambda < 1$ which indicates the short-term model will converge towards the long term. This value is related to the speed of adjustment obtained by $(1 - \lambda)$. The speed of adjustment value is 0.999656 which indicates that the short-term imbalance of CO2 emissions produced by WTO member countries due to changes in the independent variables will slowly move towards long-term equilibrium with an adjustment agreement of 0.0344% the gap between CO2 emissions produced by WTO members and their long-term equilibrium will be closed in one period. The speed value below 0.50 indicates that the adjustment of CO2 emissions produced by WTO members towards their long-term equilibrium is relatively slow. Proof of the direction of the relationship between the presence or absence of the Pollution Haven Hypothesis in WTO members is shown in Figure 5.6 in the dummy results. The dummy variables included in this analysis with categories 0 as developing countries and 1 as high-income countries show positive results. The dummy coefficient value is 3,293.2, so it can be concluded that WTO member countries in the High Income group produce more CO2 compared to the Developing Countries group. The next proof is also done by interacting the dummy variable with FDI also showing the same result, which is positive with a coefficient value of 124.17. This result shows that FDI has a role in increasing CO2 emissions in both groups of WTO member countries where the influence is more dominant in the High Income Countries group.

CONCLUSION

The results of the study concluded that Foreign Investment (FDI), Income per capita (GDP), non-renewable energy (NREC) and Urban Population did not have a significant effect on the increase or decrease in changes in CO2 emissions in the first model. Trade openness (TRD) and renewable energy (REC) had a significant effect on the increase and decrease in changes in CO2 emissions in the first model. Foreign Investment (FDI), Trade openness (TRD), Income per capita (GDP), renewable energy (REC), non-renewable energy (NREC) and Urban Population had a significant effect on changes in CO2 emissions in percent. The

results of the dummy variable show evidence that in the first CO2 model the value of the dummy variable is positive, thus indicating that High Income Countries in the WTO member group produce more CO2 emissions compared to Developing Countries. With the first model, it does not prove the existence of the Pollution Haven Hypothesis. The dummy results on the change in CO2 emissions in the first model show negative results. With the change in CO2 emission reduction in High Income Countries and the change in CO2 emission increase in Developing Countries, it shows that the Pollution Haven Hypothesis occurs in WTO members. The dummy results on the change in the percentage of CO2 emissions in the first model show negative values. With the change in CO2 emission reduction in High Income Countries and the change in CO2 emission increase in Developing Countries, it shows that the Pollution Haven Hypothesis occurs in WTO members. Based on the conclusions that have been described, suggestions can be given to WTO members, both developed and developing countries, to agree and implement climate justice that is in line with the agreed development without discrimination, to get the same space in policies to address climate change. The FDI flows that occur in WTO members must receive special attention from the host countries receiving FDI. The per capita income of each WTO member, both developed and developing countries, certainly has a very large difference. Thus, the focus of development on equality and poverty alleviation must continue to be carried out so that equality between WTO members can be achieved in order to achieve sustainable development.

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