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Research article

The Impact of FDI and Economic Growth on Environmental Damage in Member Countries of the Organization of Islamic Cooperation

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Abstract: Global warming due to environmental damage is a serious problem for all countries in the world. The aim of this research is to analyze the impact of FDI and economic growth on environmental damage and to test the existence of the environmental Kuznets curve in Organization of Islamic Cooperation (OIC) member countries. This research uses secondary data that is a panel, consisting of 57 OIC member countries as a cross-sectional unit from 1998-2020. The data analysis method used in this research is a panel regression model with a fixed effect model (FEM) estimation method approach. This research found that foreign direct investment and economic growth have positive impacts and significant on environmental damage. This research also found that the environmental Kuznets curve hypothesis is also proven to exist in 57 OIC member countries. The policy implication that must be carried out is that the governments of OIC member countries must ensure that FDI which enters the country is FDI that uses environmentally friendly technology so that this FDI is not only good for the economy, but also good for the environment. Economic growth in society must also be accompanied by the increase of public awareness on the environment. This can be achieved through improvements in education. In this way, economic growth will have a good impact on the environment.

Keywords: FDI, economic growth, environmental damage, OIC countries

JEL Classification: C23, O13, O44

Abstract: Pemanasan global karena kerusakan lingkungan merupakan masalah serius bagi semua negara di dunia. Tujuan penelitian ini yaitu untuk menganalisis dampak FDI dan pertumbuhan ekonomi terhadap kerusakan lingkungan dan menguji keberadaan teori kurva lingkungan Kuznets di negara-negara anggota OIC. Penelitian ini menggunakan data sekunder yang bersifat panel, yang terdiri dari 57 negara anggota OIC sebagai unit *cross-section* dari tahun 1998-2020. Metode analisis data yang digunakan dalam penelitian ini model regresi panel, dengan pendekatan metode estimasi *fixed effect model*. Penelitian ini menemukan bahwa penanaman modal asing dan pertumbuhan ekonomi berkontribusi signifikan terhadap kerusakan lingkungan. Penelitian ini juga menemukan bahwa hipotesis *environmental kuznets curve* juga terbukti ada di 57 negara anggota OIC. Implikasi kebijakan yang harus dilakukan yaitu pemerintah dari negara anggota OIC harus memastikan FDI yang masuk adalah FDI yang menggunakan teknologi ramah lingkungan agara FDI ini tidak hanya baik untuk perekonomian, namun juga baik untuk lingkungan. Pertumbuhan ekonomi di masyarakat juga harus dibarengi dengan peningkatan kesadaran masyarakat terhadap lingkungan. Hal itu bisa dicapai melalui peningkatan pada pendidikan. Dengan begitu, pertumbuhan ekonomi justru akan berdampak baik terhadap lingkungan.

Kata Kunci: FDI, pertumbuhan ekonomi, kerusakan lingkungan, Negara OIC

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1. INTRODUCTION

Environmental damage affects all aspects of human life on earth. Environmental damage is a major threat to sustainable economic development. Environmental damage can be a very serious problem because the livelihoods of more than half of the world's population in both developing and developed countries directly depend on the environment through agriculture, animal husbandry, hunting, fishing, forestry, and other sources. Not surprisingly, environmental damage can directly cause poverty and hunger (Todaro & Smith, 2020). The environment is the source of the factors of production. Economists agree that environmental issues should be an important part of economic policy because environmental damage such as damage to soil, polluted water and air, and deforested forests will reduce the amount of available resources to carry out production activities and all of these will hamper production activities. Production activities that are hampered will ultimately reduce the company's ability to produce goods and services. Therefore, environmental quality is very important to consider in economic analysis (Chen et al., 2022).

One of the indicators used to measure the level of environmental damage is to look at the levels of CO2 gas released in the air (World Bank, 2020). Excessive CO2 gas can not only damage air quality, but also can make the earth's temperature hotter, thus creating global warming which has an impact on the increasing amount of melting ice in both the north and south poles. This impact will eventually create rising sea levels that cover a lot of land. All of these environmental damages will lead to disruption of economy because economic activity is done on environment and the resources of economic activity are taken from the environment (M. E. Bildirici, 2017). Analyzing factors which can cause environmental damage is so important to control the rate of acceleration of environmental damage. The theory of *pollution haven hypothesis* (PHH) and Environmental *Kuznets Curve* (EKC) explain the factors that determine environmental damage. These two theories explain that there is a relationship between FDI and GDP per capita on environmental damage (Sarkodie & Strezov, 2019).

The Pollution Haven Hypothesis (PHH) theory explains that foreign direct investment (FDI) is the main locomotive of economic growth for developing countries because it is the main source of capital and technology transfer. FDI brings knowledge, modern management and communication systems to the targeted country, thereby leading to increased productivity. However, FDI can also cause environmental damage. This happens because companies in developed countries tend to set up factories/companies in developing countries because the cost of labor and other resources is cheaper. Developing countries also generally have less stringent environmental regulations, which is another factor that ultimately reduces production costs, especially for pollution-intensive production (Singhania & Saini, 2021). All of these factors can be an allure to attract FDI to developing countries. Although FDI helps increase economic growth in recipient countries, on the other hand, especially those with polluting industries, FDI has a negative relationship on environmental quality (M. Bildirici & Gokmenoglu, 2020). Empirical findings that have tested the relationship of FDI with environmental damage using the PHH theory are like the research done by Mert & Caglar (2020). In this research, Mert & Caglar (2020) also used FDI as a proxy to prove the *pollution haven hypothesis theory.* Related studies were also conducted by Ayobamiji & Kalmaz (2020), Abdouli & Hammami, (2017), and Santi & Sasana (2020).

Kuznets Curve (EKC) theory explains that economic growth in the short term also damages the environment. But in the long term, it can reduce environmental damage. Environmental Kuznets Curve (EKC) theory that relates GDP per capita to environmental damage. This relationship is formed because people with low incomes are more likely not to care about the environment in which they live. While people with high incomes tend to care about the environment around them. According to this theory, the relationship of GDP per capita to environmental damage is positive in the short term and negative in the long run (Sarkodie & Strezov, 2019). Empirical findings that have tested the relationship between income per capita with environmental damage using the EKC theory is like the research of Nikensari et al. (2019), Katircioğlu & Taşpinar (2017), Adebayo (2021), and Işik et al. (2020).

In this study, the researcher uses OIC member countries as a sample based on two reasons. First, the level of environmental pollution as measured by the number of CO2 levels in the air shows that in 2020, there were 10 OIC members who were included as the 30 largest CO2-producing countries per capita in the world. These countries are Qatar, Bahrain, Brunei, Kuwait, United Arab Emirates, Saudi Arabia, Oman, Kazakhstan, Turkmenistan, and Libya. Even, 3 of these 10 countries (Qatar, Bahrain, and Brunei), are in the highest order of the 5 largest CO2 emitting countries per capita in the world (Ritchie, 2020). For more details, it can be seen in Table 1 as follows:

Table 1. List of OIC's 10 largest CO2-producing countries per capita in 2020

No	Country	Ton per Capita	Proportion (%)
1	Qatar	33,640	12,12
2	Bahrain	25,451	9,17
3	Brunei	23,890	8,60
4	Kuwait	22,883	8,24
5	UAE	21,436	7,72
6	Saudi Arabia	18,368	6,62
7	Oman	15,959	5,75
8	Kazakhstan	14,669	5,28
9	Turkmenistan	11,523	4,15
10	Libya	8,802	3,17
	Total	196,622	

Source: (Ritchie, 2020)

Second, there are 27 OIC member countries located on the Asian continent. The Asian continent is the largest CO2-producing continent in the world. Asia is by far the largest emitter, accounting for 53% of global emissions as it is home to 60% of the world's population (Ritchie, 2019). Conditions like this could be related to the development process that is taking place in developing countries, especially countries that are members of the OIC organization. Therefore, an assessment of the influence of FDI and economic growth in OIC member countries is needed to provide a reference that can be used as a reference for decision making in efforts to reduce environmental pollution in the world.

Researches related to the impact of FDI and economic growth on environmental damage have been widely studied by previous researchers such as the research which was done by Mert & Caglar (2020). In their research, they also used the FDI variable as a proxy to prove the *pollution haven hypothesis theory* to measure the effect of FDI on environmental damage. And then, the research which was done by Nikensari et al. (2019). In their research, they also used economic growth as an independent variable on environmental damage as the dependent variable. But as far as the researcher is concerned, neither the research done by Mert & Caglar (2020) and Nikensari et al. (2019) nor other previous researches have used all OIC member countries as sample to measure. Whereas, as mentioned above, OIC member countries are very relevant to be used as semple because those countries are 10 largest CO2-producing countries per capita in 2018. Therefore, this is a novelty that this research has as a contribution to the science of development economics. Thus, the goal to be achieved through this research is to analyze how the influence of FDI and economic growth on environmental damage in OIC member countries.

2. RESEARCH METHODS

2.1. Data

This research uses secondary data that is a panel with a cross-sectional unit consisting of 57 OIC member countries from 1998 - 2020. The variables used and their operational definitions in this research are as shown in Table 2 as follows.

Table 2. The operational definition of variables

Variables	Operational definition	Unit	Data source
Environmental Damage (ED)	The total amount of carbon emissions from all human activities (energy production and consumption) in a country in one year.	Tonnes per capita	World Bank
Foreign Direct Investment (FDI)	The total amount of foreign direct investment funds entering a country *(FDI: inflow).* FDI is calculated from the sum of total equity, long-term capital and short-term capital in one year.	US$	World Bank
GDP per capita (GPC)	GDP per capita comes from the national income of the population divided by the total population of a country.	US$	World Bank
GDP per capita square (GPC^2)	GDP per capita squared is taken from the GDP data raised to the power of two.	US$	Author's calculations

2.2. Model Specification

The estimation model above is estimated using three approaches, namely the common effect model (CEM), fixed effect model (FEM), and random effect model (REM) approach (Widarjono, 2018). Of the three estimation approaches, the best one will be chosen and will be used in this research. The selection of the best estimation approach is carried out through model selection tests, namely: (a) chow test; (b) Hausman test; and (c) the Breusch (Pagan test) (Alvitiani et al., 2019). This research uses a quadratic equation model (GPC^2) to determine the inverted U pattern formed from the relationship between economic growth and environmental damage from Kuznet's theory. The Environmental Kuznets Curve (EKC) theory (inverted U) can be proven if $GPC^2 < 0$. However, if $GPC^2 \geq 0$, then there is no an inverted U relationship. EKC hypothesis only occurs if the GDP per capita variable is significantly positive and the GDP per capita squared is negative (Nikensari et al., 2019). Based on the theory of the Environmental Kuznets Curve (EKC) and the Pollution Haven Hypothesis (PHH) as well as previous research, this research can be modeled as follows:

$$lnED_{it} = \beta_0 + \beta_1 lnFDI_{it} + \beta_2 lnGPC_{it} + \beta_3 lnGPC^2{}_{it} + \varepsilon_{it} \quad (1)$$

where, ED is environmental damage; FDI is foreign direct investment; GPC is GDP per capita; GPC^2 is GDP per capita squared; β_0 is the intercept; $\beta_1 - \beta_3$ are coefficient; i is cross section; t is time series; and ε is the error term.

The panel data regression model is estimated using the CEM and FEM approaches, the estimation method used is the OLS method, so the underlying assumptions need to be tested through assumption testing. The assumption test in question is the residual distribution test, residual heterogeneity test, autocorrelation test and multicollinearity test (Alvitiani et al., 2019). The research model that was selected and met the assumptions was further tested by statistical tests to see the level of significance of the estimated parameters. The statistical tests in question are: (a) partial statistical test (t test); (b) simultaneous statistical test (F test); and test the coefficient of determination. The t test is used to test the significance level of the influence of the independent variable partially on the dependent variable. While the F test is used to test the effect of all independent variables simultaneously on the dependent variable. On the other hand, the coefficient of determination test is used to measure the contribution of the independent variables in explaining the dependent variable used in the model (Widarjono, 2018).

3. RESULTS AND DISCUSSION

Table 3 reports the number of observations used in this research was 563. The average amount of CO2 released into the air in all OIC member countries every year is 64,38 million tons. The country

with the lowest CO2 value is the Comoros country, which is at million tons and the highest country is Iran, which is at 745,035 million tons. Furthermore, the average value of FDI invested in OIC member countries during the observation period is 1.55 billion USD. The country with the lowest FDI value is Iraq, which is at 1.02 billion USD, while the country with the highest FDI value is Indonesia which is at 2.51 billion USD.

Table 3. The results of descriptive statistics

Descriptive	ED	FDI	GPC
Mean	64,379,558	1.55	2,597
Median	5,514,320	6.52	1,402
Maximum	745,035,109	2.51	14,383
Minimum	106,256	1.02	242
Std. Dev.	134,000,000	3.23	2.577
Number of Observations	563	563	563

Source: processed data

According to the classification by the world bank based on GDP per capita, the majority of OIC member countries are in low income and lower middle income (World Bank, 2020). The average GDP per capita of all OIC member countries during the observation period was 2,597 USD. The OIC member country with the highest GDP per capita value is Libya with a GDP per capita value of USD 14,383, while the lowest is Afghanistan with a GDP per capita value of USD 242. The regression model used in this research is a panel data regression model which is estimated using three approaches, namely the *Common Effect Model, Fixed Effect Model,* and *Random Effect Models.* The results of the model estimation are as presented in Table 4.

Table 4. The results of research model estimation

Dependent variable: lnED (Environmental Damage)				
Variables		**Model Estimation Approach**		
		Common Effect	**Fixed Effect**	**Random Effect**
Constant	Coefficient	-2,3514*	10,0390***	10,0177***
	Std. Error	1,2629	0,4058	0,4310
	t-statistic	-1,8661	24,7387	23,2429
	Prob.	0,0629	0,0000	0,0000
lnFDI	Coefficient	0,6029***	0,0463***	0,0487***
	Std. Error	0,0235	0,0077	0,0077
	t-statistic	25,6553	6,0129	6,3246
	Prob.	0,0000	0,0000	0,0000
lnGPC	Coefficient	1,2725***	0,9958***	0,9876***
	Std. Error	0,3340	0,1090	0,1086
	t-statistic	3,8098	9,1357	9,0939
	Prob.	0,0001	0,0000	0,0000
$lnGPC^2$	Coefficient	-0,0522**	-0,0394***	-0,0385***
	Std. Error	0,0206	0,0071	0,0071
	t-statistic	-2,5339	-5,5492	-5,4225
	Prob.	0,0112	0,0000	0,0000
R^2		0,5689	0,9869	0,4562
F-stats		520,0442	1445,5910	330,6545
Prob (F-Stats)		0,0000	0,0000	0,0000
Chow test			4149,7808	
			0,0000	
Hausman test				98,60004
				0,0000

Note: *, ** and *** represent significance at 10%, 5% and 1% levels respectively
Source: Author's calculations

The estimation results of the model will then be selected as one of the best models through the model specification test. Chow test results obtained F-statistic value of 4149,7808 and significant at 1% alpha. This shows that the fixed effect model is better than the common effect model. Furthermore, the Hausman test results obtained a statistical value of 98,60004 and significant at 1% alpha. This shows that the fixed effect model is better than the Random Effect Model. Thus, the estimation model approach used in this research is the fixed effect model approach.

Furthermore, the fixed effect model is tested for classical assumptions to ensure that the model meets the elements of the Best Linear Unbiased Estimator. The results of the classical assumption test in this study show that the model is not normally distributed. It also still has heterogeneity and a serial correlation on the residuals. In the OLS method, if the classical assumption test is not met, then the risk of the regression results being biased is very large. However, it is different from the GLS method. The use of the GLS method can make the estimation results immune to the problems caused by the classical assumption test that is not met (Gujarati, 2021). Therefore, changing the OLS method to the GLS method is a way that can be used if the classical assumption test is not met. Because the model chosen in this study is Fixed Effect no weights with the OLS method, based on the above considerations, the authors changed the OLS method to GLS by using Fixed Effect Cross-Section Weights.

Table 5. Regression results with fixed effect cross-section weights (GLS)

Dependent Variable: lnED (Environmental Damage)					
Variable	**Descriptions**	**Coefficient**	**Std. error**	**t-stat**	**Prob.**
Constant	Intercept	10,4353***	0,3289	31,728	0,000
lnFDI	Foreign Direct Investment	0,0336***	0,0053	6,339	0,000
lnGPC	GDP per capita	0,9343***	0,0880	10,617	0,000
lnGPC²	GDP per capita square	-0,0340***	0,0056	-6,071	0,000
Summary					
Obs.	563				
R^2	0,994				
Adjusted R^2	0,994				
F-stats	3203,243				
Diagnostic test	Test value	Prob.			
Normal test	23,354	0,3455			
Serial LM test	10,553	0,9732			
Heteroscedasticity	9,846	0,2531			

Note: *, ** and *** represent significance at 10%, 5% and 1% levels respectively
Source: Author's calculations

The estimation results of the model as presented in Table 5 show that simultaneously, all independent variables used in the model show significant values, this can be seen from the p-value of the F test which is less than 1% alpha. This finding is also reinforced by the fairly high value of the coefficient of determination. Thus, the model used in this research is the goodness of fit model.

Furthermore, a partial statistical test was conducted to see the level of significance of each independent variable used in the model. The coefficient of the FDI variable is 0,0336 and is significant, this is indicated by the p-value which is smaller than 1% alpha. This means that if foreign direct investment in OIC member countries continues, it will exacerbate the level of environmental damage. This finding is in line with the theory related to environmental damage, the pollution haven *hypothesis* (PHH). PHH theory states that developed countries tend to establish factories or companies in developing countries because raw materials and labor costs are relatively cheaper. In addition, developing countries generally have less stringent environmental regulations which ultimately reduce production costs (Bulus & Koc, 2021). Nations United (2020) states that of the 57 OIC members, only Saudi Arabia, the United Arab Emirates, and Qatar are developed countries. This means that there are 54 members of the OIC countries which are developing countries. This

empirical fact can support the argument related to the theory of environmental damage caused by FDI above. This finding also supports the research of Mert & Caglar (2020) which concludes that pollution-intensive production activities are directed from developed countries to countries with looser environmental regulations through FDI. In addition, research at Santi & Sasana (2020) concluded that FDI has a positive effect on environmental damage through CO2 in ASEAN countries. Then research by Abdouli & Hammami (2017) found that FDI significantly and positively increases environmental damage. Likewise research by Bakhsh et al. (2017) and Gökmenoğlu & Taspinar (2016) concludes that an increase in FDI makes the environment worse.

The statistical results in table 5 also states that GDP per capita has a significant effect on environmental damage. This is indicated by the p-value which is smaller than 1% alpha. The coefficient of the GDP per capita variable is 0,9343. This means that if GDP per capita continues to increase, the damage to the environment will continue to increase. This result is in line with the *Environmental Kuznets Curve* (EKC) theory regarding environmental damage caused by GDP per capita. This theory explains that economic development initially leads to environmental damage (deteriorating environmental quality). The positive direction of the GDP per capita variable provides empirical evidence that GDP per capita in the 57 OIC countries has a bad influence on environmental quality. This finding is also in line with the results of research conducted by Bakhsh et al. (2017) who found that economic growth and energy consumption increase environmental damage. M. Bildirici, (2018) also found that economic growth has a positive and significant impact on environmental damage in the G7 countries. Likewise, research conducted by Firman & Munim (2022), Bardi & Hfaiedh (2021) and Sabir et al. (2020) found that an increase in GDP per capita can increase environmental damage.

The findings in this research also provide empirical evidence that the *Environmental Kuznets Curve* (EKC) (inverted U) occurs in 57 OIC member countries. This can be proven from the findings in this research where the coefficient value of GDP per capita is positive and the coefficient value of GDP per capita squared is negative. This means that if GDP per capita in the 57 OIC member countries continues to increase, this condition will exacerbate environmental damage in the early stages. However, there will be a *turning point* in the future where an increasing GDP per capita will actually reduce environmental damage, this condition forms an inverted U. This finding is in line with the research conducted by Nikensari et al. (2019) which found that the inverted U-shaped EKC hypothesis occurs in *high-income* countries. While in *lower middle income* countries, the pattern of the relationship between GDP per capita and environmental damage still forms a U curve, or in other words the EKC hypothesis does not occur in these countries because in some countries these are still in the early stages of development. Usman et al. (2019) also found an EKC with an inverted U-curve between economic growth and environmental damage in India and also other researchers like Katircioğlu & Taşpinar (2017), Adebayo (2021), Işik et al. (2020) and Beşe & Kalayci (2021) also found the same results.

4. CONCLUSIONS

From the results of the analysis of hypothesis testing and the discussion that has been described, it can be concluded that FDI and GDP per capita simultaneously have an effect on environmental damage as measured by CO2 in 57 member countries in 1998-2020, meaning if there is a change in each independent variable simultaneously, then environmental damage will also experience changes in the 57 OIC countries. The FDI variable has a significant influence with a positive direction on environmental damage in the 57 OIC countries from 1998 to 2020, which means that every increase in FDI will increase environmental damage, while the GDP per capita variable has a significant effect with a positive direction towards environmental damage in 57 OIC countries in 1998-2020, meaning that if there is an increase in GDP per capita, it will increase environmental damage in 57 OIC countries. The GDP per capita variable has a positive direction and GDP per capita squared has a negative direction on environmental damage. This means that the *Environmental Kuznets Curve* is proven to exist in 57 OIC countries. Based on the result, the implication that the government should do is that the government must select FDI that enters the country. Good FDI is FDI that not only improves the economy of the recipient country, but it must

also be able to ensure that the environment of the recipient country is not damaged. Therefore, the companies from FDI must use green technology. The use of Green Technology will enable companies to produce goods and services, not produce major pollution to the environment. Economic growth per capita has a positive impact on environmental damage. This is the result of an increase in income but not accompanied by an increase in public awareness on the importance of protecting the environment. Therefore, in this case, education is one of the ways that the government can use to increase public awareness to protect the environment. Thus, although per capita income increases, this does not create problems for the environment.

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