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Does Islamic Financial Development Reduce Carbon Emissions? Evidence from OIC Countries

Nadya Setiawati, Daryn Salsabila
Padjadjaran University
Email: *nadya19007@mail.unpad.ac.id, daryn19001@mail.unpad.ac.id*

Abstract

Islamic finance has great potential in encouraging the development of social and economic infrastructure. The rapid improvement of the Islamic finance sector and the increasingly good economic growth have a positive impact on infrastructure development in the Countries of the Organization Islamic Cooperation (OIC). The study analyzed the impact of the development of the Islamic financial sector on CO2 emissions in 12 OIC countries including the United Arab Emirates, Indonesia, Jordan, Kazakhstan, Kuwait, Lebanon, Malaysia, Nigeria, Pakistan, Saudi Arabia, Sudan and Turkey from 2013 to 2018. The dependent variables used are CO2 emissions, while independent variables include GDP per capita, Sukuk issuance, total sharia-compliant, total energy consumption, and industry value-added. The study used the Panel Corrected Standard Error (PCSE) method and robustness using the Newey-West standard error model. Results from the study showed that GDP per capita and industry value added significantly increased CO2 emissions. Conversely, Islamic financial development variables namely Sukuk issuance and total sharia-compliant have a negative and significant impact on CO2 emissions. This research suggests for policymakers to further encourage sustainable development of Islamic finance to encourage energy efficiency and renewable energy production and consumption to reduce CO2 emissions and maintain environmental quality.

Keywords: *OIC Countries, Islamic Financial Development, PCSE, Newey-West Model, CO2 Emissions*

Abstrak

Keuangan syariah memiliki potensi besar dalam mendorong pengembangan infrastruktur sosial dan ekonomi. Pesatnya perbaikan sektor keuangan syariah dan pertumbuhan ekonomi yang semakin baik berdampak positif bagi pembangunan infrastruktur di Negara-negara Organisasi Kerjasama Islam (OKI). Kajian tersebut menganalisis dampak pengembangan sektor keuangan syariah terhadap emisi CO2 di 12 negara OKI antara lain Uni Emirat Arab, Indonesia, Yordania, Kazakstan, Kuwait, Lebanon, Malaysia, Nigeria, Pakistan, Arab Saudi, Sudan, dan Turki dari tahun 2013 hingga tahun 2018. Variabel dependen yang digunakan adalah emisi CO2, sedangkan variabel independen meliputi PDB per kapita, penerbitan sukuk, total syariah, total konsumsi energi, dan nilai tambah industri. Penelitian menggunakan metode Panel Corrected Standard Error (PCSE) dan robustness menggunakan model standard error Newey-West. Hasil penelitian menunjukkan bahwa PDB per kapita dan nilai tambah industri meningkatkan emisi CO2 secara signifikan. Sebaliknya, variabel perkembangan keuangan syariah yaitu penerbitan sukuk dan total syariah berpengaruh negatif dan signifikan terhadap emisi CO2. Penelitian ini menyarankan bagi pembuat kebijakan untuk lebih mendorong pengembangan berkelanjutan keuangan Islam untuk mendorong efisiensi energi dan produksi dan konsumsi energi terbarukan untuk mengurangi emisi CO2 dan menjaga kualitas lingkungan.

***Kata kunci**: Negara OKI, Pengembangan Keuangan Islam, PCSE, Model Newey-West, Emisi CO2*

Introduction

Islamic finance is derived from the principles in sharia rules. According to Zamir et al[1], there are six basic principles of the Islamic Financial System, namely the prohibition of interest: "excess" and described as "any unjustified addition of capital, whether in loan or sale" prohibited in Islamic law, risk sharing and profits by all parties system, asset-based: There is a strong relationship between the performance of the asset and the return on capital used to finance it. Then, money as "potential" capital: Money is actual capital only when combined with other resources to carry out productive activities. Then, Islam bans speculative behavior or prohibits transactions that display extreme uncertainty, and gambling. Another important thing is the prohibition in some forms of investment in some businesses, such as cigarettes, alcohol, pigs, pornography, human trafficking, and other unlawful goods and activities. In addition, Islam considers the importance of making and fulfilling contracts between parties and the openness of information, so that Islam upholds, respects, and fulfills the rights and obligations of each party. This is in line with what is expressed by Ilias (2008)[2] that there are five principles of Islamic finance that are different from conventional finance, namely the prohibition of interest (riba), the prohibition of uncertainty, the system of risk-sharing, and profit-sharing, ethical investments to realize common prosperity, and the inclusion of underlying assets.

Islamic finance has great potential in encouraging the development of social and economic infrastructure. Such as zakat and waqf instruments that have strong potential in supporting small-scale social projects. Then there are Sukuk instruments that are able to finance large-scale infrastructures such as sustainable and affordable energy, transportation, roads, shelter, and water and sanitation projects (OIC and SESRIC, 2019)[3].

Table 1. Year on Year (YoY) Performance of IFSI by Sector (2018 – 2019)

	2018		2019		
Sector	Billion USD	Share (%)	Billion USD	Share (%)	YoY Growth (%)
Islamic Banking	1,571.3	71.7	1,765.8	72.4	12.4

[1] Zamir Iqbal and Abbas Mirakhor, "An Introduction to Islamic Finance Theory and Practice," *Sematic Scholar*, 2006, p. 2.

[2] Ilias, S. (2008). Islamic Finance : Overview and Policy. *Finance*, p. 1–6.

[3] SESRIC. (2019). *OIC Environment Report 2019*. SESRIC.

Outstanding Sukuk	530.4	24.2	543.4	22.3	2.5
Islamic Funds Assets	61.5	2.8	102.3	4.2	66.3
Takaful Contributions	27.7	1.3	27. 1	1.1	-2.3
Total	2,190.9	100	2,438.6	100	11.3

Source: [4]

Over the past three decades, Islamic finance has become one of the fastest-growing sectors of the emerging global financial markets[5]. The total volume of Islamic financial assets has grown 15-20 percent per year and until 2019 it is known that the figure has reached $ 2.88 trillion[6]. The rapid growth in Islamic financial assets is known mostly from member countries of the Organisation Islamic Cooperation (OIC) with a total volume of assets of the Islamic financial sector as much as USD 2.44 trillion in 2019 with a growth rate of 11.4 percent year on year (COMCEC, 2020).

Although Islamic finance in the OIC country has increased well, its economic growth rate slowed by 3.1% in real terms in 2018, after a slowdown of 6% in 2010 and 4.2% in 2014. However, the growth rate of OIC countries was able to achieve a higher than average world growth until 2017, thus leading to an increase in the share of OIC countries to global GDP [7].

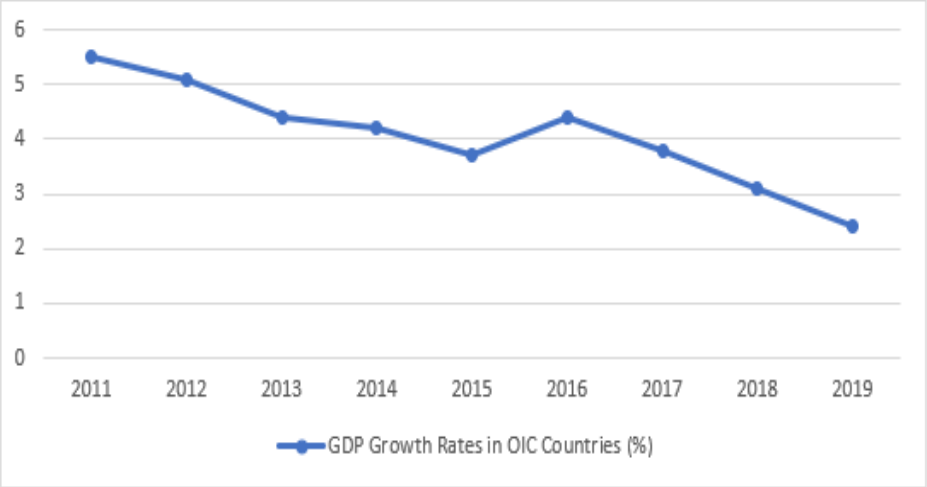
[4] IFSB (2020)

[5] Zamir Iqbal and Abbas Mirakhor, *Economic Development and Islamic Finance*, *Directions In Development* (Washington DC: The World Bank, 2013), https://doi.org/10.1596/978-0-8213-9953-8.

[6] Refinitiv, "Islamic Finance Development Report 2020: Progressing Through Development," *Islamic Finance Development Report*, 2020, 1–54.

[7] SESRIC, *OIC ECONOMIC OUTLOOK Trade and Integration Challenges Amid Rising Uncertainties 2020*, vol. 148 (Ankara: Publication Department of SESRIC, 2020).

Graph 1. Gross Domestic Product (GDP) Growth Rates in OIC Countries (%)



Source: SESRIC calculations based on IMF WEO Database [8]

The rapid improvement of the Islamic finance sector and improved economic growth have a positive impact on people's well-being and infrastructure development in OIC countries[9]. However, several studies explain that the increase in economic growth and the financial sector will be followed by environmental degradation[10]. In addition, some studies reveal a relationship between energy consumption and economic growth that shows that CO_2 emissions negatively affect economic growth, while energy consumption has a positive effect in Turkey[11]. Based on the Sesric data[12], it is known that greenhouse gas (GHG) emissions in OIC member countries are increasing coupled with limited mitigation strategies. In the period 2000-2017, there was an increase in CO_2 emissions per capita in 38 of the 54 total OIC member countries. Saudi Arabia had the highest increase in CO_2 emissions at 6.7 metric tons per capita, Kazakhstan (5.9 metric tons), Oman (5.8 metric tons), Turkmenistan (3.9 metric tons), and Iran (3.0 metric tons). Then, per capita emissions tend to be very high in fuel exporting countries such as Qatar, Bahrain, Kuwait, the United Arab Emirates, and Saudi Arabia. This increase in carbon dioxide poses a significant

[8] OIC and SESRIC, "OIC ECONOMIC OUTLOOK 2019: Mobilizing Financial Resources for Development 2019," 2019.

[9] IFSB, "Islamic Financial Services Industry Stability Report 2020."

[10] R. Carson and Y. Sun, "Forecasting the Path of China's CO2 Emissions: Using Province Level Information," *Journal of Environmental Economics and Management*, 2008; Abdul Jalil and Mete Feridun, "The Impact of Growth, Energy and Financial Development on the Environment in China: A Cointegration Analysis," *Energy Economics* 33, no. 2 (2011): 284–91, https://doi.org/10.1016/j.eneco.2010.10.003; Matthew Ntow-Gyamfi et al., "Environmental Sustainability and Financial Development in Africa; Does Institutional Quality Play Any Role?," 2020, https://doi.org/10.1080/21665095.2020.1798261.

[11] Cuma Bozkurt and Yusuf Akan, "Economic Growth, Co2 Emissions and Energy Consumption: The Turkish Case," *International Journal of Energy Economics and Policy* 4, no. 3 (2014): 484–94.

[12] SESRIC (2019)

risk to human health. According to [13], high levels of carbon dioxide can lead to various health consequences, such as inflammation, decline high levels of cognitive ability, bone demineralization, renal calcification, hedonistic eating behavior, behavioral and physiological changes. Stress, oxidative stress, and endothelial dysfunction.

Although many studies discuss the influence of the development of the financial sector on the environment, the research that explains specifically the influence in terms of Islamic finance is still need to be developed. Whereas the Islamic financial system and conventional finance have different fundamentally, where Islamic finance has characteristic socio-economic and distributive justice which has a comprehensive system of ethics and moral values[14]. However, so far there has been no broad clarity on the relationship between the Islamic financial sector and its link to total energy consumption and environmental degradation, especially regarding its relationship to increased CO_2 emissions. It is important to be researched, because it is in line with the OIC Action Program 2025, which is to maintain and preserve the environment, and strengthen the capacity of disaster risk reduction and climate change mitigation and adaptation to the economy, Islamic finance, and total growth of energy consumption to CO_2 emissions in OIC member countries.

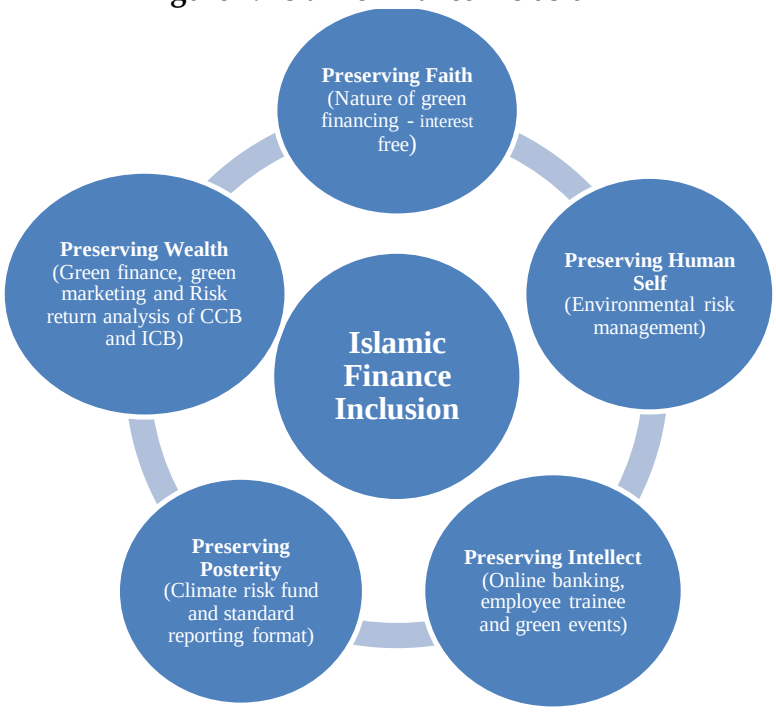
Islamic finance has a function to support efforts to achieve sustainability, through financial stability that reduces vulnerability, environmental and social activities, and infrastructure financing[15]. The realization of this function is very accordance with the moral ethics which underlying Islamic finance, namely Maqashid Sharia. Maqashid Sharia reflects the purpose or purpose of sharia, as according to Imam Al-Ghazali, the purpose is to maintain human welfare through the protection of faith (din), soul (nafs), intellect ('aql), lineage (nasl), and wealth. The Islamic paradigm encourages a financial system which in line with the Maqashid element, and it is maintained through understanding the context, community benefits and environmental sustainability (Chapra et al., 2008). The inclusivity of Islamic finance creates a common ground between sustainability and Maqashid Syariah within the following framework.

[13] Jacobson et al. (2019)

[14] Muhammad Ayub, *Understanding Islamic Finance*, *Psyche (New York)*, vol. 22 (West Sussex: John Wiley & Sons Ltd, 2007), https://doi.org/10.1155/1915/93252.

[15] Eman Hashem, "The Role of Islamic Finance in Achieving SDGs: Case Study-Egypt," *International Research Journal of Finance and Economics*, no. 176 (2019).

Figure 1. Islamic Finance Inclusion



Source: Julia & Kasim (2020)[16]

Islamic finance comes in a more ethical form and has the ultimate goal of creating a sustainable, impartial, and responsible financial system. While the conventional financial system focuses more on consideration of risk and financial benefits (Hassan et al., 2021). According to Julia & Kasim[17], Islamic finance can have a greater role in development and sustainability aspects, because it considers both aspects to be complied with, as it's contained in the five cores of Maqashid Sharia, thus requiring Islamic financial institutions to consider environmental damage as the main assessment before investing. In this case, Islamic finance has a stronger ethical foundation compared to conventional finance, so it can have a better impact on environmental sustainability. According to I. Saba et al., of the Islamic Financial Institutions (IFI), there are four key roles of Islamic Finance that differ from conventional finance in Sustainable Development. The first thing is to improve the stability and resilience of the financial sector with equity-based financing in Islamic finance that will minimize risk, reduce the likelihood of bankruptcy and improve the stability of the overall financial sector. Then, increase financial inclusion with Islamic microfinance to reach various segments to get financial services at a reasonable cost. The next point is to reduce vulnerability and mitigate risk because the Islamic financial system develops risk sharing rather than risk transfer. Then, another point is solving social and environmental problems, and facilitating infrastructure development. Third, reduce vulnerability and mitigate risk because the Islamic financial system develops risk sharing rather than risk transfer. The fourth point,

[16] Julia & Kassim (2020)
[17] Julia & Kassim (2020)

solving social and environmental problems, and facilitating infrastructure development.

The study was created to analyze the effects of Islamic financial developments and their association with total energy consumption and their effect on total CO2 emissions in some OIC member countries. The Islamic finance variables which our used comes from four main sectors in the improvement of development and economy in the OIC country, namely the total assets of Islamic banking, Sukuk, Islamic financing assets, and contributions from takaful. This study was conducted to answer the following questions: What is the effect of the increase in the Islamic financial sector on total CO_2 emissions in OIC countries? Can Islamic finance be an alternative to encourage increased development without causing negative impacts to the environment?

Literature Review

Several studies discuss the influence of financial sector development on CO2 emissions, including Tamazian et al. (2009)[18] which show that financial sector development can lead to a decrease in CO2 emissions per capita, especially in the development of capital markets and the banking sector along with higher FDI levels helping to achieve lower CO2 emissions per capita. Omri et al. (2015) in their research in 12 MENA countries (the Middle East and North Africa) found that financial sector development has an impact on environmental damage in the long term. Another relevant research according to the development of the Islamic financial sector on CO2 emissions has been conducted by Iskandar et al. (2020) shows that there is no dynamic relationship to economic growth, Islamic financial development, and CO2 emissions in the short term. While in the long term shows that the development of Islamic finance has a positive effect on CO2 emissions from the transportation sector in Indonesia. In addition, other research related to Islamic finance has also been conducted by Mahmood & Masih (2019) which shows that there is a significant long-term relationship between the performance of Islamic Banks (as part of Islamic finance) and CO2 emissions in some OIC countries.

In relation to the development of the financial sector with the environment, previous research conducted by Zhang et al. (2011) suggested that the development of the financial sector has contributed to the decline in environmental quality in China. This is reflected by the variable GDP per capita, the variable financial intermediation scale, financial intermediation efficiency, stock market scale, stock market efficiency which is projected as an indicator of

[18] Tamazian, A., Chousa, J. P., & Vadlamannati, K. C.. Does higher economic and financial development lead to environmental degradation: Evidence from BRIC countries. *Energy Policy*, *37*(1), (2009). 246–253. https://doi.org/10.1016/j.enpol.2008.08.025

financial development has a significant influence on CO2 emissions at the level of 5%. Another study conducted by Fatoni A. (2021) in his study using a panel data model with random effects for the period 2017 to 2019 showed that Islamic banking financing has a negative and significant influence on air quality in Indonesia. Then, there is a negative and significant relationship between foreign direct investments in air quality in Indonesia, so international trade activities have a negative and significant influence on air quality in Indonesia.

Methodology

Data and Variable

The study used panel data from 12 OIC member countries from 2013 to 2018. The countries selected include the United Arab Emirates, Indonesia, Jordan, Kazakhstan, Kuwait, Lebanon, Malaysia, Nigeria, Oman, Saudi Arabia, Sudan, and Turkey. The dependent variable is total CO2 emissions. The independent variables used are GDP per capita, sharia-compliant Islamic banks window, international tourism, and total energy consumption from the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC) and Sukuk issuance from the International Islamic Financial Market (IIFM) summarized in the following table:

Table 2. Data and Source

Variable Name	Type of Data	Source
gdpc	GDP Per Capita	World Bank
coemis	CO_2 Emissions	World Bank
energycons	Total Energy Consumption	SESRIC
scfin	Sharia Compliant Islamic Banks	SESRIC
lnglsukuk	Sukuk Issuance	International Islamic Financial Market (IIFM)
lnvaind	Industry value added	World Bank
lnfdi	Foreign Direct Investment	SESRIC
coal	Coal Rent	SESRIC
smca	Share Market Capital Added	World Bank
trade_open	Trade Openness	SESRIC
ka_open	Financial Openness	Chinn-Ito Index

Unit Root Test

This study used Fisher Augmented Dickey-Fuller (ADF) root test unit and Cross-Sectional Augmented ADF (CADF) root test unit to check the stationarity

of variables used by Pesaran (2004)[19]. Fisher ADF and CADF unit root tests consider cross-sectional dependency issues when testing variable stationarity.

Panel Corrected Standard Error (PCSE) Model

The method used in this study is the Corrected Standard Error Panel (PCSE). PCSE is a method used to address cross-sectional dependence (CSD), autocorrelation, and groupwise heteroskedasticity problems commonly found in data panels (Reed & Webb, 2010)[20]. This method is used because it corresponds to datasets that have a larger cross-sectional unit (N) than the time period (T).

Model Specification

The model used refers to the model equation by Tamazian et al. (2009)[21]. With the following empirical models:

$$CO_{2it} = \alpha + \beta_1 GDP_{it} + \beta_2 R\&D_{it} + \beta_3 IS_{it} + \beta_4 SMVA_{it} + \beta_5 Log(FDI)_{it} + \beta_6 DBA_{it} + \beta_7 CAC_{it} + \beta_8 FL_{it} + \beta_9 EC_{it} + \beta_{10} EC_{it} + \beta_{11} FO \quad (1)$$

Where the proxy of economic development used in the model is GDP per capita, then financial development is projected by total FDI and Deposit Bank and energy control variables used, namely total energy consumption and industry value added (industry share as percentage of GDP). The model used in this study modified the proxies of financial development to adjust the context of Islamic finance, so that the equation model used is as follows:

$$lncoemis_{it} = \alpha + \beta_1 lngdpc_{it} + \beta_2 lnscfin_{it} + \beta_3 lnenergycons_{it} + \beta_4 lnglsukuk_{it} + \beta_5 lnvaind_{it} + \beta_6 lnfdi_{it} + \beta_7 coal_{it} + \beta_8 smca_{it} + \beta_9 trade\_open_{it} + \beta_{10} ka\_open_{it} + \varepsilon_{it} \quad (2)$$

$lngdpc_{it}$ is GDP per capita, $lnscfin_{it}$ is total shariah-compliant financing, then $lnenergycons_{it}$ is total energy consumption, $lnglsukuk_{it}$ is issuance sukuk, $lnvaind_{it}$ is industry value added, $lnfdi_{it}$ is foreign direct investment where all variables used use a natural logarithm form. Then, $smca_{it}$ is share market capital added, $coal_{it}$is the level of coal rent in GDP, $trade\_open_{it}$ is trade openness and ka_open_{it} is financial openness.

[19] Pesaran (2004)

[20] Reed, W. R., & Webb, R.). The PCSE Estimator is Good -- Just Not As Good As You Think. *Journal of Time Series Econometrics*, *2*(1). (2010). https://doi.org/10.2202/1941-1928.1032.

[21] Tamazian, A., Chousa, J. P., & Vadlamannati, K. C. (2009).

Results and Dicussion

Table 3 shows the mean, standard deviation, minimum dan maximum values of the variables used

Table 3. Summary Statistics

Variable	Obs	Mean	Std. Dev	Min	Max
lncoemis	78	1.497103	1.32346	-0.9387283	3. 185433
lngdpc	78	8.981662	1.066648	7.048965	10.8075
lnenergycons	78	17.48351	1.216698	15.33502	21. 14322
lnscfin	78	8. 113448	3.671173	-2. 125276	11.81465
lnglsukuk	78	10.94425	0.319865	10.41436	11.32913
lnvaind	78	3.458604	0.4490147	2.655915	4.291815

Empirical findings of the cross-sectional dependency test (CSD) are shown in Table 5. The p value of < 0.05 indicates that the null hypothesis is rejected which means there is cross-sectional dependence on several variables, including GDP emissions per capita, total energy consumption, total sharia-compliant, sukuk issuance and industry value added.

Table 4. CD-test

	CD-test	P-value
lncoemis	-1.628	0. 104
lngdpc	3. 071***	0.002
lnenergycons	13.438***	0.000
lnscfin	8.383***	0.000
lnglsukuk	11.666***	0.000
lnvaind	21.633***	0.000
coal	2.391**	0.017
smca	0.144	0.886
ka_open	-0.139	0.890
trade_open	7.394***	0.000

Note. ***p<0.01, **p<0.05, and *p<0.1

Table 5 shows the results of the Fisher ADF root test unit. The results showed that total CO_2 emissions were not stationary, but independent variables namely GDP per capita, total energy consumption, FDI, sukuk issuance, total sharia-compliant and industry value added were stationary.

Table 5. Fisher ADF Unit Root Test

	At Level	
Variables	Statistics	P-value

lncoemis	Inverse Chi2	P	35.3902	0.1035
	Inverse normal	Z	-1.8605	0.0314
	Inverse logit	L	-1.7505	0.0422
	Modified inverse Chi2	Pm	1.3022	0.0964
lngdpc	Inverse Chi2	P	57.2109	0.0004
	Inverse normal	Z	-3.8212	0.0001
	Inverse logit	L	-3.8269	0.0001
	Modified inverse Chi2	Pm	4.3282	0.0000
lnenergycons	Inverse Chi2	P	49.0030	0.0041
	Inverse normal	Z	-3.1762	0.0007
	Inverse logit	L	-3.0612	0.0016
	Modified inverse Chi2	Pm	3.1899	0.0007
lnscfin	Inverse Chi2	P	36.5785	0.0815
	Inverse normal	Z	-1.7709	0.0383
	Inverse logit	L	-1.7080	0.0461
	Modified inverse Chi2	Pm	1.4670	0.0712
lnvaind	Inverse Chi2	P	59.9822	0.0002
	Inverse normal	Z	-4.0266	0.0000
	Inverse logit	L	-4.0529	0.0001
	Modified inverse Chi2	Pm	4.7125	0.0000
lnglsukuk	Inverse Chi2	P	71.0599	0.0001
	Inverse normal	Z	-5.4586	0.0007
	Inverse logit	L	-5.3387	0.0016
	Modified inverse Chi2	Pm	6.2487	0.0007
smca	Inverse Chi2	P	40.0447	0.0386
	Inverse normal	Z	-2.2971	0.0108
	Inverse logit	L	-2.1905	0.0159
	Modified inverse Chi2	Pm	1.9476	0.0257
coal	Inverse Chi2	P	31.0958	0.0019
	Inverse normal	Z	-2.9932	0.0014
	Inverse logit	L	-3.2500	0.0013
	Modified inverse Chi2	Pm	3.8979	0.0000
trade_open	Inverse Chi2	P	62.8300	0.0001
	Inverse normal	Z	-4.5793	0.0000
	Inverse logit	L	-4.5311	0.0000
	Modified inverse Chi2	Pm	5.1074	0.0000
ka_open	Inverse Chi2	P	2.1972	0.3333
	Inverse normal	Z	-0.4307	0.3333
	Inverse logit	L	-0.4085	0.3462
	Modified inverse Chi2	Pm	0.0986	0.4607
lnfdi	Inverse Chi2	P	50.8500	0.0025
	Inverse normal	Z	-2.8761	0.0020
	Inverse logit	L	-2.7634	0.0037
	Modified inverse Chi2	Pm	3.4461	0.0003

To find out the long-term relationship between variables, a cointegration test is carried out. The study used three panel cointegration tests including Kao,

Pedroni and Westerlund second generation[22]. The cointegration test is found on Tables 6, 7 and 8.

Table 6. Kao-Test for Cointegration

Kao Test for Cointegration		
	Statistics	P-value
Modified Dickey-Fuller t	2.6452***	0.0041
Dickey-Fuller t	1.9940***	0.0231
Augmented Dickey-Fuller t	0.4700	0.3192
Unadjested modified Dickey-Fuller t	0.4424	0.3291
Unadjested Dickey-Fuller t	-0.9204	0.1787

Table 7. Pedroni-Test for Cointegration

Pedroni Test for Cointegration		
	Statistics	P-value
Modified Phillips-Perron t	7.7417***	0.0000
Phillips-Perron t	-12.3495***	0.0000
Augmented Dickey-Fuller t	7.2537***	0.0000

Table 8. Westerlund-Test for Cointegration

Westerlund Test for Cointegration		
	Statistics	P-value
Variance ratio (all panel are cointegrated)	72.7108***	0.0000
Variance ratio (some panel are cointegrated)	180.0012***	0.0000

Then, to find out the impact of independent variables on carbon dioxide emissions, ordinary least square regression (OLS) and Fixed Effect (FE). Regression results are found in Table 9. Berdasarkan hasil estimasi, diketahui bahwa terdapat beberapa variabel yang berpengaruh secara signifikan terhadap emisi CO2, diantaranya sharia-compliant, sukuk, GDP per capita, coal rent dan share market value added. Sementara variabel yang tidak berpengaruh secara signifikan diantaranya total energy consumption, foreign direct investment, industry value added, and financial openness dan trade openness.

Table 9. Regression Using OLS, Fixed Effect

Variables	OLS	FE
lnenergycons	-0.0173	0.0485
	(0.0563)	(0.0342)

[22] Joakim Westerlund, "Testing for Error Correction in Panel Data," *Oxford Bulletin of Economics and Statistics* 69, no. 6 (2007): 709–48, https://doi.org/10.1111/j.1468-0084.2007.00477.x.

lnfdi	-0.0447	0.00930
	(0.0457)	(0.00857)
lnscfin	-0.0435**	0.0226
	(0.0168)	(0.0368)
lnglsukuk	-0.236*	-0.0385*
	(0.137)	(0.0207)
lnvaind	0.300	-0.0475
	(0.237)	(0.128)
lngdpc	1.070***	0.100**
	(0.0906)	(0.0379)
ka_open	0.132	0.0356
	(0.137)	(0.0833)
coal	0.588***	0.0210
	(0.170)	(0.0370)
smca	0.00630***	-0.000145
	(0.00205)	(0.000508)
trade_open	-0.000654	0.00328*
	(0.00214)	(0.00180)
Constant	-5.287***	-0.347
	(1.768)	(0.912)
Observations	76	76
R-squared	0.934	0.183
Number of country		13

Note. ***p<0.01, **p<0.05, and *p<0.1

The effect of GDP per capita on CO_2 emissions is positive, which means GDP per capita increases CO_2 emissions significantly at the level 1 percent based on OLS regression and 5 percent based on fixed effect. Assuming other variables are fixed (ceteris paribus), and if there is an increase of 1 percent in the GDP per capita variable in twelve OIC countries that are used as observations, CO_2 emissions will increase by 1.07 percent based on OLS and 0.1 percent based on fixed effects. These results were also in line with [23] which stated that GDP has a positive effect on increasing CO_2 emissions, because increased output can be achieved due to more intensive use of energy by existing technologies, capacity increases as well as CO_2 emissions.

Then the following is the results for the sharia-compliant variable and the Sukuk issuance which is the main point of this research. Total sharia-compliant negatively and significantly at the 5 percent affects CO_2 emissions based on OLS regression, which means total sharia-compliant lowers CO_2 emissions. Assuming other variables are fixed (ceteris paribus), and if there is an increase of 1 percent in the total sharia-compliant in twelve OIC countries that are used as observations, CO_2 emissions will decrease by 0.043 percent based on OLS. Then, variable sukuk issuance also negatively affects CO_2 emissions, indicating that

[23] Kasperowicz (2015)

sukuk issuance lowers CO_2 emissions significantly at the level 5 percent based on OLS regression and fixed effect. Assuming other variables are fixed (ceteris paribus), and if there is an increase of 1 percent in sukuk issuance in twelve OIC countries that are used as observations, CO_2 emissions will decrease by 0.23 percent based on OLS and 0.038 percent based on fixed effects. From these results, it can be seen that sharia-compliant and Sukuk actually has good potential in encouraging development while simultaneously reducing CO_2 emissions. Even with a relatively small amount of emission reduction.

Coal rent has positive effect on CO_2 emissions, these things reflect that coal rent increases CO_2 emissions significantly at the level 1 percent based on OLS method with ceteris paribus assumptions. Therefore, if coal rent increase at 1 percent, it will increase CO_2 emissions by 58.8 percent. These results were also in line with Gyamfi et al [24] on E7 countries which stated that coal rent exerts a positive and significant effect on carbon emissions with OLS method.

And finally, the share market capital added variable shows a positive and significant influence on CO2 emissions based on OLS regression. Precisely, a 1 percent increase in share market capital added will increase carbon emissions by 0.63 percent. These outcomes similarly align with the findings of Madhbi et al [25] the results suggest that both positive and negative shocks on stock market development have negative effects on environmental quality, and in long-run elasticities shows that stock market increase carbon emissions because development stock market has the potential to attract funds to finance production and manufacturing activities that lead to increase in energy consumption, especially fossil fuel energy in countries with weak environmental regulations. Consequently, this leads to an increase in the level of carbon emissions. This result is in consonance with the study of Sadorsky[26] which stock market variables as a measure of financial development were positive and statistically significant at a 5 percent level increases in energy consumption.

Furthermore, the PCSE method is used to overcome problems in regression that has been done before. The results of regression with this method are indicated by Table 10.

Table 10. Regression Using PCSE

Variables	Coefficients	Panel Corrected Standard Error	P-value
lnevergycons	-0.0173	0.0404	0.668
lnfdi	-0.0447	0.0502	0.373
lnscfin	-0.0435***	0.0115	0.000
lnglsukuk	-0.236***	0.0909	0.009
lnvaind	0.300	0.197	0.127
lngdpc	1.070***	0.0632	0.000
ka_open	0.132	0.0807	0.101
coal	0.588***	0.120	0.000
smca	0.00630***	0.00126	0.000

[24] Gyamfi et al. (2022)
[25] Mhadhbi et al. (2021)
[26] Sadorsky (2010)

trade open	-0.000654	0.000980	0.505
Constant	-5.287***	1.3889	0.000

Note. ***p<0.01, **p<0.05, and *p<0.1

To ensure the robustness of the coefficients estimated in the PCSE method, the Newey-West standard model was performed. The results of the model are shown by Table 11.

Table 11. Newey-Test Standard Model

Variables	Coefficients	Newey-West Standard Error	P-value
lnenergycons	-0.0173493	0.0588715	0.769
lnfdi	-0.0446935	0.039051	0.257
lnscfin	-0.0435066	0.0166998	0.011
lnglsukuk	-0.2361512	0.135006	0.085
lnvaind	0.299787	0.2418224	0.220
lngdpc	1.069842	0.0787509	0.000
ka_open	0.1323925	0.116425	0.260
coal	0.5881909	0.1945871	0.004
smca	0.0062984	0.0014657	0.000
trade_open	-0.000538	0.0015973	0.684
Constant	-5.28664	1.569511	0.001

Note. ***p<0.01, **p<0.05, and *p<0.1

The results from Newey-West showed a number that was not different with regression using PCSE, but the total variable of energy consumption turned out to be insignificant. So, the numbers results are robust, which reflects the model is solid.

Conclusion

This research focuses on analyzing the effect of Islamic financial developments and their association with total energy consumption and their effect on total CO2 emissions in twelve OIC member countries from 2013-2018 using dependent variable total CO2 emissions, and the independent variables used are GDP per capita, total energy consumption, sharia-compliance Islamic banks and sukuk issuance. The research method was conducted by unit root test including Fisher Augmented Dickey-Fuller (ADF) root test unit and Cross-Sectional Augmented ADF (CADF), then Panel Corrected Standard Error (PCSE) Model. The results showed that variable which used as proxy of Islamic financial development in this research, such as sukuk issuance and shariah compliance financing is decrease the CO2 emissions significantly, which highlight from our studies. Then, another variable such as total energy consumption decrease the

CO2 emissions while other variables including GDP per capita, and industry value added affect to increase the CO2 emissions significantly

This research try to recommend the stakeholder for enhancing Islamic finance to develop sustainability in environment and to accelerate renewable energy for declining CO2 emissions to protect the environment. the government can also expand the issuance of green sukuk to finance climate change actions in such a way that the financing is in accordance with Islamic law. We hope that through this study, other researchers can improve insights and bring more Islamic economic finance variables and other factors that relevance in order to estimates the impact to CO2 emissions more broadly.

This study has shortcomings in terms of data, due to limitations and lack of inclusion of several other variables that should have a significant effect on CO2 emissions. Therefore, there are still many parts of this study that can be investigated further in more advanced studies with a wider data set and it is important to add more proxies of Islamic financial development. In addition, to broaden the understanding of the ecological relationship and the impact relationship between the development of Islamic finance and other independent variables, the use of dynamic econometric models is highly recommended.

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