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Article

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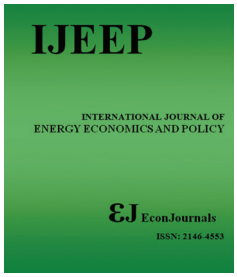

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Islamic Finance and Environmental Sustainability: Empirical Insight from OIC Countries

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ABSTRACT

Environmental degradation remains a significant global challenge, particularly in the Organization of Islamic Cooperation (OIC) countries. This study primarily examines the impact of Islamic finance, proxied by two indicators, namely Islamic financial assets and Islamic banking financing, and other variables including Gross Domestic Product (GDP), Foreign Direct Investment (FDI), urbanization, renewable energy adoption, and forest area on CO2 emissions. This study revealed that Islamic financial assets had a negative impact on CO_2 emissions, highlighting their importance in supporting green investments and sustainability. However, Islamic banking financing has little influence on emissions reduction, most likely due to carbon-intensive initiatives. Furthermore, GDP growth increases emissions, although FDI, urbanization, and forest areas help to lower them. These findings underscore Islamic finance's critical role in fostering sustainable development, as well as the necessity for better green Islamic financing policies in OIC member nations. The findings also provide important insights for policymakers working to balance economic growth with environmental sustainability in Islamic finance.

Keywords: Islamic finance, CO_2 emissions, environmental sustainability, renewable energy, OIC countries
JEL Classifications: Q56, O11, O13, O16, O53

1. INTRODUCTION

Environmental issues are a major concern in both emerging and developed countries. According to the Intergovernmental Panel on Climate Change (IPCC) (2023), global warming is expected to increase temperatures by approximately 1.0-1.2°C, which could significantly impact health, livelihoods, food security, and economic growth. The climate change policies implemented over the next 3-5 years will play a crucial role in shaping these outcomes. The primary driver of global temperature rises and climate change is the increase in greenhouse gases, particularly CO_2, largely emitted from fossil fuel use in industrial activities (Irfany et al., 2015). While economic expansion promotes energy consumption and development, it often neglects the environmental costs, leading to substantial environmental degradation. Development, originally intended to improve human welfare, is now contributing to the deterioration of life-supporting environmental quality (Laila et al., 2021).

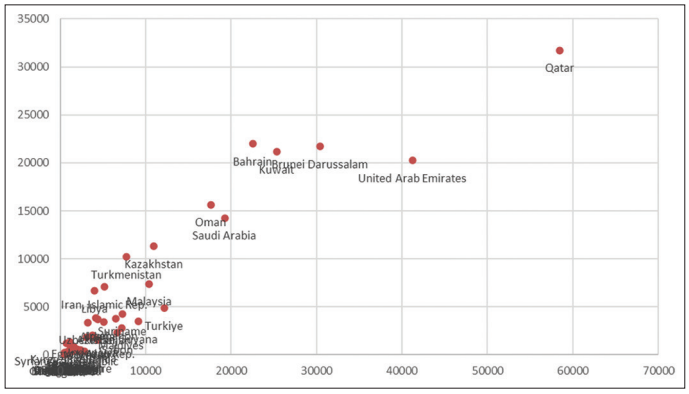
In 2022, total assets managed with Environmental, Social, and Governance (ESG) considerations exceeded $35 trillion globally, accounting for approximately 36% of all professionally managed assets worldwide. This substantial increase reflects growing investor awareness and concern about the environmental impact of economic activities. ESG is no longer viewed as a passing trend but as an essential component of responsible and sustainable investment strategies. Investors are increasingly recognizing how environmental factors such as carbon emissions, natural resource utilization, and energy efficiency can influence a company's long-term success and global economic stability. The heightened commitment to ESG investments signals a paradigm shift where sustainability is seen as a form of social responsibility and a

crucial factor in mitigating risks and creating new opportunities in the green economy. Investors are becoming more discerning in their portfolio choices, avoiding sectors deemed harmful to the environment in favor of companies committed to environmentally friendly and sustainable business practices. This growing awareness of the importance of incorporating environmental considerations into investment decisions is expected to support global efforts to reduce carbon emissions and mitigate the effects of climate change (IPMI et al., 2024).

Islamic banking impacts not only society and the economy but also the environment. According to Siswantoro and Mahmud (2023), Islamic financial principles support investments that benefit both society and the environment, such as renewable energy. This is evident in Muslim-majority countries, where Sharia-compliant financing has spurred the growth of the renewable energy sector by making external capital more accessible. Additionally, there are green sukuk, which are Islamic financial instruments specifically designed for environmentally friendly ventures. These sukuk represent an example of how Islamic financial instruments can ensure environmental sustainability. Green sukuk can be further developed to support environmental conservation efforts (Aslamah et al., 2023; Rehan et al., 2024). Thus, Islamic finance is guided by principles that prohibit investments in unethical businesses such as alcohol, tobacco, and pornography. Instead, it encourages investments in areas that benefit the social environment, such as renewable energy and wildlife protection. Islamic finance, which emphasizes sustainability and ethical standards, is an intriguing topic to explore as a potential option for reducing carbon emissions. Despite global progress toward sustainable finance, OIC countries must continue to embrace and apply financial principles that promote sustainability.

Based on the scatter plot in Figure 1, most OIC countries are still in the early stages of the Environmental Kuznets Curve (EKC), where economic growth is associated with increased environmental degradation, as measured by CO_2 emissions. Research by Grossman and Krueger (1995) and Ozcan and Ozturk (2019) indicates that in the initial stages of economic growth, emissions tend to rise alongside economic activity until a turning point is reached, where the adoption of green technology and stricter regulations can lead to a decline in emissions. In the context of OIC countries, while significant economic growth is being experienced, many have not yet reached this turning point

Figure 1: OIC's Kuznets environmental scatter plots (adapted from World Bank, 2020)



where growth is decoupled from environmental degradation. Islamic finance has the potential to accelerate the transition toward sustainable development in OIC countries. Financial instruments such as green sukuk offer opportunities to finance environmentally-friendly projects, aligning with Islamic finance principles that prohibit investment in unethical or environmentally damaging sectors (Arifudin et al., 2024). By leveraging this financial framework, OIC countries could reduce their carbon footprint even before reaching the peak of the EKC, provided there is strong commitment from both the government and the private sector to promote green investment more broadly.

Over the past 5 years, Islamic finance has seen significant development in OIC countries, marked by substantial growth in assets and diversification of financial products. As of 2023, the global Islamic finance industry, including assets held by banks, sukuk, and Islamic investment funds, was valued at approximately USD 3.2 trillion. OIC countries continue to dominate the market, with significant contributions from countries like Saudi Arabia, the UAE, and Malaysia (Islamic Financial Services Board [IFSB], 2023). Additionally, Islamic banking assets in OIC countries have grown steadily, with total Islamic banking assets in the Gulf Cooperation Council (GCC) region alone reaching around USD 1.6 trillion in 2022, reflecting an annual growth rate of approximately 8% (Refinitiv, 2023). There has also been notable diversification in Islamic financial products. Over the last 5 years, innovative products such as green sukuk and Islamic fintech solutions have emerged. For example, Malaysia issued its first green sukuk in 2022, raising USD 1.3 billion for environmentally sustainable projects (Malaysia Securities Commission, 2022).

The banking industry, financial systems, and investment practices have been extensively studied worldwide, with substantial contributions from research in finance, economics, and social impacts. However, the concept of Islamism, particularly in the context of economic practices, remains less understood and is an area of emerging research. In economic terms, Islamism involves the application of Islamic law (Shariah) to various aspects of the economy, including banking, insurance, investment, and trade. This framework prohibits practices such as *riba* (interest), *gharar* (excessive uncertainty), and *maysir* (gambling), while promoting profit-sharing models and investments in halal-certified sectors (Moisseron et al., 2015). Despite growing interest, there is still a significant need for research on the relationship between Islamic finance and carbon emissions. The current trends in understanding this relationship are limited and warrant further exploration (Irfany et al., 2022).

This study aims to fill this gap by exploring how Islamic finance can contribute to reducing CO_2 emissions through sustainable investment, demographic considerations, and the responsible management of natural resources. Employing empirical panel data analysis, this research will examine the impact of Islamic finance on carbon emissions, assessing its effectiveness in promoting more environmentally responsible financial practices. The findings of this study are expected to offer new insights and provide policy recommendations for governments and stakeholders seeking to enhance the role of Islamic finance in mitigating climate change.

2. LITERATURE REVIEW

The Environmental Kuznets Curve (EKC), first introduced by Simon Kuznets in the 1950s to describe the relationship between economic growth and environmental degradation, serves as the foundation for this study's problem approach. The EKC suggests an inverted U-shaped curve where environmental harm, such as CO_2 emissions, increases during the initial stages of economic growth. However, as economic development progresses and incomes rise, there is often a growing public awareness of environmental issues, leading to increased demand for cleaner technologies and stricter environmental regulations. This eventually results in a reduction of environmental degradation as the economy continues to grow. The concept was further popularized by the World Bank's World Development Report in 1992, which highlighted the potential environmental damage from unchecked economic growth. The EKC illustrates (Figure 2) that while early economic development is typically associated with rising CO_2 emissions, sustained economic growth coupled with environmental awareness and policy interventions can eventually lead to a decline in emissions. Therefore, it is crucial to identify and address the critical CO_2 tipping point that may hinder sustainable economic progress.

2.1. Islamic Financial Assets, Islamic Banking Financing, and Sustainability

Islamic financial assets encompass Sharia-compliant financing activities, including instruments in the Islamic money market. According to Islamic law, money is considered a measure of value rather than an asset, and practices such as *riba* (interest), *gharar* (extreme uncertainty), *maysir* (gambling), short-term sales, and financing activities harmful to society are prohibited (Kuanova et al., 2021). Islamic bank financing is rooted in these principles, promoting economic growth and industrial development while adhering to ethical standards. For instance, Hassan et al. (2022) found that Islamic finance significantly contributes to economic and industrial development in the UAE, and Yüksel and Canöz (2017) demonstrated similar benefits for Turkey.

Research on Islamic finance and environmental sustainability has gained prominence in several countries. International studies, such as those by Moisseron et al. (2015), highlight the evolution of Islamic finance into a significant component of the global financial system, driven by Shariah principles and ethics. Islamic finance holds substantial potential to advance the Sustainable Development Goals (SDGs) through effective use of global, local, and national resources. Sufian and Johara (2021) found that Islamic banks in the UAE outperform conventional banks, while Kuanova et al. (2021) explored the environmental aspects of Islamic finance, including sustainable investment and corporate sustainability.

Zuhri et al. (2023) provides a systematic analysis demonstrating that Islamic financial institutions are crucial in the evolution of Islamic public finance, particularly through tools like green sukuk. This research emphasizes the importance of maintaining financing quality to enhance Islamic bank asset growth. Similarly, Pandikar et al. (2024) highlight the critical link between sustainability practices and financial performance from an Islamic banking perspective, advocating for the integration of Islamic principles in finance to improve resource development and financial outcomes. Malini (2021) conducted a case study in Indonesia, a member of OIC, showing that green finance significantly influences Islamic bank financing decisions, financial performance, and corporate value. The study underscores that implementing green finance enhances energy efficiency, reduces greenhouse gas emissions, and improves the financial performance of Islamic banks in a sustainable manner. Based on these findings, one of the hypotheses in this study is H1: Islamic finance assets have a negative effect on carbon emissions.

In addition to Islamic financial assets, the role of Islamic banking financing in addressing environmental challenges, particularly CO_2 emissions, is becoming increasingly evident. Abduh et al. (2022) found a significant relationship between Islamic banking financing, energy consumption, and environmental quality. Their study highlights how the advancement of Islamic finance could contribute to reducing CO_2 emissions. Similarly, Al-Silefanee et al. (2022) found that the development of Islamic finance can lead to a reduction in CO_2 emissions through sustainable investment and enhanced corporate sustainability. Another finding is from research conducted by Irfany et al. (2024) which found that Islamic banking financing has a positive impact on increasing carbon emissions which shows the environmental implications of Islamic banking practices and economic growth in high-income OIC countries. Systematic research by Siswantoro and Mahmud (2023) demonstrates that the growth of Islamic finance can increase renewable energy output in Islamic countries and underscores the importance of maintaining financing quality to accelerate the expansion of Islamic bank assets. Additionally, Alajlan and Alreshaidi (2022) emphasize the crucial link between the expansion of Islamic finance and renewable energy generation. Based on these findings, one of the hypotheses in this study is H2: Islamic banking financing has a negative effect on carbon emissions.

2.2. Economy, Demography, Natural Resources, and CO_2 Emissions

Economic growth, as measured by GDP, significantly influences CO_2 emissions. As a country's economy expands, CO_2 emissions tend to rise. Maulidina and Maulana (2022) employed quantitative analysis to demonstrate that this association is particularly pronounced in high-income Southeast Asian countries. This growth leads to increased CO_2 emissions, which can exacerbate climate change and other environmental issues (Christy and Sakti, 2022). In addition, the relationship between Foreign Direct Investment (FDI) and carbon emissions has become a significant area of international research. Abduh et al. (2022) found that FDI has a notable impact on carbon emissions. While increasing FDI can reduce carbon emissions in Indonesia over the long term, it has a negligible short-term effect. This is attributed to recent surges in FDI directed towards renewable energy.

Urbanization also has a substantial impact on CO_2 emissions. Research by Zhang et al. (2017) indicates that urbanization can increase CO_2 emissions due to higher population densities in cities, leading to greater energy use, transportation needs, and fossil fuel consumption. Irfany et al. (2024) further highlight that

urbanization significantly affects CO_2 emissions, primarily through increased energy consumption and transportation in large cities. Therefore, implementing long-term environmental regulations and enhancing urban energy efficiency are essential for mitigating carbon emissions.

Forest land plays a critical role in carbon sequestration. Zhang et al. (2017) found that forests are effective carbon sinks, absorbing CO_2 from the atmosphere and thus reducing climate change impacts. Irfany (2024) noted that forest loss can increase CO_2 emissions because damaged forests are less capable of carbon absorption. Hence, protecting and conserving forest areas is crucial for reducing carbon emissions and addressing global climate change.

Renewable energy sources, such as wind, solar, and hydro, are crucial in reducing CO_2 emissions. Zhang et al. (2017) demonstrated that renewable energy significantly decreases CO_2 emissions as these sources do not produce greenhouse gases. Furthermore, Abduh et al. (2022) found that adopting renewable energy can improve energy efficiency and reduce reliance on fossil fuels, thereby contributing to a decrease in CO_2 emissions. Based on previous research, the hypotheses are that GDP and urbanization positively affect CO_2 emissions, while FDI, renewable energy use, and forest area negatively affect CO_2 emissions.

3. DATA AND METHODOLOGY

This study examines the causal relationship between carbon emissions and Islamic finance in OIC nations from 2013 to 2023. Due to data availability, the research population comprised 11 OIC countries: Bangladesh, Brunei, Indonesia, Jordan, Kuwait, Lebanon, Nigeria, Oman, Pakistan, Saudi Arabia, and Sudan. The countries in the sample were selected based on the availability of data on carbon emissions and Islamic finance. To provide a better understanding of the data features and distribution for these countries, Table 1 presents descriptive statistics that highlight the dataset's key patterns and variability. Following that, the study will use econometric models to analyze the implication among carbon emissions and Islamic finance, which are proxied by Islamic Finance Assets and Islamic Banking Financing.

The study data used is secondary data acquired from credible sources and processed using software designed for panel data regression. Table 1 provides further explanations for the research variable data. Two models are employed to study the impact of Islamic finance on carbon emissions. The first model employs Islamic finance assets per capita as one of the independent variables, which refers to the total assets of Islamic financial institutions, including both financial and non-financial assets. These assets are calculated by aggregating the total value of all assets handled by domestic and foreign-controlled institutions. This measurement is crucial for determining the size, contribution, and growth potential of the Islamic finance industry in the economy (SESRIC, 2024).

The second model uses Islamic banking financing per capita as one of the independent variables, which indicates the amount of Sharia-compliant financing from Islamic banking and non-banking business entities offering Islamic services. The funding comes from Islamic law, which prohibits interest, speculation, and investing in halal sectors. This figure indicates that Islamic financial institutions contribute significantly to Islamic banking funding (SESRIC, 2024). Accordingly, the model is as follows:

$$LnCO_2C_{it} = \alpha_1 + \alpha_2\, LnGDPC_{it} + \alpha_3\, LnIFAC_{it} + \alpha_4\, FDI_{it} + \alpha_5\, URBAN_{it} + \alpha_6\, RES_{it} + \alpha_7\, LnFOREST_{it} + e_{it} \quad (1)$$

$$LnCO_2C_{it} = \alpha_1 + \alpha_2\, LnGDPC_{it} + \alpha_3\, LnIBFC_{it} + \alpha_4\, FDI_{it} + \alpha_5\, URBAN_{it} + \alpha_6\, RES_{it} + \alpha_7\, LnFOREST_{it} + e_{it} \quad (2)$$

Models 1 and 2 describe how the independent variable affects the dependent variable. In both models, the dependent variable is calculated using the natural logarithm of carbon per capita (Ln CO_2). The first model independent variable for Islamic finance is the natural logarithm of Islamic finance assets per capita. The second model uses the natural logarithm of Islamic financing per capita (LnSF). The independent variables include the natural logarithms of real GDP per capita (LnGDPC), foreign investment (LnFDI), urbanization (LnURBAN), renewable energy use (LnRES), and forestry land (LnFOREST), with e representing the error component. CO_2 emissions, GDP, FDI, urbanization, and forest land data were obtained from the World Bank, while data on Islamic finance assets, Islamic banking financing, and renewable energy sharing were obtained from the Statistical, Economic, and Social Research and Training Center for Islamic Countries (SESRIC). Table 2 shows descriptive statistics of the data used.

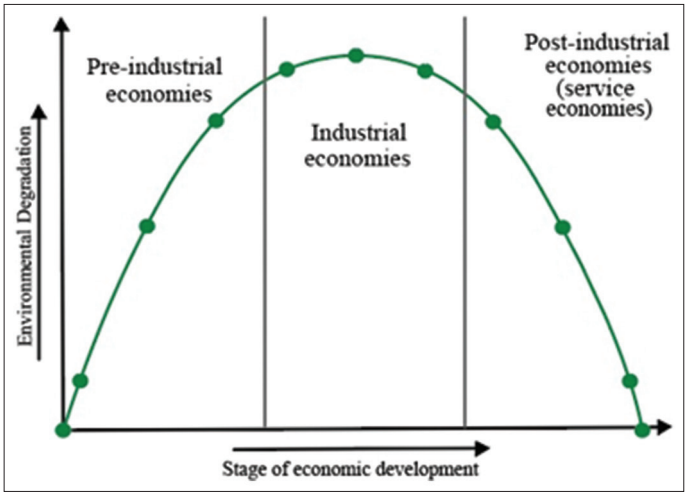
Table 1: Variable definition

Variables	Definition	Measure
CO_2 emissions per capita (CO_2C)	CO_2 emissions result from the combustion of fossil fuels, gas, and cement production.	kg per capita
Gross domestic product per capita (GDPC)	Gross domestic product divided by midyear population.	USD per capita
Islamic Finance Asset per capita (IFAC)	Total assets of banking and near-banking entities providing Islamic financial services, including all financial and non-financial assets under domestic and international control.	USD per capita
Islamic Banking Financing per capita (IBFC)	The value of outstanding Shari'ah-compliant financing for banking and near-banking entities providing Islamic financial services.	USD per capita
Foreign Direct Investment (FDI)	Net investment inflows from foreign investors to acquire a long-term managerial interest in the reporting economy, divided by GDP.	Percent
Urban population (URBAN)	National statistical offices identify people who live in urban regions.	Percent
Renewable Energy Sharing Used (RES)	The final energy used comes from renewable energy sources.	Percent
Forest Land (FOREST)	Land covered by natural or planted stands of trees of at least 5 meters in situ, whether productive or not, and excluding tree stands in agricultural.	Meter

Table 2: Descriptive statistic

Variable	Mean	Min	Max
CO_2C	5470,73	1,50	98001,28
GDPC	10855,15	1267,70	32341,75
IFAC	202,29	0,86	3050,21
IBFC	1183,93	0,35	7038,92
FDI	20,65	0	24,06
URBAN	67,165	32,76	100,00
RES	22,599	0,00	81,81
FOREST	2,49367E+12	7,27	1,9794E+14
Obs		121	

Figure 2: Kuznets Environmental Curve Model (Panayotou, 1993; Sarkis, 2019; Ozcan and Ozturk, 2019)



4. ESTIMATION RESULTS

When analyzing panel data, it is critical to select a suitable regression model. Panel data, which includes cross-sectional and time-series data, can be evaluated with a variety of models tailored to distinct data formats and assumptions. To choose the optimum model, researchers employ model testing techniques such as the Chow Test and the Hausman Test. Employing these two tests, this paper's test findings show that FEM is the best model for panel data analysis.

In regression analysis, ensuring the validity of model assumptions is critical for providing consistent findings. One important assumption is that the error terms follow a normal distribution, which is critical to the validity of statistical inference. This can be performed with histograms and the Jarque-Bera test (Gujarati and Porter, 2009). The "r" value measures the strength of the correlation between independent variables. The findings of this assessment show that the correlation value between independent variables is <0.8, implying that each variable has a weak association or relationship. As a result, the research findings show that multicollinearity is not an issue (Gujarati and Porter, 2009).

The heteroscedasticity test is used to evaluate a regression model based on the inequality of variances between observations. White's test is a useful technique for accomplishing this. The data indicate a rectangle probability value (20) of 0.0000. The probability value of 0.0000 is <0.05, indicating that a heteroscedasticity problem has arisen in the regression model. To address the problem of heteroscedasticity, this study employs a fixed effects model (FEM) with generalized least squares (GLS) weighting. The GLS model reduces the variation in research data (Gujarati, 2004). GLS is used to correct for unequal variances among observations, enhancing estimation accuracy. Finally, Table 3 displays the estimation findings produced by this current model, providing a detailed overview of the regression analysis results.

First, based on the Islamic finance asset model, Islamic financial assets are found to have a significant negative impact on carbon emissions. Specifically, a 1% increase in Islamic financial assets leads to a reduction of CO_2 emissions per capita by 0.035272% at the 1% level of significance. Additionally, real GDP per capita exhibits a positive effect on emissions, suggesting that economic growth in OIC countries may contribute to higher carbon emissions, also significant at the 1% level. Urbanization and forest land cover are both associated with reducing carbon emissions in these countries, with results significant at the 1% level. Conversely, foreign investment and renewable energy consumption do not have a statistically significant effect on CO_2 emissions.

Second, the Islamic banking financing model reveals no substantial impact on carbon emissions. However, real GDP per capita shows a positive association with emissions, reinforcing the notion that economic growth in OIC countries may drive higher carbon emissions, with significance at the 1% level. In this model, both urbanization and forest land cover negatively influence carbon emissions, with significance at the 1% level. Moreover, foreign investment and renewable energy usage are found to have a minimal impact on CO_2 emissions.

5. DISCUSSION

GDP has a positive effect on carbon emissions, suggesting that increased economic activity will result in higher carbon emissions from manufacturing, distribution, and even consumption. According to World Bank estimates, between 2000 and 2019, global CO_2 emissions increased from roughly 23.5 gigatons to 36.2 gigatons, resulting in significant GDP growth. Abbas et al. (2011) back up this finding, demonstrating that GDP and energy consumption have a favorable impact on CO_2 emissions. According to their findings, a 1% increase in GDP results in an increase of approximately 0.5% in CO_2 emissions in developing countries. This is because economic growth is typically accompanied by an increase in energy consumption, mainly from fossil fuels such as petroleum and natural gas, which constitute the main contributors of CO_2 emissions (Olii, 2024).

According to EKC theory, GDP per capita and CO_2 emissions follow an inverted U-shaped curve, which suggests that CO_2 emissions grow initially as GDP per capita rises but begin to decline after a certain point due to technical and energy efficiency gains. Based on data from the Global Carbon Project (2022), CO_2 emissions in high-income countries that fall further down the EKC curve have stabilized or decreased despite continuous economic expansion. However, as many OIC countries are still in the early stages of the EKC curve, rising GDP per capita has

Table 3: Estimation results

Variables	Islamic finance asset (Model 1) Dependent variable: CO_2 emissions				Islamic banking financing (Model 2) Dependent variable: CO_2 emissions			
	CEM	FEM	REM	FEM GLS	CEM	FEM	REM	FEM GLS
Constant	−16.48***	0.73	−9.45***	5.45***	−18.64***	5.10	−7.30**	4.48**
	(0.0000)	(0.8464)	(0.0001)	(0.0051)	(0.0000)	(0.2007)	(0.0173)	(0.0298)
lnGDPC	2.28***	1.32***	1.92***	0.73***	2.26***	1.02**	1.84***	0.86***
	(0.0000)	(0.0004)	(0.0000)	(0.0001)	(0.0000)	(0.0047)	(0.0000)	(0.0000)
lnIFAC (Model 1) or	0.18***	−0.02	−0.01	−0.03***	0.22***	0.13*	−0.02	0.03
lnIBFC (Model 2)	(0.0001)	(0.4114)	(0.6272)	(0.0009)	(0.0014)	(0.0513)	(0.6020)	(0.3835)
FDI	−0.02**	−0.01**	−0.01**	−0.00	−0.04**	−0.01*	−0.01**	−0.00
	(0.0273)	(0.0283)	(0.0357)	(0.1395)	(0.0137)	(0.0205)	(0.0386)	(0.2370)
URBAN	0.01***	−0.07***	−0.01	−0.07***	0.03***	−0.11***	−0.02*	−0.07***
	(0.0007)	(0.0000)	(0.212)	(0.0000)	(0.0004)	(0.0000)	(0.0859)	(0.0000)
RES	−0.03***	0.00	−0.00	−0.00	−0.00	−0.01	0.00	−0.00
	(0.0000)	(0.8339)	(0.5543)	(0.7963)	(0.9144)	(0.3829)	(0.5917)	(0.9327)
FOREST	0.03***	−0.09**	−0.05**	−0.08***	0.06***	−0.08**	−0.08***	−0.08***
	(0.0001)	(0.0192)	(0.0183)	(0.0000)	(0.0000)	(0.0414)	(0.0018)	(0.0001)
F-test	418.12***	1207.50***	16.60***	6189.85***	216.2235	1243.149	11.17368	4276.99
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R-Squared	0.956534	0.994646	0.46641	0.998951	0.994799	0.994799	0.370312	0.998483
Adjusted R-squared	0.954247	0.993822	0.438326	0.99879	0.914974	0.993998	0.337171	0.998249
Chow test (P-value)	(0.000)				(0.000)			
Hausman test (P-value)			(0.000)				(0.000)	

*indicates significance at the 10% level, **indicates significance at the 5% level, and **indicates significance at the 1% level. P-values are shown in parentheses

positive effects on CO_2 emissions. This is supported by Alam et al. (2023), who discover that in countries such as Pakistan and Nigeria, a 10% increase in GDP per capita leads to a 7% increase in CO_2 emissions, reflecting their current stage in the EKC. Irfany et al. (2024) discovered that GDP had a favorable impact on energy consumption and CO_2 emissions in OIC nations.

The implication between Islamic financial assets and carbon emissions is negative (Model 1), meaning that most Islamic financial assets (sukuk and other financing instruments) have facilitated environmental protection finance. This is backed by the fact that OIC nations with strong Islamic financial development see a rise in renewable energy output. Islamic finance can facilitate and increase funding for renewable energy projects (Siswantoro and Mahmud, 2023). As reported by the Islamic Development Bank (2022), it highlighted that OIC nations with higher Islamic financial development saw a 15% increase in renewable energy capacity over the past decade. For instance, countries like Indonesia and Malaysia, which have robust Islamic financial sectors, reported an increase in renewable energy investments by 20% annually due to sukuk issuance and other Islamic finance mechanisms. Islamic finance considers both financial profits and environmental concerns. To reduce carbon emissions, Islamic financial institutions are projected to participate in green areas such as renewable energy (Irfany et al., 2024).

Meanwhile, Islamic banking financing has shown a positive implication on rising carbon emissions (Model 2). However, this implication of this finding suggests that simply increasing funding is insufficient to reduce CO_2 levels effectively. While Islamic finance channels resources towards sustainable projects, the overarching impact on carbon emissions depends on how these funds are utilized and the sectors they support. The rise in carbon emissions can be attributed to heightened investments in fossil-fuel-dependent industrial sectors, such as the construction of factories or energy-intensive infrastructure (Irfany et al., 2024). Although the core objective of Islamic financing is to promote green investments, the current limitations in green technologies may inadvertently lead to increased carbon emissions. In situations where green technology fails to advance sufficiently to meet the rising energy demands, companies may still contribute to economic growth by raising per capita income and improving living standards. This trend is particularly visible in developing countries, where most development still relies on non-green development projects (Mu and Rudatin, 2024).

Research indicates that while FDI can have negative implications for rising carbon emissions, it also plays a crucial role in fostering economic growth in OIC countries. For example, every 1% increase in FDI is associated with a rise in Gross Domestic Product (GDP) by approximately US$39.05 (Rahmandani and Dewi, 2023). However, channeling FDI into green sectors in these countries could help reduce carbon emissions by promoting energy efficiency and the adoption of more advanced, environmentally friendly technologies. FDI often facilitates the transfer of such technologies, which are more energy-efficient and less polluting. For instance, multinational corporations that invest in renewable energy projects or energy-efficient manufacturing processes introduce innovations that might otherwise be inaccessible to developing countries. Furthermore, these firms frequently bring superior technologies and more efficient management techniques that enhance productivity. According to the pollution halo hypothesis, FDI can contribute to lowering carbon emissions by employing advanced production technologies and better management practices (Prasetyawati, 2019; Sarkodie and Strezov, 2019; Udemba and Yalçıntaş, 2021).

The expansion of the urban population in OIC countries significantly contributes to the reduction of carbon emissions, suggesting that urban community activities have a lower carbon footprint. Cities with lower carbon intensity are pivotal in mitigating global climate

change, emphasizing the critical role of sustainable urban planning. OIC countries are experiencing urbanization at a faster rate than their non-OIC developing counterparts, with an annual urbanization rate exceeding 3%. Projections indicate that by 2050, approximately 68.2% of the OIC population will reside in urban areas, a trend that presents both challenges and opportunities for reducing carbon emissions through the implementation of more efficient energy use and sustainable urban planning strategies (SESRIC, 2019). The findings of Wang et al. (2021), Musah et al. (2021), and Wu et al. (2016) further substantiate this by identifying the processes through which urbanization impacts carbon emissions, particularly by influencing economic growth, enhancing energy efficiency, and altering the share of final energy consumption in the industrial and residential sectors of urban regions. In high-income OECD countries, a nuanced "inverted U-shaped" relationship has been observed between urbanization and carbon emission intensity, underscoring the complex dynamics at play in the interplay between urban growth and environmental sustainability.

The study found that using renewable energy has no substantial effect on carbon emissions. This finding is supported by studies published in countries participating in the Belt and Road Initiative, which show that while renewable energy contributes to economic growth, its short-term value in terms of reducing carbon emissions is limited. This is because the shift from fossil fuels to renewable energy is sluggish, and many businesses continue to rely on nonrenewable energy (Jia et al., 2023). Additionally, without effective carbon-cutting strategies, increasing the use of renewable energy does not always result in a reduction in emissions in the short-term period. The utilization of renewable energy in middle-income developing nations has not kept pace with rising industrial activity, leading to minimal emission reductions (Nuñez Alvarez et al., 2023). As a result, these findings highlight the need for more extensive policies to ensure that the environmental advantages of the use of renewable energy can be achieved.

Forest area has a crucial role in mitigating carbon emissions, as forests function as highly effective natural carbon sinks. Through photosynthesis, forest trees absorb carbon dioxide (CO_2) from the atmosphere and convert it into biomass such as wood, leaves, and roots. Indonesia, one of the OIC member states, is home to the third-largest tropical forest in the world, accounting for 10% of the world's tropical rainforests (FAO, 2020). As forest area expands, more CO_2 can be absorbed and stored, reducing the amount of carbon in the atmosphere (Sarkodie and Strezov, 2019). By absorbing CO_2, forests help lower the concentration of greenhouse gases that contribute to global warming. Several OIC countries, including Indonesia, Malaysia, Bangladesh, and Pakistan, are participants in the global REDD+ program, which aims to reduce carbon emissions by curbing deforestation and land degradation. This initiative helps mitigate the greenhouse effect, thereby slowing the rise in global temperatures and addressing climate change (Altın, 2024).

6. CONCLUSION

Carbon emissions are influenced by multiple factors. Economic growth, measured by GDP, tends to increase carbon emissions and energy consumption, especially in developing countries that still heavily depend on fossil fuels. On the other hand, Islamic financial assets have the potential to reduce carbon emissions by funding renewable energy projects. However, Islamic banking financing is sometimes directed toward fossil fuel-based industries, which undermines its environmental benefits. FDI and growing urban populations can reduce carbon emissions by adopting environmentally friendly technologies and shifting away from carbon-intensive activities. Despite an increase in renewable energy consumption, its influence on lowering carbon emissions is limited due to the continuous reliance on fossil fuels and the delayed development of clean energy infrastructure. Furthermore, huge forests act as natural carbon sinks, absorbing CO_2 from the atmosphere and minimizing the consequences of climate change.

Policymakers must develop strategies that balance economic growth with environmental sustainability. Since GDP growth is often linked to higher carbon emissions, it is critical to implement policies that promote energy efficiency and cleaner technologies in tandem with economic expansion. This could involve setting stringent emissions standards, fostering green innovation, and investing in low-carbon infrastructure to reduce the environmental costs of economic growth. Given the mixed impact of Islamic finance on carbon emissions, there is a need for stronger regulations and incentives to steer Islamic financial instruments towards genuinely sustainable projects. Specific guidelines for green sukuk, for instance, could ensure that Islamic finance supports renewable energy and other low-emission sectors while avoiding investments in fossil fuel-intensive industries.

To maximize the positive impact of FDI on reducing emissions, policies should prioritize investments that introduce advanced, clean technologies and efficient management practices. Governments can create favorable conditions for foreign investors focused on sustainable development and technology transfer, thus leveraging FDI to foster both economic growth and environmental progress. Given that urbanization often leads to increased emissions, it is essential to incorporate environmental considerations into urban planning. Policies should promote the construction of energy-efficient buildings, the development of sustainable public transportation systems, and the integration of green urban spaces. Moreover, improving energy efficiency in urban infrastructure and incentivizing the adoption of renewable energy sources can help mitigate the environmental impacts of expanding urban populations.

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