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Research article

Does Islamic banking promote environmental sustainability? Evidence from QISMUT countries

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Abstract: This study investigated the correlation between the development of Islamic banking and environmental sustainability [through carbon dioxide (CO_2) emissions] in regard to the QISMUT countries (Qatar, Indonesia, Saudi Arabia, Malaysia, the United Arab Emirates, and Turkey), over the 2015–2023 period. Despite the theoretical alignment between Shariah-based finance principles—which emphasize harm prevention (*darar*), public interest (*maslahah*), and environmental stewardship—and sustainability objectives, empirical evidence on whether Islamic finance translates its ethical framework into tangible environmental benefits remains limited and inconclusive. To our knowledge, this study provides the first comprehensive econometric assessment of the Islamic finance–carbon emissions relationship within the QISMUT country grouping. The study employed a unique combination of three Islamic finance development proxies (total assets, Shari'ah-compliant financing, and financing-to-GDP ratio) and panel-corrected standard errors (PCSE) as the primary estimation method, with feasible generalized least squares (FGLS) used as a robustness test to address cross-sectional dependence and economic heterogeneity. The findings indicate that there is a strong negative correlation between the development of Islamic banking and CO_2 emissions under both PCSE and FGLS specifications. This supports the view that the ethical foundation of Islamic banking, when properly incorporated into lending and investment choices, can lead to the emergence of environmental advantages. The comparatively brief panel (2015–2023), the use of aggregate variables at the national level, and the lack of direct measures of transmission channels will demand future research to rely on longer time series, sector-level or project-level data, and more sophisticated identification strategies like instrumental variable methods to reinforce causal claims and explain other mechanisms through which Islamic banking influences environmental outcomes. On the whole, the research has significant implications for policymakers hoping to utilize Islamic finance to promote sustainable development goals, for Islamic financial institutions focusing on the inclusion of clear environmental standards in their financing activities, and for regulators and development partners wishing to use Islamic banking as a significant tool in the global shift to a low-carbon economy.

Keywords: Islamic finance; carbon emissions; CO_2 emissions; financial development; QISMUT; sustainable development; green finance; Panel data analysis

JEL Codes: C33, F64, G21, Q56, Q58

1. Introduction

Since the global financial crisis of 2008–2009, the traditional financial system has been largely criticized and viewed as promoting a profit maximization orientation, which is perceived to promote uncontrolled economic expansion and environmental degradation. The Islamic financial system (IFS), based on a different ethical and moral framework, is in turn frequently brought out as an attractive alternative that can be more effective in aligning financial activity with social and environmental goals (Haneef and Smolo, 2013; Smolo and Mirakhor, 2010). Whereas conventional finance normally focuses on the shareholder returns, IFS is clearly based on the Shari'ah (Islamic law), which focuses on social and environmental responsibility, accountability, equitable wealth distribution, and ethically banning interests (*riba*), excessive uncertainty (*gharar*), and gambling (*maysir/qimar*). They can be placed in the wider context of the theory of *maqasid al-Shari'ah* (objectives of Shari'ah) and, collectively, they can put the IFS as a tool to promote green activities and reduce environmental degradation.

Nevertheless, despite the apparent theoretical complementarity between Islamic finance and environmental sustainability, the nexus between Islamic banking and carbon emissions remains underexplored, and the existing empirical data is fragmented and inconclusive. The current literature tends to focus on a narrow group of nations and draws inconclusive conclusions; some show that Islamic banking is associated with more sustainable activities, while others support a "pollution halo" hypothesis, whereby financial development in some Muslim-majority countries is linked to an increased carbon footprint. In this context, the interaction between Islamic finance and environmental sustainability, especially regarding carbon emissions, has become a new and significant field of study.

To address this gap, the current research will look at the effect of Islamic banking on CO_2 emissions in the QISMUT countries (Qatar, Indonesia, Saudi Arabia, Malaysia, the United Arab Emirates, and Turkey). This group of countries is analytically important for several reasons. First, QISMUT economies have a large economic and financial impact on the broader Muslim *Ummah*. Second, they are key stakeholders in the global Islamic finance market, accounting for a significant share of global Islamic financial assets. Third, being significant producers of fossil fuels (Qatar, Saudi

Arabia, the UAE, and Indonesia) and growing economies (Malaysia and Turkey), these nations experience chronic conflicts between growth interests and sustainability promises. Lastly, they are among the world's more prominent carbon emitters, making them particularly relevant for investigating whether Islamic finance can help reconcile development with emissions reduction.

The combination of QISMUT nations as major Islamic finance hubs and significant carbon emitters will therefore provide a highly abundant and policy-relevant context for the study of the Islamic banking–environment nexus. A better understanding of these dynamics will help guide efforts to make the financial sector green and to harmonize economic development policies with environmental sustainability goals in Muslim-majority economies. Accordingly, the main objective of the research is to provide a rigorous empirical evaluation of the relationship between Islamic banking development and CO_2 emissions in QISMUT countries, producing evidence for policymakers, financial institutions, and environmental stakeholders. The findings of the analysis should inform and embolden policy reforms on sustainability and contribute to a more organized mobilization of the Islamic financial instruments in favor of a low-carbon development course.

This research contributes to existing literature in several important ways that distinguish it from prior work. First, unlike studies examining broad samples of OIC countries or single-country cases, this study provides a rigorous empirical assessment of Islamic finance's environmental impact within the QISMUT framework, which encompasses major Islamic finance hubs and significant global carbon emitters. Second, it employs multiple theoretically motivated proxies for Islamic finance development (total Islamic banking assets, Shari'ah-compliant financing, and Islamic financing as a share of GDP), providing a more comprehensive assessment of banking expansion effects than studies relying on single indicators. Third, it explicitly examines how context-specific factors such as economic growth, renewable energy availability, foreign investment patterns, and trade openness interact with Islamic banking to shape environmental outcomes, offering nuanced insights into the conditions under which Islamic banking generates sustainability benefits. Fourth, it applies rigorous panel econometric methods, including panel-corrected standard errors (PCSE) and viable generalized least squares (FGLS) with cross-sectional dependence corrections to account for common shocks and interdependencies across QISMUT economies. The main result that emerges is that Islamic banking can contribute to environmental sustainability. At the same time, more efforts are required to unravel the transmission channels through which this potential can be achieved.

Based on the theoretical foundation of Islamic finance and existing empirical evidence, this study tests the following research hypotheses:

H_1: Islamic banking assets and Shari'ah-compliant financing negatively impact CO_2 emissions in QISMUT countries, reflecting the operationalization of Shari'ah principles that prohibit financing of environmentally harmful activities and support ethical and sustainable development, thereby supporting the "pollution halo" hypothesis.

H_2: The Islamic financing-to-GDP ratio demonstrates environmental benefits, suggesting that Islamic banking market penetration, rather than its absolute scale, drives environmental outcomes through improved sectoral allocation and ethical screening.

H_3: Renewable energy consumption, economic growth, foreign direct investment, and trade openness show relationships consistent with established environmental economics literature, with renewable energy reducing emissions and economic growth reflecting development-emission trade-offs in the QISMUT context.

The rest of the paper is organized as follows: In Section 2, the theoretical and empirical literature related to the topic is reviewed; in Section 3, a description of the data and the econometric approach is provided; and in Section 4, the findings of the empirical research are presented and interpreted. Finally, Section 5 discusses the limitations of the study, and Section 6 summarizes the main findings, highlights their implications on policy, and indicates the limitations and future research directions of the study.

2. Literature review

There is a growing interest in the nexus between financial development and carbon dioxide (CO_2) emissions in environmental economics. An extensive body of literature on the subject is inconclusive and presents a complex, at times paradoxical, situation. Simple theoretical arguments indicate that financial development can play a two-edged sword role in carbon emissions, i.e., lessening environmental degradation in certain instances and increasing it in others. This review will comment on key theoretical issues and empirical evidence on this nexus in a global perspective and through an Islamic banking prism.

2.1. Theoretical literature and framework

The Environmental Kuznets Curve (EKC) theory is a critical theoretical consideration in the generalized approach to the relationship between environmental quality and economic development. Initially theorized by Simon Kuznets as an explanation of the relationship between income inequality and economic growth, the hypothesis was since applied to the environmental field, where it suggests that environmental degradation increases with economic growth; but, past a specific income level, it starts to decrease and forms an inverted U-shaped curve (Dunyo et al., 2024; Grossman & Krueger, 1995; Mahmood et al., 2018). This framework is further generalized by the idea of a Financial Environmental Kuznets Curve (FEKC), which posits that financial development can first raise emissions and then reduce them at more advanced stages of financial development and environmental consciousness. The results of the EKC and FEKC hypotheses will be presented below.

In the case of Islamic banking, Islamic teachings and ecology are intertwined. Islamic finance relies on the fundamental Shari'ah principles of the Qur'an and Hadith (the sayings of the Prophet Muhammad, peace be upon him). Human beings are the *khulafa* (pl. of *khalifah*—steward) on the Earth, entrusted by Allah (swt) with the responsibility of taking care of the Earth and its resources. The Qur'an clearly says that, *"The creation of the heavens and earth is greater than the creation of mankind, but most of the people do not know."* (Al-Qur'an, 40:57), stressing the importance of being a steward of the environment. Likewise, the Prophet Muhammad (peace be upon him) said: The world is sweet and green (alluring), and verily Allah is going to install you as vicegerents (stewards) in it in order to see how you act…",[1] which reiterates the Islamic duty to ensure environmental protection. They are supposed to maintain the natural resources and ecological equilibrium (Markom & Hassan,

[1] Narrated by Abu Sa'id Khudri and reported in Sahih Muslim No. 2742.

2019). Islam strongly frowns upon lavishness (*israf*) and corruption (*fasad*), which constitute clear injunctions against the wastage of resources and actions detrimental to nature. The Qur'an cautions, *"And be not excessive. Indeed, Allah does not like those who commit excess"* (Al-Qur'an, 7:31), and this fact shows that Islam stresses moderation and preservation of resources.

In addition, the earlier-mentioned prohibitions of interest (*riba*), excessive speculation (*gharar*), and gambling (*maysir/qimar*), combined with the emphasis on profit-and-loss sharing principles—such as partnership (*musharakah*) and passive partnership (*mudarabah*)—encourage risk-sharing and financing of real, productive, and ethical ventures, including environmentally friendly projects (Irfany et al., 2024). In particular, green *sukuk* (Islamic bonds) and Islamic social finance tools like *waqf* (endowment), *zakat* (obligatory almsgiving), *sadaqah* (voluntary charity), and *qard hasan* (interest-free loan) could be mobilized to fund green initiatives and eco-friendly projects such as renewable energy and environmental conservation projects that directly link Islamic financial development with environmental sustainability (Hosen, 2023; Setiawati & Salsabila, 2023; Smolo et al., 2024; Smolo & Rafique, 2025; Smolo & Raheem, 2024b). Recent scholarship on *maqasid al-Shariah* (the higher objectives of Shari'ah) emphasizes how Islamic principles fundamentally align with contemporary sustainability frameworks (Ejaz et al., 2025).

Furthermore, the principles of *maqasid al-Shari'ah* (objectives of Shari'ah) are guiding principles of the IFS.[2] According to Imam Al-Ghazali (1937), *maqasid al-Shari'ah* call for the preservation and protection of religion (*hifz al-din*), intellect (*hifz al-'aql*), lineage (*hifz al-nasl*), life (*hifz al-nafs*), and wealth (*hifz al-mal*). Al-Qarafi (1994) linked the concepts of *maslahah* (public interest) and *maqasid*, stating that a purpose is only valid if it leads to some good (*maslahah*) or prevents mischief (*mafsadah*). In that regard, *maqasid al-Shari'ah* is the foundation of Islamic law, which fosters justice (*'adl*), easing of hardship, and cooperation (*ta'awun*) that will result in benefiting society (*maslahah*). This is directly reflected in the fulfilment of *maslahah,* which scholars use interchangeably with *maqasid*. According to Ibn Ashur (2001, 2006), *maqasid al-Shari'ah* include preservation of order, benefit achievement, harm prevention, and nation empowerment.

To conduct this research, the ethical framework of *maqasid al-Shari'ah* provides the theoretical approach for the linkage between Islamic finance and environmental sustainability. The tenets of harm prohibition and the public good imply that, at its foundations, Islamic finance must favor eco-friendly investments and economic undertakings that reduce carbon emissions. The goal of harm avoidance (*mafsadah*) is directly associated with the reduction of environmental degradation and climate change, which makes Islamic financial institutions possible contributors to the so-called "pollution halo" effect. This theoretical background demonstrates the fact that Islamic finance can play a distinct role in green finance and sustainable development by putting the welfare of the planet and its people at heart, as per its ethics and moral values.

The main idea of *maqasid al-Shari'ah* (the higher objectives of Islamic law) is the need to preserve life, intellect, family, property, and, most importantly, the environment. This moral rationale implies that Islamic finance must be naturally biased toward green projects and investments. As an example, the ban on financing activities considered harmful to society or the environment implies that Islamic financial institutions (IFIs) are not encouraged to fund projects concerning extreme pollution.

[2] For a brief overview of *maqasid al-Shari'ah*, see Smolo and Raheem (2024a, 2024b).

There is, however, a counterargument that in reality, IFIs might act much like traditional banks, promoting economic transactions which, although profitable, are still carbon-intensive, and thereby exacerbate the "pollution haven" effect.

2.2. Empirical literature

Financial development affects CO_2 emissions through various channels. Two conflicting opinions are indicated in the literature. The first is that progress in financial development tends to increase CO_2 emissions. A strong financial sector drives economic growth by lowering borrowing costs, increasing the availability of funds, and improving the efficiency of capital allocation. However, in most cases, this leads to increased industrial development and higher energy consumption. Consequently, this tends to increase CO_2 emissions in economies that rely on fossil fuels. Household consumptions are also raised due to financial development because they have a more affordable access to credit to purchase energy-intensive commodities, including cars and larger houses, which would result in a rise in energy consumption and, thus, an increase in direct and indirect emissions (Abbasi & Riaz, 2016; Khan & Ozturk, 2021; Sadorsky, 2011; Salahuddin et al., 2018). This follows the "pollution haven" hypothesis, which indicates that multinational enterprises (MNEs) outsource their manufacturing activities to nations with weak environmental laws to reduce costs. This act increases emissions in such host countries (Al-Mulali & Tang, 2013; Duan & Jiang, 2021; Zhang, 2011).

The other side of the coin is that financial development would reduce CO_2 emissions and improve the environment. A proper and effective financial system is essential for channeling funds to eco-friendly projects. It promotes the investment in green technologies and energy-saving production through research and development (R&D), as well as the development of the renewable energy sector (Habiba & Xinbang, 2022; Zafar et al., 2019). Moreover, developed financial markets are able to attract foreign direct investment (FDI) and introduce cleaner and more modern technologies in the developed world, which might positively affect the environment (Bui, 2020). As environmental concerns become increasingly well-known, financial institutions can also implement environmental provisions in their lending policies, thereby preferring greener businesses and projects. This helps in the transition to the low-carbon economy and corresponds to the "pollution halo" hypothesis (Duan & Jiang, 2021; Jiang & Ma, 2019).

2.3. Empirical evidence: a lack of consensus

The empirical evidence examining these hypotheses has shown a considerable variety of results, where studies have shown positive, negative, and insignificant relationships. This difference may be related to the differences in the sample countries, that is, the developed, the developing, and the emerging economies, the study time periods, the proxies adopted to measure financial development, and the econometric methods applied.

2.3.1. Evidence of a positive (detrimental) relationship

A large part of the literature concludes that environmental degradation is the result of financial development. As an example, considering a large sample of 88 developing countries, Khan and Ozturk (2021) showed that several indicators of financial development have both direct and indirect positive impacts on CO_2 emissions, mainly through their stimulating effect on economic growth and energy use. Similarly, as Abbasi and Raza (2016) found in the case of Pakistan, financial development, especially at the initial stage, leads to increased emissions. Their augmented VAR method revealed that the CO_2 emissions are Granger-caused by financial development. The study by Tamazian et al. (2009) on the BRIC nations also found that financial development, particularly through stock market growth, initially leads to environmental degradation. The rationale behind these studies is that financial growth is the most important driver of industrialization and consumption, but without a similar shift to green technology, especially in developing and emerging economies, where environmental regulations might be weaker.

2.3.2. Evidence of a negative (beneficial) relationship

On the other hand, another research stream shows that CO_2 emissions can be reduced through financial development. In their comparative study of developed and emerging countries, Habiba and Xinbang (2022) found that financial market development and its sub-indices (access, depth, and efficiency) significantly reduce CO_2 emissions. To them, highly developed financial markets are better positioned to direct investments toward environmentally friendly projects. This is evidenced by research that shows the importance of financial development for technological innovation. Indicatively, a few analyses suggest that, on achieving a certain level or threshold of financial and economic growth, the financial sector becomes a very important facilitator of environmental enhancement by financing the shift to a knowledge-intensive, less energy-intensive economy (Tamazian & Rao, 2010).

2.3.3. Evidence of a nonlinear or asymmetric relationship

It has been suggested that it is not possible to assume a linear relationship; therefore, some recent studies have ventured into more complicated dynamics. An Environmental Kuznets Curve (EKC) of finance has been proposed—a nonlinear, possibly inverted U-shaped relationship. There has also been recent research into asymmetric effects. In a study of Pakistan using a nonlinear ARDL model, Majeed et al. (2020) found a strong asymmetric relationship: negative shocks to financial development (a contraction) lead to a larger increase in CO_2 emissions than smaller decreases (an expansion). This implies that economic insecurity or recessions may be especially harmful to the environment, perhaps by reducing the amount of capital available for investment in green practices. Mahmood et al. (2018) also reached similar findings, demonstrating asymmetrical impacts of financial market development on pollution in Saudi Arabia, which further complicates the hypothesis of a symmetric and linear nexus.

The most recent developments in the econometric approach have enabled researchers to study nonlinear dynamics more rigorously. Ganda and Ruza (2025) examined the effects of environmental technology and green innovation on CO_2 emissions using quantile-based nonlinear ARDL (NARDL) models in both the G7 and BRICS countries. They observed that the relationships across the distribution's quantiles are significantly different. This indicates that the influence of financial development on emissions could be heterogeneous, as it would differ depending on the level of environmental degradation at the base. In relation to Saudi Arabia, specifically, quantile regression research shows that the financial development–emissions nexus is highly nonlinear in nature, and its impact on the country accumulates at high quantiles of conditional emissions distribution (Ganda & Ruza, 2025; Ruza & Caro-Carretero, 2022).

Recent quantile regression approaches have been extended to examine the impacts of environmental technologies across different institutional contexts. A study employing quantile regression across G7 and BRICS nations demonstrated that environmental technology and green innovation exhibit heterogeneous effects on emissions across the distribution, with stronger mitigation impacts at higher quantiles (Islam et al., 2024). This methodological approach reveals that the finance–environment nexus is not uniform across countries with different baseline emission levels—a finding particularly salient for the QISMUT group, which exhibits considerable heterogeneity in both emission intensities and financial sector development. The quantile-based evidence suggests that Islamic banking's environmental impact may also vary across countries, depending on their initial environmental conditions and technological capabilities.

Nonlinear effects are particularly pronounced in the context of Islamic banking. In an extensive systematic literature review of green finance and ESG integration within the context of Islamic banking, Ejaz et al. (2025) noted that the relationship between the development of Islamic banking and sustainable performance exhibits nonlinear dynamics, associated with the quality of Shari'ah governance and regulatory maturity. Banks that have more robust Shari'ah governance and environmental screening systems may experience more negative impacts on emissions at higher levels of Islamic banking development, whereas those with weaker systems may experience little environmental benefit, even as the assets in Islamic banking continue to grow. This heterogeneity highlights the relevance of investigating the Financial Environmental Kuznets Curve (FEKC) hypothesis, particularly in the context of Islamic banking, where the turning point in the banking development–emissions relationship can be largely conditioned by institutional quality and Shari'ah-compliance systems.

Theoretically, Yuxiang & Chen (2011) defined four different channels by which the financial development influences the quality of the environment: (1) capitalization effects due to the availability of credit; (2) technology effects due to the financing of R&D; (3) income effects due to the presence of the EKC; and (4) regulation effects when environmental conditions are directly included in the lending choices. In Islamic finance, the regulatory factor can be especially relevant, as Shari'ah regulations that focus on preventing harm (*darar*) can inherently align with mandates in environmental protection. Nevertheless, the full implementation of those principles in the lending decision-making process of QISMUT countries remains an empirical issue that warrants further study.

These nonlinear dynamics may be further compounded by remittance flows and their asymmetric impacts on environmental quality. Islam et al. (2024) examined the asymmetric effects of remittances on economic growth and environmental quality in the top 20 remittance-receiving countries, finding that positive and negative remittance shocks have differential effects on CO_2 emissions. Their results indicate that remittance inflows, while promoting economic growth, can reduce environmental degradation when channeled through formal financial systems that support green investments. This finding is particularly relevant in the Islamic finance context, where remittance flows constitute a significant component of financial inflows in Muslim-majority economies and may interact with Islamic banking development to shape environmental outcomes. The study underscores energy consumption as a key transmission channel, highlighting the complex interactions among financial flows, energy use, and emissions—dynamics that warrant consideration when examining Islamic banking's environmental footprint in countries with significant remittance inflows.

The interconnection between migration, financial stability, and sustainability represents an emerging research frontier with implications for Islamic finance. Recent bibliometric analysis of the migration–financial–sustainability nexus reveals that financial stability in migrant-receiving economies is shaped by remittance flows, capital movements, and demographic shifts, all of which interact with environmental sustainability objectives (Lyeonov et al., 2025). In Muslim-majority countries within the QISMUT group—particularly Malaysia, Indonesia, and Turkey—migration dynamics influence both Islamic banking deposit bases (through remittance inflows) and environmental outcomes (through urbanization and consumption patterns). This emerging literature suggests that Islamic banking's environmental footprint may be partially mediated by migration-related financial flows, as remittances channeled through Islamic banking institutions can either support sustainable development or fuel carbon-intensive consumption, depending on the quality of financial intermediation and green finance policies.

2.3.4. Financial development–carbon emissions nexus: Islamic banking perspective

Although there is vast literature on the relationship between financial development and carbon emission, the results have been contradictory. Conversely, studies on the role of Islamic banking in this dynamic relationship are still in their infancy but are rapidly growing. In this case, we shall briefly refer to some of those studies, as well as comment on the recent empirical contributions.

Various studies have been devoted to OIC countries, which have much in common with the QISMUT group. To illustrate, Irfany et al. (2024) established that Islamic financial assets in OIC countries negatively affect CO_2 emissions, which confirms the effect of the "pollution halo" hypothesis. Setiawati and Salsabila (2023) have supported this finding by showing that *sukuk* issuance and overall Shari'ah-compliant assets substantially reduce carbon emissions across a sample of 12 OIC countries. Single-country studies within the QISMUT framework provide additional nuance to these regional findings. Islam (2024) employed a nonlinear autoregressive distributed lag (NARDL) approach to examine the asymmetric relationship between green innovation and environmental quality in Saudi Arabia, one of the QISMUT economies. The study found that green innovation exhibits asymmetric effects on CO_2 emissions, with positive shocks yielding stronger environmental benefits than negative shocks from innovation declines. This asymmetry suggests that sustained investment in green technologies and innovation—potentially financed through Islamic banking instruments such as green *sukuk*—can generate persistent environmental improvements in resource-rich QISMUT economies. The findings underscore the importance of examining country-specific dynamics within the QISMUT group, as institutional quality, innovation systems, and resource endowments may mediate the translation of Islamic finance into environmental outcomes. In addition, Yasirwan et al. (2024) found that Islamic finance positively and significantly influences reductions in CO_2 emissions. This has been generally accredited to the ethical and responsible investment values of Islamic finance, which promotes the use of the funds to finance environmentally friendly projects.

Conversely, Iskandar et al. (2020) found no short-run correlation between Islamic banking development and CO_2 emissions in Indonesia, but a long-run correlation, indicating that Islamic financial development positively influences CO_2 emissions in the transport sector. This can imply that, despite its principles, its practical implementation may not always result in improved environmental conditions. Nevertheless, it should be emphasized that the results depend on the particular countries or regions under analysis, the time span, and the econometric methodology, and that more country-specific studies are necessary. The recent in-depth overview of the effects of green finance and ESG on the sustainable performance of Islamic banking by Ejaz et al. (2025) indicates the theoretical potential and the practical implementation barriers of Islamic banking to environmental sustainability, observing that structuring ESG is not yet completely integrated in Islamic financial institutions, and that the alignment of the Islamic finance principles with global sustainability agendas, although promising, is yet to be reinforced with better regulatory procedures and standardized systems.

Other researchers have also discussed the overall implications of Islamic banking for environmental sustainability, including emissions. According to Siswantoro and Mahmud (2023), there is a positive correlation between Islamic financial development (i.e., proxied by Islamic financing and *sukuk*) and renewable energy production. This underscores an indirect yet important channel through which Islamic finance can improve environmental quality. Institutional factors are also indicated in literature. Having a regulatory framework for green Islamic financing in place and strong governance is essential in ensuring that financing is directed to projects that are truly sustainable (Markom & Hassan, 2019). The new literature therefore indicates that, although the potential of Islamic banking is enormous, the actual contribution is based on a nexus of financial development, policy, and governance.

To conclude, the literature does not provide a definite answer concerning the financial development–carbon emissions nexus, which appears to be very contextual. It depends on the level of economic development, the quality of institutions of a country, the energy system, and the features of the financial system in particular. There is no need to mention that the problem is additionally worsened by the utilization of various proxies and estimation methods. These uncertainties in the empirical findings provide several directions for further study.

To begin with, we need more subtle and in-depth measures of financial development that can differentiate among various elements of the financial system (e.g., banking vs. stock markets) and their specific functions. Second, the mechanisms are not well understood, and to get deeper insight into the channels of transmission, including energy consumption, technological innovation, and trade openness, one needs to conduct additional research on the matter. Third, the exploration of asymmetric and nonlinear relationships can be identified as a fruitful direction that will help resolve the contradictory results in the literature and offer narrower policy suggestions to leverage finance in the global transition to a sustainable, low-carbon future. Fourth, as the issue of Islamic banking becomes increasingly relevant in global finance and development, specific studies analyzing the nonlinear processes and transmission mechanisms in this context are justified.

In summary, the literature on the financial development–carbon emissions nexus remains inconclusive and highly context-dependent, shaped by economic development levels, institutional quality, energy systems, and financial sector characteristics. The empirical evidence spans positive (detrimental), negative (beneficial), and nonlinear relationships, reflecting the complexity of transmission channels through which finance influences environmental outcomes. Within the Islamic banking sphere specifically, recent studies suggest potential for emissions reduction through ethical financing principles, yet practical implementation varies considerably across jurisdictions. Critical gaps remain in understanding (1) the precise mechanisms through which Islamic banking affects environmental outcomes, (2) the role of institutional quality and Shari'ah governance in translating ethical principles into green finance practices, (3) asymmetric and nonlinear dynamics specific to Islamic finance-environment relationships, and (4) how Islamic banking interacts with other financial flows (remittances, FDI) and contextual factors (energy systems, innovation capacity, migration patterns) to shape sustainability trajectories.

This study addresses these gaps by providing the first systematic econometric assessment of Islamic banking's environmental impact within the QISMUT framework, employing multiple development proxies and advanced panel methods to account for cross-country heterogeneity and common shocks. By examining how Islamic banking development interacts with renewable energy, economic growth, and the forces of globalization in major Islamic finance hubs that are also significant carbon emitters, this research provides empirical evidence on whether and under what conditions Islamic banking can serve as an effective instrument for environmental sustainability in Muslim-majority economies.

To start with, unlike other studies of the Islamic banking–environment relationship (usually broad regional samples or OIC countries), or single-country case studies, this study is unique in its approach since it can evaluate the practical environmental implication of the development of Islamic banking through the QISMUT grouping, representing major hubs of Islamic finance, as well as major carbon emitters in the world. Second, we use various theory-based proxies of the development of Islamic banking (total Islamic bank assets, Shari'ah-compliant financing, and Islamic financing as a GDP measure) to reflect various aspects of the banking expansion and market coverage, which is a more comprehensive measure compared with single measures adopted by other studies. Third, we respond to the recent demands of the Islamic finance literature (Ejaz et al., 2025; Hosen, 2023) to test this relationships, using econometric tools that directly take into account cross-sectional dependence, which is a key aspect of macro-panel analysis in the context of international externalities such as those QISMUT countries are facing (global energy prices and international climate policies).

3. Data and methodology

3.1. Data

This study examines the relationship between Islamic finance and carbon emissions within the QISMUT countries—Qatar, Indonesia, Saudi Arabia, Malaysia, the United Arab Emirates, and Turkey. Due to data availability, the study covers the 2015–2023 period only and consists of a balanced annual panel data set. While this represents a relatively modest temporal span of nine annual observations per country, the selected period strategically captures three important characteristics. First, it encompasses the post-Paris Agreement era (2016 onward) when sustainable finance gained global prominence and became central to climate policy discussions. Second, this period marks the emergence and acceleration of green Islamic banking products, particularly green *sukuk* issuance (beginning in 2015–2016) and the integration of ESG criteria into Islamic financial institutions. Third, the 2015–2023 period represents the most policy-relevant recent period for understanding current relationships between Islamic banking development and environmental outcomes. The SESRIC database, our primary source for Islamic finance statistics, provides systematic coverage from 2015 onward; extending coverage to pre-2015 periods would require manual compilation from fragmented national sources and would compromise the consistency of our balanced panel.

Our variable selection follows established practices in environmental finance research and is justified by relevant literature. The dependent variables—carbon emissions (CO_2) and carbon emissions consumption (CO_2C)—are standard in environmental Kuznets Curve literature. We follow Ganda and Ruza (2025) and Ruza and Caro-Carretero (2022) in analyzing multiple emissions measures to ensure robustness across specifications. The former is used for the main estimation, while the latter is used for the robustness test.

The main independent variable is Islamic banking, which can be measured using several proxies. We employ three complementary proxies for Islamic finance development to capture different dimensions: Islamic banking assets (IBA) reflect institutional scale, Shari'ah-compliant financing (IBF) reflects actual credit provision, and financing-to-GDP ratio (IBFGDP) captures relative importance in national financial systems (Irfany et al., 2024; Setiawati & Salsabila, 2023; Siswantoro & Mahmud, 2023; Yasirwan et al., 2024). This multi-proxy approach provides robustness and allows the identification of which dimension of Islamic finance drives environmental outcomes. Islamic banking development, as briefly noted in the literature, could have both positive (Iskandar et al., 2020) and negative (Irfany et al., 2024; Setiawati & Salsabila, 2023; Siswantoro & Mahmud, 2023; Yasirwan et al., 2024) impacts on carbon emissions. Using multiple proxies can provide a more comprehensive view.

Several control variables are commonly used in the literature, such as the gross domestic product (GDP), measured in USD constant 2015 prices (Adeleye et al., 2022; Saygın et al., 2025; Setiawati & Salsabila, 2023). GDP follows the Environmental Kuznets Curve framework with an expected positive effect reflecting industrialization's energy intensity (Yuxiang & Chen, 2011). Renewable energy usage (REEC) is measured as the share of renewable energy in total final energy consumption, and this directly mitigates carbon emissions (Adeleye et al., 2022). Renewable energy (REEC) share enters with an expected negative sign, consistent with Habiba and Xinbang (2022) and Adeleye et al. (2022), who showed that renewable expansion reduces emissions. Net inflows of foreign direct investment (FDI) and trade openness (TO) capture globalization effects, where results remain ambiguous between "pollution haven" and "pollution halo" hypotheses (Khan & Ozturk, 2021). By including multiple control variables, we ensure that Islamic finance effects are not artifacts of omitted variable bias.

Control variables are selected based on established environmental economics theory. Logarithmic transformation ensures that coefficients represent elasticities (the percentage change in emissions from a one-percentage-point change in the explanatory variable), facilitating interpretation and cross-study comparison.

All data come from the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC) website. The variable names, descriptions, expected signs, and sources are presented in Table 1.[3]

Table 1. Variable, description, sign, and source.

Variable	Description	Sign	Source
CO_2	CO_2 emissions (million tons)	N/A	SESRIC Database*
CO_2C	CO_2 emissions consumption (million tons)	N/A	
IBA	Islamic banking assets (million USD)	+/-	
IBF	Islamic banking financing (million USD)	+/-	
IBFGDP	Islamic banking financing (% share in GDP)	+/-	
GDP	GDP (2015 Prices) (million USD)	+	
REEC	Renewable energy (% of the total energy consumption)	-	
FDI	Foreign direct investment, net inflows (% of GDP)	+/-	
TO	Trade openness (%)	+/-	

Source: Author's compilation. * SESRIC OICStat: https://oicstat.sesric.org/query.

3.2. Methodology

The study uses a comprehensive panel data econometric methodology to investigate the relationship between Islamic finance and carbon emissions in the QISMUT countries over the period 2015–2023. Panel data analysis offers several advantages. It accounts for unobserved heterogeneity and produces robust, reliable results by capturing cross-sectional dependence and temporal dynamics (Baltagi, 2021).

3.2.1. Pre-estimation

Given the data structure and the nature of the research question, the study relies on several panel estimators and employs a multi-step process. In particular, the pre-estimation stage involves testing for slope homogeneity, cross-sectional dependence (CSD), stationarity (unit root), and cointegration analysis.

Before proceeding to the main estimation, we test for slope heterogeneity across QISMUT countries using the Pesaran and Yamagata (2008) slope homogeneity test. This test evaluates whether the long-run coefficients on key explanatory variables differ significantly across the six countries. Results from the Pesaran-Yamagata test yield Delta = 0.593 with p-value = 0.553, indicating failure to reject the null hypothesis of slope homogeneity.

Following this, we begin with Pesaran's (2007, 2021) CD test for CSD, which is suitable for both small and large panels (*Equation 1*). Ignoring CSD in panel data can lead to biased estimates and misleading inferences. If the null of cross-sectional independence is rejected, we should use second-generation panel unit root tests to avoid spurious results due to cross-sectional dependence.

[3] The plan was also to utilize energy consumption and urbanization as crucial control variables. However, due to multicollinearity, they were dropped.

$$CD = \sqrt{2T/N(n-N)}\left(\sum_{i=1}^{N-1}\sum_{k=i+1}^{n}\widehat{\rho_{i,k}}\right) \tag{1}$$

Given that the results indicate CSD in our panel, the study applies Pesaran's (2007) cross-sectionally augmented Im, Pesaran, and Shin (CIPS) test. This test is an extension of Im et al. (2003) that accounts for dependence across units and is expressed as follows:

$$CIPS(N,T) = \bar{T} = N^{-1}\sum_{i=1}^{N} t_i\,(N,T) \tag{2}$$

where N and T are the numbers of cross-sections and years, respectively, and t_i is the ordinary least squares (OLS) t-ratio from the cross-sectional averaged augmented Dickey–Fuller (ADF) regression. As a preliminary check, we will also use the Im-Pesaran-Shin (IPS) first-generation unit root test, which allows for heterogeneity in the autoregressive parameter (Im et al., 2003).

Thereafter, we will assess whether a long-run relationship exists among the variables. This is done using Pedroni's (1999, 2004) and Kao's (1999) residual-based tests, which are suitable in the absence of CSD. However, when CSD is present, we need to use the second-generation error-correction test developed by Westerlund (2007). Establishing cointegration confirms the existence of a long-run equilibrium relationship, even if the individual series are nonstationary.

3.2.2. Estimation methods

The estimation strategy is guided by the outcomes of the cointegration analysis. In the absence of cointegration, the variables are differenced to induce stationarity, and regressions are estimated using conventional panel estimators such as fixed effects (FE), random effects (RE), or the generalized method of moments (GMM) approach (Arellano & Bond, 1991). In this case, the analysis focuses on short-run dynamics, as no long-run equilibrium relationship exists.

Given the likely presence of cross-sectional dependence and a long-run cointegrating relationship, the primary estimation will be conducted using the Prais–Winsten regression model with panel-corrected standard errors (PCSE). This method simultaneously addresses heteroscedasticity, serial correlation, and cross-sectional dependence (Beck & Katz, 1995; Kao & Chiang, 2000). The baseline model, a modified version of Adeleye et al. (2022), is specified as follows:

$$CO_{2,it} = \alpha_i + \beta_1 IF_{it} + \beta_2 Z_{it} + \varepsilon_{it} \tag{3}$$

where $CO_{2,it}$ denotes the (log of) carbon emissions in country i at time t, IF_{it} represents Islamic finance indicators, Z_{it} is a vector of control variables (e.g., GDP, renewable energy use, FDI inflows, and trade openness), and ε_{it} represents the error term.

For robustness checks and to observe the consistency of the results, feasible generalized least squares (FGLS) is estimated, offering efficiency gains in the presence of heteroskedastic and correlated errors. PCSE and FGLS methods are particularly useful for dealing with common econometric problems in panel data, such as cross-sectional dependence and heteroskedasticity. This approach produces heteroskedasticity- and autocorrelation-consistent covariance matrices. The results, thus generated, are robust to cross-sectional dependence, heteroscedasticity, and autocorrelation. This adjustment is necessary in the context of QISMUT, where countries are exposed to common external shocks such as global energy prices and international climate policies.

We acknowledge that recent panel econometric literature has proposed second-generation estimators, such as augmented mean group (AMG), common correlated effects mean group (CCEMG), and cross-sectional augmented ARDL (CS-ARDL), for simultaneously addressing slope heterogeneity and cross-sectional dependence (Eberhardt & Bond, 2009; Pesaran, 2006, 2021). However, these methods produce reliable estimates primarily in datasets with $N \geq 20$ countries and $T \geq 20$ time periods, where individual country-specific slopes can be estimated with sufficient precision. Our sample—six countries observed over nine years—falls well below these thresholds. Deploying AMG, CCEMG, or CS-ARDL with such a small panel would introduce severe estimation bias due to the bias-variance trade-off inherent in estimating individual-country slopes with only 9 observations per unit. Our PCSE specification with Driscoll–Kraay corrections explicitly addresses contemporaneous cross-sectional dependence, while FGLS addresses heteroskedasticity and allows country-specific error variances. Together, these methods provide a theoretically sound and empirically appropriate approach for our data structure. The consistency of results across PCSE and FGLS (Table 5) provides evidence of robustness. Extension of second-generation techniques represents a valuable direction for future research, as Islamic finance data become available with larger country samples ($N > 20$) and longer time series ($T > 20$), where the theoretical advantages of these methods can be fully realized.

4. Empirical results and discussions

4.1. Descriptive statistics

Table 2 presents the descriptive statistics and pairwise correlation among the variables. Based on the data, Indonesia has the highest CO_2 emissions (20.418), while Qatar has the lowest (18.286). The expansion of Indonesia's economy and its large population are significant drivers of rising energy consumption and, consequently, increased CO_2 emissions (Yasirwan et al., 2024). Qatar's low total CO_2 emissions, despite its high GDP per capita, are likely due to its small population and small land area (Al-Asmakh & Al-Awainati, 2018).

As for Islamic financial development, the highest levels of assets and Shari'ah-compliant financing are in Saudi Arabia (12.769 and 12.463, respectively), and the lowest are in Indonesia (9.64 and 9.32, respectively). Malaysia has the highest share of Shari'ah-compliant financing in GDP (64.332), and Indonesia has the lowest (1.797).

The bottom part of Table 2 presents the pairwise correlations of the variables. Our main independent variables indicate a negative, but insignificant, impact on CO_2 emissions, as expected from Islamic finance theory. Among the regressors, there is no evidence of perfect linear correlation except between different measures of Islamic finance and CO_2 emissions.

Table 2. Summary statistics and pairwise correlation analysis.

Variable		CO_2	CO_2C	IBA	IBF	IBFGDP	GDP	REEC	FDI	TO
Full sample	Obs	54	54	54	54	54	54	54	54	54
	Mean	19.57	5.694	11.481	11.082	24.713	13.322	1.899	5.723	94.037
	Std. Dev.	0.663	0.765	0.812	0.855	18.984	0.38	1.706	6.206	48.43
	Min	18.286	4.14	9.647	9.32	1.797	12.616	−1.69	0.01	32.97
	Max	20.418	6.57	12.769	12.463	64.332	13.98	5.97	16.725	202.33
Indonesia	Obs	9	9	9	9	9	9	9	9	9
	Mean	20.239	6.429	10.128	9.684	2.512	13.828	1.766	14.592	39.931
	Std. Dev.	0.119	0.102	0.292	0.233	0.481	0.101	0.53	1.742	3.656
	Min	20.106	6.3	9.647	9.32	1.797	13.666	0.49	12.5	32.97
	Max	20.418	6.57	10.54	10.061	3.207	13.98	2.3	16.725	45.47
Qatar	Obs	9	9	9	9	9	9	9	9	9
	Mean	18.422	4.253	11.627	11.255	16.025	12.763	−0.388	0.092	92.663
	Std. Dev.	0.084	0.058	0.254	0.247	3.103	0.091	0.931	0.087	3.286
	Min	18.286	4.14	11.212	10.857	11.606	12.616	−1.69	0.03	89.55
	Max	18.567	4.337	11.95	11.563	19.953	12.902	0.66	0.3	100.21
Malaysia	Obs	9	9	9	9	9	9	9	9	9
	Mean	19.387	5.507	12.127	11.843	53.699	13.48	3.088	5.98	130.463
	Std. Dev.	0.078	0.07	0.257	0.271	9.107	0.055	1.299	1.562	8.215
	Min	19.279	5.414	11.717	11.41	40.564	13.414	1.2	3.41	116.79
	Max	19.481	5.6	12.381	12.148	64.332	13.57	5.42	8.2	146.66
Saudi Arabia	Obs	9	9	9	9	9	9	9	9	9
	Mean	20.307	6.475	12.236	11.877	29.976	13.48	1.538	0.055	60.652
	Std. Dev.	0.069	0.045	0.343	0.383	9.147	0.055	1.279	0.057	5.297
	Min	20.235	6.413	11.839	11.447	20.691	13.414	0.14	0.01	49.71
	Max	20.417	6.54	12.769	12.463	45.267	13.57	3.3	0.16	69.5
Turkiye	Obs	9	9	9	9	9	9	9	9	9
	Mean	19.855	6.028	10.806	10.316	7	13.48	1.456	12.972	62.317
	Std. Dev.	0.049	0.033	0.223	0.16	1.29	0.055	0.37	0.972	10.09
	Min	19.769	5.981	10.539	10.122	5.513	13.414	0.98	11.4	48.33
	Max	19.931	6.088	11.146	10.546	8.931	13.57	2.23	14.12	81.17
UAE	Obs	9	9	9	9	9	9	9	9	9
	Mean	19.211	5.475	11.96	11.518	39.066	12.902	3.937	0.646	178.196
	Std. Dev.	0.031	0.047	0.121	0.099	2.982	0.056	1.463	0.483	13.239
	Min	19.161	5.378	11.747	11.332	34.133	12.822	2.31	0.12	159.64
	Max	19.251	5.52	12.162	11.668	42.958	13.007	5.97	1.338	202.33
Pairwise correlation	CO_2	1								
	CO_2C	0.995*	1							
	IBA	−0.063	−0.094	1						
	IBF	−0.049	−0.083	0.994*	1					
	IBFGDP	−0.308*	−0.313*	0.845*	0.849*	1				
	GDP	0.815*	0.806*	−0.276*	−0.225	−0.284*	1			
	REEC	0.026	0.06	0.271*	0.254	0.511*	0.078	1		
	FDI	0.424*	0.430*	−0.666*	−0.623*	−0.515*	0.771*	0.01	1	
	TO	−0.673*	−0.646*	0.439*	0.397*	0.719*	−0.629*	0.557*	−0.522*	1

Notes: ***, **, and * denote significance at 1, 5, and 10% levels. CO_2: CO_2 emissions; CO_2C: CO_2 emissions consumption; IBA: Islamic banking assets; IBF: Islamic banking financing; IBFGDP: IBF as share in GDP; GDP: gross domestic product; REEC: renewable energy as share of the total energy consumption; FDI: foreign direct investment, net inflows; TO: trade openness**.** Source: Authors' computations.

4.2. Pre-estimations: CSD, unit root tests, and cointegration

The results from the pre-estimations are summarized in Table 3. The Pesaran (2021) cross-sectional dependence (CD) test rejects the null hypothesis of cross-sectional independence at the 1% significance level, indicating that shocks in one country may influence other QISMUT countries. To evaluate the stationarity of the variables, we utilized two unit root tests: the Im-Pesaran-Shin test, which assumes cross-sectional independence, and the Pesaran (2007) test, which accounts for cross-sectional dependence. The outcomes from both tests indicate that all variables, except GDP, are stationary after first differencing.

Furthermore, Table 4 presents cointegration test results based on Pedroni's (1999, 2004), Kao's (1999), and Westerlund's (2007) tests. However, due to the presence of CSD, we rely on the second-generation error-correction test results by Westerlund (2007), which confirm the presence of a long-run relationship among the variables.[4]

Table 3. CSD and panel unit root tests.

Variable	Pesaran (2021) CSD	Im-Pesaran-Shin (IPS)		Pesaran (2007) CIPS	
		Level	1st Diff	Level	1st Diff
lnCO2	6.272***	−1.931	−3.150**	−2.158	−3.414***
lnCO2C	−0.959	−1.235	−2.513**	−2.742**	−2.443*
lnIBA	10.704***	−2.436	−3.312**	−2.216***	−3.016***
lnIBF	10.102***	−2.074	−3.336***	−2.446*	−2.644***
IBFGDP	4.766***	−0.683	−2.578*	−1.916	−3.381**
lnGDP	11.012***	−1.525	−2.165*	−3.214***	−2.273***
REEC	6.904***	−1.614	−3.080***	−2.578**	−3.151***
FDI	0.136	−2.452**	−4.145***	−1.983	−3.144***
TO	5.405***	−1.332	−2.448**	−1.190	−2.675**

Notes: ***, **, and * denote significance at 1, 5, and 10% levels. Source: Author's calculation.

[4] Table 4 results are based on our main model where the dependent variable is *$lnCO_2$*, and the main independent variable is *lnIBA*. The rest of the variables are the same as in all models. Nevertheless, the evidence of a long-run relationship among the variables is detected in all models. The results from these tests are not reported but are available upon reasonable request from the corresponding author.

Table 4. Cointegration test results.

	Without trend		With trend	
Pedroni test for cointegration	t-stat	p-value	t-stat	p-value
Modified Phillips–Perron t	3.8735	0.0001	4.1375	0.0000
Phillips–Perron t	−9.7219	0.0000	−14.6983	0.0000
Augmented Dickey–Fuller t	−3.7493	0.0001	−9.5866	0.0000
Kao test for cointegration				
Modified Dickey–Fuller t	1.1036	0.1349	NA	NA
Dickey–Fuller t	0.1042	0.4585	NA	NA
Augmented Dickey–Fuller t	2.373	0.0088	NA	NA
Unadjusted modified Dickey–Fuller t	−1.2814	0.1000	NA	NA
Unadjusted Dickey–Fuller t	−2.0006	0.0227	NA	NA
Westerlund test for cointegration				
Variance ratio	2.3905	0.0084	3.1176	0.0009

Source: Author's calculation.

4.3. Main findings and robustness checks

Table 5 presents the main findings of this study using both PCSE and FGLS methods, which also serve as a robustness check for our analysis. As mentioned earlier, we use two proxies for pollution [CO2 (CO_2 Emissions) and CO2C (CO_2 emissions consumption)] and three proxies for Islamic banking development [IBA (Islamic banking assets), IBF (Shari'ah-compliant financing), and IBFGDP (Shari'ah-compliant financing as a share of GDP)].

Our findings consistently demonstrate a negative and statistically significant relationship between Islamic banking development and CO_2 emissions across multiple model specifications. These results provide strong support for H_1 and H_2, confirming that Islamic banking development is associated with reduced emissions in the QISMUT context. This result, robust across PCSE, FGLS, and POLS estimators, supports the "pollution halo" hypothesis for Islamic banking in the QISMUT context and aligns with recent evidence for OIC countries (Setiawati & Salsabila, 2023; Siswantoro & Mahmud, 2023; Yasirwan et al., 2024). The magnitude of effects varies by Islamic banking proxy. The findings from Table 5 indicate that a 1% increase in Islamic banking development (assets, financing, and the financing-to-GDP ratio) within the QISMUT countries would decrease CO_2 emissions by 0.10%, 0.175%, and 0.014%, respectively (Models 1, 2 & 3). Our results echo the principles of Islamic finance, which not only discourage investments in environmentally damaging activities but also support ethical and sustainable development that may result in real environmental benefits. Simply put, these findings, taken together, indicate a "pollution halo" effect whereby Islamic banking stimulates cleaner economic development.

Different proxies were used to represent various facets of Islamic banking. The larger coefficient for financing (Model 2) relative to assets (Model 1) indicates that environmental enhancements are primarily driven by actual lending to productive sectors rather than by mere asset accumulation. The smaller coefficient for IBFGDP (Model 3) is due to the denominator effect: as economies expand, the ratio may fall even as absolute financing increases. These patterns suggest Islamic banking's environmental benefits operate through credit allocation toward green or less-polluting projects rather than simple scale effects.

Renewable energy consumption consistently shows a strong negative effect on emissions across all specifications, consistent with H_3 regarding the expected relationships of control variables with environmental outcomes and global evidence (Adeleye et al., 2022; Bui, 2020; Dunyo et al., 2024; Habiba & Xinbang, 2022). This finding underscores that the renewable energy transition, enabled by financial development, represents a primary mechanism for emission reduction. The elasticity of renewable energy of around 0.05–0.06 represents that a 1% rise in the renewable energy share results in a reduction of emissions by about one-twentieth to one-twelfth of a percent, which, in effect, if spread over the whole economy, is a significant contribution to climate goals.

The impact of economic growth is strongly positive (GDP coefficient ranging from 1.64% in Model 1 to 2.47% in Model 6; the exact size depends on the proxy used). This finding aligns with H_3's expectation of development–emissions trade-offs characteristic of industrializing economies. This implies that the carbon-intensive development path of the QISMUT economies is a major challenge to sustainability that Islamic banking can only partially alleviate. The result shows that Islamic banking is part of a wider industrialization scenario. Therefore, even if Islamic banking lowers emissions compared to the situation without it, total emissions will still increase as economies grow. At the same time, it suggests that Islamic banking should be supported by general energy transition and efficiency measures. The findings align with the recent literature (Habiba & Xinbang, 2022; Irfany et al., 2024; Petrović & Lobanov, 2022; Saygın et al., 2025).

Table 5. PCSE and FGLS results.

	PCSE, main analysis						FGLS, robustness					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	$lnCO_2$	$lnCO_2$	$lnCO_2$	$lnCO_2C$	$lnCO_2C$	$lnCO_2C$	$lnCO_2$	$lnCO_2$	$lnCO_2$	$lnCO_2C$	$lnCO_2C$	$lnCO_2C$
lnIBA	−0.100*			−0.200***			−0.0734**			−1.01e−06***		
	(0.059)			(0.075)			(−2.524)			(−2.602)		
lnIBF		−0.175***			−0.283***			−0.175*			−3.13e−06**	
		(0.065)			(0.080)			(−1.902)			(−2.234)	
IBFGDP			−0.014***			−0.018***			−0.0140***			−0.0181***
			(0.004)			(0.006)			(−3.629)			(−3.453)
lnGDP	1.635***	1.767***	2.125***	1.939***	2.098***	2.471***	1.711***	1.767***	2.125***	2.080***	2.106***	2.471***
	(0.149)	(0.132)	(0.170)	(0.197)	(0.178)	(0.248)	(29.33)	(7.469)	(8.648)	(22.11)	(6.550)	(7.394)
REEC	−0.047***	−0.058***	−0.062***	−0.059***	−0.072***	−0.070***	−0.0417***	−0.0584***	−0.0625***	−0.0484***	−0.0655***	−0.0697***
	(0.008)	(0.010)	(0.009)	(0.010)	(0.012)	(0.012)	(−9.900)	(−3.789)	(−5.603)	(−9.682)	(−3.539)	(−4.598)
FDI	0.103**	0.096**	0.089**	0.134**	0.125**	0.121**	0.0668***	0.0958***	0.0891***	0.0704***	0.141***	0.121***
	(0.045)	(0.041)	(0.036)	(0.059)	(0.054)	(0.049)	(5.513)	(2.714)	(2.757)	(3.497)	(3.081)	(2.762)
TO	−0.004***	−0.003**	0.001	−0.003	−0.002	0.002	−0.00304***	−0.00322*	0.000510	−0.00155**	−0.00291	0.00250
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(−6.485)	(−1.818)	(0.248)	(−2.227)	(−1.355)	(0.891)
Constant	−0.616	−1.579	−8.258***	−17.514***	−18.775***	−26.847***	−1.975***	−1.579	−8.258**	−21.58***	−21.71***	−26.85***
	(1.977)	(1.787)	(2.271)	(2.632)	(2.443)	(3.319)	(−2.626)	(−0.590)	(−2.512)	(−16.97)	(−5.135)	(−6.004)
Obs.	54	54	54	54	54	54	54	54	54	54	54	54
Countries	6	6	6	6	6	6	6	6	6	6	6	6
R^2	0.839	0.846	0.868	0.786	0.797	0.817						
Wald Stat.	2698.373	1991.011	1338.873	903.107	737.015	673.060	7312	297.5	355.8	1725	210.2	241.2

Notes: ***, **, and * denote significance at 1, 5, and 10% levels; *ln*: natural logarithm; CO_2: CO_2 emissions; CO_2C: CO_2 emissions consumption; IBA: Islamic banking assets; IBF: Islamic banking financing; IBFGDP: IBF as share in GDP; GDP: gross domestic product; REEC: renewable energy as share of the total energy consumption; FDI: foreign direct investment, net inflows; TO: trade openness. Source: Author's own calculations.

Foreign direct investment effects are predominantly positive across models, reflecting QISMUT specialization in extractive industries and fossil fuel-dependent sectors where the pollution haven hypothesis dominates (Al-Mulali & Tang, 2013; Duan & Jiang, 2021; Dunyo et al., 2024; Zhang, 2011). In QISMUT, FDI concentration in oil/gas (Saudi Arabia, UAE), extraction industries (Indonesia), and manufacturing (Malaysia, Turkey) explains a predominantly positive effect. This suggests that without targeted environmental criteria in FDI policy, capital inflows contribute to emissions growth. These results, however, contrast with those reported by Saygın et al. (2025) and Tamazian & Rao (2010), who found this relationship to be negative, or with those indicating no relationship at all (Siswantoro & Mahmud, 2023).

Trade openness effects remain ambiguous, varying across models and specifications, reflecting the theoretical debate between comparative advantage (potentially increasing emissions in energy-abundant QISMUT nations) and technology diffusion channels. No conclusive policy implication emerges from this control variable, suggesting that country-specific trade composition and technology transfer mechanisms dominate. The mixed results are somewhat in line with the conflicting results reported in the literature. For instance, Petrović and Lobanov (Petrović & Lobanov, 2022), Tamazian and Rao (2010), and Bui (2020) found a positive relationship.

In general, our findings contrast with the nonlinear patterns identified by Ganda and Ruza (2025) for general financial development across BRICS/G7 countries, where inverted U-shaped relationships emerge. However, our monotonically negative result aligns with Setiawati and Salsabila (2023) for OIC countries and may reflect two factors: (1) Islamic finance's ethical framework explicitly discourages harmful sectors, and (2) QISMUT countries' focus on relatively recent Islamic banking expansion that has explicitly incorporated environmental criteria (green *sukuk*, ESG guidelines) from inception, unlike conventional finance systems that retrofitted environmental considerations.

5. Limitations of the study

The study provides important evidence on the environmental potential of Islamic banking in major Islamic finance jurisdictions, but several limitations should be kept in mind when interpreting the results and planning future research. Methodologically, the analysis rests on a relatively short panel from 2015 to 2023, giving nine annual observations for each of the six QISMUT countries. This window is substantively relevant—it coincides with the post-Paris Agreement period, when sustainable finance gained prominence and Islamic finance began to more explicitly incorporate environmental and sustainability concerns—but the limited time span restricts the strength of causal claims and the ability to trace longer-term structural change. The short panel largely reflects constraints in the SESRIC database, and future studies that can exploit longer time series, once historical Islamic banking data are more systematically available, will be better positioned to test the persistence and stability of the relationships documented here.

The econometric strategy also involves trade-offs. Recent empirical work on finance–environment linkages increasingly turns to so-called second-generation panel estimators—such as augmented mean group (AMG), common correlated effects mean group (CCEMG), or cross-sectionally augmented ARDL (CS-ARDL)—which are designed to accommodate slope heterogeneity and cross-sectional dependence in macro panels. By contrast, this study uses panel-corrected standard errors with Driscoll–Kraay corrections and feasible generalized least squares, approaches that are well established and appropriate for moderate panels but do not fully draw on the capabilities of these newer estimators. While the chosen methods suit the size and structure of the sample, future research with broader country coverage and richer time dimensions could deploy advanced techniques to probe robustness and sharpen estimates. In addition, the empirical design mainly uncovers statistical associations rather than clear causal effects. Cointegration tests indicate long-run relationships between Islamic banking development and carbon emissions, but the possibility of reverse causality and omitted dynamic feedback remains; for example, higher environmental awareness and stronger climate policies may at once encourage Islamic banking expansion and reduce emissions. Extensions using instrumental variables or dynamic panel estimators, such as the Arellano–Bond or Blundell–Bond system GMM, would therefore be useful for strengthening causal inference.

A second set of limitations relates to data and measurement. The analysis relies on country-level annual data that, while suitable for cross-country comparison, inevitably conceal sectoral and firm-level variation in both financial allocation and environmental impact. The effect of Islamic banking on emissions is likely to differ across sectors—renewable energy, heavy industry, transport, or land-intensive activities—and national aggregates can offset or obscure these differences. Gaining access to sectoral or firm-level Islamic finance data would permit a more granular examination of the channels through which Islamic banking shapes environmental outcomes. Moreover, the indicators used to proxy Islamic banking development—total Islamic banking assets, total Shari'ah-compliant financing, and Islamic finance as a share of GDP—capture the scale and macroeconomic footprint of Islamic banking, but not the environmental quality of its portfolios. These aggregates treat finance for carbon-intensive activities and genuinely green projects in the same way, limiting the ability to distinguish between "brown" and "green" Islamic finance. Given that green *sukuk* and explicitly environmental Islamic banking products are still relatively nascent, and in light of recent work on ESG in Islamic banking, there is a growing case for complementing scale-based proxies with metrics that directly capture the environmental orientation of Islamic financial assets.

Related limitations stem from omitted variables and an incomplete characterization of the broader policy and energy context. The empirical model does not include explicit indicators of environmental regulatory stringency, governance quality, or climate policy frameworks, mainly because comparable series are not consistently available for all QISMUT economies. Yet such factors plausibly influence both emissions trajectories and the ability of Islamic banking to function as a credible green finance channel. Similarly, the analysis does not control directly for fossil-fuel dependence, even though several QISMUT countries remain heavily reliant on oil and gas sectors. If Islamic banking growth is correlated with progress in these sectors, the coefficients estimated for Islamic banking variables will capture financial-development effects partially in favor of a latent energy-structure dynamic. The future incorporation of measures of environmental regulation, indices of governance and climate policy, and fuel-dependence ratios would likely improve the estimates and give a more subtle perspective on the context-specific dynamics.

The third shortcoming is conceptual, and it deals with the interpretation of the "pollution halo" mechanism. The research concludes that the negative linkage between the development of Islamic banking and carbon emissions is also consistent with a halo effect, but it fails to establish the exact channels through which it operates. The possible options are the growth in green *sukuk* and other

Shari'ah-compliant instruments to finance renewable energy and energy-efficiency initiatives, finance reallocation to industries that harm the environment, environmental risk screening, and ESG-type and credit decision pressure by stakeholders and investors who prefer ethical and sustainable practices. Without adequate details on sectoral credit allocation and environmental due diligence within Islamic banks, these channels are only assumed to exist and remain unseen. Moreover, although there is a strong normative justification for *maqasid al-Shari'ah* and other general principles of Islamic ethics to care for the environment, the extent to which banking systems in QISMUT are systematic in realizing these principles remains uneven and has not been systematically evaluated. The disparities in regulations, Shari'ah governance structures, and market incentives can create a gap between normative ideals and real-world portfolios, suggesting that conclusions about the role of Islamic banking in this environment require careful formulation and consideration of the institution's context.

Generalizability is also limited by the study's geographic scope. The analytical choice of QISMUT countries is justified by their status as Islamic banking hubs and primary carbon emitters. The findings, however, may not be applicable to OIC countries as a whole, most of which have smaller Islamic banking sectors, weaker regulatory frameworks, and different development priorities. In other words, we should not extrapolate the findings to all Islamic finance jurisdictions, especially those where Islamic banking plays a minor role within the financial system. Also, the analysis does not account for the growing issuance of Islamic financial instruments, particularly green *sukuk*, in non-Muslim-majority countries such as the United Kingdom and Luxembourg, where the interrelationships among Islamic, regulatory, and climate policies may appear quite distinct. Further extending the empirical coverage to include Muslim-majority and non-Muslim-majority jurisdictions that are actively issuing Islamic products would assist in creating a complete picture of the potential role of Islamic banking in decarbonization at the global level.

Taken together, the above-mentioned limitations do not undermine the study's fundamental findings but do indicate that the study should not be regarded as conclusive or generally applicable. They also note that future research should use richer datasets, more comprehensive identification strategies, and sector- and product-level data, and expand country coverage to explain when, how, and under what circumstances Islamic banking can become an effective instrument of environmental sustainability.

6. Conclusions and policy implications

This paper presents empirical evidence supporting our core hypotheses. The findings confirm H_1 and H_2, demonstrating that Islamic banking development is negatively associated with carbon emissions in QISMUT countries across all three proxies. Across the PCSE and FGLS estimations, the three proxies for Islamic banking (namely, total assets, Shari'ah-compliant financing, and Islamic finance relative to GDP) consistently display emission-reducing effects. This advances the interpretation of a "pollution halo" hypothesis where ethical underpinnings based on harm prevention (*darar*), public interest (*maslahah*), and stewardship (*khalifah*) promote environmental sustainability. Concomitantly, economic growth has a powerful positive effect on emissions, highlighting the carbon-intensive nature of existing development patterns in the QISMUT economies. The empirical relationships identified for renewable energy, economic growth, FDI, and trade openness broadly support H_3, confirming expected patterns from environmental economics literature adapted to the QISMUT context. On the other hand, renewable energy may be seen as the most efficient tool for lowering emissions, while FDI may demonstrate context-specific and sometimes pollution haven–type tendencies.

Theoretically, the results are relevant to Islamic banking and environmental finance. As for Islamic banking, the findings align with the *maqasid al-Shari'ah*. This means that, once properly implemented, a financial system organized around justice, harm avoidance, and intergenerational responsibility will deliver clear environmental benefits, although current practices are primarily "Islamic" and not necessarily "green". The comparative maturity of green *sukuk* and sustainability-labeled Islamic products, as highlighted in recent literature, indicates considerable untapped potential to ensure that the environmental orientation of Islamic banking goes beyond mere scale. In environmental finance terms, the evidence indicates that the structure of the financial system is important. Unlike the mixed and nonlinear results for overall financial development, Islamic banking in QISMUT is associated with systematically positive environmental outcomes, underscoring the importance of explicit ethical requirements and governance structures in shaping the interaction between finance and the environment.

A number of policy implications can be drawn. Islamic banking must be viewed and utilized by policymakers in QISMUT economies as a part of a broader climate and sustainable development policy, especially as a tool to address climate action and clean energy policies. Regulatory frameworks that prompt Islamic banks to incorporate environmental standards in credit ratings, promote the growth of green *sukuk* and other environmentally oriented instruments, and align Islamic banking activities with national decarbonization strategies can strengthen the identified halo effects. Yet, they cannot replace fundamental changes needed in the energy mix, carbon pricing, and energy efficiency standards. The findings highlight the need for Islamic financial institutions to go beyond Shari'ah-compliance form to substantive environmental risk management, specialized skills in green projects, and enhanced environmental disclosure in actual lending and investment practices. The findings suggest increased capacity-building efforts to develop green Islamic banking, the green *sukuk* market, and a need for more empirical research on specific channels through which Islamic banking influences the environment. All this relates to international and development organizations, such as Islamic standard-setting bodies and multilateral development banks.

Beyond that, the research confirms that sustainable finance is influenced not only by technical ESG integration but also by the values and governance provisions that underpin it. The comparatively positive environmental implications of Islamic banking in QISMUT countries are an indication that financial systems built on a clear ethical foundation are able to produce superior environmental performance compared to value-neutral, profit-maximizing designs, when combined with compatible climate and energy policies. With the world's decarbonization efforts accelerating, Islamic banks can play an important role. They can improve environmental assessments, offer more green products, and contribute to sustainability efforts. This is especially relevant in economies that produce high emissions and rely heavily on resources, where both significant risks and opportunities exist.

On the whole, the findings of QISMUT countries indicate that Islamic banking makes a significant contribution to environmental sustainability, with theological and ethical values translated into the visible macro-level behaviors in emissions. To unlock the potential of Islamic banking as a driver of the low-carbon transition, however, long-lasting regulatory support, enhanced institutional capacity, and additional empirical evidence that elucidates causal processes and specifies the circumstances under which Islamic banking will yield the best environmental outcomes will be required.

Use of AI tools declaration

I acknowledge the use of *Perplexity* during the ideation phase of this research to brainstorm potential case studies and refine the research question. Additionally, I used *Grammarly* to improve grammar and refine the manuscript's style. The intellectual content, data analysis, and conclusions remain the sole work of the authors, who reviewed all AI-suggested edits for accuracy.

Conflict of interest

The author declares no conflicts of interest.

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