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GREEN SUKUK AND FINTECH AS DRIVERS OF ENVIRONMENTAL FINANCE EFFICIENCY IN ISLAMIC ECONOMIES: EVIDENCE FROM MALAYSIA, INDONESIA, AND THE UAE (2010–2024)

Abstract

For sustainable development to be achieved, financial systems must be in place that can channel financial resources more efficiently into sectors that positively impact the environment. This study aims to examine whether the development of both green sukuk and financial technology increases environmental finance efficiency in Malaysia, Indonesia, and the UAE. A balanced panel dataset of 45 country-years from 2010 to 2024 is employed in this study. Fixed effects and dynamic system generalized method of moments estimators are used to estimate the model based on secondary data from various sources such as the World Bank, International Monetary Fund's Financial Access Survey, United Nations Conference on Trade and Development, Environmental Performance Index, Climate Bonds Initiative, Refinitiv, and Bloomberg. The study finds that both green sukuk and financial technology have a positive and significant impact on environmental finance efficiency in Malaysia, Indonesia, and the UAE, and that financial technology enhances the efficiency effect of green sukuk in Malaysia and other Islamic economies in general. In Malaysia, the highest efficiency effect comes from the sukuk market depth, while in the UAE, it comes from financial technology development. In Indonesia, it comes from both financial deepening and financial technology development. The study suggests that financial technology and green sukuk are complementary in driving environmental finance efficiency in Islamic economies.

Keywords

green sukuk, FinTech, efficiency, sustainability, investment, Islamic finance

JEL Classification

Q56, G21, O33, P43

INTRODUCTION

The increasing global call for a sustainable transition has increased the need for financial systems that can effectively allocate funds to environmentally positive activities. But traditional finance faces the challenge of incorporating environmental externalities into its framework, as well as providing sufficient funds for the low-carbon transition, particularly in emerging economies whose financial infrastructure is still underdeveloped (Abdelmalek & Khemakhem, 2025). Green sukuk has been developed as a new financial instrument that aims to integrate the principles of sustainability and social aspects within the framework of investment strategies (Abdelmalek & Khemakhem, 2025). The need for this agenda is becoming increasingly important within the context of an Islamic economy. The ethical principles of equity, risk-sharing, and welfare, which form the foundation of an Islamic economy, represent a model of ethical finance that is well-aligned with sustainability. In this scenario, green sukuk can facilitate investments in renewable energy sources and climate-resilient infrastructure be-



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cause of its asset-backed nature, participative approach, and outcome-linkages (Widiastuti et al., 2025). However, new technology in the financial sector, referred to as FinTech, is also changing the way markets generate, transmit, and verify information related to the environment. FinTech innovations, such as blockchain and AI-powered validation, increase transparency, traceability, and inclusivity, as well as mitigate issues of information asymmetry and transaction costs (Kou & Lu, 2025). Nevertheless, current research efforts have not provided adequate insights into how FinTech innovations can improve the effectiveness of Islamic green financial tools to optimize the efficiency of financial value related to the environment. This is why there is a need to create empirical clarity on the combined effect of green sukuk innovations and FinTech on increasing financial efficiency related to the environment.

1. LITERATURE REVIEW AND HYPOTHESES

The recent literature on sustainable finance has increasingly emphasized environmental goals as an essential part of modern financial systems. In environmental economics, green finance has been described as a corrective measure to financial market failures caused by carbon emissions, pollution, and depletion of environmental resources, particularly if such environmental externalities are not fully taken into account in financial markets (Iqbal et al., 2025; Van Niekerk, 2024). In traditional financial markets, environmental externalities are often ignored, which causes allocative inefficiencies as financial markets' private incentives do not align with social welfare (Fligstein & Huang, 2025). To address this problem, green financial instruments such as green bonds, sustainability-linked loans, and environmental, social, and governance funds have been developed to achieve environmentally friendly financial allocations (Abdelmalek & Khemakhem, 2025; Ogwu & Kosoe, 2025). Such green financial instruments have been viewed as a new class of Pigouvian policy-compatible financial instruments that internalize environmental values into financial markets (Abdelmalek & Khemakhem, 2025; Ogwu & Kosoe, 2025).

This global growth in environment-oriented finance further reinforces the importance of this domain, while the data also reveal scope for further growth. For instance, green bonds have risen from less than USD 50 billion in 2014 to more than USD 500 billion in 2021, indicating a significant shift toward environmental finance across global markets (Fligstein & Huang, 2025). However, this shift toward green finance is not uniform, especially in emerging markets, where factors such as

low institutional depth, low disclosure, and low market maturity have restricted their growth and, thus, their efficiency (Yamahaki et al., 2022). If one were to view this shift toward green finance through the lens of environmental economics, one would realize that such factors as low institutional depth and low disclosure have resulted in high levels of information asymmetry, which, according to environmental economic theories, restricts the ability of markets to price environmental externalities correctly, thus affecting their ability to finance green sectors (Khan et al., 2025; Morshed, 2025c). This is a general overview of the scientific landscape, which indicates that green finance is not just about the availability of financial instruments, but also about the institutional setting where such financial instruments operate.

One such area that is gaining importance is Islamic finance, which is considered to have a strong link with environmental welfare, considering its foundation in *adl*, *khalifah*, and *darar*, which emphasize equity, stewardship, and prevention of harm, respectively, thus creating a natural link between finance and environmental welfare (Alhammadi, 2024; Morshed, 2024). Among all Islamic finance instruments, green sukuk is considered to have a strong link with green finance, considering that such financial instruments have their foundation in green finance. In contrast, Islamic finance is built around asset-based finance, where risk is shared, thus creating a link between financial returns, environmental externalities, and their efficient allocation toward environmentally productive sectors (Uluyol, 2023; Mohamed, 2025; Musari, 2021).

Past research has also shown that green sukuk has progressed from the conceptual stage to the application stage. For instance, the first corporate green sukuk in Malaysia in 2017 and the first sovereign

green sukuk in Indonesia in 2018 are often cited as examples of the potential of Islamic financial instruments in supporting renewable energy, green transport, and climate change adaptation initiatives (Widiastuti et al., 2025; Ulfah et al., 2024). This suggests that the use of Islamic finance could contribute positively to allocative efficiency in the environment because it has the potential for supporting initiatives with high social and environmental returns (Tita & Obalade, 2025). However, the literature has also noted several issues with the current green sukuk market. For instance, the lack of standardization in the certification of green sukuk and the fragmentation of the entire process have been noted as challenges facing the market (Mohd Roslen et al., 2024; Taylor et al., 2025). These issues could also be seen as transaction cost issues affecting the efficiency of the environment financial intermediation process (Zhang et al., 2024b).

Another set of studies also describes financial technology as an instrument that may help mitigate these frictions. This recent financial technology literature emphasizes the role of digital finance in transforming sustainable finance through technologies such as blockchain technology, artificial intelligence, and mobile technology (Kou & Lu, 2025; Othman, 2025; Kashif et al., 2025; Morshed & Khrais, 2025). This perspective argues that financial technology may help mitigate information asymmetry through the increased transparency and verifiability of green project performance for investors. Financial technology may also increase participation in sustainable finance and thus enhance allocative efficiency through its ability to decrease participation costs. This is because financial technology may help increase participation in sustainable finance not only for institutional investors but also for retail investors through its ability to simplify verification and monitoring processes for investors (Harasis, 2026; Rizwan et al., 2024). This perspective is consistent with the argument in welfare economics that increasing the number of participants in sustainable finance may help increase the overall efficiency in the allocation of environmental capital through the broader market for sustainable financial instruments. Financial technology may also help increase allocative efficiency in sustainable finance through its ability to decrease transaction costs for investors. This per-

spective is consistent with the argument in welfare economics that decreasing contracting costs may lead to increased social welfare (Sikiru et al., 2024; Kukman & Gričar, 2025).

The most relevant body of previous study in relation to this current study is that which intersects with green sukuk and financial technology. Past studies have shown that this intersection may lead to better efficiency in environmental finance by leveraging better transparency, monitoring, and targeting, and greater credibility in financial systems. It has also been shown that financial technology may be leveraged to better channel funds to eligible projects under a green sukuk issuance, monitor environmental outcomes in real-time, and reduce information asymmetry between financial institutions and environmental stakeholders. Other studies have shown that financial technology may be leveraged to better monitor financial institutions' environmental efficiency and that financial technology may be leveraged to better channel financial sustainability in a green sukuk issuance (Kashif et al., 2024; Zaid et al., 2025; Ahmad et al., 2024).

Additionally, country-specific evidence also points to the existence of variations in the manner in which the relationship is developed in different institutional settings. For example, evidence from Malaysia and Indonesia points to the positive contribution of green sukuk in mobilizing public and financial resources for climate change adaptation and other sustainability-related projects (Muhamat et al., 2024; Faizi, 2024; Rahman et al., 2024). On the other hand, evidence from the United Arab Emirates points to the positive contribution of financial technology in supporting the advancement of environmental objectives through more flexible and innovation-driven financial channels (Alkasasbeh et al., 2024; Hariz et al., 2025). These variations are also in line with the arguments of institutional environmental economics, which point to the impact of country-specific financial, technological, and regulatory structures on the efficiency of environmental finance mechanisms (Alkadi, 2024).

Three theoretical arguments can be advanced as a rationale for the convergence of evidence on green sukuk and financial technology. For

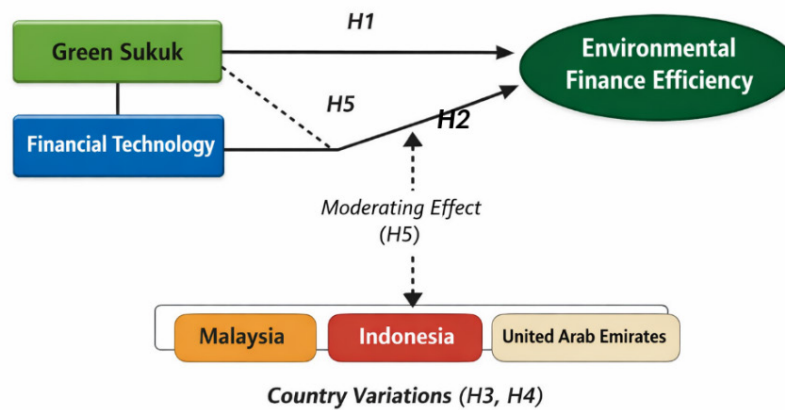


Figure 1. Conceptual model

example, the Resource-Based Theory can be advanced as a rationale for understanding the positive contribution of the integration of financial and technological resources in developing distinctive capabilities for improved sustainable performance (Achyar, 2025). Similarly, Institutional Theory can also be advanced as a rationale for understanding the positive contribution of policy frameworks, financial system quality, and socio-cultural factors in supporting the advancement of environmental finance objectives (Alkadi, 2024). Finally, Stakeholder Theory can also be advanced as a rationale for understanding the pressure on financial systems for returns that are more in line with environmental and social welfare expectations (Mahomed & Mahbot, 2024).

Overall, the reviewed literature confirms that both green sukuk and financial technology have the potential for positive effects on the environmental efficiency of finance, but the findings are scattered across different research areas. Although existing research is useful for understanding the effects of green finance, Islamic finance, and financial technology, it provides only limited evidence of the combined effects of green sukuk and financial technology on the environmental finance efficiency of countries. This confirms the need for a comparative study of the individual and combined effects of both concepts in Malaysia, Indonesia, and the UAE.

Based on the reviewed literature, the research objective of this study is an exploration of the effects of green sukuk intensity and financial technology

development on environmental finance efficiency in Malaysia, Indonesia, and the United Arab Emirates from the perspective of environmental economics. Accordingly, the study tests the following hypotheses (Figure 1):

- H1: *Green sukuk is positively related to environmental finance efficiency.*
- H2: *FinTech is positively related to environmental finance efficiency.*
- H3: *The strength of the relationship between green sukuk and environmental finance efficiency differs across Malaysia, Indonesia, and the UAE.*
- H4: *The strength of the relationship between FinTech and environmental finance efficiency differs across Malaysia, Indonesia, and the UAE.*
- H5: *FinTech positively moderates the relationship between green sukuk and environmental finance efficiency.*

The conceptual model suggests that green sukuk and financial technology have a direct positive effect on environmental finance efficiency, and financial technology also enhances the effect of green sukuk by having a positive interaction effect. Moreover, it is suggested that these relationships will differ in Malaysia, Indonesia, and the UAE due to differences in institutional, financial, and technological conditions in these countries.

2. METHODS

The study focuses on three countries, namely Malaysia, Indonesia, and the UAE, covering a period from 2010 to 2024. The period coincides with and encompasses the changing nature of the green sukuk markets, the FinTech phenomenon, and sustainable finance, with particular significance from 2015 onwards. These three countries were purposively chosen for their pioneering roles in the development of Islamic sustainable finance. These are the achievements of the Malaysian financial system in the regulations and capital markets of green sukuk; the pioneering role of Indonesia in the sovereign green sukuk issue to fund climate change investments; and the role of the UAE as a FinTech hub that connects finance and sustainability in the Islamic world. The panel study allows the research to take advantage of the cross-sectional and time-series variations to provide a more precise estimation of the differences between the countries with regard to the impact of digital finance on sustainable finance. The study uses secondary data for all the variables annually for the whole sample period for all three countries. The data are collected from the World Bank World Development Indicators and Findex, the International Monetary Fund Financial Access Survey, the United Nations Conference on Trade and Development (UNCTAD) database UNCTADstat, Yale University Environmental Performance Index, the Climate Bond Initiative, as well as the Refinitiv (LSEG) and Bloomberg data on financial issuances and markets. These are complemented with national sources such as the Central Banks of Malaysia, Indonesia, and the UAE to validate the data for each country on an annual basis. The standardization of the variables is done to allow cross-country comparisons. The balanced panel consists of 45 observations: 3 countries and 15 time periods.

Environmental finance efficiency (EFE), the value of which ranges from 0 to 10, is based on the percentage of Green/ESG investment as a proportion of gross capital formation, weighted by the Environmental Performance Index (EPI). Green sukuk, as a percentage of the total sukuk issued per year, and FinTech, as the overall digital finance capability, are the values of the independent variables (Sethi et al., 2024).

Variables like GDP growth rate, FDI, inflation rate, energy intensity, and CO2 emissions are the independent variables, and with the inclusion of these variables, the impact of different macro and environmental factors is determined. The policy variable used here is the inclusion of the dummy variable, with the value of 1, as the year 2015 marked the change in the overall orientation of the sustainability policy with the inclusion of the Paris Agreement (Taqa, 2025).

Variables are transformed into their logs where applicable for correction of skewness, variance stabilization, and robustness enhancement. Variables are also z-score normalized for interaction terms, for which Cook's distance tests are employed for validation of robustness against undue influence of observations (Morshed, 2025b).

The relationship between green sukuk, FinTech, and environmental finance efficiency is estimated using the following panel regression framework:

$$EFE_{it} = \alpha + \beta_1 GS_{it} + \beta_2 FT_{it} + \beta_3(GS_{it} \cdot FT_{it}) + \gamma' X_{it} + \mu_i + \lambda_t + \varepsilon_{it}, \quad (1)$$

where EFE_{it} denotes environmental finance efficiency; GS_{it} captures green sukuk intensity; FT_{it} measures FinTech development; $GS_{it} \times FT_{it}$ is the interaction term; and X_{it} is the vector of control variables. Country fixed effects (μ_i) and year fixed effects (λ_t) are included to address unobserved heterogeneity and common shocks. Both Fixed Effects (FE) and Random Effects (RE) models are estimated, guided by the Hausman test for model selection. To address potential endogeneity (e.g., simultaneity between GS, FT, and EFE) and dynamic persistence in macroeconomic panels, System GMM is additionally estimated using lagged values of endogenous variables as internal instruments (Baştürk, 2024; Morshed, 2025a).

The procedure involves the use of a successive diagnosis algorithm. Panel stationarity tests employ the Levin, Lin, and Chu, as well as the Im, Pesaran, and Shin, tests. FE model vs. RE model choice is performed using the Hausman χ^2 test. Subsequent dynamic estimation, em-

ploying the System GMM, is conducted to correct for endogeneity and persistence, with the reporting of heteroskedasticity (Modified Wald), Wooldridge (autocorrelation), and multicollinearity (VIF) tests included to aid with inference. Validity of the GMM instrument, as well as the absence of serial correlation, is diagnosed through the Hansen J test and the Arellano-Bond AR(1)-AR(2) tests. Robustness analysis employs different proxies (a digital index for FinTech, as well as the Green Asset Ratio for EFE), as well as subsample estimation (prior to/post-2016, including the period of the Paris Agreement), to analyze the stability across time (Morshed, 2025b). All analyses are conducted in Stata 18.1, with cluster-robust standard errors to account for the issues of heteroskedasticity and serial correlation.

All data are derived from public and credible sources of the institutions, and this ensures transparency and validity of the data. Since the study entails the use of only secondary data, and the data are not handled in a way that involves human subjects and any form of confidential data, the study does not require any form of ethical approval.

The study is based on a limited amount of source data, which is directly relevant to the methodology. Therefore, the detailed variable-to-source mapping and country-specific source data are presented in Appendix A, Appendix B, and Appendix C instead of a repository.

3. RESULTS AND DISCUSSION

This paper discusses the relationship between the issuance of green sukuk (GS) and the development of FinTech (FT) in relation to environmental finance efficiency (EFE) in Malaysia, Indonesia, and the UAE from 2010 to 2024. This study incorporates the principles of environmental economics, which state that markets can solve environmental externalities if financial efficiency is achieved. In this case, the issuance of green sukuk serves as an appropriate financing mechanism in line with Shariah principles, which promotes efficiency in the allocation of funds in projects that are environmentally favorable.

As depicted in Table 1, the overall mean score of environmental finance efficiency (EFE) is 5.84, with a range of approximately 0-10, reflecting a moderate level of efficiency across the three countries with significant variation (SD = 2.11). The level of green sukuk issuance, as a proportion of overall sukuk issuance, averages 2.67%, with a standard deviation of 1.42, while the FinTech index averages 54.32, with a standard deviation of 15.27, reflecting significant variation across countries and time in terms of market development and FinTech potential. GDP growth and FDI are positive, supporting green capital mobilization, but inflation can negatively impact efficiency through macroeconomic instability (Elsayed et al., 2024).

Malaysia emerges as the leader in green sukuk offerings as well as EFE, as shown in Table 2, with a well-developed Islamic finance framework. Its

Table 1. Descriptive statistics and measurement units for all variables

Variable	Mean	Std. Dev.	Min	Max
Environmental finance efficiency (EFE, index approx. 0-10)	5.84	2.11	1.20	10.45
Green sukuk (GS, % of total sukuk)	2.67	1.42	0.50	6.85
FinTech Index (FT, 0-100)	54.32	15.27	22.10	78.65
GDP Growth (%)	3.75	2.14	-1.20	8.30
FDI (% of GDP)	3.22	1.17	1.10	6.70
Inflation (%)	3.85	1.92	0.60	8.10

Note: Malaysia, Indonesia, UAE; 2010–2024; N = 45 country-years.

Table 2. Country-level descriptive results (2010–2024; averages across years)

Country	Avg. EFE (index approx. 0-10)	Avg. GS (% of sukuk)	Avg. FT (0-100)	Notable Trend
Malaysia	7.2	3.8	56.4	Consistent sukuk growth, strong regulatory integration
UAE	5.1	1.9	68.7	FinTech-driven growth, digital leadership
Indonesia	5.2	2.3	47.9	Rapid post-2018 sovereign sukuk expansion

framework represents allocative efficiency, where the capital market allocates funds into activities with positive externalities. UAE represents a growth trend driven by FinTech, as it has the highest score (68.7) in FinTech index, where the digital platform supports financial inclusion, traceability, and green funds allocation. Indonesia displays average values with a strong positive trend since 2018, signifying that the issuance of sovereign sukuk and digital inclusion policies have greatly accelerated its environmental finance sector (Kharrat et al., 2024).

Table 3. Fixed effects estimates of environmental finance efficiency (EFE) (2010–2024)

Variable	Coefficient	t-stat	Sig.
Green sukuk (GS)	0.274	3.11	0.002
FinTech (FT)	0.196	2.45	0.015
GS × FT	0.081	2.02	0.046
GDP growth	0.089	2.17	0.032
FDI inflows	0.072	1.98	0.048
Inflation	-0.063	-2.04	0.042
Energy intensity	-0.051	-1.67	0.097
CO ₂ emissions	-0.078	-2.22	0.028
Within R ²	0.61		

Note: Country and year fixed effects included; cluster-robust standard errors at the country level. N = 45.

As evident in Table 3, green sukuk and FinTech, together and significantly, increase environmental finance efficiency (EFE) in a complementary manner. Green sukuk (0.274, $p < 0.01$) and FinTech (0.196, $p < 0.05$) with a positive coefficient establish the role of green sukuk in allocating resources to the environment and the role of FinTech in increasing transparency and mitigating asymmetry of information, respectively. A significant $GS \times FT$ (0.081, $p < 0.05$) suggests that technology can complement the overall efficiency of sukuk in terms of increasing accessibility, verification, and involvement of investors in the financial market. All the control variables behave as expected, where the growth of GDP and FDI inflows increase the overall efficiency of finance in the environment, whereas inflation, energy intensity, and CO₂ emissions negatively affect it. An R² of 0.61 indicates that the overall efficiency of environmental finance is determined by the complementary effects of financial depth, technological advancement, and overall macroeconomic conditions (Zhang et al., 2024a).

Table 4. Dynamic system GMM estimates of environmental finance efficiency (EFE) (2010–2024)

Variable	Coefficient	z-stat	Sig.
Lagged EFE	0.213	2.52	0.012
Green sukuk (GS)	0.268	3.06	0.003
FinTech (FT)	0.191	2.39	0.017
GS × FT	0.076	2.04	0.041
Diagnostics: Hansen J ($p = 0.27$); AR(2) ($p = 0.34$)			

Note: Hansen J and AR(2) p-values reported; robust two-step standard errors. N = 45.

As shown in Table 4, the dynamic model confirms the base model results with the addition of significant path dependence on the efficiency of environmental finance. The lagged EFE variable of 0.213 with a significance level of $p < 0.05$ indicates that efficiency levels at a given stage are dependent on previous levels of efficiency. This indicates that the greening of capital markets tends to establish dynamic persistence through the adoption of sustainable finance mechanisms (Oreqat, 2021).

The fact that green sukuk (0.268, $p < 0.01$) and FinTech (0.191, $p < 0.05$) are still significant means that these effects are not merely short-term in nature but are already ingrained in the structural dynamics of the finance system. The diagnostic tests also confirm the instrument set and the model specification. This is consistent with the principles of environmental economics, where innovation-driven early investments in the green finance sector and FinTech improve allocative efficiency (Ali et al., 2024).

Table 5. Country-specific coefficients for green sukuk and FinTech on EFE (2010–2024)

Country	GS Coefficient	FT Coefficient	Dominant Driver
Malaysia	0.321***	0.142*	Sukuk-driven efficiency
UAE	0.168*	0.287***	FinTech-driven efficiency
Indonesia	0.205**	0.176**	Balanced dual mechanism

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Based on Table 5, the environmental finance efficiency (EFE) is improved by unique country-specific variables. In the Malaysian context, green sukuk is the most important factor (0.321, $p < .01$), which reflects the country's well-

Table 6. Sub-period estimates for green sukuk and FinTech on EFE (Pre-2017/18 vs Post-2017/18)

Period	GS Coefficient	FT Coefficient	Outcome
Pre-2017/18	0.12	0.09	Limited effect before reforms
Post-2017/18	0.31	0.24	Significant impact after policy integration

developed infrastructure in the field of Islamic finance, and FinTech is a supporting factor by increasing the level of transparency (0.142). In the UAE, FinTech is a leading factor (0.287, $p < .01$), which reflects the country's well-developed infrastructure that supports efficient processing with very small transaction charges. In Indonesia, a balanced position is maintained between the country's green sukuk and increased readiness of infrastructure to support increased financial flows for environmental objectives through $GS = 0.205$ and $FT = 0.176$, respectively. The disparity among these countries reflects that the level of developed institutions and infrastructure readiness plays a determining factor in the capability of financial markets to integrate the value of the environment, as stated by Rossoni et al. (2024).

From Table 6, both coefficients increase substantially from 2017–2018 onwards; this is consistent with the development of the Malaysian corporate sukuk market as well as the development of the Indonesian green sukuk market. In the same period, the FinTech coefficient also increases (0.09–0.24); this is a result of the fast pace of digitization initiatives such as the FinTech sandbox environment within the UAE as well as digitized payments within Indonesia. These findings are in line with the principles of environmental economics, where the strategic role of the state can mitigate the problem of coordination failure and transaction costs in the environmental market, thereby enabling the success of market-based approaches (Tanchangya et al., 2025).

Cumulatively, the findings in Tables 1–6 support the five research hypotheses ($H1$ – $H5$). Green sukuk improves allocative efficiency by allocating funds into projects supportive of the environment, whereas FinTech improves informational efficiency by ensuring higher transparency at cheaper costs. Their interaction effect produces an additional efficiency boost in environmental

finance efficiency (EFE). This persistence in the model suggests that the development of finance and technology supports each other, cumulatively providing sustained efficiency. Moreover, cross-national results revealed that the sukuk-based model in Malaysia, the technology-oriented model in the UAE, and the policy-based hybrid model in Indonesia are all different yet integrating aspects of the fully evolved green finance sectors. As such, the results individually confirm the efficacy of the combination of the development of the Islamic finance sector and the development of technology.

These findings support the view of environmental economics, which states that the efficiency of environmental finance increases as the share of environmental failures decreases, rather than increasing in line with the scale of green finance. Green sukuk is found to be positively correlated to environmental finance efficiency (EFE) ($\beta = 0.274$, $p < 0.01$). The higher the share of green sukuk, the higher the overall allocative discipline through the use of proceeds, governance, and disclosure standards, which would ultimately translate into higher returns on investment in the environment (Alkawasbeh et al., 2024; Rahman et al., 2024). The development of FinTech is found to be positively correlated to environmental finance efficiency (EFE) ($\beta = 0.196$, $p < 0.05$), which may be due to the reduction in costs of searching, screening, and monitoring through digitalization (Zaid et al., 2025; Al-Muntasir, 2022). The positive interaction effect of green sukuk and FinTech ($GS \times FT = 0.081$, $p < 0.05$) implies the complementary effect of the development of FinTech on the overall marginal efficiency gain of green sukuk through digital reporting, analytics, and verification (Kashif et al., 2024).

From the country-specific results, it is evident that the constraints faced by the country are related to institutional preparedness and technological preparedness. For the Malaysian

case, the results reveal a profile of “Sukuk-Led,” where GS equals 0.321*** and FT equals 0.142*. This is consistent with a well-developed sukuk governance structure and a rich Islamic capital market infrastructure where financial discipline is a prerequisite. The UAE shows a “FinTech-Led” profile, where GS = 0.168* and FT = 0.287***, consistent with a well-developed FinTech finance scene, which is a prerequisite for transparency, price discovery, and access in green markets. Indonesia shows a balanced dual-channel profile, where GS = 0.205** and FT = 0.176**, consistent with the development of

green sukuk markets after 2018 and the development of digital inclusion (Ahmad et al., 2024).

The dynamic results show persistence in EFE, where the lagged EFE is equal to 0.213, and the *p*-value is less than 0.05. In addition, the effect is larger after 2017/18 for both channels, where GS increases to 0.31 from 0.12 and FT increases to 0.24 from 0.09, suggesting improvements in instrument quality, disclosure, and coordination to internalize environmental externalities, allowing both channels to produce more enduring efficiency gains.

CONCLUSION

The objective of this paper is to investigate the impact of the development of green sukuk and financial technology, and the combined impact of the two factors, on environmental finance efficiency in Malaysia, Indonesia, and the United Arab Emirates. The results of the analysis reveal that the development of green sukuk improves efficiency in the allocation of capital resources to renewable energy and low-carbon technologies and infrastructure, while the development of financial technology improves information efficiency in the financial markets of the environment. The results also reveal the presence of a complementarity effect between the development of green sukuk and financial technology, indicating that the combined impact of the two factors is greater than the sum of the individual effects of each factor on environmental finance efficiency. In addition, the results reveal the country-specific factors that improve environmental finance efficiency in Malaysia, Indonesia, and the United Arab Emirates. The improvement in environmental finance efficiency in Malaysia is driven by the development of the sukuk market, while in the United Arab Emirates, it is driven by the development of financial technology. In Indonesia, the results reveal the balanced contribution of the development of the sukuk market and financial technology to the improvement in environmental finance efficiency. The results of the analysis lead to the conclusion that the integration of Islamic green financial instruments with financial technology is a viable and effective tool for improving environmental finance efficiency in Islamic emerging economies.

AUTHOR CONTRIBUTIONS

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Data curation: Mohammed Othman

Formal analysis: Mohammed Othman

Funding acquisition: Mohammed Othman

Investigation: Mohammed Othman.

Methodology: Mohammed Othman.

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REFERENCES

1. Abdelmalek, W., & Khemakhem, M. (2025). Exploring the connect-edness between green bonds and financial markets and its drivers during recent crises: New evi-dence from a TVP-VAR extended joint connectedness approach and wavelet coherence analysis. *International Journal of Finance & Economics*, 31(2), 2160-2179. <https://doi.org/10.1002/ijfe.70035>
2. Achyar, D. H. (2025). Islamic fi-nance for sustainable development in clean technology: Dynamic capabilities and natural resource-based view. *Sustainability Ac-counting, Management and Policy Journal*. <https://doi.org/10.1108/sampj-10-2024-1119>
3. Ahmad, A. K., Nahar, H. M., & Manajreh, M. M. N. (2024). Effect of social media on shaping the agenda of the communicator in the Jordanian TV channels. *Middle East Journal of Communication Studies*, 3(2), Article 3. <https://doi.org/10.71220/2585-003-002-003>
4. Alhammadi, S. (2024). Islamic finance as a driver for enhancing economic sustainability and innova-tion in the GCC. *Journal of Sci-ence and Technology Policy Man-agement*, 17(1), 25-46. <https://doi.org/10.1108/JSTPM-11-2023-0206>
5. Ali, A., Li, J., Zhang, J., & Chishti, M. Z. (2024). Exploring the impact of green finance and technological innovation on green economic growth: Evidence from emerging market economies. *Sus-tainable Development*, 32(6), 6392-6407. <https://doi.org/10.1002/sd.3031>
6. Alkadi, R. S. (2024). Towards a sustainable future: A comprehen-sive review of green sukuk. *Review of Accounting and Finance*, 23(4), 467-488. <https://doi.org/10.1108/RAF-03-2023-0105>
7. Alkasasbeh, H., Oudat, M. S., Abu-AlSondos, I., & Alhawamdeh, L. (2024). Metaverse finance: Shap-ing the future of Islamic fintech solutions in UAE. *Journal of Islamic Marketing*, 17(2), 551-569. <https://doi.org/10.1108/JIMA-01-2024-0039>
8. Al-Muntasir, M. (2022). The phenomenon of information flow from traditional and new media about the Corona pandemic from the perspective of newly gradu-ated media professionals in Yemen. *Middle East Journal of Commu-nication Studies*, 2(2), Article 1. <https://doi.org/10.71220/2585-002-002-005>
9. Baştürk, M. F. (2024). Does green finance reduce carbon emissions? Global evidence based on system generalized method of moments. *Sustainability*, 16(18), Article 8210. <https://doi.org/10.3390/su16188210>
10. Elsayed, A. H., Guedira, I., Alghussein, T., Almheiri, H., Alo-mari, M., & Elmassri, M. (2024). The impact of FinTech technology on financial stability of the UAE. *Heliyon*, 10(19), Article e38255. <https://doi.org/10.1016/j.heli-yon.2024.e38255>
11. Faizi, F. (2024). How are Islamic banking products developed? Evi-dence from emerging country. *Cog-ent Economics & Finance*, 12(1), Article 2378961. <https://doi.org/10.1080/23322039.2024.2378961>
12. Fligstein, N., & Huang, J. Z. (2025). Finance in sustainable transition: A comparative review across insti-tutional investors, asset managers, venture capital, insurance, and bonds. *WIREs Climate Change*, 16(4), Article e70012. <https://doi.org/10.1002/wcc.70012>
13. Harasis, A. (2026). Impact of data warehousing adoption on under-writing and claims performance in Saudi insurance firms. *Insurance Markets and Companies*, 17(1), 65-77. [https://doi.org/10.21511/ins.17\(1\).2026.05](https://doi.org/10.21511/ins.17(1).2026.05)
14. Hariz, F., Mezghani, T., & Abbes, M. B. (2025). Modeling depen-dence structure between green sukuk spread in Malaysia and the uncertainty factors before and during the COVID-19 pandemic. *Journal of Islamic Accounting and Business Research*, 16(5), 950-975. <https://doi.org/10.1108/JIABR-10-2022-0285>
15. Iqbal, M. A., Shaheen, W. A., Shabir, S., Ullah, U., Ionel-Alin, I., Mihut, M.-I., Raposo, A., & Han, H. (2025). Towards a green economy: Investigating the impact of sustainable finance, green technologies, and environmental policies on environmental degrada-tion. *Journal of Environmental Management*, 374, Article 124047. <https://doi.org/10.1016/j.jenv-man.2025.124047>
16. Kashif, M., Pinglu, C., Ullah, A., & Qian, N. (2025). The impact of green finance and FinTech mechanisms on financial stabil-ity: Evidence from advanced and emerging economies. *China Finance Review International*. <https://doi.org/10.1108/CFRI-07-2024-0393>
17. Kashif, M., Pinglu, C., Ullah, S., & Zaman, M. (2024). Evaluating the influence of financial technology (FinTech) on sustainable finance: A comprehensive global analysis. *Financial Markets and Portfolio Management*, 38(1), 123-155. <https://doi.org/10.1007/s11408-023-00439-w>
18. Khan, M. A., Yau, J. T.-H., Sarang, A. A. A., Gull, A. A., & Javed, M. (2025). Information asymmetry and investment efficiency: The role of blockholders. *Journal of Applied Accounting Research*, 26(1), 194-221. <https://doi.org/10.1108/JAAR-05-2023-0123>
19. Kharrat, H., Trichilli, Y., & Abbes, B. (2024). Relationship between FinTech index and bank's performance: A compara-tive study between Islamic and conventional banks in the MENA region. *Journal of Islamic Account-ing and Business Research*, 15(1), 172-195. <https://doi.org/10.1108/JIABR-03-2022-0081>
20. Kou, G., & Lu, Y. (2025). FinTech: A literature review of emerging financial technologies and applica-tions. *Financial Innovation*, 11(1), Article 1. <https://doi.org/10.1186/s40854-024-00668-6>
21. Kukman, T., & Gričar, S. (2025). Blockchain for quality: Advancing security, efficiency, and transpar-

- ency in financial systems. *FinTech*, 4(1), 7. <https://doi.org/10.3390/fintech4010007>
22. Mahomed, Z., & Mahbot, A. (2024). Sustainable and responsible investment (SRI) Sukuk: Lessons from Khazanah's Sukuk Ihsan. *International Journal of Islamic and Middle Eastern Finance and Management*, 17(6), 1065-1081. <https://doi.org/10.1108/IMEFM-05-2024-0219>
 23. Mohamed, H. (2025). Sukuk and sustainability: Exploring green financial instruments and the transition to low-carbon economies. In F. Taghizadeh-Hesary, H.M. Thas Thaker, M.I. Bhatti & M.A. Mohd Thas Thaker (Eds.), *Islamic Finance and Sustainability: A Research Companion* (pp. 465-486, 1st ed.). Routledge. <https://doi.org/10.4324/9781003518617-24>
 24. Mohd Roslen, S. N., Chua, M.-S., & Hj Mohd Ruslan, R. A. (2024). Long-run asymmetric effects of financial risks on Sukuk market development: Empirical evidence from Malaysia. *Journal of Islamic Accounting and Business Research*, 16(8), 1394-1425. <https://doi.org/10.1108/JIABR-08-2022-0200>
 25. Morshed, A. (2024). Comparative analysis of accounting standards in the Islamic banking industry: A focus on financial leasing. *Journal of Islamic Accounting and Business Research*, 17(1), 59-73. <https://doi.org/10.1108/JIABR-12-2022-0349>
 26. Morshed, A. (2025a). Cultural norms and ethical challenges in MENA accounting: The role of leadership and organizational climate. *International Journal of Ethics and Systems*, 41(3), 630-656. <https://doi.org/10.1108/IJOES-08-2024-0247>
 27. Morshed, A. (2025b). Ethical challenges in designing sustainable business models for responsible consumption and production: Case studies from Jordan. *Management & Sustainability: An Arab Review*, 5(1), 86-108. <https://doi.org/10.1108/MSAR-09-2024-0131>
 28. Morshed, A. (2025c). Sustainable energy revolution: Green finance as the key to the Arab Gulf States' future. *International Journal of Energy Sector Management*, 20(2), 556-577. <https://doi.org/10.1108/IJESM-10-2024-0007>
 29. Morshed, A., & Khrais, L. T. (2025). Cybersecurity in digital accounting systems: Challenges and solutions in the Arab Gulf region. *Journal of Risk and Financial Management*, 18(1), Article 41. <https://doi.org/10.3390/jrfm18010041>
 30. Muhamat, A. A., Nizar, N., Senawi, A. R., Karim, N. A., Kassim, S., & Ismail, H. R. (2024). Green sukuk issuance: A case study of Public University in Malaysia. *Journal of Sustainability Science and Management*, 19(11), 210-222. <https://doi.org/10.46754/jssm.2024.11.013>
 31. Musari, K. (2021). Green sukuk, Islamic green financing: A lesson learned from Indonesia. In O. Olarewaju & I. Ganiyu (Eds.), *Handbook of research on climate change and the sustainable financial sector* (pp. 1-16). IGI Global Scientific Publishing. <https://doi.org/10.4018/978-1-7998-7967-1.ch001>
 32. Ogwu, M. C., & Kosoe, E. A. (2025). Environmental economics: Valuing ecosystem services and green technologies. In M.C. Ogwu & S. Chibueze Izah (Eds.), *Evaluating Environmental Processes and Technologies* (pp. 487-511). Springer. https://doi.org/10.1007/978-3-031-85327-2_15
 33. Oreqat, A. (2021). The degree of satisfaction of Facebook users about its features, usage motives and achieved gratifications: An applied study on students of the Faculty of Mass Communication at the Middle East University. *Middle East Journal of Communication Studies*, 1(1), Article 1. <https://doi.org/10.71220/2585-001-001-001>
 34. Othman, M. (2025). Evolving financial practices in family enterprises: The impact of generational dynamics on digital transformation in Jordan. *Investment Management & Financial Innovations*, 22(2), 141-154. [https://doi.org/10.21511/imfi.22\(2\).2025.12](https://doi.org/10.21511/imfi.22(2).2025.12)
 35. Rahman, A., Ahmad, A. U. F., Bin-Nashwan, S. A., Muneeza, A., Abdul Halim, A. H., & Markom, R. (2024). Policy approach adopted for issuance of Green Sukuk: Is priority given to priority needed areas? *Journal of Islamic Accounting and Business Research*, 15(5), 818-837. <https://doi.org/10.1108/JIABR-10-2022-0279>
 36. Rizwan, A., Naveed, S., Mustafa, F., Hanif, M. S., Khurshid, A., & Khan, T. Z. A. (2024). Prospects for institutionalization of crowd-funding: A developing country perspective. *Journal of Entrepreneurship and Public Policy*, 13(4), 566-598. <https://doi.org/10.1108/JEPP-09-2023-0086>
 37. Rossoni, A. L., de Vasconcelos, E. P. G., & Sbragia, R. (2024). Influence of social capital, market orientation, and technological readiness on researchers' interactions with companies. *Future Business Journal*, 10(1), Article 69. <https://doi.org/10.1186/s43093-024-00359-9>
 38. Sethi, L., Behera, B., & Sethi, N. (2024). Do green finance, green technology innovation, and institutional quality help achieve environmental sustainability? Evidence from the developing economies. *Sustainable Development*, 32(3), 2709-2723. <https://doi.org/10.1002/sd.2811>
 39. Sikiru, A. O., Chima, O. K., Otunba, M., Gaffar, O., & Adenuga, A. A. (2024). The tokenization of illiquid assets: Architecting the next generation of investment banking advisory and capital markets. *International Journal of Scientific Research in Humanities and Social Sciences*, 1(2), 404-432. <https://doi.org/10.32628/IJSRSSH242553>
 40. Tanchangya, T., Siddiqi, K. O., Dhar, B. K., Rahman, J., Islam, N., & Das, S. (2025). Leveraging green capabilities and digital accounting under ESG pressure: Strategic insights from an emerging market's global value chains. *Thunderbird International Business Review*. <https://doi.org/10.1002/tie.70058>
 41. Taqa, S. B. A. (2025). The mediating role of remote communication on the relationship between electronic human resource management practices and organizational performance in Iraqi commercial banks. *Middle*

- East Journal of Communication Studies*, 5(1), Article 2. <https://doi.org/10.71220/2585-005-001-001>
42. Taylor, L. L., Grosskopf, S., & Hayes, K. J. (2025). Top heavy? On the allocative efficiency of small school districts. *International Transactions in Operational Research*, 32(5), 2707-2731. <https://doi.org/10.1111/itor.13617>
 43. Tita, A. F., & Obalade, A. A. (2025). Measuring SME technical cost and allocative efficiency and its determinants in South Africa. *International Journal of Monetary Economics and Finance*, 18(2-3), 176-186. <https://doi.org/10.1504/IJMEF.2025.148106>
 44. Ulfah, I. F., Sukmana, R., Laila, N., & Sulaeman, S. (2024). A structured literature review on green sukuk (Islamic bonds): Implications for government policy and future studies. *Journal of Islamic Accounting and Business Research*, 15(7), 1118-1133. <https://doi.org/10.1108/JIABR-10-2022-0255>
 45. Uluyol, B. (2023). A comprehensive empirical and theoretical literature survey of Islamic bonds (sukuk). *Journal of Sustainable Finance & Investment*, 13(3), 1277-1299. <https://doi.org/10.1080/20430795.2021.1917224>
 46. Van Niekerk, A. J. (2024). Economic inclusion: Green finance and the SDGs. *Sustainability*, 16(3), Article 1128. <https://doi.org/10.3390/su16031128>
 47. Widiastuti, T., Al-Shami, S. A., Mawardi, I., Zulaikha, S., Atiya, N., & Rusanti, E. (2025). Unlocking the future of green finance: A bibliometric and systematic literature review on intellectual capital and Islamic financial development. *Journal of Islamic Marketing*, 17(6), 2047-2070. <https://doi.org/10.1108/JIMA-10-2024-0461>
 48. Yamahaki, C., Felsberg, A. V., Köberle, A. C., Gurgel, A. C., & Stewart-Richardson, J. (2022). Structural and specific barriers to the development of a green bond market in Brazil. *Journal of Sustainable Finance & Investment*, 12(2), 389-406. <https://doi.org/10.1080/20430795.2020.1769985>
 49. Zaid, A. A., Alnasr, F., & Asmar, H. M. (2025). Health care service quality and patients trust: Does hospital image mediate the relationship? In S. Khairy, G. Hayder, A. Al Shukaili, S. Al Abri, A. Soosaimanickam, & R. S. Raja Kasim (Eds.), *Exploring trends, innovations, and digitalization of entrepreneurship* (pp. 275-288). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-92942-7_19
 50. Zhang, C., Zhang, L., Liu, L., & Du, C. (2024a). The study of the relationship between green finance and resource efficiency in East Asian economies. *Resources Policy*, 89, Article 104658. <https://doi.org/10.1016/j.resourpol.2024.104658>
 51. Zhang, S., Zhang, M., & Meng, S. (2024b). Corporate transaction costs and corporate green total factor productivity. *Finance Research Letters*, 61, Article 105041. <https://doi.org/10.1016/j.frl.2024.105041>

APPENDIX A

Table A1. Main data sources and variable-source mapping

Variable (paper)	Source name	Source link
Environmental Finance Efficiency (EFE) (constructed)	World Bank WDI (capital formation inputs)	https://databank.worldbank.org/source/world-development-indicators
	Yale Environmental Performance Index (EPI) (adjustment factor)	https://epi.yale.edu/downloads
	UNCTAD (green/ESG investment and capital flow measures, as cited in the paper)	https://unctadstat.unctad.org/
Green Sukuk (GS)	Climate Bonds Initiative (green and sustainable sukuk and bond market data)	https://www.climatebonds.net/
	Bloomberg and Refinitiv (issuance-level series; subscription databases)	https://www.bloomberg.com/professional/ ; https://www.lseg.com/en/data-analytics
FinTech Index (FT) (constructed)	World Bank Global Findex (digital financial usage indicators)	https://www.worldbank.org/en/publication/globalfindex/download-data
Green Sukuk (GS)	IMF Financial Access Survey (FAS) (annual financial access/usage indicators)	https://data.imf.org/en/datasets/IMF.STA:FAS
GDP growth	World Bank WDI	https://databank.worldbank.org/source/world-development-indicators
FDI inflow	World Bank WDI	https://databank.worldbank.org/source/world-development-indicators
Inflation	World Bank WDI	https://databank.worldbank.org/source/world-development-indicators
Energy intensity	World Bank WDI	https://databank.worldbank.org/source/world-development-indicators
CO ₂ emissions	World Bank Open Data / WDI (or equivalent emissions dataset)	https://data.worldbank.org/

APPENDIX B

Table B1. Country-level World Bank indicator links

Variable	Malaysia (MYS)	Indonesia (IDN)	UAE (ARE)
GDP growth (annual %)	https://api.worldbank.org/v2/country/MYS/indicator/NY.GDP.MKTP.KD.ZG?format=json	https://api.worldbank.org/v2/country/IDN/indicator/NY.GDP.MKTP.KD.ZG?format=json	https://api.worldbank.org/v2/country/ARE/indicator/NY.GDP.MKTP.KD.ZG?format=json
FDI, net inflows (% of GDP)	https://api.worldbank.org/v2/country/MYS/indicator/BX.KLT.DINV.WD.GD.ZS?format=json	https://api.worldbank.org/v2/country/IDN/indicator/BX.KLT.DINV.WD.GD.ZS?format=json	https://api.worldbank.org/v2/country/ARE/indicator/BX.KLT.DINV.WD.GD.ZS?format=json
Inflation, CPI (annual %)	https://api.worldbank.org/v2/country/MYS/indicator/FP.CPI.TOTL.ZG?format=json	https://api.worldbank.org/v2/country/IDN/indicator/FP.CPI.TOTL.ZG?format=json	https://api.worldbank.org/v2/country/ARE/indicator/FP.CPI.TOTL.ZG?format=json
Energy intensity (primary energy)	https://api.worldbank.org/v2/country/MYS/indicator/EG.EGY.PRIM.PP.KD?format=json	https://api.worldbank.org/v2/country/IDN/indicator/EG.EGY.PRIM.PP.KD?format=json	https://api.worldbank.org/v2/country/ARE/indicator/EG.EGY.PRIM.PP.KD?format=json
Gross capital formation (current US\$)	https://api.worldbank.org/v2/country/MYS/indicator/NE.GDI.FTOT.CD?format=json	https://api.worldbank.org/v2/country/IDN/indicator/NE.GDI.FTOT.CD?format=json	https://api.worldbank.org/v2/country/ARE/indicator/NE.GDI.FTOT.CD?format=json
CO ₂ emissions (metric tons per capita)	https://api.worldbank.org/v2/country/MYS/indicator/EN.ATM.CO2E.PC?format=json	https://api.worldbank.org/v2/country/IDN/indicator/EN.ATM.CO2E.PC?format=json	https://api.worldbank.org/v2/country/ARE/indicator/EN.ATM.CO2E.PC?format=json

APPENDIX C

Table C1. Country-level green sukuk and national source links

Country	Green Sukuk / Sukuk market sources (good for country extraction)
Malaysia	Securities Commission Malaysia (market/bond-sukuk statistics portal + reports): https://www.sc.com.my/ Capital Markets Malaysia (SRI Sukuk resources): https://www.capitalmarketsmalaysia.com/
Indonesia	Ministry of Finance / DJPPR (Green Bond & Green Sukuk framework + related publications): https://www.djppr.kemenkeu.go.id/
UAE	Securities & Commodities Authority (green bonds/sukuk market announcements/regulation): https://www.sca.gov.ae/ Central Bank of the UAE publications (Islamic finance context): https://www.centralbank.ae/