

Islamic Finance and Blue–Green Indicators amid Policy Uncertainty in Indonesia

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Islamic finance; Policy uncertainty; Blue–green indicators; Indonesia; Governance; Model identification

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ABSTRACT

This article reassesses how Islamic financial-sector depth, general policy uncertainty and governance relate to Indonesia's blue–green indicators, focusing on the measurement and small-sample identification constraints of an annual national series. The source study covers 2010–2023 (14 annual observations) and combines renewable energy, carbon intensity and marine protection with banking, sukuk and governance measures. We examine construct alignment, index reproducibility, interaction hierarchy and the arithmetic of the published ordinary least squares tables. The conventional adjusted R^2 implied by the reported regressors is -0.014 for the additive model and 0.307 for the interacted model, rather than 0.44 and 0.72 . With three residual degrees of freedom, conventional two-sided tests do not support the two reported interaction coefficients at the 5 per cent level. The policy-uncertainty proxy does not isolate trade-war shocks, while aggregate Islamic-finance depth does not establish sustainability-directed financing. The analysis distinguishes an economically meaningful conditional-association question from a causal financing-resilience claim and establishes a parsimonious, auditable framework for future blue–green evidence in an archipelagic economy.

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1. INTRODUCTION

Trade-related policy uncertainty can influence capital expenditure, international supply chains and the financing of environmental investment. Yet an uncertainty index does not directly observe a tariff change, and its macroeconomic association with sustainability indicators is not equivalent to the causal effect of a trade war. Baker et al. (2016) measure broad economic policy uncertainty from news coverage, whereas Ahir et al. (2022) develop the World Uncertainty Index from country reports; their conceptual scope differs from an identified trade-policy intervention. The distinction matters when interpreting Indonesia's annual response to external uncertainty.

A blue–green transition encompasses several outcomes that are not interchangeable. Renewable energy deployment and carbon intensity capture energy-system and emissions aspects of environmental performance. Protection of marine areas is relevant to conservation, but it does not by itself measure sustainable fisheries, coastal livelihoods, adaptation capacity or realised ecological improvement. The World Bank (2021) describes Indonesia's ocean economy in terms of healthy marine

ecosystems and viable livelihoods, reinforcing the need to report blue-sector and green-sector indicators separately before interpreting a composite index.

Islamic finance may support environmentally oriented activities when financing is actually allocated to eligible projects. Indonesia's sovereign green sukuk programme provides a concrete example of Sharia-compliant financing dedicated to environmental uses, and government allocation reports distinguish such proceeds from aggregate sukuk outstanding (Ministry of Finance, 2023). An economy-wide share of Islamic banking assets or aggregate sukuk to GDP, however, measures financial-sector depth and not the volume of investment reaching fisheries, marine conservation, renewable energy or climate adaptation. The theoretical argument based on *maqasid al-shariah* is a normative rationale for stewardship rather than a directly measured risk-sharing transmission mechanism.

Recent Indonesian research has examined Islamic financial development alongside indicators of environmental quality (Siregar & Hasbi, 2025). Research on trade policy uncertainty and renewable energy in China considers a different external exposure and outcome (Zuo & Majeed, 2024). Neither body of evidence establishes that general Islamic-finance depth cushions a combined marine-and-green index against trade-specific shocks in Indonesia. The remaining question is narrower: whether conditional covariation between policy uncertainty and blue-green indicators changes with observable Islamic financial-sector depth after allowing for common macroeconomic time patterns.

A national annual study of Indonesia for 2010–2023 offers a useful descriptive setting but an unusually small statistical sample. The original specification included nine parameters in its additive model and eleven in its interaction model, leaving only five and three residual degrees of freedom respectively. These constraints, together with incomplete documentation of the composite indices, require reassessment of the substantive conclusions before any environmental-resilience mechanism is inferred. The present article accordingly separates the documented numerical record from the statistical assumptions and evidence needed for stronger interpretation.

The article contributes by mapping the distinction between sustainable-finance deployment and general Islamic-finance depth, specifying separate environmental and marine indicators, and auditing the inferential consequences of an overparameterised macroeconomic equation. Rather than treating statistically fragile interactions as confirmed protection against uncertainty, it sets out a parsimonious conditional-association design and an explicit disclosure framework for index construction

2. LITERATURE REVIEW

2.1 Conceptual separation and closely related evidence

A blue economy concerns ecological integrity, economically productive marine resources and the wellbeing of coastal communities. A green economy concerns, among other dimensions, lower-carbon energy production and more resource-efficient growth.

Marine-protected-area coverage is a narrow institutional-input measure; improvements in fishing stocks or habitat condition require additional observations. Treating a first principal component of three differently oriented indicators as overall 'resilience' assumes a latent structure that must be demonstrated with loadings, eigenvalues, sensitivity to weights and component-level analysis.

For Islamic finance, financial deepening and sustainable-finance allocation are separate constructs. A general banking market share can increase while environmentally directed financing remains constant, and conventional sovereign sukuk outstanding can rise without any change in green project allocations. Ministry of Finance (2023) reports green sukuk uses under an earmarked framework, but the original regression does not contain those allocation amounts. Consequently, a general Islamic Finance Development Index (IFD) may capture structural financial transformation or correlated growth, not an observed environmental funding channel.

The policy-uncertainty literature offers plausible competing mechanisms. Elevated uncertainty may delay irreversible investment, but it may also coincide with energy-policy reforms, exchange-rate changes or shifts in global commodity prices. Governance could condition access to finance or environmental regulation, but the Worldwide Governance Indicators summarise perceptions of public institutions rather than programme-specific implementation (Kaufmann et al., 2010). With a national aggregate time series, common trends and reverse causation remain important alternatives to a financial-resilience explanation.

Table 1. Closest evidence and the distinction examined

Study	Established focus	Unresolved distinction
Siregar and Hasbi (2025)	Islamic finance and environmental quality in Indonesia	No verified blue-sector allocation or identified tariff shock
Zuo and Majeed (2024)	Trade uncertainty and renewable energy in China	Not Indonesia; no Islamic-finance buffering mechanism
World Bank (2021)	Marine ecosystems and blue-economy reforms	Ecological and livelihood scope wider than marine protection area
Ministry of Finance (2023)	Documented green sukuk uses and impacts	Earmarked green proceeds differ from total sukuk depth

2.2 Competing expectations

Two associations are theoretically plausible. Under the investment-delay account, higher policy uncertainty accompanies slower progress on energy or marine outcomes, particularly where investment requires costly long-horizon commitments. Under the financing-adaptation account, stronger sustainable-finance capacity could coincide with greater investment continuity. The second account requires evidence of funds reaching environmentally or ocean-oriented projects; IFD alone cannot identify that pathway. Governance may affect either relationship through policy credibility or implementation capacity, but a national governance index is not evidence of a tested transmission mechanism.

H1: The relationship between a measured policy-uncertainty index and blue–green indicators is conditionally associated with the level of general Islamic financial-sector development. The direction of that association is assessed rather than assumed.

H2: The conditional relationship may vary with governance quality. A comprehensive three-way interaction requires all lower-order terms and sufficient observations; with the available annual sample it is a theoretical extension rather than an estimable central claim.

H3: Associations may differ between renewable-energy, carbon-intensity and marine-protection outcomes. A composite sign alone is insufficient to identify the component responsible.

3. METHODOLOGY

3.1 Design, observed series and conceptual boundaries

The study considers Indonesia over 2010–2023, corresponding to 14 annual observations in the source article. The unit is a calendar year rather than an independent firm, household or region. The published material contains summary statistics, aggregate model tables and test summaries but no annual data matrix or exact extraction metadata. Numerical conclusions are consequently restricted to algebraic quantities directly implied by the tables; other statistical claims require the underlying observations and model output. A 14-period series cannot support unrestricted inference from a model containing eleven estimated parameters.

The reported dependent variable, the Blue–Green Economy Index (BGE), combines renewable-energy share, negatively oriented carbon intensity and marine-protected-area coverage using principal component analysis (PCA). Its reported values lie between 0 and 1. The marine series identifier, annual source coverage, standardisation convention, PCA weights, signs, eigenvalues and any transformation from raw principal component scores are not specified in the source record. Accordingly, index values are treated as reported indicators rather than independently validated observations of resilience. Renewable energy and carbon intensity should additionally be analysed as separate outcomes; marine conservation cannot be extrapolated to fisheries productivity or coastal wellbeing. The published component definitions refer to World Bank (2024a) alongside domestic marine-source reporting.

The published Islamic Finance Development Index combines Islamic banking assets as a share of all banking assets and sovereign sukuk outstanding as a share of GDP. These inputs require separate standardisation because their denominators and units differ. The source describes the index as a financial-depth aggregate; no project-level blue or green financing allocation is entered into the regression. The general uncertainty measure draws on the World Uncertainty Index and global economic policy uncertainty, neither of which is intrinsically a bilateral tariff shock. Negative index

observations are compatible with centring or standardisation but require explicit source-specific confirmation.

Governance is reported as an average of government effectiveness, regulatory quality, rule of law and control of corruption drawn from the Worldwide Governance Indicators. Negative observed scores are permissible on the WGI scale and do not imply a negative amount of governance. Other tabulated controls are logged GDP per capita, trade openness, domestic private-sector credit, logged population and urbanisation. These variables share national trends with finance and environmental performance and cannot be treated as independent information simply because they occupy separate columns. The index design refers to World Bank (2024b).

Table 2. Variable architecture and identification boundaries

Measure	Source construct	Required interpretative boundary
BGE	Renewables; inverted carbon intensity; marine protection	A composite environmental proxy, not measured shock resilience
U	WUI / EPU uncertainty series	General uncertainty, not an identified trade-war intervention
IFD	Islamic banking share and all sovereign sukuk / GDP	Sector depth, not sustainability-directed allocations
GOV	WGI four-component mean	National institutional perception index
REN, CO ₂ , MPA	Each BGE component separately	Distinct energy, emissions and conservation dimensions

3.2 Reproducible index definitions

For a reproducible future construction, each underlying indicator must have a defined series code, unit, frequency, source vintage, missing-value rule and year-level observation. A clear candidate standardisation is shown in Equation (1), with an a priori sign chosen so that higher values consistently denote better performance. PCA loadings and eigenvalues must be obtained from that same completed annual matrix. Equation (2) describes a possible normalised first-component score. These expressions define an auditable estimation protocol and do not assert that the undocumented original weights follow either formula.

$$z_{\{jt\}} = s_j x_{jt} - x_j SD x_j \quad (1)$$

$$BGE_t = \frac{PC_{1t} - \min(PC_1)}{\max(PC_1) - \min(PC_1)} \quad (2)$$

Here $s_j = +1$ for an indicator increasing with the intended outcome and $s_j = -1$ for carbon intensity; PC_{1t} denotes the first principal component using published loadings. Because annual minima and maxima depend on the sample, the reference period must remain fixed in any comparison over time. A two-component Islamic finance score could be computed from pre-specified equally weighted standardised banking and sukuk

measures, but the primary analysis must report those underlying components and contrast it with measures explicitly earmarked for green and blue uses.

3.3 Econometric design matched to sample information

To reduce parameter proliferation, the preferred conditional-association specification contains policy uncertainty, lagged IFD and their interaction without the full set of five trending controls. An alternative first-difference equation is appropriate only if the time-series inspection supports that transformation. Its period-on-period change in BGE is associated with a contemporaneous change in uncertainty and the level of financial depth observed in the previous year. The equation is a proposed low-dimensional estimand, not a re-estimation of the original numerical table.

$$\Delta BGE_t = \alpha + \beta_1 \Delta U_t + \beta_2 IFD_{t-1} + \beta_3 (\Delta U_t \times IFD_{t-1}) + \varepsilon_t \quad (3)$$

With complete consecutive years this version would contain up to 13 usable first differences and four regression parameters, leaving at most nine residual degrees of freedom. If the data or transformation rules imply missing observations, degrees of freedom must be recalculated. Standard errors require an explicitly stated small-sample procedure, and no distribution-free significance is inferred from the equation alone.

For conceptual clarity, a three-way interaction requires the fully hierarchical representation in Equation (4). It contains the main effects of uncertainty, IFD and governance, their three two-way interactions and the three-way product. With an intercept, this involves eight parameters before adding even one macroeconomic control, leaving at most six residual degrees of freedom if fit to 14 years. Its inclusion below defines the conditional structure expected from a properly powered future sample rather than a model whose coefficients are supported by the current source record.

$$BGE_t = \alpha + \beta_1 U_t + \beta_2 I_t + \beta_3 G_t + \beta_4 U_t I_t + \beta_5 U_t G_t + \beta_6 I_t G_t + \beta_7 U_t I_t G_t + \varepsilon_t \quad (4)$$

$$\frac{\partial E(BGE_t | U, I, G)}{\partial U_t} = \beta_1 + \beta_4 I_t + \beta_5 G_t + \beta_7 I_t G_t \quad (5)$$

For Equation (4), uncertainty, finance and governance should be centred with a stated reference period before interaction construction. Conditional effects from Equation (5) require the complete coefficient variance–covariance matrix; their standard error is the square root of $g'Vg$ for the appropriate gradient vector g . Coefficient signs alone do not establish differences between high- and low-governance conditions. Comparisons must use jointly observed IFD–governance combinations, not merely separate marginal minima and maxima.

3.4 Identification, diagnostic and reproducibility rules

Annual plots and descriptive coverage are necessary before modelling. The deterministic time trend, persistence and possible integration order of BGE, uncertainty and IFD should

be reported. In a short annual sample, an augmented Dickey–Fuller test has limited power, and a significant residual test from an overfit equation does not independently establish cointegration. Differenced specifications, a transparent limited-covariate level comparison and alternative index construction should be treated as separate sensitivity analyses.

A replication record must include the year-by-year matrix, original source identifiers, WGI version, source transformation code, PCA weights, all model commands, residual degrees of freedom, coefficient covariance matrices, and numerical outputs for component outcomes and alternative uncertainty series. Variance inflation factors must be given regressor by regressor. A mean VIF and a qualitative statement of robustness are insufficient. Inference from auxiliary White or Breusch–Godfrey regressions with nearly exhausted degrees of freedom is intrinsically weak.

4. RESULTS

4.1 Original descriptive record

Table 3 reproduces the numerical descriptive statistics in the source article without altering the observations. It does not represent independently reconstructed annual data. The BGE index averaged 0.54 and ranged from 0.29 to 0.79. The uncertainty proxy included negative values, which indicates that some transformation or centring occurred, although its precise formula is not in the published source. Governance scores were negative across the period, consistent with the standard WGI coding conventions.

Table 3. Descriptive statistics transcribed from source (2010–2023; N = 14)

Variable	Mean	SD	Min	Max
BGE	0.54	0.15	0.29	0.79
Uncertainty proxy	0.07	0.46	−0.62	1.10
IFD	0.58	0.12	0.39	0.76
GOV	−0.17	0.09	−0.32	−0.03
ln GDP per capita	8.45	0.18	8.18	8.75
Trade openness (%)	42.7	5.8	33.5	52.4
Private credit/GDP (%)	38.9	4.7	31.0	46.2
ln population	18.38	0.04	18.32	18.43
Urban population (%)	53.6	2.1	49.8	57.1

4.2 Internal audit of the reported OLS models

The reported additive equation includes eight regressors and an intercept; the expanded equation includes ten regressors and an intercept. Their nominal residual degrees of freedom are therefore five and three. By the ordinary least squares identity $\text{adjusted } R^2 = 1 - (1 - R^2)(N - 1)/(N - p)$, the two values corresponding to the reported R^2 and parameter counts are −0.014 and 0.307. The original adjusted R^2 cells, 0.44 and 0.72,

cannot simultaneously describe these OLS equations with 14 observations and the displayed regressor sets.

$$\bar{R}^2 = 1 - (1 - R^2) \frac{N-1}{N-p} \quad (6)$$

Table 4. Arithmetic consistency of the originally reported OLS specifications

Quantity	Additive	Interacted
Annual observations N	14	14
Slope regressors	8	10
Total parameters p	9	11
Residual degrees of freedom N – p	5	3
R ² reported	0.610	0.840
Adjusted R ² reported	0.440	0.720
Adjusted R ² implied by N, p, R ²	–0.014	0.307

The interaction coefficients reported in the expanded model are 0.210 (standard error 0.082) for uncertainty × IFD and 0.145 (standard error 0.058) for the uncertainty × IFD × governance product. The displayed coefficient-to-standard-error ratios are approximately 2.56 and 2.50. Against a conventional two-sided Student t distribution with three residual degrees of freedom, these correspond to $p \approx 0.083$ and $p \approx 0.088$. They therefore do not establish 5 per cent significance under that conventional reference distribution. The original article describes heteroskedasticity/autocorrelation-robust errors without the requisite kernel, bandwidth, degrees-of-freedom adjustment or covariance export, so the exact reported robust-inference convention cannot be reconstructed.

Table 5. Conventional finite-sample audit of selected reported coefficients

Source coefficient	β	SE	$t = \beta/SE$	Two-sided p^1
Additive uncertainty	–0.062	0.032	–1.938	0.110
Interacted uncertainty	–0.084	0.041	–2.049	0.133
Uncertainty × IFD	0.210	0.082	2.561	0.083
Uncertainty × IFD × GOV	0.145	0.058	2.500	0.088

4.3 Interaction interpretation and diagnostic scope

The original interacted equation lacks both uncertainty × governance and IFD × governance terms. Under precisely that restricted, non-hierarchical equation, its conditional uncertainty slope is $-0.084 + 0.210(IFD) + 0.145(IFD \times GOV)$. Substituting the reported mean IFD of 0.58 and mean governance of –0.17 yields approximately +0.0235, not the negative main-effect coefficient of –0.084. This is an algebraic illustration of the reported restricted equation at separate sample means; it is neither a fitted hierarchical effect nor an observed joint-cell estimate. No confidence interval can be deduced without the covariance matrix.

$$\frac{\partial BGE}{\partial U} = -0.084 + 0.210 IFD + 0.145(IFD \times GOV) \quad (7)$$

The source diagnostic table lists a Breusch–Godfrey statistic of 2.11, White statistic of 5.32, Jarque–Bera statistic of 1.24 and residual ADF statistic of –3.45. Their effective

auxiliary degrees of freedom, residual series and deterministic/lag settings were not supplied. A reported average VIF of 2.43 cannot substitute for regressor-level values, especially where the model includes a triple product. Likewise, statements that results are unchanged under an alternative EPU index or renewable-energy-only outcome lack numerical coefficients, sample counts and uncertainty intervals. These assertions are not treated as independent robustness evidence here.

5. DISCUSSION

5.1 Implications for Islamic sustainable finance and maqasid

The relationship of Islamic finance to environmental stewardship remains a substantive topic, but the present national indices do not permit attribution to a specific financing channel. A maqasid-based ethical framework can motivate screening and allocation criteria for financing environmental protection; its presence in the conceptual discussion does not demonstrate that risk sharing or environmental project funding explains observed national changes. Verified green sukuk allocations, renewable-energy project finance and blue-sector lending would be more direct mechanism indicators than broad Islamic financial-sector depth (Ministry of Finance, 2023).

The reviewed literature does not settle the sign of a policy-uncertainty association with environmental progress. Investment may be deferred when financing is disrupted, but energy regulation, commodity prices, installed renewable capacity and marine zoning also change over time. These omitted influences may jointly affect the uncertainty proxy and the environmental indicators. At the national annual level, even a corrected positive interaction would remain a conditional association rather than evidence that Islamic finance prevented loss of resilience.

5.2 Blue–green multidimensionality and governance

The composite BGE index may conceal opposing movements across energy and marine dimensions. Expansion of marine protected areas is a policy-design outcome; improving livelihoods and ecosystem health are different outcome levels. Reporting separate renewable share, carbon intensity and conservation indicators is therefore a substantive validity requirement rather than merely a conventional robustness check. It would allow interpretation to identify which dimension, if any, covaries with Islamic finance and uncertainty.

Governance effects deserve similar restraint. WGI aggregates country-level institutional perceptions that move slowly and correlate with macroeconomic development. In a 14-year national series, a three-way interaction against several trending variables is weakly identified. Stronger tests could exploit longer consistent annual series or heterogeneous exposure across regions, industries or financing

programmes, while respecting the specific level at which governance and sustainability outcomes are measured.

5.3 Practical implications and research design priorities

For Islamic financial institutions and public agencies, a defensible policy implication is to improve the traceability of funds allocated to green and blue activities. Relevant reporting would separate outstanding sukuk from earmarked green proceeds; distinguish approved financing from annual disbursement; and report sector, year, project completion and independently evaluated outcomes. Such recommendations follow a measurement and accountability rationale, not an evaluated intervention in the available econometric record.

Future work could combine verifiable allocation data with national policy shocks measured at source, or use exposure-weighted regional and firm-level comparisons. An observed tariff schedule or partner-specific trade exposure is a more direct trade-policy measure than a country WUI series. Longer coverage and full model diagnostics would permit a test of interaction hierarchy, confidence intervals for marginal effects and credible stationarity analyses. Until those conditions hold, claims of enhanced climate or marine resilience should remain conditional and evidence-bounded.

6. CONCLUSION

This article reassessed the proposed relationship between policy uncertainty, Islamic financial-sector development, governance and Indonesia's blue-green indicators. The available descriptive statistics identify substantial differences across the measured macroeconomic series, but the original regression tables do not provide coherent adjusted explanatory power under their reported regressor counts. The interaction specification also omits necessary lower-order terms, and the reported significance levels are not established by conventional small-sample inference.

The principal theoretical contribution is to distinguish a plausible sustainability-financing pathway from a demonstrated one. Aggregate Islamic banking and sukuk depth are not interchangeable with documented financing of renewable energy, sustainable fisheries or marine conservation. Likewise, protection-area coverage, carbon intensity and renewable energy share are informative yet partial indicators; their aggregation alone does not observe resilience to a shock. Governance and *maqasid al-shariah* can inform hypotheses and policy principles without constituting measured mediating mechanisms.

For Indonesia, the strongest defensible implication is the importance of traceable allocation data, clearly defined uncertainty measures and component-level environmental evidence. This study offers a transparent low-dimensional conditional-association model and specifies the required documentation for future analyses. Firm- or region-level trade exposure, programme-specific Islamic sustainable finance and verified environmental outcomes would provide a stronger foundation for evaluating

whether financing architecture supports a blue–green transition under external uncertainty.

Author Contributions

A.C.S: Conceptualisation, Methodology, Formal Analysis, Writing – Original Draft.

A.F.A: Investigation, Data Curation, Validation, Writing – Review and Editing.

Disclosure Statement

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