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EVALUATING BANK PERFORMANCE UNDER THE PAKISTAN GREEN TAXONOMY: A COMPARATIVE ANALYSIS OF ISLAMIC AND CONVENTIONAL FRAMEWORKS

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	Abstract
Dr. Syed Muhammad Imran Assistant Professor, Department of Economics, Government Associate College Yazman. syedimran.ravian@gmail.com Iftikhar Ali Manager Operation, Taqwa Islamic Branch Fortabbas, The Bank of Punjab. iftiikhar7056146@gmail.com	The State Bank of Pakistan’s implementation of the Pakistan Green Taxonomy (PGT) marks a major empirical shift toward climate-resilient finance. This study examines how PGT compliance affects bank performance in Pakistan’s dual-banking system using a rigorous, purely quantitative methodology. We balance a panel data set of 20 commercial Pakistani banks over a nine-year period (2018–2026), generating 180 firm-year observations. Using Fixed-Effects (FE) and Two-Step System Generalized Method of Moments (GMM) econometric estimation, we find a dual trend: PGT compliance creates a statistically significant short-term drag on profitability metrics (ROA, ROE) due to immediate operational compliance expenditures, but leads to a substantial long-term enhancement of asset quality by lowering Non-Performing Loan (NPL) ratios. Crucially, the interaction models reveal that Shariah-compliant frameworks enjoy a distinct resilience advantage over conventional banks, mitigating the initial profitability drop while yielding sharper reductions in credit default rates. The paper concludes with objective, data-driven macroprudential recommendations, including the recalibration of risk-weighted assets (RWA) by the central bank to support sustainable financial growth.

1. Introduction

Climate change presents a measurable threat to global financial stability, with frontier economies facing the most direct asset impairments. Pakistan consistently ranks among the world's most climate-vulnerable nations, exposing its heavily bank-dominated financial system to severe physical and transition risks. Physical climate disruptions (e.g., floods, agricultural shocks) translate directly into corporate loan defaults, while global transitions toward a low-carbon economy introduce systemic asset devaluation risks across traditional industrial collateral. To mitigate these risks, the State Bank of Pakistan (SBP) rolled out the Pakistan Green Taxonomy (PGT), which establishes a strict legal framework defining environmentally sustainable economic activities. The PGT mandates that commercial banks screen their corporate lending portfolios, perform climate stress testing, and actively divert capital away from carbon-heavy industries toward green projects. Concurrently, Pakistan's banking sector is undergoing a historic structural transformation. Following federal court mandates, the entire financial sector is legally transitioning away from interest-based operations toward a fully Shariah-compliant Islamic system. This creates a unique dual-banking landscape where conventional commercial credit desks operate alongside rapidly growing Islamic banking institutions and windows. While both conventional green loans and green Islamic finance instruments share identical ecological goals, their underlying financial structures differ fundamentally. Conventional green banking relies on traditional debt-based, interest-bearing loan contracts. Islamic banking rejects interest (*riba*) and excessive speculation (*gharar*), relying instead on risk-sharing, equity-partnership, and tangible asset-backed contractual arrangements (e.g., *Ijarah*, *Musharakah*). This structural divergence raises a critical empirical question: How does complying with the newly mandated Pakistan Green Taxonomy impact the financial performance, asset quality, and operational stability of Islamic banks compared to conventional commercial banks? This paper investigates that question through a purely quantitative approach. We model the statistical performance trade-offs, portfolio adjustments, and risk variations that emerge at the intersection of green regulations and Shariah governance within Pakistan's changing dual-banking system.

1.2 Review of Literature

The relationship between climate change and financial sector stability has shifted from a peripheral corporate social responsibility topic to a core element of macroprudential regulation. Financial literature establishes that climate change injects systemic risks into the banking network through physical and transition risks. Physical risks stem directly from weather-related catastrophes—such as severe flooding, agricultural degradation, and rising volatile weather patterns—which impair the operational cash flows of corporate borrowers, triggering an increase in non-performing loans (NPLs) across commercial bank balance sheets (Campiglio et al., 2018).

Conversely, transition risks represent the broader economic, legal, and regulatory shocks associated with the shift toward a low-carbon economy. As central banks enforce strict environmental disclosure requirements and penalize carbon-intensive activities, traditional high-emission or energy-inefficient industrial assets face economic obsolescence, becoming "stranded assets" (Aglietta & Espagne, 2016). Consequently, central banks use specialized green macroprudential instruments, including differential reserve requirements, climate stress-testing rules, and targeted concessional refinancing windows, to force commercial lenders to insulate their capital reserves against climate-driven capital devaluations (Aglietta & Espagne, 2016).

In developing, highly climate-vulnerable frontier economies like Pakistan, these macroprudential frameworks introduce unique complexities. Lenders operate in highly leveraged corporate ecosystems where sudden regulatory compliance costs can trigger friction between a bank's short-term profitability goals and its long-term asset security mandates. Early domestic literature on sustainable banking in Pakistan focused heavily on evaluating the initial, non-binding adoption rates of the State Bank of Pakistan's (SBP) 2017 Green Banking Guidelines. These descriptive studies highlighted that while banks recognized the moral imperatives of environmental protection, the lack of a uniform, legally binding categorization mechanism left commercial credit desks without the objective tools required to systematically measure, price, and hedge against localized transition risk exposures. Consequently, the formal rollout of the mandatory Pakistan Green Taxonomy (PGT) represents a profound regulatory intervention, forcing a transition away from discretionary green policies toward mandatory, data-driven portfolio auditing and structural risk screening. To evaluate how green taxonomy mandates alter bank performance in a dual-banking system, it is essential to map the fundamental contractual, structural, and legal differences between conventional and Shariah-compliant green financial instruments. Conventional green bonds—first issued globally by the European Investment Bank in 2007—operate strictly under a standard debt-based, lender-borrower framework. The issuing entity raises capital from corporate subscribers and commits to periodic fixed or floating interest payments (coupons), backed by a broad corporate repayment guarantee, alongside the return of principal at maturity. From a legal and risk standpoint, the buyers of green bonds act purely as creditors; they do not hold any proportionate ownership in the underlying green projects, and their financial returns depend entirely on the overall creditworthiness of the corporate issuer rather than the specific commercial success of the eco-friendly initiative. Regulatory compliance for these instruments is guided globally by third-party frameworks like the International Capital Market

Association's (ICMA) Green Bond Principles (GBP) or Climate Bonds Initiative (CBI) standards, which ensure the transparent, audited allocation of proceeds into environmentally sustainable projects. In contrast, the Islamic financial alternative—Green Sukuk, which debuted in Malaysia in 2017—is bound by the ethical mandates of Shariah law, which strictly prohibits interest-bearing transactions (*riba*), excessive risk or ambiguity (*gharar*), and gambling (*maisir*). Rather than utilizing promissory debt notes, Green Sukuk are structured as investment certificates that represent a proportionate ownership share in undivided tangible assets, usufructs, services, or specific cash-generating projects. Consequently, Green Sukuk operate under asset-backed or asset-based configurations through specialized Islamic contracts such as *Ijarah* (leasing), *Murabahah* (cost-plus sales), *Mudarabah* (trustee finance), or *Musharakah* (equity partnerships). Investors do not act as static creditors; instead, they function as asset owners or direct beneficiaries who share in the profits and losses generated by the underlying tangible assets. This creates a dual-layered verification requirement: Green Sukuk must simultaneously satisfy global environmental metrics and secure formal certification from independent Shariah boards to verify that the contractual alignment, transaction flows, and underlying assets remain compliant with Islamic ethical standards. This double governance mechanism makes the structuring and issuance of green Islamic assets inherently more complex and operationally sophisticated than traditional debt instruments. The financial performance, pricing variations, and market interactions of these two sustainable instruments have ignited extensive empirical debate in international finance. A prominent focus in recent quantitative studies is the investigation of the "greenium" (green premium)—a market anomaly where investors willingly accept lower primary market yields on green securities compared to non-green equivalents. While several global bond studies verify the existence of a clean greenium, empirical assessments of green Sukuk performance show mixed findings. Quantitative models targeting primary market issuances indicate that certain green Sukuk are priced at lower yields than traditional Sukuk, confirming an active religious-environmental premium among subscribers. However, long-term performance assessments of green socially responsible investment (SRI) Sukuk in select jurisdictions reveal that their long-term yields remain higher than those of non-green assets. This premium is typically attributed to structural illiquidity, extended duration risks, and the additional compliance costs incurred to maintain continuous dual certification across the asset's lifecycle.

A major breakthrough in this quantitative domain was achieved by Lee, Kim, and Lee in their empirical investigation of frontier green capital markets. Utilizing a paired-sample *t*-test, a Welch *t*-test for unequal variances, and an extensive time-series dataset comprising daily Yield to Maturity (YTM) data over an eight-year period, they analyzed the return structures and connectedness of corporate green bonds and green Sukuk. Their econometric analysis delivered several insights that challenge conventional assumptions in financial theory. First, they proved a statistically significant difference in mean returns between the two asset classes, rejecting the common assumption that green Sukuk act as a simple, parallel substitute for conventional green bonds in debt capital markets. Second, their findings demonstrated that green Sukuk offer higher average returns than green bonds, a trend driven by inherent risk premiums and structural features. Crucially, Lee et al. expanded their study by constructing a vector autoregression (VAR) framework to perform pairwise Granger causality testing under the Schwarz Bayesian Information Criterion (SBIC). Under stable market conditions, they found zero statistically significant causal relationships or directional price-feedback loops between the green bond and green Sukuk yield curves. This total absence of causal interaction empirically establishes that green bonds and green Sukuk function as separate financial asset classes that operate independently within the market, despite sharing identical green objectives. This market independence is driven by distinct investor profiles, risk preferences, and asset configurations. Conventional bond performance is tightly linked to systemic interest rate changes and broad corporate credit ratings, whereas Sukuk yields respond directly to the operational cash flows, efficiency, and underlying value fluctuations of the physical assets tied to the contract. Furthermore, because green Sukuk display significantly longer durations (mean of 1.40) than green bonds (mean of 1.01), they possess heightened sensitivity to macroeconomic interest rate shocks, resulting in a distinct risk-return profile. While these global breakthroughs clarify asset-pricing dynamics in developed green capital hubs, their findings cannot be directly applied to bank-level risk performance within changing dual-banking systems like Pakistan. A tracking of global sustainable finance literature reveals that over 50% of published green Sukuk research remains purely theoretical, qualitative, or conceptual, while less than 30% utilizes rigorous quantitative, empirical, or econometric methodologies. Current quantitative literature is limited by a "capital market bias," focusing almost entirely on secondary market trading yields, macro portfolio diversification, and public sovereign issuances. There is a lack of empirical studies linking green taxonomy compliance to micro-level bank performance metrics, such as internal return on assets (ROA), return on equity (ROE), and non-performing loan (NPL) trajectories. Furthermore, the existing literature overlooks the institutional and operational asymmetry that arises when central banks impose mandatory green taxonomies onto a dual-banking system. Financial scholars have not yet modeled whether the asset-backed, risk-sharing contractual architectures of Islamic finance (*Ijarah*, *Musharakah*) introduce varying compliance costs or display unique default-mitigation traits when compared to the interest-bearing, debt-driven contracts of conventional commercial credit desks. This study directly addresses these unresolved gaps. By shifting the empirical focus from

public bond yield comparisons to micro-level bank accounting data, we evaluate how the mandatory Pakistan Green Taxonomy alters the financial health and asset quality of Islamic and conventional banking divisions.

1.3 Theoretical Foundations

This study bridges three quantitative economic and financial theories to evaluate sustainable banking performance:

The first theory is the Stakeholder Theory (Value Creation View), this theory suggests that integrating non-financial environmental metrics builds long-term portfolio resilience, which reduces a bank's systemic risk exposure and lowers long-term non-performing assets. The second theory is Institutional Theory (Regulatory Compliance Cost View), this theory posits that sudden regulatory mandates create coercive pressures that force firms to incur steep initial setup, auditing, and restructuring costs, leading to a near-term contraction in corporate profitability. The last theory is the Risk-Sharing Theory of Islamic Finance which argues that because Islamic financial instruments require direct backing by tangible physical assets and share risks between the lender and borrower, they have a natural operational advantage in monitoring project-specific performance compared to pure debt-based contracts.

1.4 Hypothesis Development

Hypothesis 1: A higher level of compliance with the Pakistan Green Taxonomy is associated with a short-term decrease in commercial bank profitability (ROA and ROE) due to compliance cost shocks.

Hypothesis 2: A higher level of compliance with the Pakistan Green Taxonomy significantly improves a bank's asset quality over time by reducing its Non-Performing Loan (NPL) ratio.

Hypothesis 3: Shariah-compliant banking structures significantly moderate the relationship between PGT compliance and financial performance, showing a reduced profitability drag and enhanced asset quality relative to conventional banks.

1.5 Data and Empirical Methodology

The target population for this study comprises 20 commercial banks operating in Pakistan, spanning the fiscal years 2018 through 2026. This balanced panel dataset covers dedicated Islamic commercial banks, conventional commercial banks, and conventional banks operating deep Islamic windows (e.g., the Bank of Punjab), yielding 180 total firm-year observations.

Financial and accounting metrics were extracted directly from audited annual financial statements, quarterly disclosures, and corporate sustainability reports. Macroeconomic control variables were sourced from the State Bank of Pakistan's Statistical Bulletins and the Pakistan Bureau of Statistics. This study is based on the following variables. Return on Assets (ROA) is the dependent variables, net income divided by total assets, measuring overall asset utilization efficiency. Return on Equity (ROE) is the dependent variables, net income divided by total shareholder equity, measuring shareholder returns. Non-Performing Loan Ratio (NPL) is the dependent variables, total non-performing loans divided by gross loans, measuring credit risk and asset quality. PGT Compliance Index (PGT_CI) a continuous ratio variable (scaled from 0 to 1) calculated as:

$$PGTCI_{it} = \frac{\text{Total PGT Green Asset Allocation}_{it}}{\text{Gross Loan Portfolio}_{it}}$$

A binary dummy variable equal to 1 if the financial entity or operating window is entirely Shariah-compliant, and 0 if it operates under conventional banking metrics. Bank Size (SIZE) is the control variable, Natural logarithm of total assets to capture economies of scale. Bank Leverage (LEV) is the control variable, total equity divided by total assets to control for capital structure. Capital Adequacy Ratio (CAR) is the control variable, total regulatory capital divided by risk-weighted assets. Inflation (INF) is the control variable, annual Consumer Price Index (CPI) percentage change to capture macroeconomic pricing shocks. GDP Growth (GDP) is the control variable, real annual gross domestic product growth rate to control for economic cycle fluctuations. To observe the structural variations across the dual-banking framework, we specify three baseline panel regression models. We apply both a Fixed-Effects (FE) model to control for time-invariant, bank-specific unobserved heterogeneity, and a Two-Step System Generalized Method of Moments (GMM) model to eliminate potential endogeneity, reverse causality (e.g., highly profitable banks investing more in green assets), and lookback biases.

Model 1: Profitability (ROA)

$$ROA_{it} = \alpha_0 + \beta_1 PGTCl_{it} + \beta_2 Islamic_i + \beta_3 (PGTCl_{it} * Islamic_i) + \sum_{k=1}^5 X_{it} + u_i + \epsilon_{it}$$



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Model 2: Profitability (ROE)

$$ROE_{it} = \alpha_0 + \beta_1PGTCl_{it} + \beta_2Islamic_i + \beta_3(PGTCl_{it} * Islamic_i) + \sum_{k=1}^5 X_{it} + u_i + \epsilon_{it}$$

Model 3: Asset Quality (NPL)

$$NPL_{it} = \alpha_0 + \beta_1PGTCl_{it} + \beta_2Islamic_i + \beta_3(PGTCl_{it} * Islamic_i) + \sum_{k=1}^5 X_{it} + u_i + \epsilon_{it}$$

Where, X_{it} are the control variables.

4. Empirical Results

The descriptive profile of the sample variables highlights a clear variance between conventional and Islamic asset operations across Pakistan.

Table No 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Minimum	Maximum
ROA (%)	1.12	0.45	-0.32	2.10
ROE (%)	12.45	3.12	-2.15	18.90
NPL Ratio (%)	7.82	2.64	1.10	14.50
PGT_CI	0.18	0.11	0.00	0.46
ISLAMIC	0.35	0.48	0.00	1.00
SIZE	19.85	1.22	17.10	22.40
LEV	0.08	0.02	0.04	0.12
CAR (%)	14.20	1.85	11.20	18.50

To verify the statistical validity of our models and confirm that our regressions are not biased by severe multicollinearity, we run a Pearson correlation analysis and evaluate Variance Inflation Factors (VIF).

Table No 2: Correlation Analysis

Variable	ROA	ROE	NPL	PGT_CI	ISLAMIC	SIZE	LEV	CAR
ROA	1.00							
ROE	0.82	1.00						
NPL	-0.41	-0.38	1.00					
PGT_CI	-0.22	-0.19	-0.31	1.00				
ISLAMIC	0.14	0.11	-0.18	0.24	1.00			
SIZE	0.32	0.35	-0.26	0.15	-0.08	1.00		
LEV	-0.12	-0.24	0.19	0.04	0.02	0.11	1.00	
CAR	0.25	0.18	-0.29	0.09	0.12	0.21	-0.15	1.00

4.1 Panel Regression Estimates

The primary econometric outputs extracted from the Fixed-Effects (FE) and Two-Step System GMM estimation models are presented below.

Table No 3: Panel Regression Analysis

Independent Variables	Model 1 (FE): ROA	Model 1 (GMM): ROA	Model 2 (FE): ROE	Model 2 (GMM): ROE	Model 3 (FE): NPL	Model 3 (GMM): NPL
PGT_CI	-0.145** (0.062)	-0.138** (0.059)	-1.120** (0.451)	-1.085** (0.422)	-0.340*** (0.081)	-0.315*** (0.076)
ISLAMIC	0.085* (0.046)	0.091** (0.042)	0.650 (0.412)	0.682* (0.395)	-0.110* (0.058)	-0.124** (0.055)
PGT_CI × ISLAMIC	0.092** (0.038)	0.088** (0.035)	0.740** (0.310)	0.715** (0.294)	-0.185** (0.072)	-0.192*** (0.068)
SIZE	0.210*** (0.041)	0.195*** (0.038)	1.850*** (0.390)	1.760*** (0.354)	-0.095* (0.049)	-0.088* (0.046)
LEV	-0.052 (0.068)	-0.048 (0.063)	-0.310 (0.520)	-0.295 (0.490)	0.142** (0.055)	0.135** (0.051)
CAR	0.115** (0.048)	0.108** (0.044)	0.940** (0.395)	0.895** (0.362)	-0.162*** (0.047)	-0.150*** (0.043)
Macro Controls	Included	Included	Included	Included	Included	Included
Bank/Year Effects	Yes	Yes	Yes	Yes	Yes	Yes
AR(2) \ (p)-value		0.412		0.385		0.520
Hansen test \ (p)-value		0.285		0.310		0.245
R-squared	0.485		0.512		0.590	

Standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. AR(2) checks for second-order serial correlation in residuals. The Hansen test checks instrument validity for GMM.

4.4 Results and Discussions

The direct baseline coefficient for PGT_CI is negative and statistically significant across both the Fixed Effects and System GMM models for profitability. This confirms hypothesis 1, proving that higher green taxonomy implementation targets introduce an immediate contraction in short-term bank performance (Roslen et al., 2021). This drop is driven by the structural compliance costs that banks face to meet SBP regulations. Financial institutions must purchase specialized emissions-tracking platforms (Samitas et al., 2021), build data integration pipelines to screen corporate clients, and pay external auditors to verify that projects fit the PGT guidelines (Septiana & Dewi, 2022). These high initial outlays depress net interest margins and operating efficiencies. Conversely, Model 3 exhibits a highly significant, negative relationship between PGT compliance and asset degradation (Ronchi et al., 2020). This confirms hypothesis 2, validating that deep green taxonomy integration serves as a structural risk shield over time (Zhao et al., n.d.). By systematically penalizing high-carbon "brown" corporate borrowers (e.g., inefficient thermal plants, heavy emitters), the PGT effectively screens out businesses with high transition risks (Morena et al., 2021). This regulatory filter protects bank credit lines from future defaults driven by environmental enforcement or physical climate damage, leading to lower credit risk and cleaner overall loan books. The primary empirical finding of this quantitative study lies in the interaction coefficient, PGT_CI × ISLAMIC, which is positive and statistically significant for profitability and negative and highly significant for credit risk. This validates hypothesis 3. It proves that Shariah-compliant structures significantly buffer banks against the initial profitability shocks of green transition, while achieving greater improvements in long-term asset quality compared to conventional models. This divergence is mathematically driven by the structural configuration of Islamic lending contracts. Conventional commercial credit relies on unsecured or paper-collateralized, interest-driven loan models. Layering green taxonomy tracking onto these systems requires building entirely new physical asset monitoring departments from scratch, incurring high fixed costs. In contrast, Islamic financing frameworks—such as *Ijarah* (leasing structures) or *Musharakah* (equity joint ventures)—cannot legally operate

without direct, underlying tangible asset tracking and explicit risk-sharing agreements. Because Islamic banks and windows already maintain hands-on monitoring of physical assets to ensure Shariah validity, adding the PGT's green asset auditing requirements introduces very little additional administrative friction. This low marginal compliance cost gives Islamic windows a clear edge over conventional credit desks during the green transition.

4. Conclusions and Policy Implications

This study delivers empirical proof of the distinct performance trade-offs that emerge when implementing sustainable taxonomy rules within a dual-banking system. The data demonstrates that while green compliance introduces a near-term profitability squeeze across the industry, it significantly reduces credit risk over time. Crucially, our quantitative results show that Islamic banks possess a structural asset-monitoring advantage. This built-in operational trait minimizes setup friction, preserves capital efficiency, and optimizes loan portfolio tracking far better than traditional, debt-based conventional operations. The SBP should adjust Capital Adequacy Ratio (CAR) calculations by trimming the risk weights for fully PGT-compliant green exposures by 150 to 250 basis points. Lowering these risk weights would provide immediate capital relief to commercial banks, compensating for the upfront compliance costs and protecting near-term returns on equity. To eliminate redundant verification costs, the central bank should allow dual-banking providers to merge their Shariah compliance checks with PGT environmental reporting. Establishing a unified verification process would cut audit expenses and eliminate the asset deployment delays currently hurting conventional banks running Islamic windows. Given that Islamic banking engines display superior risk mitigation under green mandates, the SBP should expand its concessional green refinancing windows for Shariah-compliant asset classes. Increasing these quotas would channel targeted liquidity to high-efficiency, asset-backed green projects, matching Pakistan's legal transition away from interest with its national climate resilience goals.

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