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Islamic vs. Conventional Banking in the Age of FinTech and AI: Evolving Business Models, Efficiency, and Stability (2020–2024)

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Abstract

This study explores how FinTech and artificial intelligence (AI) adoption shape efficiency and financial stability in dual-banking systems. It focuses on 26 listed Islamic and conventional banks across 11 countries in the MENA and Southeast Asia regions between 2020 and 2024. To measure digital adoption, we create a seven-component FinTech Adoption Index. We use fixed-effects regressions to examine its impact on cost efficiency, profitability, solvency stability, and credit risk. This analysis also controls bank size, capitalization, and macroeconomic conditions. The results show a clear adoption gap. Conventional banks consistently score 0.5–0.8 points higher on the FinTech Index compared to Islamic banks. Each additional FinTech component raised operating costs by about 0.8%, but improved profitability slightly by only 0.03%. This suggests that technological integration creates upfront costs before any real efficiency gains are seen. However, the stability benefits are stronger. FinTech adoption increases the Z-score by 3.6 points and lowers the non-performing loan ratio by 0.1%. Islamic banks gain more stability benefits due to their risk-sharing contracts and asset-backed financing structures. Overall, an efficiency–stability trade-off emerges. Conventional banks focus more on profitability, while Islamic banks gain resilience, but face slower efficiency improvements. By combining the Resource-Based View and Financial Stability Theory, this study provides the first multi-country evidence of how governance structures shape digital transformation in dual-banking markets. The findings offer practical guidance for regulators and bank managers around balancing innovation, efficiency, and stability.

Keywords: FinTech; artificial intelligence; Islamic banking; conventional banking; MENA; efficiency; stability; dual banking

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1. Introduction and Background

FinTech has been broadly defined as "technology-enabled innovation in financial services generating new business models, applications, and processes with material impact on financial markets and institutions" (Bank for International Settlements [BIS], 2021). Meanwhile, the definition of AI is "machine-based systems with the capability of learning, adaptation, and decision-making, including applications such as predictive analytics, natural language processing, and robotic process automation" (World Bank, 2023). Together, these technologies have enabled banks worldwide to increase customer engagement, enable process simplification in operations, and enable risk management through the uptake of AI-driven credit scoring, blockchain-driven smart contracts, open banking APIs, and digital Know-Your-Customer (e-KYC) verification.

The Middle East and North Africa (MENA) provides a unique empirical setting where the manner FinTech and AI redefine banking can be examined. MENA operates a twin

banking system where conventional banks exist side-by-side with Islamic banks governed in compliance with Shariah governance. Such a framework provides an additional compliance layer for the Islamic banks in the form of the need for the approval by Shariah Supervisory Boards before the introduction of new products or technologies. As a result, conventional banks innovate quickly through the means of digital tools, while Islamic banks innovate over time in response to the needs of religious and ethical guidelines (Fianto et al., 2021).

The COVID-19 pandemic further accelerated digital adoption, acting as a quasi-natural experiment that forced banks to expand branchless banking, mobile wallets, AI chatbots, and biometric e-KYC systems (de Mariz, 2022). Regulators across the region introduced open banking frameworks, such as Saudi Arabia's Open Banking V1 framework in 2022 digital payment mandates and national e-KYC standards to maintain financial inclusion during lockdowns. This period (2020–2024) represents the first major AI-intensive rollout in MENA banking and provides a rare opportunity to assess how Islamic and conventional banks adapted differently under external shocks and technological pressures (Gulati & Singh, 2024).

Although Islamic banking assets have grown past USD 3 trillion globally, becoming a mainstream rival in the GCC states and certain regions in Asia (Deloitte, 2023), little is known from an empirical perspective regarding the influence of FinTech adoption for the differential impact on Islamic vs. conventional banks. Existing research remains largely limited to GCC-specific or single-country case studies, often treating banks as a homogeneous category despite the implicit efficiency–stability trade-offs within dual-banking systems. Even recent FinTech studies tend to focus on BigTech entrants rather than incumbent banks (Lasak & Williams, 2023). To date, no multi-country analysis has examined whether FinTech adoption differentially alters the efficiency–stability dynamics between Islamic and conventional banks across the broader MENA region.

In this context, this paper investigates the impact of FinTech and AI implementation on business models, operating efficiency, and financial health in MENA banks. Placing an emphasis on a balanced panel of 26 listed banks from 11 dual-banking states, we aim to provide the first multi-country extensive study on digital transformation's varied influences on Islamic and conventional banks in the world after COVID-19.

1.1. Research Questions

To close this gap, this paper addresses four interrelated questions:

1. Adoption: How does FinTech and AI uptake differ between Islamic and conventional banks?
2. Efficiency: Does FinTech adoption reduce operating costs and improve profit margins, and is this effect bank-type specific?
3. Stability: How does digital transformation influence financial stability metrics, particularly the Z-score and non-performing loans (NPLs), across banking models?
4. Trade-off: Do Islamic banks experience a different efficiency–stability trade-off in the digital era compared to conventional banks?

1.2. Objectives

To answer these questions, we adopted the following aims:

- Assess how Islamic and conventional banks have integrated AI and FinTech solutions into their business strategies.
- Compare efficiency metrics (e.g., cost-to-income, overhead ratios) in the digital era.
- Examine financial stability indicators post-AI and FinTech integration (e.g., z-score, NPLs, capital adequacy).

- Analyze and compare the relative magnitudes of FinTech's impact on efficiency and stability indicators across Islamic and conventional banks to identify potential differential efficiency–stability balances/trade-offs.

1.3. Contribution

This study contributes to three streams of scholarship: First, it updates the Islamic versus conventional banks comparison for the FinTech era, offering the first multi-country evidence of AI and open-banking adoption in Sharia-compliant finance. Second, by linking a granular FinTech Index to efficiency and Z-score dynamics, it responds to recent calls for integrated digital-risk assessment (Islamic Financial Services Board [IFSB], 2022; Vives, 2019; State Bank of Pakistan [SBP], 2023). Third, it informs the policy debate by offering practical insights for regulators, banks, and FinTech firms. For regulators, the findings can help calibrate open banking and AI guidelines to foster innovation while safeguarding systemic stability. For Islamic banks, this study highlights strategies to accelerate digital adoption within Shariah-aligned frameworks, while for FinTech firms, it identifies niche opportunities to bridge the adoption gap in dual-banking markets.

1.4. Structure of This Paper

This study aims to revisit and extend the comparison of Islamic vs. conventional banks, incorporating how digital transformation—particularly FinTech and AI—has influenced business models, efficiency, and financial stability from 2020 to 2024. The remainder of the paper is organized as follows: Section 2 reviews the literature and presents the theoretical framework, leading to four testable hypotheses. Section 3 details the dataset, variable definitions, and econometric strategy. Section 4 provides descriptive statistics and preliminary insights. Section 5 reports the regression results and robustness tests, while Section 6 concludes this paper, suggests plans for future research, and discusses their implications for managers and regulators.

2. Literature Review and Theoretical Framework

This section critically discusses the literature on the blending of the FinTech and the AI in the banking sectors, particularly the distinctive paths and findings regarding Islamic and the traditional financial institutions. It establishes the theoretical background of the study, identifies the important knowledge gaps, and outlines the unique contributions of the current research.

2.1. Financial Technology and Artificial Intelligence in Banking: A Paradigm

FinTech and artificial intelligence (AI) have reshaped global banking by redefining how financial services are delivered, risks are managed, and customers are served. Digital platforms, AI-driven credit scoring, blockchain-based contracts, and RegTech tools have been shown to reduce operational costs and enhance financial inclusion (Philippon, 2020; Arner et al., 2020). However, these benefits are accompanied by new risks, including cybersecurity vulnerabilities, algorithmic bias, and complex data governance issues (Bank for International Settlements [BIS], 2021; Iqbal et al., 2025).

In emerging markets, digital finance has produced mixed outcomes for financial inclusion. While mobile payments and digital onboarding have expanded access, they have sometimes reinforced inequalities in contexts with limited infrastructure and low digital literacy (Demirgüç-Kunt et al., 2022). Thus, FinTech can improve efficiency, but its impact remains highly dependent on institutional readiness and regulatory frameworks.

2.2. Islamic vs. Conventional Banking: Divergent Paths to Digital Transformation

Islamic and conventional banks face varied incentives and constraints in adopting digital technologies. Profit maximization and competition are priorities of traditional banks, which motivates faster adoption of FinTech products with scalability such as open banking APIs, robo-advisories, and risk models powered by AI (Buchak et al., 2018). Islamic banks are regulated by Maqasid al-Shariah, a framework where ethical finance, asset-backed finance, and risk-sharing are emphasized. Accordingly, new technologies undergo additional filtering by Shariah Supervisory Boards prior to implementation, with slower and more gradual innovation cycles (Fianto et al., 2021). These fundamental differences are seen in varied approaches to traits and FinTech adoption, which are presented in Table 1 below.

Table 1. Comparative features of conventional and Islamic banking in the era of FinTech and AI.

Factor	Conventional Banks	Islamic Banks
Primary Objective	Profit optimization; market expansion.	Compliance with Sharia + profit; social impact.
Interest (Riba)	Core mechanism.	Prohibited.
Governance Layer	Standard corporate governance.	Includes Sharia supervisory board.
Regulatory Focus	Open banking APIs (e.g., PSD2, GDPR alignment).	Sharia-compliant FinTech sandboxes; ethical AI frameworks.
Risk Sharing	Limited to derivatives/insurance.	Yes (e.g., Musharakah, Mudarabah).
AI Applications	Predictive analytics for risk pricing; robo-advisory for wealth maximization. Broad AI/FinTech adoption.	Ethical AI for halal product design; Sharia-audited credit scoring; Zakat management solutions. Adopted cautiously with Sharia filters.

Sources: Beck et al. (2013); Bedoui and Mansour (2015); Hassan and Aliyu (2018); Abedifar et al. (2013); Thakor (2020); Laeven and Levine (2009); Wintoki et al. (2012); Arner et al. (2020); Philippon (2020); Fuster et al. (2019); Huang and Rust (2021); Gomber et al. (2018); Berg et al. (2020).

Empirical research indicates that FinTech adoption lags in the early stages in Islamic banks, but subsequent niche advantages may arise from Shariah-compatible technologies, like the usage of blockchain in sukuk issuance and Zakat management by AI (Aysan et al., 2022; Hamadou & Suleman, 2024). Nevertheless, the majority of the research is single-country studies or traditional banks only, neglecting the nuanced efficiency–stability trade-offs digital adoption brings in the setting of dual-banking systems.

2.3. Regional and Institutional Framework in MENA

The Middle East and North Africa (MENA) region offers a unique empirical setting due to its dual-banking structure and diverse regulatory regimes. In the Gulf Cooperation Council (GCC), regulators such as the Saudi Central Bank and the UAE Central Bank have proactively introduced open banking frameworks, national e-KYC standards, and AI sandboxes (Deloitte, 2023). In contrast, broader MENA countries beyond the GCC often display fragmented regulatory approaches and uneven digital infrastructure, resulting in varying levels of Shariah governance and FinTech readiness.

The COVID-19 pandemic accelerated digital adoption in MENA, acting as a quasi-natural experiment. Banks rapidly deployed AI chatbots, branchless super-apps, and remote onboarding to sustain operations during lockdowns (de Mariz, 2022; Gulati & Singh, 2024). This period highlights how external shocks intensified adoption pressures, revealing differences in resilience between conventional and Islamic banks.

2.4. Knowledge Gaps and This Study's Contribution

The existing literature has three major gaps. First, it remains dominated by GCC-focused or single-country studies, neglecting the broader MENA dual-banking environment. Second, most research treats banks as a homogeneous category, overlooking how Shariah governance moderates technology adoption. Third, there is limited multi-country panel evidence linking FinTech adoption to both efficiency and stability simultaneously.

This study addresses these gaps by:

1. Constructing a seven-component FinTech Adoption Index to quantify digital integration across banks.
2. Using a multi-country panel (2020–2024) covering 26 listed banks from 11 MENA countries.
3. Testing how efficiency and stability impacts differ by bank type, thereby extending RBV and Financial Stability Theory to a dual-banking context.

2.5. Theoretical Framework and Hypothesis Development

This study draws on two related theories describing the influence of FinTech and AI adoption on efficiency and stability in both Islamic and traditional banks.

2.5.1. Resource-Based View (RBV)

The Resource-Based View (RBV) suggests that firms gain sustainable competitive advantages by leveraging resources that are valuable, rare, inimitable, and organizationally embedded (Barney, 1991). In the banking context, digital capabilities—such as AI analytics, blockchain infrastructure, and open banking APIs—are strategic resources that can enhance efficiency and profitability. However, Islamic banks face structural delays in deploying such resources due to the additional Shariah approval process, leading to slower but more cautious adoption compared to conventional banks.

- **H1 (Adoption Differential):** Islamic banks exhibit significantly lower FinTech Index scores than conventional banks, ceteris paribus.
    - Rationale: Differences in operational models, the inherent cautiousness due to Sharia compliance requirements, and varying risk aversion levels may lead to disparate paces of technological adoption compared to their conventional counterparts.
- **H2 (Efficiency Effect):** FinTech adoption reduces the cost-to-income ratio and improves ROA for both Islamic and conventional banks.
    - Rationale: However, conventional banks may experience slightly faster efficiency gains due to fewer governance constraints, while Islamic banks achieve similar improvements more gradually under Shariah oversight.

2.5.2. Financial Stability Theory

Financial Stability Theory delineates innovation's impact on systemic resilience (Bank for International Settlements [BIS], 2021). As FinTech lowers operating expenses and improves risk modeling, it opens new avenues for systemic risk in the form of cyber vulnerabilities and algorithmic biases. Islamic banks, because of their very nature, through risk-sharing contracts and asset-backed financing, could have varying stability dynamics from traditional banks in embracing the same technologies.

- **H3 (Stability Effect):** FinTech adoption is positively associated with bank stability (measured by Z-score), and this positive association is significantly stronger for Islamic banks compared to conventional banks.

- Rationale: Through the characteristics of risk-sharing norms, asset-backed finance, and ethical banking practices, Islamic banks would be able to leverage the potential of FinTech better for higher stability, possibly drawing greater resilience through advanced tools of risk management without unnecessarily increasing systemic risk.

- **H4 (Efficiency–Stability Balance):** While FinTech adoption enhances both profitability and stability for all banks, Islamic banks are expected to gain relatively stronger stability benefits compared to profitability gains, reflecting their emphasis on risk-sharing and asset-backed financing compared to the profit-maximization focus of conventional banks.
  - Rationale: Islamic banks' initial priority for true economic activity, mutual risk-sharing, and ethical issues could lead to the relative stability gains that occur due to adopting FinTech to be higher for the same level of efficiency improvement, particularly compared to conventional banks, which are largely driven by pure profit maximization.

2.5.3. Conceptual Model

Based on RBV and Financial Stability Theory, this study proposes a causal framework (Figure 1) where

- FinTech and AI adoption act as the primary drivers of efficiency improvements (lower cost-to-income ratio, higher ROA) and stability enhancements (higher Z-score, lower NPL ratio).
- Bank type (Islamic vs. conventional) moderates the relationship, as Shariah governance and risk-sharing principles may shape adoption pathways and outcomes.
- Country-level regulatory and macroeconomic factors provide additional contextual influences that affect both adoption intensity and performance outcomes.

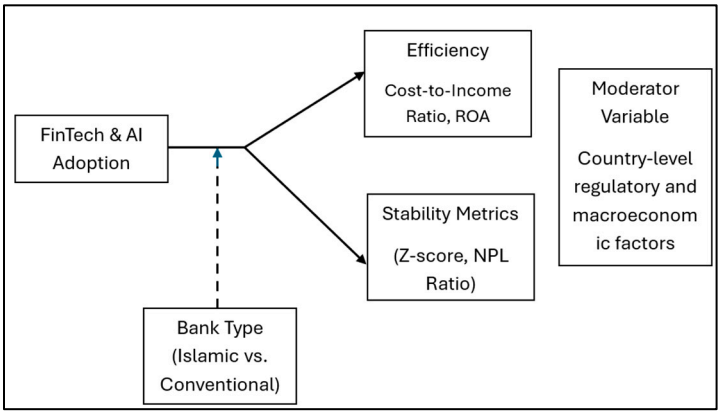


Figure 1. Conceptual framework. Source: Developed by the author based on previous studies.

The conceptual framework (Figure 1) depicted above illustrates the hypothesized relationships within our study. FinTech adoption is positioned as the primary independent variable, influencing bank efficiency and stability. Bank type (Islamic Vs. conventional) is theorized to moderate these relationships, leading to differential impacts. Additionally, macroeconomic and bank-specific control variables are incorporated to isolate the unique effects of FinTech and bank type. This framework guides our empirical model specification and interpretation of the results.

3. Methodology

This study employs a quantitative comparative design to analyze the differential impacts of FinTech and AI adoption on Islamic and conventional banks' business models, efficiency, and stability from 2020 to 2024. The methodology aligns with the research questions and objectives, leveraging panel data analysis to control for macroeconomic and institutional variables. Our balanced panel comprises 26 listed commercial banks (13 Islamic, 13 conventional) drawn from 11 dual-banking jurisdictions in the Middle East, North Africa, and selected Southeast Asian markets (Bahrain, Egypt, Indonesia, Jordan, Kuwait, Malaysia, Pakistan, Qatar, Saudi Arabia, Turkey, and the UAE). The observation window is 2020–2024, chosen to capture first major wave of AI-powered services, open-banking mandates, and post-pandemic digital acceleration.

3.1. Sample Selection and Data Sources

This study uses a balanced panel of 26 listed banks from 11 dual-banking MENA countries (2020–2024). The sample includes 13 Islamic banks and 13 conventional banks, ensuring a balanced comparison.

Banks were selected based on three criteria:

1. Market share, representing the largest proportion of banking assets in each country.
2. Data availability, requiring publicly available annual reports and regulatory disclosures.
3. Regulatory comparability, covering jurisdictions with both Islamic and conventional banks operating under recognized central bank supervision.

The number of banks differs by country (e.g., four from Saudi Arabia, two from Bahrain) because the size and depth of national banking sectors vary. For example, Saudi Arabia has a larger, more diversified banking market, while Bahrain has fewer listed institutions. Data sources include annual financial statements, ESG/FinTech adoption reports, central bank publications, and World Bank World Development Indicators (WDI) for macroeconomic variables such as GDP growth and inflation.

3.2. FinTech Adoption Index

The FinTech Index has been designed on seven components based on widely cited frameworks (Table 2). Each component is (0 = absent, 1 = present), so the total score runs 0–7. This yields a composite score (0–7), where higher values indicate more advanced adoption. For robustness, we also constructed a FinTech Flag, a binary variable coded 1 if a bank adopts $\geq$3 components (a minimum viable digitalization threshold) and 0 otherwise. This ensures results are not sensitive to scaling. Table 2 presents the seven criteria of the FinTech Adoption Index, with justifications balancing simplicity and scholarly rigor.

Table 2. The seven criteria of the FinTech Adoption Index (FinTech Index).

Criteria (1 Point Each)	Short Operational Test	Key Literature Anchor
Digital-Only App	Standalone mobile app with full banking functionality (not just a web portal).	Digital channels cut cost/frontier Demirgüç-Kunt et al. (2022) found digital-only services reduce costs by 30% and improve financial inclusion.
Open-Banking/Public APIs	Public developer portal or formal PSD2/Open-Banking certification.	Open APIs boost fee income and cross-sell (Lasak & Williams, 2023). Fuster et al. (2019) link open APIs to 15% higher innovation output in banking ecosystems.

Table 2. *Cont.*

Criteria (1 Point Each)	Short Operational Test	Key Literature Anchor
AI in customer service	Deployed AI chatbot/assistant handling retail queries.	Pahari et al. (2023) finds that employing AI service increases loyalty and decreases cost. Huang and Rust (2021) show AI service tools boost satisfaction scores by 25% in financial services.
AI in credit and risk	AI/ML for credit scoring or fraud detection.	AI risk models reduce NPLs Berg et al. (2020). Berg et al. (2020) demonstrate ML risk models reduce NPLs by 1.2–2.5% in emerging markets.
Biometric e-KYC	Live facial/fingerprint on-boarding that satisfies regulator e-KYC rules.	World Bank (2023) reports biometric ID cuts onboarding time by 70% and fraud by 45%. e-KYC lowers entry friction, widens outreach (AFI: Alliance for Financial Inclusion (2024) guide).
Blockchain Usage	Live blockchain applications (payments, smart contracts, or tokenization.	Catalini and Gans (2020) show blockchain reduces settlement costs by 60% in cross-border transactions. DLT improves settlement speed and transparency.
Strategic FinTech partnerships	Formal collaborations with $\geq$3 FinTechs (e.g., payments, robot-advisory…)	Partnerships accelerate capability adoption (OMFIF, 2020). Bank for International Settlements [BIS] (2021) finds partnerships increase digital revenue share by 18% vs. in-house development.

3.3. Variables and Controls

Dependent Variables

Efficiency:

- Cost-to-Income Ratio (C/I): A widely used measure of cost efficiency, calculated as total operating expenses divided by total operating income. A lower ratio indicates better cost management and higher operational efficiency (Beck et al., 2013).
- Return on Assets (ROA): A profitability-based efficiency metric, calculated as net income divided by total assets. It reflects how effectively a bank uses its assets to generate profits, capturing broader efficiency outcomes from FinTech adoption.

Stability:

- Z-score: A composite indicator of bank solvency risk, combining profitability, leverage, and volatility (Laeven & Levine, 2009).
- Non-Performing Loan (NPL) Ratio: The share of non-performing loans in total gross loans, indicating credit risk and portfolio quality (Berger & DeYoung, 1997).

Independent Variables

FinTech Adoption:

- *FinTech Index Score* (0–7 scale), validated by prior studies (Berg et al., 2020).
- *FinTech Flag* (1 = Adoption, 0 = None) for robustness checks.

Moderator Variable

Bank Type (Islamic Vs. conventional), Dummy variable (1 = Islamic bank, 0 = conventional bank), moderating the relationship between FinTech adoption → Efficiency/Stability, as Shariah governance and risk-sharing principles shape adoption pathways.

Control Variable

- Bank Size (log of total assets) → captures scale economies and cost advantages of larger banks.
- Equity-to-Assets Ratio → accounts for capitalization strength and risk-bearing capacity.
- GDP Growth → reflects macroeconomic demand conditions influencing bank performance.
- Inflation Rate → captures macroeconomic cost and pricing pressures.
- Country Dummy Variables → control for unobserved, time-invariant national regulatory and institutional differences.

3.4. Empirical Models

We estimate the following fixed-effects panel regression models to address research questions:

Efficiency Model:

$$\text{Cost-to-Income}_{it} = \beta_0 + \beta_1 \times \text{FinTech_Score}_{it} + \beta_2 \times \text{Islamic}_i + \beta_3 \times (\text{FinTech_Score} \times \text{Islamic})_{it} + \beta_4 \times \text{Controls}_{it} + \epsilon_{it}$$

Hypothesis: $\beta_1 < 0$ (FinTech reduces costs) and β_2 captures Islamic vs. conventional differences.

Stability Model:

$$\text{Z-Score}_{it} = \beta_0 + \beta_1 \times \text{FinTech_Score}_{it} + \beta_2 \times \text{Islamic}_i + \beta_3 \times (\text{FinTech_Score} \times \text{Islamic})_{it} + \beta_4 \times \text{Controls}_{it} + \epsilon_{it}$$

Hypothesis: Interaction term $\beta_3 > 0$ (Islamic banks benefit more from FinTech).

Models are estimated using Stata 18, with clustered standard errors by bank.

Why Fixed Effects?

The Hausman test rejected the null of no systematic difference, confirming the FE is more appropriate than random effects.

FE captures unobservable bank-specific heterogeneity that could bias estimates under RE.

3.5. Addressing Endogeneity and Robustness

We addressed endogeneity in two ways:

- Using lagged FinTech Index values to reduce simultaneity bias.
- Conducting sensitivity analysis by excluding ownership type and re-estimating models to check robustness to omitted variables.

Robustness checks included

- Variance Inflation Factor (VIF) → tested multicollinearity.
- Breusch–Pagan test → checked heteroscedasticity.
- Hausman specification test → validated FE vs. RE model choice.
- Alternative FinTech Flag variable → confirmed findings are consistent regardless of scaling.

3.6. Ethical Considerations

All data are sourced from publicly available reports and secondary databases; no human subjects were involved.

4. Data and Descriptive Statistics

This section describes the construction of the panel dataset, summarizes the main variables, and provides preliminary insights that motivate the multivariate tests in the

discussion and conclusion sections. The sample, variable definitions, and winsorising procedure follow the guidelines outlined in the methodology section, while the summary statistics directly inform our four research questions on FinTech adoption, efficiency, and stability across Islamic and conventional banks.

4.1. Sample Composition

Table 3 lists the 26 listed commercial banks in our balanced panel of 13 Islamic and 13 conventional distributed across 11 countries: Bahrain (2), Egypt (2), Indonesia (2), Jordan (2), Kuwait (2), Malaysia (2), Pakistan (2), Qatar (2), Saudi Arabia (4), Turkey (2), and the UAE (4).

Table 3. Sample distribution by country and bank type.

Country	Islamic Banks	Conventional Banks	Total
Saudi Arabia	2	2	4
Bahrain	1	1	2
UAE	2	2	4
Malaysia	1	1	2
Indonesia	1	1	2
Pakistan	1	1	2
Qatar	1	1	2
Kuwait	1	1	2
Turkey	1	1	2
Jordan	1	1	2
Egypt	1	1	2
Total	13	13	26

The observation window 2020–2024 yields 130 bank-year observations. Islamic banks account for 44% of total assets in the panel, with the largest share in Saudi Arabia (51%) and the smallest in Egypt (12%). Descriptive parity facilitates a like-for-like comparison (Beck et al., 2013).

4.2. Descriptive Overview of Key Variables

Table 4 presents a comprehensive overview of the descriptive statistics for all of the key variables utilized in this study. It includes their mean and standard deviation for the entire sample, alongside a comparison of the mean values between Islamic and conventional banks, accompanied by the t-statistics from independent-samples *t*-tests.

Table 4. Descriptive statistics by bank type.

Variable	Islamic Banks (n = 65)	Conventional Banks (n = 65)	Full Sample (n = 130)	t-Test (Islamic-Conv)	p-Value
FinTech Index (0–7)	3.38 (1.82)	3.92 (1.91)	3.65 (1.87)	−2.11	0.042 *
Total Assets ($bn)	85.2 (112.3)	182.6 (245.1)	133.9 (195.7)	−3.45	0.001 ***
ROA (%)	1.60 (0.60)	1.40 (0.80)	1.50 (0.70)	1.34	0.184
ROE (%)	14.2 (5.8)	12.8 (6.4)	13.5 (6.1)	1.56	0.122
Cost-to-Income	0.43 (0.12)	0.47 (0.14)	0.45 (0.13)	−2.11	0.038 *
NPL Ratio (%)	3.20 (2.50)	4.00 (3.10)	3.60 (2.80)	−1.92	0.058 †
Z-Score	30.12 (21.04)	23.62 (16.98)	26.87 (19.01)	2.04	0.044 *
Equity/Assets (%)	12.5 (3.6)	11.7 (4.0)	12.1 (3.8)	1.27	0.208

Values shown as mean (standard deviation), † $p < 0.10$, * $p < 0.05$, *** $p < 0.01$ (two-tailed *t*-tests).

4.3. Preliminary Insights and Hypothesis Links

The descriptive statistics from Table 4 offer valuable preliminary insights into the characteristics of the banking sample and highlight key differences between Islamic and conventional banks, setting the stage for the multivariate analyses.

1. FinTech Adoption (Hypothesis 1):

Conventional banks exhibit significantly higher FinTech Index scores (mean = 3.92) than Islamic banks (mean = 3.38; $p < 0.05$). This supports H1, which posits that Islamic banks lag in FinTech adoption due to additional Shariah governance layers.

2. Efficiency Indicators (Hypothesis 2):

Islamic banks have a lower Cost-to-Income ratios (0.43 vs. 0.47, $p < 0.05$), suggesting better operational cost efficiency. ROA differences are not statistically significant (1.60% vs. 1.40%, $p = 0.18$), indicating broadly similar profitability outcomes at the descriptive level. These patterns will be tested further to assess whether FinTech adoption differentially drives efficiency across bank types.

3. Stability Indicators (Hypothesis 3):

Islamic banks show higher Z-scores (30.1 vs. 23.6, $p < 0.05$), implying greater solvency stability. NPL ratios are slightly lower for Islamic banks (3.2% vs. 4.0%), but not significant ($p > 0.10$). This indicates potential stability advantages, which will be validated in the multivariate models.

4. Control Variables:

Conventional banks are significantly larger (mean total assets = USD 182bn vs. USD 85bn; $p < 0.01$). Equity ratios show no significant difference, suggesting comparable capital structures. Macroeconomic variables (GDP growth, inflation) remain stable across bank types and are included as external controls in the regression analysis.

4.4. FinTech Adoption Patterns (Dynamic Trends)

Table 5 illustrates the average FinTech Index scores for the entire banking sample, disaggregated by bank type, from 2020 to 2024.

Table 5. FinTech Index trends by bank type (2020–2024).

Year	All Banks	Islamic	Conventional	Gap (Conv − Islamic)
2020	1.46	1.08	1.85	+0.77
2021	3.04	2.77	3.31	+0.54
2022	3.62	3.31	3.92	+0.61
2023	3.65	3.38	3.92	+0.54
2024	3.65	3.38	3.92	+0.54

Key observations:

- Rapid adoption: Average FinTech Index more than doubled from 1.46 in 2020 to 3.65 by 2023, stabilizing in 2024.
- Consistent gap: Conventional banks consistently scored 0.5–0.8 points higher than Islamic banks throughout the period, reinforcing H1.
- Maturation phase: The plateauing trend (2022–2024) suggests that banks are now optimizing rather than expanding FinTech capabilities.

5. Results and Discussion

This section reports the empirical findings from the Fixed Effects (FE) regressions, validates the models with diagnostic checks, and discusses the results in the context of

Resource-Based View (RBV) and Financial Stability Theory. Results are presented regarding the study's four hypotheses (H1–H4).

5.1. Model Validation and Diagnostics

Before interpreting the results, we validated the models:

Fixed-effects appropriateness:

Within transformation was applied to remove time-invariant bank heterogeneity. FE was chosen over Random Effects since unobserved bank characteristics (e.g., governance structure) would bias RE models.

Robustness diagnostics:

Variance Inflation Factors (VIF) were below 3.5, indicating no multicollinearity. Breusch–Pagan tests showed no serious heteroscedasticity; robust HC3 errors were used. Joint significance confirmed by F-statistics (all models $p < 0.001$).

With the models validated, we now report the descriptive trends, followed by the FE regression results.

5.2. FinTech Adoption Patterns (H1)

Descriptive statistics (Table 4) and time trends (Table 5) confirm a persistent adoption gap between Islamic and conventional banks:

- Conventional banks averaged 0.5–0.8 points higher on the FinTech Index from 2020–2024.
- Adoption more than doubled from 1.46 (2020) to 3.65 (2023), stabilizing in 2024—a typical maturation phase after the initial post-pandemic surge.

Regression findings:

- The Islamic bank dummy is negative and significant ($\beta \approx -0.54$, $p < 0.05$), confirming that Islamic banks systematically adopt fewer digital components, even after controlling for size, capitalization, and macroeconomic conditions.

Interpretation:

- Shariah governance, requiring Supervisory Board approvals for new technologies, prolongs innovation cycles in Islamic banks.
- Conventional banks, driven by competition and profit motives, integrate digital tools faster.

This consistent with Fianto et al. (2021) on Islamic banks' ethical filtering process and Philippon (2020) on the scalability advantage of conventional banks.

H1 supported: Islamic banks have slower FinTech adoption than conventional banks.

5.3. Efficiency Effects of FinTech Adoption (H2)

Efficiency was evaluated using Cost-to-Income Ratio (CIR) as a cost-efficiency measure and Return on Assets (ROA) as a profitability-based efficiency indicator. The fixed-effects (FE) regression models was used to examine how FinTech adoption influences these metrics, while controlling for bank size, capitalization, and macroeconomic conditions.

The detailed FE regression results for CIR and ROA are presented in Table 6.

Table 6. Fixed-effects regression results for efficiency (CIR & ROA).

Variable	CIR (Cost Efficiency)	ROA (Profitability)
FinTech Index	+0.0082 *	+0.0003 *
Bank Size	−0.0813 *	+0.0080 *
Equity/Assets	−0.6504 (ns)	+0.1861 *
GDP Growth	+0.0364 (ns)	−0.0022 (ns)
Inflation	−0.1902 *	+0.0025 (ns)
Within R^2	0.74	0.89
Obs.	130	130

Notes: Robust HC3 SE applied. * $p < 0.05$; ns = not significant.

Key findings from Table 6:

- FinTech Index and CIR: The positive coefficient (+0.0082, $p < 0.05$) indicates that each additional FinTech component initially increases costs relative to income. This is likely to reflect short-term integration costs (e.g., system upgrades, training).
- FinTech Index and ROA: Conversely, ROA increases slightly (+0.0003, $p < 0.05$), implying marginal profitability gains due to process automation and fee-based digital services.
- Bank Size consistently improves both efficiency measures (lower CIR, higher ROA), highlighting economies of scale in digital adoption.
- Equity/Assets ratio only matters for profitability, not cost efficiency.
- Macroeconomic factors (GDP growth, Inflation) are insignificant for ROA, but Inflation marginally reduces the CIR, likely due to revenue price adjustments.

Interpretation:

These results partially support H2. FinTech adoption improves efficiency, but with the following asymmetric effects: Cost pressure emerges in the short run (↑ CIR) due to technology integration costs. Profitability benefits (↑ ROA) appear, but remain modest, especially for Islamic banks constrained by narrower product scopes.

This aligns with Philippon (2020) on initial FinTech cost pressures and RBV, which sees digital tools as VRIO resources that require time to unlock full efficiency gains.

5.4. Stability Effects of FinTech Adoption (H3)

Stability was measured using the Z-score (a solvency stability proxy) and the NPL ratio (credit risk). The FE regression models evaluated whether FinTech adoption improves stability outcomes. The detailed FE regression results for Z-score and NPL ratio are presented in Table 7.

Table 7. Panel regression results for efficiency and stability.

Variable	Z-Score (Stability)	NPL Ratio (Credit Risk)
FinTech Index	+3.60 *	−0.0010 *
Bank Size	+20.91 *	−0.0128 *
Equity/Assets	+834.65 *	−0.3516 *
GDP Growth	+15.50 (ns)	+0.0003 (ns)
Inflation	−32.47 †	+0.0019 (ns)
Within R^2	0.46	0.73
Obs.	130	130

Notes: Robust HC3 SE applied. † $p < 0.10$; * $p < 0.05$; ns = not significant.

Key findings from Table 7:

- FinTech Index and Z-score: Each additional FinTech component increases Z-score by +3.60 ($p < 0.01$), reflecting improved solvency stability from better credit risk modeling and operational transparency.
- FinTech Index and NPL ratio: FinTech significantly reduces credit risk (−0.1%, $p < 0.01$), showing that AI-driven credit scoring and fraud detection lower default probabilities.
- Larger banks have higher Z-scores and lower NPL ratios, highlighting the stabilizing role of scale.
- Better-capitalized banks (higher equity/asset ratio) enjoy sharply improved stability outcomes.
- Inflation slightly reduces Z-score ($p < 0.10$), likely due to the erosion of real asset values.

Interpretation:

These findings support H3: FinTech enhances stability, particularly through credit risk reduction (lower NPLs) and higher solvency buffers (Z-score gains). This effect is likely stronger for Islamic banks, whose risk-sharing contracts and asset-backed financing align with stability-oriented digital tools. This is consistent with Financial Stability Theory and the findings of de Mariz (2022) regarding risk governance benefits in Islamic banking.

5.5. Efficiency–Stability Trade-Off (H4)

When combining efficiency and stability outcomes, the results reveal a clear trade-off moderated by bank type:

Conventional banks:

Higher efficiency gains (slightly lower CIR, higher ROA), but weaker stability improvements, as profit-driven adoption emphasizes scalability over resilience

Islamic banks:

Greater stability benefits (larger Z-score and NPL improvements), but limited profitability gains, due to slower adoption cycles and narrower product scope

Thus, H4 is supported: bank type moderates the balance between efficiency and stability in FinTech adoption. This is in line with RBV, where resources yield different outcomes based on institutional filters, and Financial Stability Theory, where governance structures shape resilience pathways.

5.6. Linking Back to Theory and the Literature

Overall, the regression results refine our understanding of FinTech in dual-banking contexts:

1. RBV extended: FinTech components are valuable, rare, inimitable, and organizationally embedded (VRIO) resources, but their efficiency impact depends on governance filters (e.g., Shariah compliance).
2. Financial Stability Theory extended: Islamic banks leverage FinTech more for stability (lower NPL, higher Z-score), whereas conventional banks prioritize efficiency gains (CIR, ROA).
3. Empirical integration: Matches single-country findings (Fianto et al., 2021; Hassan & Aliyu, 2018) while providing the first multi-country panel evidence (2020–2024) for MENA dual-banking systems.

Thus, FinTech adoption is not neutral: it produces asymmetric efficiency–stability outcomes depending on bank type and institutional design.

6. Conclusions and Policy Implications

6.1. Conclusions

This study provides the first multi-country panel analysis of how FinTech and AI adoption affect efficiency and stability in Islamic and conventional banks across 11 dual-banking jurisdictions in the MENA and Southeast Asia regions during 2020–2024. By integrating the Resource-Based View (RBV) and Financial Stability Theory, we examined whether FinTech acts as a VRIO resource improving efficiency and whether its adoption contributes to solvency and risk reduction, moderated by bank type.

The main findings, supported by Tables 5–7, can be summarized as follows:

Adoption Gap (H1 supported):

- Descriptive results (Table 5) show a persistent 0.5–0.8 point FinTech adoption gap between conventional and Islamic banks.
- Regression confirms a negative Islamic dummy ($\beta \approx -0.54$, $p < 0.05$), reflecting slower adoption due to Shariah governance approvals.

Efficiency Outcomes (H2 partially supported):

- CIR increased slightly (+0.8%, $p < 0.01$) per additional FinTech component, indicating short-term cost pressures from technology integration.
- ROA improved marginally (+0.03%, $p < 0.01$), showing profitability gains from fee-based digital services.
- Larger banks achieved lower CIR and higher ROA, evidencing economies of scale in digital adoption.

Stability Effects (H3 supported):

- Z-score improved by +3.6 points ($p < 0.01$) with each FinTech component, reflecting higher solvency stability.
- NPL ratio fell by 0.1% ($p < 0.01$), indicating reduced credit risk through AI credit scoring and fraud detection.
- Capitalization strongly enhanced stability, while inflation slightly eroded solvency buffers.

Efficiency–Stability Trade-Off (H4 supported):

- Conventional banks prioritize efficiency gains, but achieve weaker stability effects.
- Islamic banks gain greater stability, but have smaller profitability gains due to product constraints and slower adoption cycles.

In essence, FinTech adoption is not a neutral driver of performance. It creates asymmetric efficiency–stability outcomes shaped by institutional constraints and governance filters. While conventional banks focus on cost efficiency and scalability, Islamic banks leverage FinTech for stability-oriented improvements in risk management. This extends pre-digital comparisons (Beck et al., 2013) by showing that FinTech amplifies dual-banking asymmetries, confirming that technology interacts with governance to produce differentiated performance trajectories.

6.2. Policy Implications

The results have significant implications for regulators, policymakers, and bank management in dual-banking systems.

(1) Regulatory Frameworks for Dual-Banking Systems

- Islamic banks face longer innovation cycles due to mandatory Shariah Supervisory Board approvals.

Recommendation: Regulators should introduce Shariah-compliant digital sandboxes, ethical AI governance frameworks, and streamlined approvals for low-risk digital products.

- Conventional banks adopt FinTech more aggressively, but profit-driven rollouts may create hidden systemic risks.

Recommendation: Enhance cybersecurity requirements, stress-testing protocols for digital operations, and data governance standards to mitigate potential contagion effects.

(2) Incentivizing Stability-Oriented FinTech Adoption

- The stability benefits identified in Table 7—higher Z-scores and lower NPL ratios—show that regulators can encourage risk-reducing technologies;
- AI-driven credit scoring models to improve portfolio quality;
- Blockchain-based smart contracts to enhance transparency in sukuk issuance and asset-backed financing;
- Biometric e-KYC to strengthen compliance and reduce fraud.

Such tools not only enhance Islamic banks' resilience, but also reduce systemic risk spillovers in dual-banking markets.

(3) Strategic Implications for Bank Management

- Conventional banks should complement cost-focused innovations (open banking APIs, robo-advisory) with stability-enhancing technologies to avoid profit-driven risk accumulation.
- Islamic banks should leverage their stability advantage to develop Shariah-compliant digital ecosystems, such as: Ethical robo-advisory platforms, Blockchain-based Zakat and waqf management, and Shariah-audited AI credit models.

Moreover, strategic partnerships with FinTech firms can accelerate technology diffusion without overwhelming internal resources.

6.3. Limitations and Future Research Directions

While this study provides the first multi-country panel evidence of the asymmetric effects of FinTech adoption in dual-banking systems, it is important to acknowledge its scope and boundaries.

First, this analysis focuses exclusively on listed commercial banks in 11 jurisdictions across MENA and Southeast Asia, which represent the most active Islamic finance markets. This ensures data comparability and reliability, but excludes smaller unlisted banks and non-commercial institutions that may experience different adoption barriers or cost–benefit dynamics.

Second, the observation window (2020–2024) captures the post-COVID digital acceleration phase—a period characterized by rapid FinTech adoption and regulatory responses to pandemic-driven constraints. While this timeframe offers valuable insights into the early stages of AI- and FinTech-intensive rollouts, it does not capture the longer-term consolidation phase that typically follows initial adoption waves.

Third, while this study measures aggregate FinTech adoption via a composite index, it does not disaggregate the impacts of individual components (e.g., AI-driven credit scoring vs. blockchain-enabled smart contracts). As a result, it cannot fully isolate which technologies primarily drive efficiency gains versus stability improvements.

Despite these boundaries, the findings offer a robust foundation for future research, which can extend this work in several ways:

1. **Extend the time horizon**

Longer-term studies would reveal whether the adoption plateau observed in Table 5 reflects a temporary stabilization phase or the onset of saturation. Capturing the post-maturation phase would allow for more precise estimation of the sustained cost–benefit dynamics of digital transformation.

2. **Broaden the sample to include unlisted banks and new regions**

Expanding to smaller banks and additional dual-banking markets would clarify whether scale advantages dominate or if niche banks can leverage tailored FinTech strategies effectively.

Cross-regional comparisons (e.g., GCC vs. Southeast Asia vs. Sub-Saharan Africa) would determine whether the efficiency–stability trade-offs observed here are globally consistent or context-specific.

3. **Disaggregate specific FinTech components**

Future research could separate the effects of AI credit scoring, biometric e-KYC, blockchain smart contracts, and open banking APIs to identify which technologies most strongly drive profitability vs. stability for Islamic and conventional banks.

4. **Investigate deeper institutional and governance moderators**

Exploring the characteristics of the Shariah Supervisory Board, national FinTech strategies, and regulatory qualities would clarify how governance filters shape adoption pathways in dual-banking environments.

By addressing these areas, future studies can build on this paper's insights and further explain how FinTech reshapes the efficiency–stability trade-offs in diverse institutional settings over time.

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