JMFS
Journal of Management and Financial Sciences

Volume XVIII
•
Issue 56
pp. 71–95
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Collegium of Management and Finance

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Risk, Default and Recovery in Islamic and Conventional Banks: A Cross-Country Empirical Investigation During the 2007 Financial Crisis

Abstract

Islamic banks showed resilience during the 2007 financial crisis, prompting interest in their risk management mechanisms.Prior studies suggest that Islamic Financial Institutions (IFIs) have lower insolvency rates than Conventional Financial Institutions (CFIs), yet empirical comparisons remain limited. Thisstudy examines default probabilities (PD), distance-to-default (DD), and recovery rates (RR) between IFIs and CFIs in the UK, Switzerland and Turkey from 2004–2013. Despite structural differences, their coexistence in these markets allows a comparative assessment of default risk and financial stability.Using the Merton-KMV and Black-Scholes models, findings reveal that IFIs had lower default risk than CFIs, particularly during the crisis, yet recovery rates remained comparable, challenging assumptions about superiority of Islamic finance in loan recoveries. The study contributes to financial stability discourse and suggests that conventional banks may benefit from adopting Islamic risk-sharing mechanisms. Future research should explore broader regulatory implications and regional variations in Islamic finance performance.

Keywords: Islamic banking, financial crisis, risk-sharing, default rates, recovery rates, risk management
JEL Classification: G21, G33, E44, G32, G01

Introduction

The 2007 financial crisis and the on-going European debt crisis have underscored the critical importance of monitoring the health of the global banking system. Despite extensive efforts within the last 2 decades to restore confidence in the global financial system, the Islamic banking sector continued to flourish and has become one of the fastest growing segmentsin the financial sector. According to recent data from the Global Islamic Finance Report (GIFR) and Islamic Finance Development Report 2022, the global size of the Islamic financial services industry was valued at USD 1.357 trillion with a growth rate of 25% [GIFR, 2012]. However, the latest 2022 estimates place the industry's current value at USD4.5 trillion, reflecting an 11% growth rate annually, with projections indicating that Islamic finance is set to surpass USD 6.67 trillion by 2027, highlighting the sector's resilience and its increasing role in the global financial landscape.

Although more than a decade has passed since the 2007 crisis, its lessons remain highly relevant in today's financial landscape. Studying banking stability during a systemic crisis provides valuable insights for current and future financial risks. The 2004–2013 study period was selected for several different reasons; firstly, it captures the full cycle of financial stress – before, during and after the crisis, allowing for a robust comparative analysis. More importantly, Islamic banking was still evolving at that time, making it an ideal case study to assess long-term resilience. Furthermore, the regulatory shifts post-crisis reshaped banking frameworks, hence understanding how different financial systems performed in past crises has implications for risk mitigation strategies today.

Given the persistent global economic uncertainties, banking sector volatility and continuous innovation in corporate debt and derivative products, both academics and practitioners have shown renewed interest in default risk modelling. The Merton-KMV model, derived from Merton's [1974] foundational work, is among the most studied forecasting models. Table 2 provides a summary of selected empirical literature comparing the relative performance of both Islamic and conventional banks. Although numerous studies focused on aspects such as business models [Cihak, Hesse, 2010], efficiency [Beck et al., 2013], profitability and the stability of Islamic banks [Weill,2010], very few addressed measuring the distance-to-default that depicts the default behaviour of Islamic loans.

Existing studies provide some insights into default risks but leave gaps in understanding recovery rates. Baele et al. [2010] examined default risk for Islamic and conventional loans using data obtained from the Pakistani Credit Information Bureau, covering all business loans outstanding between April 2006 and December 2008. Using a hazard modelling approach and controlling for a variety of factors, they found that default rates on Islamic loans are lower than for conventional loans, attributing this to religious reasons. Boumediene [2011] used Merton's model to measure the distance to default and default probability of Islamic and conventional banks, finding that Islamic banks had a significantly higher mean distance to default compared

to conventional banks.While extensive studies have analysed Islamic banking profitability, efficiency and stability, there is no empirical article dealing explicitly with the measurement of recovery rates on defaulted loans in Islamic financial institutions and comparing them with conventional banks using bank-level data.

The primary aim of this study is to determine whether Islamic banks exhibit lower default risk and higher recovery rates compared to conventional banks, particularly during financial crises. The research focuses on understanding the financial resilience of Islamic banking and exploring whether its risk-sharing mechanisms contribute to greater stability compared to conventional banks. To address this, the study empirically compares default risks and recovery rates between IFIs and CFIs by analysing financial stability in both Islamic and conventional banks, specifically seeking to answer two fundamental questions: Do Islamic banks have lower default probabilities (PD) than conventional banks? And do Islamic banks demonstrate higher recovery rates (RR) on defaulted loans compared to conventional banks?

To address these objectives, the study develops, and tests two hypotheses derived from theoretical and empirical perspectives.

- H1: Islamic banks have lower default probabilities (PD) compared to conventional banks.
- H2: Islamic banks have higher recovery rates (RR) compared to conventional banks.

Based on these hypotheses and objectives, the study contributes to financial stability research and offers insight into whether conventional banks could benefit from Islamic banking principles.

This paper is organised as follows: Section 1 identifies the tenets of the Islamic banking system and explains their implications for credit risk exposure in IFIs and CFIs, section 2 introduces theoretical framework on loan default, section 3explains the hypotheses tested in this study, section 4 outlines the methodology,and section 5 examinesdata, variables and any econometric specifications. Finally, section 6 presents conclusions and implications.

Islamic banking and loan default

IFIs – CFIs structural differences and implications for risk exposure

The defining feature of Islamic financial system IFIs, besides having banking practices consistent with the Shariah, is the prohibition of interest, known as"riba". Unlike conventional banks'CFIs, which operate on fixed rates and prioritise profits maximisation, IFIs operate within a risk-sharing framework that integrates economic and social development, a fundamental distinction that influences the nature of risk exposure in both systems. IFIs do so by embodying social justice to ensure that returns are reinvested in society through the system of a profit and risk sharing (PLS) paradigm. It is a partnership-based approach used by the bank with its customers to achieve the goal of being socially responsible without forgetting about profitability, under which the bank and its customers engage in trading activities as partners,

agreeing on sharing the risk and reward. The trading activities are generally asset-backed, which maintains a direct link between financial services and the real economy, reducing speculative activities that trigger financial crises.

While PLS financing remains the core principle of Islamic banking in theory, its practical application presents challenges. IFIs need to determine the profit-loss-sharing ratio for each project, with moral hazard concerns often deterring IFIs from extensively using PLS, as quantifying the characteristics of clients and the proposed business success potential can be complicated. Revenue in PLS is uncertain and collateral cannot be always collected, and IFIs must engage in extensive due diligence andput more effort into selection and monitoring to ensure that information rent is not exploited by borrowers. Hence, for short- term financing needs, IFIs tend not to rely extensively on PLS modes, and although IFIs make every effort to ensure that their investments are solid and produce profits, under the Mudaraba contract (PLS mode) Islamic banks have limited means to control and intervene in the management of a project [Abedifar et al., 2011]. Table 1highlights the key differences in the financial structures and risk exposure of IFIs and CFIs, offering insights into how risk-sharing mechanism affects banking stability.

Table 1. Comparison of IFI and CFI frameworks

Nominal value guarantee of:		
	Islamic Financial Institutions	Conventional Financial Institutions
Demand deposits	YES	YES
Equity-based system where capital is at risk	YES	NO
Rate of return on deposits	Uncertain, not guaranteed	Certain and guaranteed
Mechanism to regulate final returns on deposits	Depends on bank's performance	Irrespective of bank's performance
PLS principle is applied	YES	NO
Use of Islamic modes of financing		
PLS and non-PLS modes	YES	N/A
Use of discretion by bankers regarding collateral	Possible for reducing moral hazard in PLS mode, YES in non-PLS modes	Yes always
Banks' pooling of depositors' funds to provide depositors with professional investment management	YES	NO

Source: Errico and Farahbaksh [1998, p.10].

From the liability side, IFIs manage deposits mainly in two forms [Iqbal et.al., 1998]: current accounts that bear no interest but guarantee payinga principal to holders upon demand, and investment (or savings) accounts, where agreed-upon returns are shared between the Islamic bank and the investment account holders under a PLS agreement. The investment depositors are considered as equity holders of the IFIs, incentivising them to continuously monitor Islamic bank's performance and discipline their risk-taking and sharing behaviour more effectively, while conversely, the nature of the relationship between CFIs and their customers is different, as they are considered debtholders rather than partners. To meet their fixed

interest obligations, CFIs allocate a huge part of their funds to interest-bearing loans, trying to decrease the volatility and uncertainty of loan revenues. This structural difference means that CFIs focus on creditworthiness and securing interest income, whereas IFIs emphasise risk-sharing and economic participation.

From the above clarification, it is somewhat evident that IFIs are more exposed to risk than their conventional counterparts due to their reliance on profit-sharing arrangements. A key risk that IFIs face is known as Displaced Commercial Risk (DCR) [AAOIFI, 1999] – a scenario where banks must decide between absorbing financial losses or passing them onto investment account holders. In the likelihood of financial difficulties, IFIshave the dilemma whether to give larger payouts or to share realised losses with their clients. The first situation-maintains investors' confidence, which leads to an increase in deposits,which can force a bank's shareholders to raise more equity capital to maintain capital ratios and prevent dilution of their ownership rights. Conversely, poor payouts may encourage deposit withdrawals, leading to potential liquidity and (ultimately) solvency problems [Abedifar et al., 2011]. When IFIs are performing well they may adjust profit rates upward, but at a slower rate than realised profitability, while during economic downturns, IFIs tend to share realised losses with investment account holders to avoid insolvency, which suggests that IFIs may have a slightly greater capacity to absorb losses compared to conventional banks. Unlike CFIs, which must continue interest payments irrespective of performance, IFIs can adjust profit rates dynamically to reflect economic conditions, allowing them to maintain stability during crises, as observed in the 2007 financial crisis, when IFIs were relatively less affected by loan defaults.

Islamic lending structures and characteristics

As stated above, the most common Islamic modes of financing are based on PLS. The fixed rate of return that is used in conventional loan products is totally prohibited in Islamic contracts and replaced by a return that is uncertain and dependent on the project's actual profit. This inherent uncertainty can create hesitation among investors who are concerned about the ex-post nature of profits. While Musharakah and Mudarabah are considered the most Shariah-compliant financing arrangements, and although they are the most common modes to be compatible with Shariah principles, in practice they constitute a small share of the market for Islamic loan products. For example, Baele et al. [2010] found that PLS contracts play a minor role in Pakistani Islamic banking, amounting to less than 2% of the existing Islamic loans. The limited adoption of these financing models can be attributed to problems such as "adverse selection" and "asymmetric information", where IFIs struggle to assess borrowers' true risk profile.

Table 2. Existing literature

Authors	Countries of studies	Period	Methodology	Main Findings
Al-Jarrah, Molyneux [2005]	Bahrain, Egypt, Jordan and Saudia Arabia	1992–2000	Stochastic Frontier Analysis	Islamic banks are more cost and profit efficient compared to conventional commercial and investment banks.
Boumediene, Caby [2008]	Nine Islamic countries	2005–2009	E-Garch and GJR-Garch	Islamic banks were at least partially immune to the subprime crisis, and were not subjected to the same risks as conventional banks.
Baele et al. [2010]	Pakistan	2006–2008	Hazard function	Defaults rates on Islamic loans are lower than for conventional loans.
Cihak, Hesse [2010]	20 OIC member countries	1993–2004	Regression – OLS and Robust	Small Islamic banks are more stable than small conventional banks. Large Islamic banks, however, are less stable than their conventional counterparts.
Hasan, Dridi [2010]	Eight countries	2007–2009	Regression – OLS	The credit and asset growth of Islamic banks were more than of conventional banks from in 2008–2009. Profits of Islamic banks fell more than conventional banks in 2009 due to limitations in their risk management practices.
Elrahman, Saaid Ali [2011]	Bank-level data of 39 full-fledged IBs, 17 countries	1998–2008.	Z-Score	IBs are associated with higher credit risk, although with lower overall risk. IBs are financially stable.
Pappas et al. [2012]	Middle and far Eastern countries	1995–2010	Survival models	IBs have lower failure risk and are less interconnected, which reduces the likelihood of domestic co-failure.
Farook, Hassan, Clinch [2013]	14 Islamic countries	1992–2005	Descriptive and correlation analysis	IBs have significantly lower loan loss provision expenses and loan loss allowances, but a significantly higher loan growth.
Johnes, Izzeldin, Pappas [2014]	Global sample	2004–2009	Efficiency comparison using DEA	Islamic banks perform better during crises in terms of risk and efficiency.
Boumediene, Marston [2022]	OIC Member Countries	2008–2020	GARCH Option Pricing Model	Islamic banks have lower credit default probabilities than conventional banks during crisis periods, indicating a more stable credit risk profile.
Farhan et al. (\ [2024]	Pakistan	2023	Survey Methodology	IFIs in Pakistan are efficient in managing various risks, with emphasis on equity investment risk, liquidity risk, and risk assessment & analysis.
This paper [2025]	Three European countries	2004–2013	Black & Scholes models	Conventional banks are more exposed to credit risk than Islamic banks. The recovery rates of defaulted Islamic loans seem to be similar in both CFI and IFIs.

Source: own material.

Instead of engaging solely in a large-scale Mudarabah contracts, it may be more effective to subdivide the project in a sum of small arrangements, allowing financial institutions to terminate partnership in case of moral hazard, and try to find another partner,in an attempt to minimise losses. This approach also discourages dishonest behaviour from borrowers, as they risk losing future financing agreements.

Instead of widening their complex products offerings, many IFIs have been mimicking the conventional way of lending to mitigate risk exposure. In a Murabaha contract, for example, the IFI purchases a real asset from a supplier (phase I) and then sells it to the customer at a predetermined mark-up price in a different contract (phase II), allowing for repayment in instalments over a specified period or in lump sum upon contract maturity. Thisclearly-shows that IFIs are much more exposed to risk throughout the asset acquisition and resale process, particularly starting from the beginning of phase I until the asset is transferred to the borrower, i.e. the end of phase II.

The shift towards non-PLS structures such as Murabaha reduces uncertainty but does not eliminate default risk. While Murabaha transactions provide a clear repayment structure, they still expose IFIs to credit risk if borrowers fail to meet their instalment obligations, and the reliance on non-PLS structures therefore influences the probability of default (PD) and indirectly affects the recovery rate (RR), as IFIs must determine how to enforce repayments without violating Shariah principles. The dominance of Murabaha and other non-PLS structures in Islamic banking suggests that IFIs face similar credit risksas CFIs, despite their underlying ethical and Shariah principles. Since these contracts resemble conventional loans in practice, it remains an open question whether IFIs achieve lower default rates or better loan recovery outcomes than their conventional counterparts.

Theoretical framework of default and recovery rates on Islamic loans

The previous section shows that many practical financing modes used in IFIs largely resemblethose in CFIs, although thisdoes not necessarily imply that their default and recovery rates should be also identical, without obvious strong evidence, as Islamic loans are structured and managed differently. The fundamental difference lies in the Shariah principles embedded in Islamic financial contracts and their influence on borrower behaviour, aswhen borrowers face financial distress, they rationally compare the cost of default. The higher the default ex-post costs (including penalties, fees, interest and collection costs etc.) charged to the overall debt comparing with the net present value of the underlying asset at the time of default, the more likely will the borrower decide to write-off the loan. In contrast to conventional banks, Islamic financial contracts prohibit excessive default costs, offering distressed borrowers additional time to recover without incurring additional financial burden. The Quran reinforces these principles by giving respite to borrowers facing such difficult circumstances:

"And if the debtor is in a hard time (has no money), then grant him time till it is easy for him to repay, but if you remit it by way of charity, that is better for you if you did but know." (2:280).

The leniency afforded by Islamic banks may serve as a positive incentive for loan recovery, as borrowers are not subjected to escalating costs that might otherwise drive them towards insolvency. From a behavioural perspective, the absence of additional penalties in IFIs may create mixed incentives.While some borrowers may appreciate the leniency and work towards repayment, others may strategically delay payments, knowing they will not incur extra financial costs, which could lead to a different default dynamic compared to CFIs, where rising interest payments act as a deterrent against late repayment. The second reason behind this argument is the significant differences in the classification and management of non-performing loans between (NPLs), with IFIs tending to adopt more lenient reclassification policies. For example, some Islamic banks allow non-performing financing to be reclassified as performing as long as instalment arrears remain below six months or 180 days. This contrasts withthe Basel requirements [Basel, 1999], which mandate that a loan can only be reclassified as performing once all outstanding arrears have been fully settled. However, the flexible treatment of non-performing loans (NPLs) in Islamic banks could result in higher recovery rates (RR), as borrowers may be more likely to settle their debts without accumulating excessive financial burdens. The effectiveness of this approach in improving overall loan recovery remains an empirical question that this study seeks to address.

Following these fundamental structural and policy differences, the following framework is proposed, from which two key hypotheses are derived. The first hypothesis examines whether Islamic banks exhibit lower default rates due to their risk-sharing structures, while the second one explores whether Islamic banks have higher recovery rates as a result of their flexible repayment structures and ethical financial principles.

Research approach and hypotheses

The theoretical framework presented in the previous sections provides the foundation for testing the differences in default risk and recovery rates between IFIs and CFIs. To empirically examine these differences, three key assumptions and two hypotheses are formulated, which align with the study objectives of evaluating whether IFIs have lower default risk and higher recovery rates compared to their conventional counterparties.

The following assumptions are derived from the structural differences in Islamic and conventional banking, as discussed earlier:

ASSUMPTION 1: regardless of the client's current financial situation or estimated financial background, anyborrower (M or S) that has been granted a loan is exposed to the risk of default within the period $t < T$.

ASSUMPTION 2: The borrower (whether devout M or secular S), regardless of their financial profile, is less likely to default on Islamic loans compared to conventional loans due

to the risk-sharing nature of IFIs and the ethical obligations imposed by Shariah compliance. This is based on the assumption that IFIs emphasise partnership and social responsibility, leading to stronger loan selection criteria and greater borrower commitment to repayment.

$$e = \alpha f \quad \text{with} \quad \frac{1}{n} > \alpha > 0 \tag{1}$$

$$g = \beta h \quad \text{with} \quad \beta > s > 1 \tag{2}$$

where:

- e represents the expected probability of default (PD).
- α is a risk-adjustment coefficient, which accounts for borrower discipline and ethical obligations in IFIs.
- f denotes financial exposure, representing the total loan commitment at risk.
- g is another function of default probability in CFIs, where β represents a risk coefficient specific to conventional banking practices and h denotes financial exposure in CFIs.
- n is the number of screened applicants who pass Islamic banks' stringent credit assessment.
- s represents a threshold factor related to default probability in conventional banking.
- The inequality constraints ensure that default probabilities remain bounded within a specific range, reinforcing that IFIs screen borrowers more rigorously, and may experience lower default rates.

ASSUMPTION 3: Defaulted Islamic loans are more (less) likely to be recovered (written-off) compared to defaulted conventional loans. Islamic banks, bound by religious and ethical constraints, grant borrowers time to recover from financial difficulties before enforcing repayment, in accordance to surah (2:280) mentioned in the previous section. This structured flexibility could result in higher recovery rates compared to conventional banks, which impose stricter penalties and quicker write-offs.

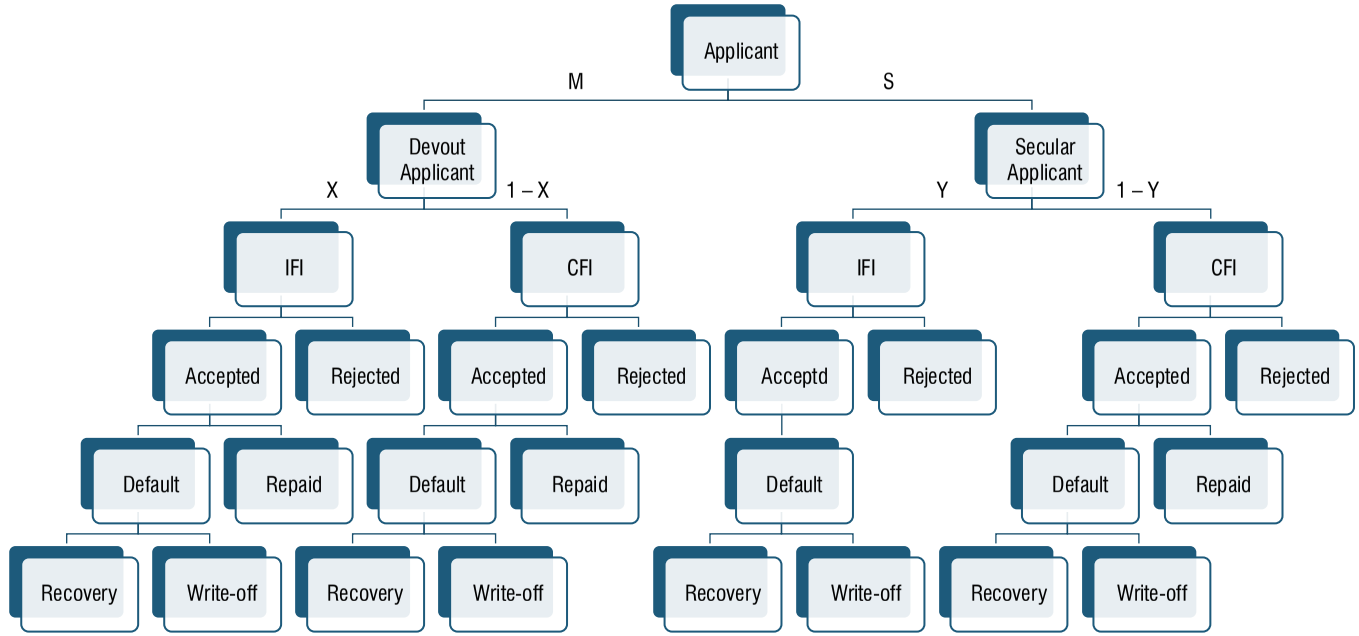
$$i = \gamma j \quad \text{with} \quad \gamma > \frac{1}{j} > 0 \tag{3}$$

$$k = \delta l \quad \text{with} \quad 1 > \frac{1}{l} > \delta \tag{4}$$

where:

- i represents the expected recovery rate (RR) in IFIs.
- γ is the recovery efficiency coefficient reflecting borrower trust, ethical obligations, and flexible repayment structures in Islamic banking.
- j is a scaling factor for loan repayment outcomes in IFIs. It represents a factor influencing Islamic loan recoverability, accounting for borrower commitment and extended repayment periods.
- k and δ represent the same relationships but for CFIs, where loan recovery policies are often stricter.
- l represents conventional loan enforcement mechanisms, such as strict foreclosure policies and penalty-driven recovery processes.

Figure 1. Simplified loan application and recovery process flow for IFIs and CFIs



Source: ownmaterial.

The loan application process and default-recovery cycle are illustrated in Figure 1, which provides a visual representation of how applicants, both devout and secular, navigate the lending system within IFIs and CFIs, from the initial application process phase to loan repayment, default and potential recovery or write-off. Building on the theoretical framework and assumptions outlined earlier, the following hypotheses are proposed to test the relationship between credit risk and recovery rates in IFIs and CFIs. These hypotheses are based on the distinct structural and operational differences between the two systems, particularly PLS, risk management practices and loan recovery policies. Thus, the following hypotheses are proposed:

HYPOTHESIS 1. Credit risk is lower in IFIs compared to CFIs, despite IFIs being more exposed to credit risk.

The level of credit risk does not depend on the differences between Islamic and conventional modes of financing, but on the underlying attributes and management of defaulted bank loans, derived from the teachings of Shariah. This hypothesis suggests that the Shariah-compliant principles guiding IFIs, particularly the prohibition of interest and emphasis on risk-sharing, lead to better borrower selection and more conservative risk management practices. Although IFIs engage in riskier projects due to PLS, their screening process, moral hazard controls and closer monitoring reduce the overall credit risk.

Moreover, IFIs cannot increase loan prices or apply penalty interest in cases of default, but insteadrely on partnership-based modes, encouraging clients to honour their financial commitments, which results in enhanced scrutiny in loan portfolio selection and mitigates default risk despite higher initial exposure. Empirical tests will compare PD and DD between IFIs and CFIs to validate this hypothesis.

HYPOTHESIS 2. The recovery rates on defaulted bank loans are higher in IFIs compared to CFIs.

This may be a result of the nature of the banking system, and the ethical and partnership-based nature of IFIs, which fosters long-term trust and mutual responsibility between banks and borrowers. According to Surah 2:280 of the Quran, IFIs grant borrowers time to recover from financial difficulties, ensuring that the recovery process is fair and free of additional burdens. This lenient approach allows borrowers to stabilise their financial situation, ultimately improving the likelihood of full loan repayment.

Moreover, there is a big difference in classification and management of NPLs between the two banking systems, with IFIs managing NPLs more flexibly, allowing reclassification of loans as performing once partial payments are resumed. By contrast, CFIs apply stricter enforcement and quicker write-off policies, reducing overall recovery rates.Recovery rates (RR) are therefore expected to be significantly higher for IFIs, reflecting the more cooperative and lenient recovery process embedded in Shariah-compliant finance.

The empirical analysis will estimate RR for both IFIs and CFIs using the KMV–Merton model and Black-Sholes framework to validate this hypothesis.

Methodology

Estimating default risk

This study employs Merton's model [1974], based on Black and Scholes's option pricing formula [1973], to measure the distance-to-default DD and the probability of default PD of five IFIs and five CFIs operating in the UK, Switzerland and Turkey from 2004 to 2013. These indicators are widely recognised for assessing the financial health of companies, providing a robust framework to gauge how close a limited-liability company is to default. This methodology also has the advantage of remaining neutral to the specific characteristics and size of each bank, making it suitable for comparative analysis.

The framework of the model is built on a simple accounting identity: the value of the firm, V, (or the value of its assets) should be equal to the sum of the values of its debt, D, and equity, E. Because debt is senior to equity, shareholders are residual claimants on the firm: the firm's assets are first used to pay debt-holders, and whatever is left is distributed to shareholders. Concisely, the value of equity can be written as:

$$E = max(0, V - D) \tag{5}$$

The Merton model treats a firm's equity as a call option on the firm's assets, with the strike price equal to the value of its debt. The strike price of the option is also known as the default barrier. Given an option pricing formula, knowledge of any two of the following three variables – the value of the firm, the debt owed by the firm, and the market value of equity – is sufficient for estimating the remaining unknown variable. In most practical applications, the option pricing formula used is the Black-Scholes-Merton pricing formula for European call options, and the strike price or default barrier is set equal to the level of the firm's short-term liabilities and half its long-term liabilities. According to this framework, default occurs when the market value of the firm's assets (V) falls below the value of its debt (D) at maturity (T).

The current market value of equities can be expressed by Black and Scholes [1973] option pricing formula:

$$E=VN(d_1) - DN(d_2) \tag{6}$$

where:

- V = the market value of the firm's assets
- D = the face value of the firm's debt (default barrier)
- $N(d_1)$ and $N(d_2)$ = cumulative probabilities from the standard normal distribution

The variables d_1 and d_2 are defined as:

$$d_1 = \frac{\ln\left(\frac{V}{D}\right) + \frac{1}{2}\sigma^2 T}{\sigma\sqrt{T}} \tag{6a}$$

$$d_2 = d_1 - \sigma\sqrt{T} = \frac{\ln\left(\frac{V}{D}\right) - \frac{1}{2}\sigma^2 T}{\sigma\sqrt{T}} \tag{6b}$$

where:

- σ = asset volatility (standard deviation of returns)
- T = time to maturity

The expressions for d_1 and d_2 help determine the probability that the firm's asset value will exceed its debt at maturity (T), thereby measuring the firm's distance to default. If $V<D$ at maturity, the firm defaults and equity holders receive nothing.

In the context of banking, particularly for IFIs, certain modifications to the standard Merton model are necessary to align with Shariah principles. According to Ronn and Verma [1986], the risk-free rate of interest will not appear in the calculation of d_1 and d_2, as the present value (PV) of the debt is used instead of the discounted strike price, which eliminates the need to include the discount factor e^{-rT} in the formula. This approach is consistent with the treatment of liabilities in Islamic banks, where deposits are generally insured, and their PV therefore guarantees that uninsured liabilities are only a small fraction of the total liabilities. The previously mentioned assumptions allow us to use the formula of option pricing for IFIs, since Sharia does not recognise the time value of money in financial transactions, as it results from the concept of interest [Nurraschmi et al., 2012].

According to Merton [1974], the dynamics of the market value of equity (E), which is a function of the firm's asset value (V) and time to maturity (T), can be expressed as a stochastic differential equation:

$$dE = \mu_E E dt + \sigma_E E dW_E \tag{7}$$

Applying Ito's Lemma, the stochastic differential for (E) can be written as:

$$dE = \left(\frac{1}{2}\frac{\partial^2 E}{\partial V^2}\sigma_V^2 V^2 + \mu_V V\frac{\partial E}{\partial V} + \frac{\partial E}{\partial t}\right)dt + \sigma_V V\frac{\partial E}{\partial V}dW \tag{8}$$

where:

- μ_V = the growth rate of the firm's asset value
- σ_V = volatility of the firm's asset value (asset volatility)
- dW = standard Brownian motion
- $\frac{\partial^2 E}{\partial V^2}$ = the second partial derivative of equity value with respect to asset value, representing the curvature or sensitivity of the rate of change of equity value as the asset value fluctuates.

The first partial derivative $\frac{\partial E}{\partial V}$ represents the rate of change of equity value (E) with respect to the asset value (V) – essentially the slope of the relationship between equity and asset value. The second partial derivative $\frac{\partial^2 E}{\partial V^2}$ represents the rate of change of this rate of change, capturing the curvature or convexity of the equity value relative to the asset value. This term plays a critical role in Ito's Lemma,as it accounts for how the uncertainty from asset volatility (σ_V) affects the stochastic behaviour of equity value over time. Ignoring this term would lead to significant inaccuracies in estimating risk and option value.

The term $\frac{1}{2}\frac{\partial^2 E}{\partial V^2}\sigma_V^2 V^2$ therefore represents the contribution of volatility and convexity to the dynamics of equity value, ensuring more accurate modelling of the firm's financial risk.

From this, we derive the relationship between equity volatility and asset volatility (Equation 9a and 9b):

$$\sigma_E E = \sigma_V V \frac{\partial E}{\partial V} \tag{9a}$$

$$\frac{\sigma_E E}{\sigma_V V} = \frac{\partial E}{\partial V} = N(d_1) \tag{9b}$$

$$\sigma_E E = \sigma_V V N(d_1) \tag{10}$$

The concept of a distance measure of risk follows simply from equation (5) representing the relationship between asset value (V) and debt level (D). The higher the value of the firm's assets, V, relative to the strike price or default barrier, D, the farther away from default the firm is. In the case of the Merton [1974] model, which assumes that the asset value of the firm follows a geometric Brownian motion process, the distance-to-default (T periods ahead), is given by

$$DD = \frac{\ln \frac{V}{D} + \left(\mu_V - \frac{1}{2}\sigma_v^2\right)T}{\sigma_V \sqrt{T}} \tag{11}$$

where:

- $\ln \frac{V}{D}$ = the logarithm of asset-to-debt-ratio. It measures the relative size of the firm's asset valued compared to its debt level. A higher value suggests lower likelihood of default.
- $\frac{1}{2}\sigma_v^2$ = adjustment for volatility. It reduces the drift rate μ_V to reflect risk-neutral dynamics of asset value over time.
- $\sigma_V \sqrt{T}$ = annualised volatility term

Equation (10) simply states that the distance-to-default is the expected difference between the asset value of the firm relative to the default barrier, after normalising for the volatility of assets σ. In this context, the modified Merton model is particularly suited for analysing Islamic financial institutions, because it provides a distance-based measure of credit risk without relying on interest-based components. The key advantage of this model is that it

allows for a neutral assessment of default risk across both IFIs and CFIs, despite differences in their financial structures.

The above equations clearly that when the market value of firm's assets V_T falls below the value of debt, the default barrier D_T at maturity T, there is a probability of default PD, given by:

$$P_T = prob(V_T \leq D_T) = \varphi(-DD) \tag{12}$$

where:

- $\varphi(.)$ = the cumulative distribution function of the standard normal distribution.
- $-DD$ = negative distance-to-default, representing the likelihood that the asset value will fall below the default barrier.

The values of debt and equity D, E can be extracted from the bank's balance sheet, and the market value of assets V and their volatility σ can be estimated from the equations (6) and (10). The equations (11) and (12) are then used to obtain the distance-to-default and probability of default over the given time horizon. These calculations are applied to each of the 10 banks in the sample (5 IFIs and 5 CFIs), providing a comparative analysis of DD and PD for both IFIs and CFIs.

Estimating recovery rates

In this model, we estimate the recovery rates by assuming a positive correlation between the firm's asset values and collateral value. The model is simplified under the assumption of a single level of debt seniority and a continuous monitoring of the firm's asset value. The following derivation expresses RR as the expected value of $\frac{V}{D}$, conditional on the asset value falling below the default barrier D_T, which shows the probabilistic nature of asset values at the time of default. The expected recovery rate can be determined using the following equations:

$$E\left(\frac{V}{D}\middle| V < D\right) = \frac{1}{D_T} E(V \mid V < D_T) \tag{13}$$

This equation represents the expected asset value given that it falls below the default barrier D_T, which is the mean of a truncated lognormal variable:

$$E(V \mid V < F) = e^{\mu + \frac{\sigma^2}{2}} \frac{\theta(\ln D_T - \mu)}{\theta(\ln D_T - \mu - \sigma)} \tag{14}$$

where:

- $\mu = \ln V + \left(\mu - \frac{\sigma^2}{2}\right)t$ is the mean of the $\ln(V)$ (15)
- $\sigma^2 = \sigma^2 t$ is the variance of $\ln(V)$ (16)
- $\theta(.)$ is the standard normal cumulative density function

Plugging these two quantities (15) and (16) into equation (14), the expected asset value below the default barrier simplifies to:

$$E(V \mid V < D_T) = E(V)\frac{\theta(-d_1)}{\theta(-d_2)} \tag{17}$$

Thus, the expected recovery rate (RR) is given by

$$RR = E\left(\frac{V}{D} \mid V < D_T\right) = E\left(\frac{V}{D}\right)\frac{\theta(-d_1)}{\theta(-d_2)} \tag{18}$$

This approach provides a probabilistic framework for estimating the recovery rate in the event of default, linking it directly to the firm's asset value distribution and the probability of default (PD), with the assumption of a positive correlation between asset value and collateral value ensuring that changes in asset volatility and debt levels have a measurable impact on recovery rates.By running sensitivity analyses on PD and RR, we can investigate how variations in asset volatility (σσ), debt levels (DD), and time horizon (TT) influence the expected recovery rate. These results are important for validating Hypothesis 2, which suggests that recovery rates for Islamic loans (IFIs) are higher compared to conventional loans (CFIs) due to structural and risk-sharing differences.

Data, variable specification and econometric specification

Data

Table 3 below shows the sample used in the study. It consists of 10 publicly listed commercial financial institutions,made up of 5 IFIs and 5 CFIs operating in 3 countries: The United Kingdom, Switzerland and Turkey. These countries were selected for their diverse banking environments, representing a mix of established financial markets (UK and Switzerland) and an emerging market with a growing Islamic finance sector (Turkey).

To ensure comparability, banks were selected based on their market share and non-performing loan ratios to achieve a homogenous sample, with data obtained from financial statements sourced from Thomson Reuters DataStream, Bloomberg and individual bank websites when necessary. The estimation covers a period of nine years, from 2004 to 2013.

It is noteworthy that Islamic banks, compared to conventional ones, are relatively smaller in size and newer in history, particularly in Europe. This characteristic may influence the results and should therefore be considered when interpreting the findings. Additionally, key macroeconomic variables – such as GDP growth, inflation rate and interest rate volatility – were included to control for external shocks that may affect both default probabilities and recovery rates.

Table 3. Name and location of IFIs and CFIs in the sample

Name of CFIs	Country	Name of IFIs	Country
Standard Chartered	UK	Islamic Bank of Britain	UK
Standard Life Bank	UK	European Islamic Investment Bank	UK
Bank Coop AB	Switzerland	Dar Almaal Al-Islami Trust	Switzerland
Tekstilbank	Turkey	Albaraka Turk	Turkey
Şekerbank T.A.Ş.,	Turkey	AsyaKatılımBankası A. Ş	Turkey

Source: own material.

Study variables

The key variables used in this study are Distance-to-Default (DD), Probability of Default (PD) and Recovery Rate (RR). Table 4 summarises the definitions, methods of calculation, and data sources for these variables.

Table 4. DD and PD variables and computation methodology

	CFIs	IFIs
E (Equity)	Number of shares outstanding X price of the share at the beginning of each year (current market capitalisation)	Idem
D (Debt)	Total Liabilities	Total Liabilities: PLS accounts
V (Market value of assets)	from equations (6), (8), (9), (10), (11)	Idem
σ_E (equity volatility)	Historical volatility (standard deviation of daily change in share price return x√265) for each year.	Idem
σ_V (Asset volatility)	from equations (11), (12)	Idem
T (maturity)	typically, 1 year	Idem
μ_V (growth rate)	Annual rate of return of assets	Idem

Source: own material.

These variables were computed using the Merton-KMV model and Black-Scholes framework, as previously explained in the methodology section.

Results and discussion

The results are presented in Tables 5, 6, 7 and 8. The descriptive statistics examine the relationship between credit risk variables by comparing the average (mean) for each variable across Islamic and conventional banks. The mean distance-to-default is equal to 2.34 and –2.5 for Islamic and conventional banks respectively, which indicate that Islamic banks are further from default than conventional banks. The default probability is high for both types of banks, but it is evident that Islamic banks have less than half of the probability of default of conventional banks.

Table 5. Summary Results – Mean Distance-to-Default, Probability of Default, and Recovery Rate (2004–2013)

Bank Type	PD	DD	RR
Islamic Banks	.1020329	2.339788	.7079488
Conventional Banks	.3758477	–2.495592	.9735583
P-Value	0.0821	0.0782	0.0000

Source: own material.

The Wilcoxon rank-sum test was performed to measure whether the probability of default between the two types of banks is statistically significant. Theresults confirm that the mean probability of default between the two types is statistically significant at the 10% level (p-value = 0.0821), allowing us to reject the first null hypothesis and conclude that credit risk was significantly lower in Islamic banks compared to conventional banks in the years 2004–2013.

The p-value for the recovery rate is highly significant (p-value = 0.0000). Althoughthe significance in the p-value means that the two types of banking are extremely different in terms of recovering their debt, we find that the mean recovery rate is higher in conventional banking than in Islamic banking, leading us to reject the second hypothesis.

To better understand the impact of the 2007–2008 financial crisis, the data weresplit into three periods: 2004–2007 (pre-crisis), 2007–2008 (crisis period), and 2008–2013 (post-crisis). In the pre-crisis phase, the mean probability of default for IFIs was 0.076, compared to 0.224 for conventional banks. For the same period, the p-value shows no significance between the two groups of banks (p-value = 0.4435), although recovery rates are significantly higher for conventional banks.

Table 6. Default Probabilities and Recovery Rates – Pre-crisis (2004–2007)

Bank Type	PD	RR
Islamic Banks	0.0758081	0.5104429
Conventional Banks	0.2244	0.9652833
P-Value	0.4435	0.0000

Source: own material.

The situation changed during the second phase to reflect a high divergence in PD between the IFIs and CFIs, with conventional banks having nearly four times higher PD. Recovery rates remained higher for conventional banks during this period.

Table 7. Default Probabilities and Recovery Rates – Crisis period (2007–2008)

Bank Type	PD	RR
Islamic Banks	0.0954	0.6002
Conventional Banks	0.3958	0.9341
P-Value	0.0956	0.0015

Source: own material.

In the post-crisis period, the mean PD for conventional banks tripled compared to Islamic banks, with significant p-value (0.0724). Recovery rates for Islamic loans increased by 58.7%, whereas conventional loan recovery decreased by 12%.

Table 8. Default Probabilities and Recovery Rates – Post Crisis (2008–2013)

Bank Type	PD	RR
Islamic Banks	0.1156309	0.8103593
Conventional Banks	0.4750713	0.8585233
P-Value	0.0724	0.0081

Source: own material.

The lower credit risk observed in Islamic banks can be partially explained by their small size and early stage in European markets. Additionally,more rigid client screening processes for IFIs may contribute to this outcome,as the clientele of IFIs, mainly Muslims, are subject to more scrutiny than customers targeted by CFIs.

However, the recovery rate findings are less straightforward. Despite the theoretical expectation that Islamic banks would exhibit higher recovery rates due to their risk-sharing structure and client support mechanisms, the results suggest otherwise.Islamic banks do not impose any default costs on borrowers, and clients are given a period for recovery from their financial difficulties, and it has been empirically proven that the default probability on Islamic loans are less than half if compared with conventional loans. Several factors may explain this discrepancy. Notably, collateral practices in IFIs are akin to those in CFIs, suggesting that collateral is not a significant factor influencing this disparity. First, IFIs may have limited transparency in reporting NPLs, leading to an incomplete assessment of asset quality and recovery potential. Coupled with rigid regulatory oversight requiring frequent reporting, this indicates that IFIs may adopt recovery processes similar to CFIs, tailored to the regulatory and legal frameworks of their respective countries. Secondly, differences in sector exposure exist, as IFIs often concentrate on specific industries such as real estate or trade finance, which may have distinct risk and recovery profiles compared to the diversified portfolios of CFIs. Thirdly, the unique profit-and-loss sharing arrangements in IFIs can introduce complexities in asset recovery, as these structures may lead to different risk-sharing dynamics between the institution and its clients. Furthermore, variations in client demographics and risk profiles can also play a role, as IFIs frequently serve very niche markets seeking Shariah-compliant products within the European market, potentially involving first-time borrowers and SMEs with unique risk characteristics. The operation inefficiencies in the recovery process within IFIs are possible due to less advanced recovery systems, or complexities and different interpretations of Shariah procedures,which differ from one country to another. Moreover, IFIs often have lower loss reserves compared to CFIs, which may limit their capacity to absorb loan losses and affect the recover outcomes, which can all hinder effective loan recovery compared to CFIs.

However, a more detailed post-crisis analysis reveals an important trend– while CFIs experienced a decline of 12% in their recovery rates, IFIs showed a notable increase of 58.7%. This shift suggests that IFIs, despite historically facing operational inefficiencies in managing loan recoveries, adapted effectively to the post-crisis financial landscape. One major driver was the enhancement of risk management frameworks, as IFIs adopted more advanced credit assessment processes, allowing them to identify and manage distressed assets more effectively. Regulatory reforms also played an important role in strengthening the recovery outcome, with post-crisis financial regulations imposing stricter requirements on banks to improve their transparency, increase and strengthen capital buffer, and adopt better risk monitoring systems. While these measures applied to both IFIs and CFIs, IFIs particularly benefited by aligning their risk mitigation strategies with global financial standards. Furthermore, the economic recovery post-crisis supported asset values, particularly in industries where IFIs had the highest exposure, such as real estate and trade finance. As asset values bounced back, the collateral backing Islamic loans increased in value, thereby enhancing recovery rates.

The improvement in IFI recovery rates challenges the belief that Islamic banks have weaker credit risk management practices compared to CFIs. It highlights the potential of IFIs to build resilience while maintaining Sharia-compliant principles. Their ability to increase recovery rates, despite ethical lending restrictions, reflects their adaptability through adaptive risk management and sectoral diversification. The empirical findings presented in Table 9 further reinforces this discussion. A closer examination of bank-level data reveals that Albaraka Turk's RR rose from 0.4268 in 2005 to 1.0 in 2013, while Standard Chartered maintained an RR above 0.99 throughout this period, highlighting the ability of certain CFIs to keep the recovery efficiency despite market volatility. Meanwhile, Dar Al-Maal Al-Islami showed an upward trend in DD, improving from 1.41 in 2011 to 2.13 in 2013, alongside a consistent reduction in PD. Similar trends were observed in IBB (Islamic Bank of Britain), where RR improved to 1.0 by 2013 despite initial challenges in the early years.

Moreover, distance-to-default (DD) values for IFIs improved across multiple institutions post-crisis, reducing default risk exposure, a finding consistent with the enhanced risk management strategies undertaken in response to global regulatory changes. The data further demonstrates that PD values for Islamic banks remained lower in the later years of the dataset, reflecting better credit screening mechanisms. These findings indicate that while CFIs historically enjoyed stronger recovery rates, IFIs' post-crisis progress suggests that, despite their unique structure, they handle financial distress more effectively and narrowing the gap in credit risk outcomes between the two banking systems. This reinforces the argument that Islamic finance is a viable and resilient alternative, especially in uncertain economic times.

To further validate these results, sensitivity analyses were performed on key variables such as asset volatility (s), debt levels (D) and time horizon (T), which confirm the robustness of the findings, particularly for PD and DD measures. Future research could benefit from more granular data on the types of loans and collateral used by Islamic banks to provide a clearer picture of recovery rate dynamics.

Table 9. Empirical results

	European Islamic Investment Bank			Standard Life bank		
Year	DD	PD	RR	DD	PD	RR
2005	11.44	1.28E-30	0.0108			
2006	4.08	2.20E-05	0.1837	5.1171	1.55E-07	1
2007	3.0098	0.0013	0.5343	3.1766	7.45E-04	0.9982
2008	1.08	0.1409	0.5072	1.3281	0.0921	0.918
2009	1.50	0.0668	0.24	1.7979	0.0361	0.9983
2010	1.74	0.0411	0.33	4.044	2.63E-05	0.9994
2011	2.33	0.0099	0.27	3.2859	5.08E-04	0.9966
2012	2.22	0.0131	0.41	4.6497	1.66E-06	1
2013	3.42	3.16E-04	0.28	3.7761	7.97E-05	0.9954
	Dar Al-Maal Al-Islami Trust			Bank Coop AB		
	DD	PD	RR	DD	PD	RR
2004				–9.7261	1	1
2005				7.5812	1.71E-14	0.9722
2006				–9.6559	1	1
2007				17.1497	3.16E-66	0.8751
2008				–35.9188	1	1
2009				–5.1826	1	1
2010				–39.0947	1	1
2011	1.4139	0.0787	0.8359	–7.2063	1	1
2012	1.6079	0.0539	0.8221	–5.8406	1	1
2013	2.1347	0.0164	0.8473	–7.0592	1	1
	ASYA			Sekerbank		
	DD	PD	RR	DD	PD	RR
2004	5.7	5.99E-09	0.5325	–6.5997	1	1
2005	3.5569	1.88E-04	0.6692	1.811	0.0351	0.8056
2006	2.8376	0.0023	0.8204	1.8046	0.0356	0.9624
2007	3.9056	4.70E-05	0.7543	21.8134	8.66E-106	0.9868
2008	3.9338	4.18E-05	0.9531	–11.5205	1	1.1723
2009	2.7846	0.0027	0.9215	2.2449	0.0124	0.9065
2010	3.3864	3.54E-04	0.9722	3.5807	1.71E-04	0.9994
2011	2.691	0.0036	0.998	–23.9719	1	1.179
2012	4.2011	1.33E-05	1	3.6573	1.27E-04	0.8881
2013	–13.3326	1	1.4006	2.8729	0.002	0.9996
	IBB			Standard Chartered		
	DD	PD	RR	DD	PD	RR
2004	11.1726	2.78E-29	0.0322	5.8277	2.81E-09	1
2005	2.1782	0.0147	0.2434	5.0489	2.22E-07	1
2006	1.7566	0.0395	0.5465	4.365	6.36E-06	1

cont. Table 9

	IBB			Standard Chartered		
	DD	PD	RR	DD	PD	RR
2007	–7.6282	1	1.0174	3.3728	3.72E-04	1
2008	1.4602	0.0721	0.8864	–5.5843	1	1.1963
2009	–6.2903	1	1.0001	1.6335	0.0512	0.9113
2010	0.4362	0.3314	0.4973	3.2596	5.58E-04	0.9998
2011	0.5643	0.2863	0.7654	–9.1285	1	1.0249
2012	3.4831	2.48E-04	1	3.2214	6.38E-04	0.9794
2013	3.4933	2.39E-04	1	–13.4994	1	1
	Albaraka Turk			Tekstilbank		
	DD	PD	RR	DD	PD	RR
2004				–5.3778	1	1
2005	3.8593	5.69E-05	0.4268	1.4825	0.0691	0.9503
2006	3.0256	0.0012	0.6083	1.9355	0.0265	0.9789
2007	2.8767	0.002	0.7664	2.6427	0.0041	0.8456
2008	3.167	7.70E-04	0.999	–0.2375	0.5939	0.5463
2009	3.0204	0.0013	0.9757	2.1085	0.0175	0.6206
2010	3.3606	3.89E-04	0.9832	3.4722	2.58E-04	0.9239
2011	3.1799	7.37E-04	1	–21.7023	1	1.221
2012	3.9763	3.50E-05	0.9847	–32.0851	1	1
2013	3.1988	6.90E-04	1	1.5414	0.0616	0.8796

Source: own material.

Summary

Using a comprehensive daily dataset that follows the changes in the equities, equity volatility, liabilities and market value of assets forfive Islamic banks and five conventional banks across the UK, Switzerland and Turkey for the years 2004–2013, this study provides compelling evidence that 1) credit risk in Islamic finance is less than half the credit risk of conventional banks, and 2) recovery rates on defaulted loans are largely comparable across both banking systems. Thisanalysis integrates both theoretical and empirical approaches to evaluate credit risk and recovery outcomes.

From a theoretical perspective, Islamic financial institutions IFIs are generally perceived asriskier,despite being characterised by various activities employing risk-reducing mechanisms (such as PLS modes of financing). To test these assumptions empirically, this study uses key financial risk parametersthat estimate credit risk for Islamic and conventional financial institutions: PD- Probability of default, DD–Distance to default, and finally RR –the recovery rate based on the KMV model for defaulted loans. The findings reveal that IFIs consistently exhibit higher DD values, implying a significantly lower PD compared to their conventional

counterparts, which supports the first hypothesis and theoretical justification, confirming that Islamic banks are less exposed to credit risk than conventional banks.

When comparing recovery rates, we find that IFIs and CFIs have no significant difference in their ability to recover defaulted loans. Despite the initial expectation that IFIs would have higher recovery rates, based on the ethical principles of Islamic finance, which supports responsible lending and borrower support, the results show that both banking systems follow an institutional recovery process shaped by regulatory and legal requirements. These finding leads to the rejection of the second hypothesis, suggesting that ethical considerations in Islamic finance do not materially affect the recovery rates, as both systems converge in their approach to handling NPLs.

These findings shed light on the growing role of Islamic finance in the global financial system. While Islamic banks demonstrate significantly lower credit risk, their approach to loan recovery closely mirrors that of conventional banks, which suggests that despite their unique ethical and structural foundations, IFIs are becoming increasingly integrated into mainstream financial frameworks. As Islamic finance continues to evolve, future research should explore how regulatory environments and industry-specific factors influence credit risk and recovery strategies, providing a deeper understanding of its resilience and long-term sustainability.

References

1. Abdul Karim, M., How, J.C.Y., Verhoeven, P. (2005). Islamic Financing and Bank Risks: The Case of Malaysia. *Thunderbird International Business Review*, p. 47.
2. Abedifar, P., Molyneux, P., Tarazi, A. (2011) and (2012). *Risk and Stability in Islamic Banking. Working Paper*.
3. Ahmad, A., Iqbal, M., Khan, T. (1998). Challenges Facing Islamic Banking, *Islamic Research and Training Institute*. Islamic Development Bank.
4. Akers, M., Bellovary, J.L., Giacomino, D.E. (2014). *A Review of Bankruptcy Prediction Studies: 1930 to Present*. JSTOR.
5. Akhtar, R., Fathia, M., Mad-ahdin, A., Nurrachmi, R., Radenarmad, N. (2012). Time Value of Money in Islamic Perspective and the Practice in Islamic Banking Implications. *MPRA*.
6. Al-Jarrah, I.M.W., Molyneux, P. (2005). Efficiency in Arabian Banking. In: M. Iqbal & R. Wilson (Eds. *Islamic Perspectives on Wealth Creation* (pp. 97–117). Edinburgh University Press.
7. Ali, A.E.E.S. (2011). *Cost, Revenue and Profit Efficiency of Islamic Versus Conventional Banks: Evidence from Selected Countries, PhD Thesis*. Durham University.
8. Altman, E., Resti, A., Sironi, A. (2003). *Default Recovery Rates in Credit Risk Modelling: A Review of the Literature and Empirical Evidence*.
9. Baele, L., Farooq, M., Ongena, S. (2010). *Of Religion and Redemption: Evidence from Default on Islamic Loans*. Working Paper.
10. Baele, L., Farooq, M., Ongena, S. (2014). Of Religion and Redemption: Evidence from Default on Islamic Loans. *Journal of Banking and Finance*, 44, pp. 141–159.

11. Boumediene, A., Caby, J. (2008). *The Stability of Islamic Banks During the Subprime Crisis*. Working Paper.
12. Boumediene, A. (2011). Is Credit Risk Really High in Islamic Banks? *The Journal of Credit Risk*.
13. Boumediene, A., Marston, D. (2922). Islamic Banking and Default Risk: Empirical Evidence Using Merton´s Model.*Journal of Islamic Accounting and Business Research*, 13(3), pp. 377–396.
14. Beaver, W., Correia, M., McNichols, M. (2012). Do Differences in Financial Reporting Attributes Impair the Predictive Ability of Financial Ratios for Bankruptcy? *Review of Accounting Studies*, 17, pp. 969–1010.
15. Beck, T., Demirguc-Kunt, A., Merrouche, O. (2013). Islamic vs. Conventional Banking: Business Model, Efficiency and Stability. *Journal of Banking and Finance*, pp. 433–447.
16. Black, F., Scholes, M. (1973). The Pricing of Options and Corporate Liabilities, *Journal of Political Economy*, 81(3), pp. 637–654. DOI: 10.1086/260062.
17. Cihak, M., Hesse, H. (2010). Islamic Banks and Financial Stability: An Empirical Analysis, *Journal of Financial Services Research*, 38(2–3), pp. 95–113.
18. Elnahass, M., Izzeldin, M., Abdelsalam, O. (2014). Loan Loss Provisions, Bank Valuations and Discretion: A Comparative Study Between Conventional and Islamic Banks, *Journal of Economic Behavior & Organization*, 103, pp. 160–173.
19. Farhan, M., Yousaf, H., Khan, M. (2024). Comparative Credit Risk and Recovery Performance of Islamic and Conventional Banks: Evidence from Emerging Markets, *Journal of Islamic Finance and Banking*, 16(1), pp. 22–45.
20. Farook, S., Hassan, M., Clinch, G. (2013) and (2014). Islamic Bank Incentives and Discretionary Loan Loss Provisions, *Pacific-Basin Finance Journal*, 28, pp. 152–174.
21. Hasan, M., Dridi, J. (2010). *The Effects of the Global Crisis on Islamic and Conventional Banks: A Comparative Study*. IMF Working Paper, 10/201.
22. Ismail, A.G., Sulaiman, A. (2007). Default and Recovery Rates on Islamic Banks Financing: Implications for the New Capital Adequacy Standard. *International Association for Islamic Economics*, pp. 107–122.
23. Izzeldin, M., Fuertes, A., Pappas, V. (2012). Failure Risk in Islamic and Conventional Banks. *Journal of Economic Behavior & Organization*.
24. Izzeldin, M., Johnes, J., Pappas, V. (2014). A Comparison of Performance of Islamic and Conventional Banks 2004–2009. *Journal of Economic Behavior & Organization*, 103, pp. 93–107.
25. Izzeldin, M., Saeed, M. (2014). Examining the Relationship Between Default Risk and Efficiency in Islamic and Conventional Banks, *Journal of Economic Behavior & Organization*.
26. Jessen, C., Land, D. (2014). Robustness of Distance-to-Default. *Journal of Banking and Finance*.
27. Jin-Chuan, D. (2012). Measuring Distance-to-Default for Financial and Non-Financial Firms. *Global Credit Review*.
28. Jokivuolle, E., Peura, S. (2003). A Model for Estimating Recovery Rates and Collateral Haircuts for Bank Loans. *European Financial Management*.
29. Karim, M., Hassan, M.K., Hassan, T., Mohamad, S. (2014). Capital Adequacy and Lending and Deposit Behavior of Conventional and Islamic Banks. *Pacific-Basin Finance Journal*, 28, pp. 58–75.

30. Merton, R.C. (1974). On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. *Journal of Finance*, 29, pp. 449–470.
31. Ronn, E.I., Verma, A.K. (1986). Pricing Risk-Adjusted Deposit Insurance: An Option-Based Model.*Journal of Finance*, 41(4), pp. 871–895. DOI: 10.1111/j.1540–6261.1986.tb04561.x.
32. Rosman, R., Wahab, N.A., Zainol, Z. (2014). Efficiency of Islamic Banks During the Financial Crisis: An Analysis of Middle Eastern and Asian Countries. *Pacific-Basin Finance Journal*.
33. Salas, V.J., Saurina, J. (2002).Credit Risk in Two Institutional Regimes: Spanish Commercial and Savings Banks.*Journal of Financial Services Research*, pp. 203–224.
34. Varian, K. (2009). Islamic Financing and Foreclosure. *Real Estate Issues*, 34(1).
35. Vasicek, O. (1984). Credit Valuation, *KMV Corporation*.
36. Weill, L. (2010). Do Islamic Banks Have Greater Market Power? *Comparative Economic Studies*, 52(3), pp. 351–373.