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ORIGINAL RESEARCH

Systemic risk: new evidence from alternative financial systems

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Abstract

This study examines the systemic stability of alternative financial systems alongside traditional ones. Utilizing data from 376 conventional and Islamic financial institutions in South and Southeast Asia, as well as MENA countries, spanning 2000–2019, we analyze systemic risk and potential cross-transmission effects. Initially, we evaluate systemic stability considering both systems as a unified framework, then as separate entities. Subsequently, we investigate distress transmission between them to identify the systemically important financial system in these economies. Our findings suggest that systemic risk in one system may stem from distress in the other, with the conventional system exhibiting greater systemic influence on the Islamic system, while the latter transmits lower systemic shocks to the former. These results remain robust regardless of institution size. Additionally, the Islamic financial system demonstrates greater resilience and lower contagion during the 2008 financial crisis. Ultimately, our findings suggest that Islamic financial institutions complement conventional ones in terms of systemic financial stability in dual-banking systems.

Keywords Systemic risk · Financial stability · Alternative financial systems · Conventional finance · Islamic finance · Conditional *VaR* (*CoVaR*) · Systemically important financial institutions (SIFIs)

JEL Classification F650 · G21 · G23 · G150 · P430

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1 Introduction

Systemic risk reflects how an adverse shock at one financial institution can spread to others. After the 2008 Global Financial Crisis (GFC), regulators focused on strengthening financial stability through more effective risk management across the global banking industry. A key priority has been improving banks'ability to absorb systemic shocks transmitted within the financial system. With growing evidence showing how systemic risk differs from traditional bank risk measures (like the z-score, return volatility, and value-at-risk — VaR), ongoing discussions are considering the introduction of systemic risk-based capital requirements for banks (Acharya et al. 2017). Systemic risk is shaped by factors that go beyond those influencing traditional bank risk (Laeven et al. 2016). Adrian and Brunnermeier (2016) and Pflug (2000) show that common risk measures like VaR, which focus on individual institution risk in isolation, differ from systemic risk, typically captured through conditional correlation measures. Recent studies (Acharya et al. 2017; Aldasoro and Alves 2018; Brunnermeier and Cheridito 2019; Hedström et al. 2024; Kaserer and Klein 2019; Laeven et al. 2016; Li and Perez-Saiz 2018) advocate for a sustainable financial system free from hidden systemic risks. Regulators are particularly focused on enhancing institutions' integrity, resilience, and risk management techniques, moving beyond traditional, standalone approaches (Liu et al. 2022).

The last three decades have witnessed substantial growth in the Islamic financial sector, especially in the South/Southeast Asia and MENA regions (Abuzayed et al. 2018). The growth has been more prominent after the 2008 GFC following a shift in the investment preferences of major market participants towards more ethical and sustainable investments (Uddin et al. 2024). Islamic finance is based on the principles of good governance, social virtue, and environmental and ethical concerns, which stem from the objectives of Islamic law *(Maqasid al-Shariah)* (Jan and Marimuthu 2015; Jatmiko et al. 2024). The two distinguishing features of Islamic financing are profit/loss sharing and prohibition of interest *(Riba)* and gambling *(Gharar)* (Abedifar et al. 2013; Jatmiko et al. 2023). The essence of Islamic finance lies in implementing fair and equitable operations for the welfare of society (Jatmiko et al. 2024).

Both financial systems operate on distinct principles – yet side-by-side – leading to differences in their risk profiles and distress transmission. Specifically, conventional finance treats money as a commodity lent with interest, while Islamic finance is asset-backed, making it less risky (Abedifar et al. 2013). The fundamental operational differences, along with numerous instances of mismanagement, poor performance, and failure of conventional financial institutions during the 2008 GFC (Mirakhor and Krichene 2009), reinforce the idea that the two financial systems would differ in their systemic risk profiles. For investors, a dual-banking system may enhance resilience and provide better protection against unexpected systemic shocks. This is especially relevant during financial turmoil, as riskier institutions are more likely to transmit distress to others, thereby heightening systemic risk. In contrast, only a few studies argue that there is no difference in the lending patterns of these financial systems (Aysan and Ozturk 2018). While risk transmission may occur between both types of financial institutions, it is expected to be less pronounced when they adhere to ethical banking principles (Jatmiko et al. 2024).

In this study, we compare the systemic risk profiles of conventional and Islamic financial institutions that operate in dual-banking systems and examine their spillover effects. Specifically, we seek to answer the following questions. First, do Islamic institutions exhibit lower systemic risk than conventional ones when operating in dual-banking systems?

Second, we analyze each financial sector independently to determine whether the Islamic sector exhibits lower systemic risk compared to the conventional sector. Third, we examine systemic risk spillovers by assessing whether Islamic institutions transmit systemic risk to the conventional sector (and vice versa). We then analyze the resilience of Islamic versus conventional financial institutions to systemic risk spillovers, focusing on systemic risk dynamics by country, identifying systemically important financial institutions (SIFIs), and comparing their risk profiles during the 2008 GFC and periods of elevated systemic risk. Additionally, we explore the impact of institution size within the context of systemic risk transmission.

We focus on the financial sectors of South and Southeast Asia, and MENA countries, where dual-banking systems predominantly operate. Our sample includes 126 Islamic and 250 conventional financial institutions from 12 countries over the period from 2000 to 2019. We employ a market-based systemic risk measure, specifically the change in conditional value at risk (ΔCoVaR), as proposed by Adrian and Brunnermeier (2016). This measure has not been previously applied in the systemic risk analysis of dual financial institutions; existing literature has primarily utilized micro- and macro-level measures such as structural credit risk models and London Interbank Offer Rate (LIBOR) spreads (Rodriguez-Moreno & Peña 2013).

We find that the Islamic sector is (systemically) less risky and exhibits lower spillover effects, either towards the overall financial system or the conventional sector. The analysis of systemic risk spillovers reveals that conventional institutions pose a significant threat to Islamic ones, while the reverse effect is more subdued. The difference in systemic risk between the two types of institutions remains robust despite size differentials. Systemic risk is more pronounced in conventional financial institutions over time, regardless of size, especially during the 2008 GFC. The results are robust to using the alternative method of Dynamic Conditional Correlations Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH) model to estimate ΔCoVaR, and the use of Credit Default Swap (CDS) spread-based CoRisk measure. Despite its smaller market size and limited services, Islamic finance complements mainstream finance by offering financially robust and lower-risk products. This is mainly attributed to the robust inherent characteristics of Islamic finance based on the principles of just sharing of risk and return, asset-backed financing, and avoidance of interest-based dealings *(Riba)* and speculation *(Gharar)* (Jatmiko et al. 2024).

We contribute to the literature on dual-banking systems and systemic risk in several ways. First, it is, to the authors' knowledge, the most comprehensive cross-sectional and longitudinal analysis of systemic risk among dual-banking systems, identifying systemically important conventional and Islamic financial institutions.[1] Most related literature emphasizes stand-alone risks over systemic risk, primarily focusing on conventional institutions. Attention to the systemic risk profile of Islamic institutions has so far been limited. Our second contribution lies in the examination of the systemic spillover effects of one type of financial institution on the other. To date, very few studies have assessed the

[1] Systemically Important Financial Institutions (SIFIs) are financial entities whose failure could trigger significant disruptions in the financial system and broader economy due to their size, interconnectedness, complexity, or the critical nature of their services. Because of their potential impact on financial stability, SIFIs are subject to heightened regulatory scrutiny and more stringent capital requirements (BCBS 2013). In our context, we define SIFIs as those exhibiting high systemic risk and significant spillover effects on the overall financial system, or their own, during periods of distress.

interplay of systemic risk between Islamic and conventional financial institutions. Third, we contribute by not classifying institutions as Islamic solely based on their claims of "Shariah-compliance" or the use of "Islamic" in their profile. Instead, we employ rigorous sample selection and classification criteria based on GICS, BICS, Is-Islamic IDeal ratings, and Is-Islamic Shariah ratings.[2] Additionally, we individually assess each financial institution's actual compliance with legal and regulatory requirements — such as having a Shariah Supervisory Board and a Shariah advisor — to accurately identify each institution as Islamic. Existing research comparing the systemic risk of Islamic and conventional financial systems has myopically focused on banks (or even a subset of banks, namely Global Systemically Important Banks). However, a chain of bank runs and disintermediation — where funds shift from banks to capital markets for financing — are recognized as two root causes of increased spillovers, affecting not only banking firms but also other financial institutions, including capital markets (Li and Perez-Saiz 2018), multi-line and life insurance companies (Kaserer and Klein 2019). These effects were observed during both the 1929 Great Depression and the 2008 Great Recession (Kaserer and Klein 2019). Therefore, it is essential to consider all financial institutions when analyzing the systemic risk.

The remainder of the study is organized as follows. Section 2 reviews prior literature and develops testable hypotheses. Section 3 describes the empirical methods. Section 4 presents the data and sample. Section 5 reports findings and discusses empirical results. Robustness analyses are presented in Section 6. A final section concludes the study.

2 Prior literature and hypotheses development

2.1 Systemic risk of Islamic and conventional institutions

Research indicates that Islamic banks demonstrate better financial stability and capitalization, higher asset quality, stronger corporate governance, and greater efficiency, both during and after the 2008 GFC (Beck et al. 2013; Bitar et al. 2017; Gheeraert 2014; Mamatzakis et al. 2023; Pappas et al. 2017; Poledna et al. 2015; Sorwar et al. 2016). This enhanced performance can be attributed to specific characteristics inherent to Islamic banking. For instance, Azmat et al. (2020) argue that the self-imposed restrictions and rigidities of Islamic banking — designed to ensure compliance with Shariah (Islamic law) — help prevent excessive lending. These measures effectively neutralize the risk of asset price bubbles and contribute to lower systemic banking failures.

Several studies have focused on bank risk profile of Islamic and conventional banks. For example, Čihák and Hesse (2010) compares the financial stability of the Islamic and conventional banks through the popular z-score measure. Other studies have analyzed standalone bank risk aspects, including credit, liquidity, and market risk (Abedifar et al. 2013; Alqahtani and Mayes 2018; Beck et al. 2013; Ibrahim and Rizvi 2018; Sorwar et al. 2016).

[2] GICS is the Global Industry Classification Standard and BICS is the Bloomberg Industry Classification Standard. Is Islamic (IDeal ratings) and Is-Islamic (Shariah) are two sub-classifications of GICS to identify the Islamic financial institutions based on their individual rankings. The former refers to the securities that are issued by a company which abides by Shariah (Islamic) laws and principles as per generic screening criteria by IDeal Ratings and the latter refers to a list of equities where the security is issued by a company which abides by Shariah laws and specifically considers the presence of Shariah Board in its corporate structure.

However, the extant literature comparing the systemic risk profiles of these institutions is scant (Berger et al. 2019).

In this study, we address this gap by investigating the systemic risk levels of both types of financial institutions, considering their coexistence as well as their treatment as independent systems. We argue that Islamic institutions are inherently more resilient than conventional ones and are therefore expected to carry and transmit lower levels of systemic risk. Several of these distinct features of contrasting bank business models exist, contributing to the comparatively higher financial stability of the Islamic financial system. We outline them below:

i. Prohibition of *Riba* (interest rate/usury), avoidance of *Gharar* (speculation leading to high uncertainty), and implementation of *Profit-and-Loss Sharing* (PLS) mechanism through PLS instruments (such as *Mudarabah*) that forbid any pre-determined profit/interest charge (Sorwar et al. 2016), which tends to lower the credit/default risk of banks. This risk-sharing (PLS) principle posits that all transactions have to be backed by a real economic transaction that involves a tangible asset (Beck et al. 2013). This suggests vivid differences in the lending and deposit structures of Islamic and conventional banks.
ii. Islamic institutions have low leverage and refrain from complex financial instruments such as derivatives and debt securitization, hence depicting higher financial stability relative to conventional institutions (Čihák and Hesse 2010). Sorwar et al. (2016) find that the capital structure of Islamic banks is distinctive due to their lower levels of leverage and debt.
iii. Islamic institutions are less exposed to market risk due to their higher equity-to-debt ratios compared with their conventional peers. This gives them a competitive advantage in terms of lower market risk exposure. Additionally, they are relatively independent of the market, as supported by El Alaoui et al. (2015).
iv. Islamic banks exhibit greater efficiency and reduced exposure to credit risk, largely attributable to better asset quality (Pappas et al. 2017). This is primarily a result of Shariah restrictions, which promote asset concentration and limit the use of risky hedging instruments. Additionally, Islamic banks benefit from asset-backed financing and the avoidance of interest-based transactions. Consequently, they maintain lower loss reserves, reduced loan loss provisions, and fewer non-performing loans—three key measures of asset quality—compared to conventional banks (Beck et al. 2013).
v. Baele et al. (2014) demonstrate that the default rate on Islamic loans is less than half that of conventional loans. This lower rate is largely attributed to the absence of interest-based transactions, which allows Islamic banks to avoid substantial and time-bound interest obligations, resulting in minimal interest-rate risk (Abedifar et al. 2013). Additionally, by promoting equity-based transactions, these institutions maintain low leverage (Jatmiko et al. 2024), further reducing their risk of default.
vi. Ashraf et al. (2016) suggest that the new regulatory measures introduced by the Islamic Financial Services Board (IFSB), such as the net stable funding ratio, further enhance the financial stability of Islamic banks.
vii. Islamic institutions are prohibited from investing in businesses associated with alcohol, gambling, and weapons (Riaz et al. 2017). This restriction aligns with the rising appeal of responsible investment choices and investors placing a value on the "emotional dividend" from ethical, faith-based or socially responsible investments (Bollen 2007; Riedl and Smeets 2017).

Thus, due to substantial structural, operational, and regulatory differences, Islamic institutions possess a distinct risk profile compared to their conventional counterparts. In contrast, research suggests that Islamic financial institutions may exhibit comparable risk levels due to a significant alignment between their mark-up ratios and fee margins with prevailing interest rates (Khan 2010). Based on the above discussion, we formulate hypothesis H1.

HYPOTHESIS 1 (H1): Islamic institutions exhibit lower systemic risk compared to their conventional counterparts.

2.2 Intra-sector systemic risk transmission

Since the late 1970 s, the gradual integration of Islamic institutions into the financial system has significantly diversified the financial industry in countries where both systems coexist.[3] While both Islamic and conventional systems exhibit unique market strengths, Islamic banks appear to be better capitalized yet less competitive than their conventional counterparts in dual-banking systems (Ariss 2010). As alternative systems operating side-by-side, both Islamic and conventional banks compete for the same market share and thus influence each other's market structures and client base. However, the dynamics of market share are more complex.

On one hand, Meslier et al. (2017) find that conventional banks are affected by the competitiveness of Islamic banks, while Islamic banks in Muslim-majority countries are primarily influenced by their own peers. On the other hand, Ariss (2010) characterizes the conventional financial services market as distinct and segregated from Islamic banking, suggesting that each type tends to compete primarily within its own sector rather than against the other. While investigating the dual-banking systems, Weill (2011) finds the two bank types to have comparable market power. In contrast, Risfandy et al. (2019) reported that Islamic banks exhibit greater market power and, as a result, face less competition compared to their conventional counterparts. Given these structural and market power differences between the two financial systems, we assess the transmission of systemic risk within each sector in isolation. Therefore, we formulate hypothesis H2.

HYPOTHESIS 2 (H2): Within their respective sectors, Islamic institutions transmit lower systemic risk compared to conventional institutions.

2.3 Cross-sector systemic risk transmission

In the previous subsection, we examined the transmission of systemic risk within each sector in isolation; in this subsection, we investigate whether systemic risk transmission can occur across sectors. Existing literature lacks insight into the transmission of systemic risk between the Islamic and conventional sectors, specifically regarding whether one sector is influenced by the distress of the other. To establish preliminary assumptions, we draw on related literature that identifies key factors driving systemic risk. Studies have highlighted several critical aggravators, including firm-level idiosyncratic factors such as default probability, liquidity, size, and leverage, as well as macroeconomic factors like

[3] We direct you to Pappas (2020) for a brief historical overview of Islamic finance.

market concentration, GDP, and inflation (Brownlees and Engle 2017; Fang et al. 2018; Adrian and Brunnermeier 2016).

Research indicates that size is a significant determinant of systemic risk (Hedström et al. 2024; Laeven et al. 2016; Varotto and Zhao 2018). Additionally, other studies emphasize the role of bank regulation, non-interest income, capital adequacy, diversification, and terrorism risk as important drivers of systemic risk in the conventional financial sector (Brunnermeier et al. 2020; Chen et al. 2021; Elnahass et al. 2022; Hoque and Liu 2023; Laeven et al. 2016; Wagner 2010). Čihák and Hesse (2010) argue that enhancing the conventional financial system with alternatives like the Islamic financial system can improve the long-term stability and resilience of the overall financial system; however, their analysis does not incorporate systemic risk measures. Building on these arguments and our discussion in subSect. 2.1, we assess the transmission of systemic risk across sectors. Therefore, we formulate hypothesis H3.

HYPOTHESIS 3 (H3): Islamic institutions'systemic risk transmission toward the conventional sector is lower compared to conventional institutions'systemic risk transmission toward the Islamic sector.

3 Methodology

3.1 Systemic risk

Market data-driven systemic risk measures capturing the conditional tail dependency across institutions include Systemic Expected Shortfall (SES) and Marginal Expected Shortfall (MES) (Acharya et al. 2017), a conditional capital shortfall measure of systemic risk (SRISK) (Acharya et al. 2012; Brownlees and Engle 2017), and ΔCoVaR (Adrian and Brunnermeier 2016) among others. Our study employs ΔCoVaR as a measure of systemic risk due to its unique advantages in modeling the interaction between individual financial institutions and the broader financial system, providing clear interpretations for stakeholders. First, ΔCoVaR captures the pairwise dependency between an individual institution and the entire financial system, making it effective in understanding how distress in one institution impacts the overall financial network. In contrast, measures like SES and MES primarily focus on individual institutions without modeling their interactions with the entire system. Second, ΔCoVaR explicitly assesses the systemic risk contribution of a financial institution by evaluating how the risk of the entire financial system changes when that institution is in distress. In contrast, SES, MES, and SRISK focus on marginal contributions to systemic risk, which is less direct. Third, ΔCoVaR offers an intuitive interpretation by quantifying how the value-at-risk of the entire financial system changes in response to an individual institution's distress. This straightforward interpretation is appealing to stakeholders and aligns well with existing value-at-risk models.

ΔCoVaR emerged as a useful reduced form, market-based, and statistical tail-dependent measure capturing co-movements of asset returns (Cao 2021; Hattori et al. 2014; López-Espinosa et al. 2012; Adrian and Brunnermeier 2016). Here, we discuss the systemic risk measure, ΔCoVaR, which is derived from the well-known VaR measure. It measures financial institutions' systemic risk contribution by conditioning market events on financial institutions' events. In particular, the one-period-ahead, q% (quantile) VaR for institution j, is denoted as $\mathrm{VaR}^{j}_{q,t+1|t}$ and for which is true that:

$$\Pr\left(r_{j,t+1} \leq VaR^{j}_{q,t+1|t}\right) = q\% \tag{1}$$

where $r_{j,t+1}$ is the (return) loss of institution j for which the $VaR^{j}_{q,t+1|t}$ is defined. In line with Adrian and Brunnermeier (2016), the VaR of institution j conditional on a particular event $\mathbb{C}\left(r_{i,t+1}\right)$ for institution i, is denoted as $CoVaR^{j|i}_{q,t+1|t}$, defined by the q% quantile of the conditional probability distribution and for which is true that:

$$\Pr\left(r_{j,t+1} \leq CoVaR^{j|i}_{q,t+1|t} | \mathbb{C}\left(r_{i,t+1}\right)\right) = q\% \tag{2}$$

A common choice of the conditioning event is that a VaR violation is observed in institution i, namely $r_{i,t+1} \leq VaR^{i}_{q,t+1|t}$. Such a conditioning event highlights the role of CoVaR in modelling tail-event linkages in financial institutions. Common choices for q% are 95% and 99%. In our analysis, we employ a more restrictive 99% level and omit *q* from subsequent notation to reduce notational clutter.[4] The $\Delta CoVaR$ quantifies the risk contribution in an institution j, of events happening in institution i, by measuring the difference in CoVaR between a stressed institution i (i.e., when the conditioning event is true) and a normal (median) institution i. More formally:

$$\Delta CoVaR^{j|i}_{t+1|t} = CoVaR^{j|VaR(i)}_{t+1|t} - CoVaR^{j|Med(i)}_{t+1|t} \tag{3}$$

where $CoVaR^{j|VaR(i)}_{t+1|t}$ denotes institution's j VaR when a VaR violation is observed for institution i, and $CoVaR^{j|Med(i)}_{t+1|t}$ denotes institution's j VaR in normal times when institution's i returns (losses) equal its median (q = 0.50). For illustrative purposes, we have discussed the case of two financial institutions (i, j); a more interesting case is institution i's contribution to the financial system stability. Expanding the notation, we set j = FS (financial system) so that $\Delta CoVaR^{FS|i}_{t+1|t}$ measures the difference in VaR conditional on institution i being under stress, and the market VaR conditional on institution i experiencing a normal time.

For each institution, we compute financial returns using daily closing prices, denoted as $r_{t+1} = -\left(\Delta P_{t+1}/P_t\right)$. We express them as negative returns (losses) to obtain a positive $\Delta CoVaR$ that can be interpreted as an increase in the systemic risk, given the distress of the institution i. It is customary to present the downside risk (−VaR) outcomes in positive values (López-Espinosa et al. 2012). For the financial system return (losses), we use lagged market equity-weighted returns of individual financial institutions, represented by r^{FS}_{t+1}.

3.2 Estimation via quantile regressions

In this section, we provide a roadmap for testing our hypotheses. To test hypothesis H1, we estimate and compare the systemic risk ($\Delta CoVaR$) of both types of institutions operating within a dual-banking system. In this context, we assume that both types of institutions coexist as integral components of the aggregate financial sector. To test hypothesis H2, we segregate the financial sectors and re-estimate $\Delta CoVaR$ independently for each sample of Islamic and conventional institutions focusing on intra-sector systemic risk spillovers. To test hypothesis H3, we examine cross-sector systemic risk spillovers from Islamic institutions to the conventional sector and vice-versa.

[4] We reintroduce q in specific instances to avoid potential confusion.

To estimate systemic risk, we adopt the approach of Adrian and Brunnermeier (2016) by utilizing quantile regressions and lagged state variables. The state variables are not the systemic risk factors themselves; rather, they serve as mean and volatility conditioning variables for risk measures. Quantile regression is the simplest and most efficient method to measure ΔCoVaR, compared to other techniques such as GARCH (Girardi & Ergün 2013) or maximum likelihood estimation (Cao 2013).[5]

The two quantile regressions, denoted as eq. (4) and eq. (5), are estimated using monthly data for the overall financial sector, as well as for the conventional and Islamic sectors, in accordance with the hypotheses.

$$r^{i}_{t+1} = \alpha^{i} + \beta^{i} SV_{t-1} + \varepsilon^{i}_{t} \tag{4}$$

$$r^{FS}_{t+1} = \alpha^{FS|i} + \beta^{FS|i} SV_{t-1} + \gamma^{FS|i} r^{i}_{t+1} + \varepsilon^{FS|i}_{t} \tag{5}$$

Equation (4) represents the quantile regressions of the equity returns defined alternatively for all institutions, Islamic institutions, and conventional institutions $\left(r^{i}_{t+1}\right)$ and lagged state variables $\left(SV_{t-1}\right)$. Equation (5) represents the quantile regressions of equity return of the overall, Islamic and conventional financial sectors with the equity returns of Islamic or conventional financial institution i(as appropriate per hypothesis) and lagged state variables. For the intra-sector analysis, the equity returns of Islamic (conventional) institutions are regressed on the returns of the Islamic (conventional) sector to examine the transmission of intra-sector systemic risk. For the cross-sector analysis, the equity returns of Islamic (conventional) institutions are regressed on the returns of the conventional (Islamic) sector.

The estimated values from Eq. (4) and Eq. (5) are used to obtain VaR and CoVaR as follows:

$$VaR^{i}_{t+1} = \widehat{\alpha}^{i} + \widehat{\beta}^{i} SV_{t-1,} \tag{6}$$

$$CoVaR^{FS|i}_{t+1} = \widehat{\alpha}^{FS|i} + \widehat{\beta}^{FS|i} SV_{t-1} + \widehat{\gamma}^{FS|i} VaR^{i}_{t+1} \tag{7}$$

Finally, the ΔCoVaR of each institution is computed by subtracting the CoVaR estimate at the extreme quantile (q = 0.99) from the CoVaR estimate at the median quantile (q = 0.50) as shown in Eq. (8).

$$\Delta CoVaR^{FS|i}_{0.99,t+1|t} = CoVaR^{FS|i}_{0.99,t+1|t} - CoVaR^{FS|i}_{0.50,t+1|t} \tag{8}$$

For simplicity, we denote the systemic risk of the aggregate, Islamic, and conventional financial institutions as ΔCoVaR, $\Delta CoVaR^{IFI}$, and $\Delta CoVaR^{CFI}$ respectively. The intra-sector systemic risk transmissions are represented by $\Delta CoVaR^{IFS|IFI}$ for the Islamic financial sector and $\Delta CoVaR^{CFS|CFI}$ for the conventional financial sector.[6] Cross-sector systemic risk transmissions are denoted as $\Delta CoVaR^{CFS|IFI}$ for the transmission from Islamic to the conventional financial sector, and $\Delta CoVaR^{IFS|CFI}$ for the transmission from conventional to

[5] For details, please refer to Koenker and Hallock (2001).

[6] IFS represents Islamic financial sector; CFS represents conventional financial sector.

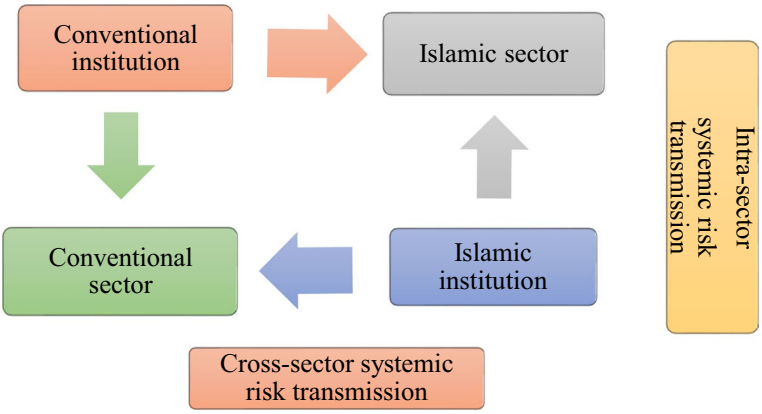

Fig. 1 Intra-sector and cross-sector systemic risk transmission mechanism

the Islamic financial sector. Figure 1 depicts the intra-sector and cross-sector systemic risk transmission mechanisms.

4 Data and sample

Our sample comprises 376 publicly listed financial institutions — 126 Islamic and 250 conventional — across 12 countries, representing a mix of nine financial industries. The sample countries were selected from South Asia (Pakistan, Bangladesh), Southeast Asia (Indonesia, Malaysia, Singapore), and the MENA region (Bahrain, Egypt, Jordan, Kuwait, Qatar, Saudi Arabia, and the UAE. These countries host the largest number of coexisting Islamic and conventional financial institutions, providing a robust basis for examining dual-banking systems. The sample period, spanning from 2000 to 2019, includes two recessions (2001 and 2007–09), two financial crises (2000 and 2008), and the European debt crisis and U.S. credit rating downgrade in 2011.[7] Panel A of Table 1 presents the sample breakdown by country and industry.

The initial selection of Islamic institutions was guided by GICS and BICS classifications. To address misclassification issues inherent in various databases (Abedifar et al. 2013; Čihák and Hesse 2010; Gheeraert 2014), we conducted a manual review of each Islamic institution's profile and management structure to verify compliance with Islamic (Shariah) law and regulations, as set by authorities like the IFSB. Institutions found non-compliant were excluded from the sample. Additionally, we excluded conventional banks with Islamic banking windows, a common practice in countries like Pakistan and Malaysia.

Daily stock prices are sourced from Bloomberg and monthly state variables data for each sample country from the International Financial Statistics of the IMF and the World Bank. Outliers in equity returns and macroeconomic variables are winsorized at the 1st and 99th percentiles. We employ five lagged sample country-specific state variables to

[7] We limit our sample period to 2019, coinciding with the onset of the Covid-19 crisis, to concentrate on significant financial events like the 2008 GFC. This approach ensures that our results are not influenced by other non-financial exogenous events.

Table 1 Sample composition and summary statistics

	Panel A: Distribution of institutions												Panel B. Summary statistics						
	Islamic	Conventional	Aggregate	Commercial Banks	Consumer Finance	Diversified Fin. Services	Institutional Brokerage	Insurance Services	Islamic Banks	Islamic Insurance	Islamic Modaraba	Real Estate Investment	Equity Return (Losses)	System Return (Losses)	Δ(T-bills yield)	TED spread	Market return	Market volatility	Inflation
Bahrain	7	8	15	3	1	0	2	2	6	0	0	1	0.010	0.029	1.27	−0.25	0.21	3.04	14.25
Bangladesh	1	29	30	8	2	0	1	18	1	0	0	0	−0.020	0.028	4.09	−4.50	0.78	6.68	1.22
Egypt	2	11	13	6	0	0	3	2	2	0	0	0	0.050	0.028	0.59	−9.17	1.10	8.77	0.96
Indonesia	13	23	36	8	3	1	1	10	0	1	0	12	0.000	0.027	1.62	−4.70	1.01	5.61	8.16
Jordan	5	28	33	11	1	2	4	10	3	2	0	0	0.010	0.028	1.74	−1.49	−0.38	2.31	19.17
Kuwait	20	18	38	5	1	1	15	4	5	0	0	7	0.000	0.029	1.18	1.51	0.52	5.19	6.86
Malaysia	40	31	71	11	3	1	9	5	1	2	0	39	0.030	0.027	0.17	−0.94	0.00	0.03	10.38
Pakistan	14	42	56	12	6	1	6	17	2	0	12	0	0.040	0.028	0.47	−6.56	1.20	6.92	1.60
Qatar	6	9	15	4	0	1	0	4	3	1	0	2	−0.020	0.022	9.70	−0.16	0.19	6.82	15.08
Saudi Arabia	8	10	18	7	0	1	2	0	4	3	0	1	0.000	0.029	1.94	−0.07	0.59	6.60	−2.76
Singapore	1	17	18	3	4	2	5	3	0	0	0	1	0.000	0.027	2.07	0.92	0.14	4.74	42.95
UAE	9	24	33	14	0	2	0	9	5	1	0	2	0.000	0.019	2.57	−0.73	0.73	5.71	−2.71
Total	126	250	376	92	21	12	48	84	32	10	12	65							
Mean													0.010	0.020	1.49	−2.66	0.55	4.85	8.31
Std. Dev													0.790	0.150	18.79	4.06	5.94	3.39	140.69
1% stress level													1.930	0.530	−39.79	5.35	−17.17	13	277.7

Panel A categorizes the sample financial institutions by country, type and industry. Panel B presents country-wise summary statistics, expressed as percentages, for equity returns (losses)$\left(r_t^i\right)$; daily financial system returns (losses)$\left(r_t^{FS}\right)$, and monthly state variables. The 1% stress level reflects the equity losses and state variables observed during the worst 1% of distressed regimes. For example, the average 1% market equity return of −17.17 signifies the lowest percentile, indicating the most extreme quantile of the state variables

capture time variations in the conditional moments of asset returns: (i) the monthly change in the three-month treasury yield; (ii) the monthly short-term TED spread (the difference between the 3-month LIBOR rate and the 3-month secondary market T-bill rate); (iii) the monthly equity index return;[8] (iv) stock market volatility, calculated as the 22-day rolling standard deviation of daily equity index returns; and (v) the monthly Consumer Price Index (CPI) as a proxy for inflation. Panel B of Table 1 provides summary statistics for these state variables.

5 Empirical results

5.1 Systemic risk of Islamic and conventional institutions

Panel A of Table 2 presents summary statistics of equity returns, market risk and systemic risk estimates of Islamic and conventional institutions over the full sample.[9] The results show that equity return losses of Islamic institutions are approximately 4.3 times larger than those of conventional institutions, on average. However, the VaR of conventional financial institutions is higher than that of Islamic financial institutions. The mean systemic risk for the aggregate financial sector is 0.485, while the Islamic and conventional sectors have mean systemic risks of 0.465 and 0.496, respectively, with the difference being statistically significant. Therefore, the findings indicate that Islamic institutions exhibit lower systemic risks than their conventional counterparts, providing reassurance that we cannot reject H1.

Our ΔCoVaR estimates are comparable to those reported in earlier studies. For instance, it ranged from 0.9% to 5% in Japan (Hattori et al. 2014), 0.11% for listed commercial banks in Pakistan (Zeb and Rashid 2015), and 0.5% for the EU financial sector (Koelemij 2018).

5.2 Intra-sector systemic risk transmission

Panel B of Table 2 presents summary statistics on intra-sector systemic risk transmission. The results indicate that systemic risk transmission within the Islamic sector is approximately 4% higher than within the conventional sector, suggesting that Islamic institutions may contribute slightly more to systemic risk within their sector compared to conventional institutions. However, this difference is relatively small in economic terms.

In summary, the systemic risk transmission of conventional institutions differs significantly from that of Islamic institutions within their respective sectors, leading us to reject hypothesis H2. This difference may primarily stem from the fact that conventional institutions are more established, have a longer history, are widely accessible, and are subject to stricter oversight by central banks and regulatory bodies. In addition, conventional

[8] The respective stock market indices for each country in our sample are: BAX (Bahrain), DSEX (Bangladesh), EGX 30 (Egypt), JKSE (Indonesia), ASE All Shares (Jordan), Premier Market (Kuwait), FTSE Malaysia (Malaysia), KSE 100 (Pakistan), QSI (Qatar), TASI (Saudi Arabia), FTSE-STI (Singapore), and ADX General (UAE).

[9] For brevity, the quantile regression estimation results are presented in Appendix I.

Table 2 Systemic risk estimates

	Mean	Std. Dev	Min	Max	Observations
Panel A: Systemic risk					
Equity returns (Islamic)	0.030	0.717	−19.88	9.380	25,239
Equity returns (Conventional)	0.007	0.827	−43.63	44.07	57,503
VaR (Islamic)	1.485	0.974	−1.470	12.55	16,076
VaR (Conventional)	1.539	1.478	−1.030	27.46	32,474
$\Delta CoVaR$	0.485	0.269	−0.330	2.170	48,550
$\Delta CoVaR^{IFI}$	0.465	0.242	−0.250	1.930	16,076
$\Delta CoVaR^{CFI}$	0.496	0.281	−0.330	2.170	32,474
$\Delta CoVaR^{CFI}$–$\Delta CoVaR^{IFI}$	0.031***				
Panel B: Intra-sector systemic risk transmission					
$\Delta CoVaR^{IFS\|IFI}$	0.514	0.186	−0.458	2.310	16,076
$\Delta CoVaR^{CFS\|CFI}$	0.494	0.274	−0.509	2.210	32,474
$\Delta CoVaR^{CFS\|CFI}$–$\Delta CoVaR^{IFS\|IFI}$	−0.019***				
Panel C: Cross-sector systemic risk transmission					
$\Delta CoVaR^{IFS\|CFI}$	0.542	0.226	−0.705	2.251	32,474
$\Delta CoVaR^{CFS\|IFI}$	0.454	0.231	−0.328	1.705	16,076
$\Delta CoVaR^{CFS\|IFI}$–$\Delta CoVaR^{IFS\|CFI}$	0.088***				

Panel A reports summary statistics of equity returns (losses), market risk and systemic risk. Panels B and C present the intra-sector, and cross-sector systemic risk transmission respectively. IFS represents the Islamic financial sector; CFS, conventional financial sector; IFI, Islamic financial institution; and CFI, conventional financial institution. The intra-sector systemic risk transmissions are represented by $\Delta CoVaR^{IFS|IFI}$ for the Islamic sector and $\Delta CoVaR^{CFS|CFI}$ for the conventional sector. Cross-sector systemic risk transmissions are denoted as $\Delta CoVaR^{CFS|IFI}$ for the transmission from Islamic to the conventional sector, and $\Delta CoVaR^{IFS|CFI}$ for the transmission from conventional to the Islamic sector. *** denote significance at the 1% level

institutions display higher levels of maturity, sophistication, and competitive behavior (Beck et al. 2013).

5.3 Cross-sector systemic risk transmission

Panel C of Table 2 presents summary statistics on cross-sector systemic risk transmission, reflecting the interconnectedness between the two financial systems. The results indicate that conventional institutions transmit more systemic risk to the Islamic sector than Islamic institutions do to the conventional sector. Specifically, systemic risk transmission from conventional institutions to the Islamic sector is approximately 19.4% higher than the transmission in the opposite direction. Put simply, the Islamic sector is a net systemic risk importer. Consequently, we cannot reject hypothesis H3.

5.4 Country-based systemic risk analysis

In this section, we examine the dynamics of systemic risk by country. To ensure a robust analysis, we set a minimum threshold of five Islamic institutions for inclusion in our country-based evaluation, with the results presented in Table 3. Our findings indicate that

systemic risk is highest in Pakistan, which leads in both intra-sector (conventional sector only) and cross-sector systemic risk transmission. Bahrain ranks first in terms of Islamic intra-sector systemic risk transmission, while Malaysia consistently ranks among the top three countries for overall systemic risk levels.

Our findings indicate that financial institutions in Pakistan and Malaysia consistently exhibit higher systemic risk compared to those in other sample countries. This highlights the need to investigate country-specific factors that may foster interconnections within and across both sectors, leading to increased systemic risk transmission. Both countries have undergone gradual financial liberalization, resulting in greater interconnectedness between conventional and Islamic financial institutions (Song and Oosthuizen 2014).

Moreover, Song and Oosthuizen (2014) note that in Malaysia and Bahrain, conventional banks are permitted to control Islamic banks, which may not align with the global practices of Islamic finance. As a result, Islamic banks in these countries could be less heterogeneous and prone to higher systemic risk. In Pakistan, the central bank's Shariah board lacks the legislative authority to enforce Shariah compliance (Song and Oosthuizen 2014). As a result, Islamic institutions may not operate with full autonomy in implementing Shariah-based financial practices. This relatively liberal Islamic banking model brings their operations closer to those of conventional finance. Consequently, there are concerns that the operations of Islamic banks may be somewhat influenced by conventional banks, which could lead to similarities in their risk profiles.

There is a notable disparity among countries regarding the determination and adjustment of the Capital Adequacy Ratio for Islamic banks, which is essential for accurately reflecting their specific financial risk buffers. Kahf (2005) argues that Islamic banks face qualitatively similar credit risks as conventional banks, suggesting that the methodologies used to calculate minimum capital requirements for credit risk exposure may not differ significantly from those applied to conventional banks. This lack of differentiation could further explain why Pakistan's Islamic banking system is more interrelated to the conventional sector, and hence depicts higher levels of systemic risk. In contrast, countries like Jordan exhibit the lowest systemic risk, a situation attributed to stringent regulations that prohibit the operation of Islamic banking windows under conventional banks. Instead, Islamic banks in Jordan must function as stand-alone, fully Shariah-compliant entities (Song and Oosthuizen 2014).

5.5 Systemically important financial institutions (SIFIs)

In this section, we identify SIFIs by selecting the top 50 institution-year observations with the highest systemic risk estimates during the full sample period, representing approximately 13% of the total sample. Among these, 44 are conventional financial institutions, while only six are Islamic.

Figure 2 illustrates their systemic risk, showing that the Islamic financial institutions (represented by red squares) exhibit only modest systemic risk compared to the conventional institutions (shown as blue crosses). Additionally, it highlights those conventional institutions experienced significantly higher systemic risk during the 2008 GFC period.

Based on the top 50 institution-year observations, Panel A of Table 4 presents the type and country of each financial institution, along with their corresponding systemic risk estimates. A preliminary inspection of these results indicates that a total of sixteen financial institutions consistently exhibited the highest systemic risk across different years during the sample period. These institutions are predominantly from Pakistan (8), Bahrain (2),

Bangladesh (2), Malaysia (1), and Saudi Arabia (1). Notably, eleven of these institutions are conventional, while only a few are Islamic. Thus, conventional institutions demonstrate higher systemic risk not only on average but also at the lower end of the distribution. These results are consistent with those of Chakroun and Gallali (2017), who report that in four (out of six) countries in the Middle East, conventional banks were systemically more important than Islamic banks.

Panels B and C of Table 4 present the top ten institutions in terms of intra-sector and cross-sector systemic risk transmission, respectively. Hidong Estate, Malaysia and Alinma Bank, Saudi Arabia emerge as the leading systemic risk transmitters among conventional and Islamic sectors, respectively, with mean systemic risks of 1.870 and 1.676. Overall, the intra-sector systemic risk transmission among the top ten Islamic institutions is lower than that of their conventional counterparts. In terms of cross-sector transmission, AB Bank, Bangladesh and BF Modaraba, Pakistan appear as the leading conventional and Islamic systemic risk transmitters, with mean systemic risks of 0.992 and 0.812, respectively. Although Islamic financial institutions transmit low systemic risk to the conventional financial system, conventional financial institutions transmit high levels of systemic shocks to Islamic institutions. These findings corroborate our earlier results.

Table 4 further illustrates that systemic risk is significantly higher in segregated sectors compared to cross-sector analyses. For instance, the maximum systemic risk for conventional institutions in the intra-sector analysis is notably greater than that observed in the cross-sector analysis. Similarly, the maximum systemic risk for Islamic institutions is also higher in the intra-sector analysis compared to across sectors.

The findings suggest that Islamic and conventional institutions do not operate independently; instead, systemic risk transmission is possible and significant (Chakroun and Gallali 2017). Systemic risk levels are reduced when both types coexist in a country, whereas they increase when treated separately. Jalbani and Shaikh (2009) notes that Islamic and conventional banks can coexist without significant "crowding out" effects. Therefore,

Table 3 Country-based systemic risk ranking

		Intra-sector		Cross-sector	
	ΔCoVaR	ΔCoVaR$^{CFS\|CFI}$	ΔCoVaR$^{IFS\|IFI}$	ΔCoVaR$^{IFS\|CFI}$	ΔCoVaR$^{CFS\|IFI}$
Bahrain	0.383	0.281	**0.643**	0.395	0.421
Indonesia	0.250	0.265	0.388	0.384	0.246
Jordan	0.079	0.071	0.201	0.184	0.102
Kuwait	0.477	0.482	0.452	0.465	0.471
Malaysia	0.533	0.529	0.512	0.535	0.511
Pakistan	**0.558**	**0.557**	0.610	**0.655**	**0.543**
Qatar	0.258	0.242	0.446	0.451	0.223
Saudi Arabia	0.369	0.347	0.500	0.484	0.355
UAE	0.175	0.172	0.463	0.295	0.211

This table reports the mean systemic risk by country for Islamic and conventional financial institutions. The standard errors are reported in parentheses. IFS represents the Islamic financial sector; CFS, conventional financial sector; IFI, Islamic financial institution; and CFI, conventional financial institution. The intra-sector systemic risk transmissions are represented by ΔCoVaR$^{IFS|IFI}$ for the Islamic sector and ΔCoVaR$^{CFS|CFI}$ for the conventional sector. Cross-sector systemic risk transmissions are denoted as ΔCoVaR$^{CFS|IFI}$ for the transmission from Islamic to the conventional sector, and ΔCoVaR$^{IFS|CFI}$ for the transmission from conventional to the Islamic sector. The highest systemic risk measure in each column is bolded

stakeholders, including regulators and practitioners, should prioritize a financial system that integrates both conventional and Islamic institutions, as exclusive reliance on either may heighten contagion risks due to their individual systemic vulnerabilities.

5.6 Systemic risk and the size of financial institutions

In this section, we examine the relationship between systemic risk and the size of financial institutions. Existing literature highlights that the size of a financial institution significantly impacts systemic risk (Laeven et al. 2016; Varotto and Zhao 2018), particularly demonstrated by the 2008 GFC, which underscored the detrimental effects of large institution failures on global financial stability (Girardi and Ergün 2013). Contributing factors include the excessive risk-taking behavior of "too-big-to-fail" institutions, which often anticipate bailouts, rely on unstable short-term funding, and maintain lower capital ratios. As a result, they are more susceptible to liquidity shocks, leading to shortages and fire sales (Laeven et al. 2016).

We focus on a subsample of the top 20 largest financial institutions in our study, which represent approximately the largest 5% of the total sample based on market capitalization as of 2008 (López-Espinosa et al. 2012). Table 5 presents summary statistics for the systemic risk of the top 20 institutions (denoted as "Large"). Unsurprisingly, the results indicate that these financial institutions exhibit significantly higher systemic risk compared to their smaller counterparts. However, the mean difference in their market capitalization is insignificant, implying that large Islamic and conventional institutions do not differ in size.

Among the 20 largest financial institutions, 12 are conventional and eight are Islamic, demonstrating a diverse representation in this size-based sub-sample. Notably, the higher systemic risk associated with conventional institutions is not solely due to their larger size;

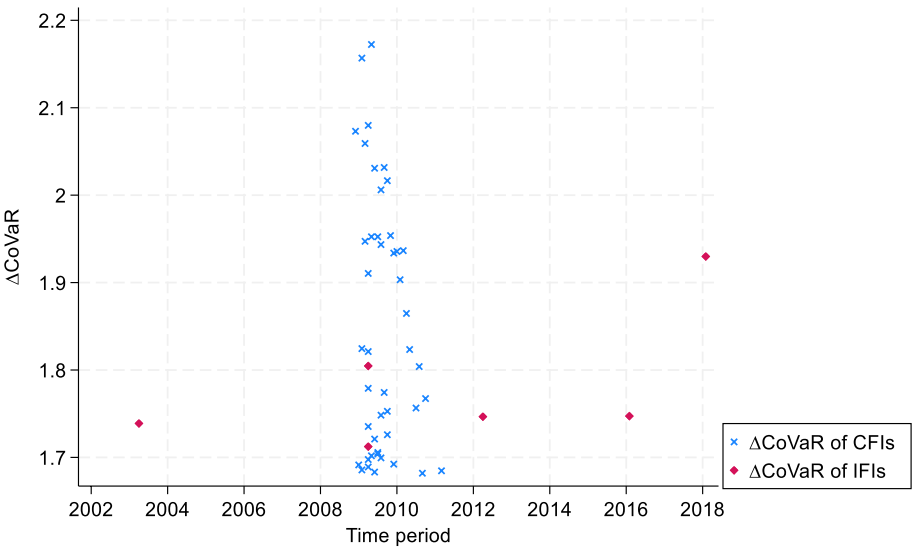

Fig. 2 Highest systemic risk financial institutions. (CFIs = conventional financial institutions; IFIs = Islamic financial institutions)

Table 4 Systemically important financial institutions (SIFIs)

Panel A. Aggregate sector

Financial institution	Country	Type	ΔCoVaR
Hidong Estate PLC	Malaysia	Conventional	1.988
Alinma Bank	KSA	Islamic	1.930
Standard Chartered Leasing	Pakistan	Conventional	1.907
M/S Crescent Star Ins. Ltd	Pakistan	Conventional	1.779
KASB Bank Ltd	Pakistan	Conventional	1.778
BF Modaraba	Pakistan	Islamic	1.772
Grays Leasing Ltd	Pakistan	Conventional	1.760
Khaleeji Commercial Bank	Bahrain	Islamic	1.747
GFH Financial Group	Bahrain	Islamic	1.747
Askari General Insurance Co Ltd	Pakistan	Conventional	1.735
BRR Guardian Modaraba	Pakistan	Islamic	1.712
International Finance Investment Bank	Bangladesh	Conventional	1.706
Habib Insurance Co Ltd	Pakistan	Conventional	1.698
MCB Bank Ltd	Pakistan	Conventional	1.691
Security Investment Bank	Pakistan	Conventional	1.689
Uttara Bank Ltd	Bangladesh	Conventional	1.684

Panel B. Intra-sector systemic risk transmission

Conventional	$\Delta CoVaR^{CFS\|CFI}$	Country	Islamic	$\Delta CoVaR^{IFS\|IFI}$	Country
Hidong Estate PLC	1.870	Malaysia	Alinma Bank	1.676	KSA
International Finance Inv	1.767	Bangladesh	First Al-Noor Mod	1.497	Pakistan
Uttara Bank Ltd	1.726	Bangladesh	Inovest BSC	1.485	Bahrain
Egyptian Financial Group	1.640	Egypt	Deyaar Development	1.385	UAE
Grays Leasing Ltd	1.633	Pakistan	GFH Financial Group	1.380	Bahrain
Standard Chartered Leasing	1.620	Pakistan	Khaleeji Com. Bank	1.366	Bahrain
UOB-Kay Hian Holdings	1.607	Singapore	BF Mod	1.354	Pakistan
MCB Bank Ltd	1.604	Pakistan	Meezan Bank Ltd	1.320	Pakistan

Table 4 (continued)

Pubali Bank Ltd	1.579	Bangladesh	Securities House	1.310	Kuwait
Security Leasing Corp Ltd	1.578	Pakistan	First Habib Mod	1.307	Pakistan
Panel C. Cross-sector systemic risk transmission					
Conventional	$\Delta CoVaR^{IFS\|CFI}$	Country	Islamic	$\Delta CoVaR^{CFS\|IFI}$	Country
AB Bank Ltd	0.992	Bangladesh	BF Mod	0.812	Pakistan
Standard Chartered Ltd	0.904	Pakistan	First Al-Noor Mod	0.794	Pakistan
International Finance Inv	0.900	Bangladesh	First Para. Mod	0.746	Pakistan
National Bank Ltd	0.895	Bangladesh	IBRACO Bhd	0.692	Malaysia
Hidong Estate PLC	0.894	Malaysia	GFH Group	0.627	Bahrain
Faysal Bank Ltd	0.862	Pakistan	TIJARA & RE	0.622	Kuwait
Habib Metropolitan Bank	0.855	Pakistan	KASB Mod	0.614	Pakistan
Askari Bank Ltd	0.825	Pakistan	KEN Holdings	0.605	Malaysia
KASB Bank Ltd	0.797	Pakistan	BIMB Holdings	0.600	Malaysia
Cyan Ltd	0.795	Pakistan	Islami Bank Ltd	0.600	Bangladesh

The table presents systemically important financial institutions (SIFIs), based on systemic risk. Panel A lists systemically important financial institutions from the aggregate sector, while Panels B and C list conventional and Islamic institutions based on intra-sector and cross-sector systemic risk transmission. IFS represents the Islamic financial sector; CFS, conventional financial sector; IFI, Islamic financial institution; and CFI, conventional financial institution

rather, large Islamic institutions do not exhibit the same level of systemic risk as their conventional counterparts, as indicated in Table 5. In fact, the sub-sample of the largest conventional institutions shows the highest mean systemic risk (0.551) across all size-based sub-samples. This significant difference in systemic risk based on size indicates that both large conventional and large Islamic institutions display higher systemic risk compared to the overall sample, aligning with findings elsewhere (Cooley et al. 2009; Laeven et al. 2016; Rodriguez-Moreno and Peña 2013).

Furthermore, the mean systemic risk of the largest conventional institutions is significantly greater than that of the largest Islamic institutions, emphasizing the results of the comparison between all conventional and Islamic institutions. This difference in systemic risk is not merely a function of size; rather, it may stem from inherent factors such as the risky nature of interest-based operations, higher default and market risks, and elevated leverage levels in conventional institutions compared to Islamic ones (Beck et al. 2013; Pappas et al. 2017; Sorwar et al. 2016).

6 Robustness analysis

We conduct two alternative analyses to ensure the reliability of our findings.[10] First, we estimate systemic risk using a multivariate DCC-GARCH model, a widely recognized method for capturing and analyzing volatility in financial contexts such as risk analysis, portfolio optimization, and derivative pricing (Bollerslev 1986; Brownlees and Engle 2017; Füss et al. 2016). The analysis shows that systemic risk estimates from the DCC-GARCH models are statistically not different from those obtained using the study's main quantile estimation technique. Additionally, comparisons between the two methods reveal no significant differences in average systemic risk for either randomly selected average-sized financial institutions or the smallest institutions.

Second, we use an alternative technique for deriving systemic risk using CDS spreads, namely CoRisk. This measure incorporates financial institutions'CDS spreads, Moody's KMV expected default frequencies, corporate bond spreads, distance-to-default metrics, and the VaR of their trading portfolios (Chan-Lau 2010; IMF 2009). Our analysis reveals that the mean and median CoRisk values for conventional financial institutions are significantly higher than those for their Islamic counterparts, aligning with our findings from the ΔCoVaR measure.

7 Conclusion

The 2008 Global Financial Crisis and the subsequent recession sparked significant regulatory and academic interest in examining the systemic linkages between conventional and Islamic financial systems. This study contends that integrating alternative financial models, such as Islamic finance, alongside conventional banking practices enhances economic resilience and stability. It comprehensively compares and assesses the systemic

[10] For brevity, the detailed tests and analyses are presented in the supplementary material file, available as an online appendix.

Table 5 Systemic risk estimates - Large institutions

	Mean	Std. Dev	Min	Max
Size (Islamic)	1178.36	3707.29	0.404	32704.9
Size (Conventional)	1644.56	3726.11	0.701	21923.6
Islamic – Conventional	466.20			
ΔCoVaR (Large)	0.496	0.263	−0.076	1.685
ΔCoVaR (All)	0.485	0.269	−0.330	2.172
ΔCoVaR (Large) –ΔCoVaR (All)	0.011**			
$\Delta CoVaR^{IFI}$ (Large)	0.391	0.182	−0.076	1.098
$\Delta CoVaR^{CFI}$ (Large)	0.551	0.282	−0.024	1.685
$\Delta CoVaR^{CFI}$ (Large) – $\Delta CoVaR^{IFI}$ (Large)	0.160***			

The table reports summary statistics of systemic risk based on the size (market capitalization) of the financial institutions. IFS represents the Islamic financial sector; CFS, conventional financial sector; IFI, Islamic financial institution; and CFI, conventional financial institution. We identify as "Large" the largest 5% of the institutions based on market capitalization as of 2008. *** denote significance at the 1% level

interconnections between these two structurally and operationally distinct financial models. We analyze and compare the systemic risk profiles of Islamic and conventional financial institutions within dual-banking systems, emphasizing their spillover effects. Our analysis

Table 6 Quantile regression estimation results

		Intra-sector		Cross-sector	
	ΔCoVaR	$\Delta CoVaR^{CFS\|CFI}$	$\Delta CoVaR^{IFS\|IFI}$	$\Delta CoVaR^{IFS\|CFI}$	$\Delta CoVaR^{CFS\|IFI}$
System return	0.078**	0.072**	0.109***	0.080***	0.083**
	(0.004)	(0.006)	(0.003)	(0.003)	(0.004)
Δ(T-bills yield)	0.019**	0.017**	0.017**	0.004***	0.035**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
TED spread	0.029**	0.034*	0.013***	0.004***	0.048**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
Market return	-0.024**	0.035*	-0.534***	-0.179**	-0.066**
	(0.011)	(0.007)	(0.015)	(0.006)	(0.018)
Market volatility	-0.167**	-0.041**	-1.100***	-0.483***	-0.133**
	(0.030)	(0.021)	(0.040)	(0.015)	(0.052)
Inflation	-0.001	-0.001*	0.000***	-0.001***	-0.001**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)

This table reports the mean regression results from 99% conditional quantile regressions of Islamic and conventional financial institutions. The standard errors are reported in parentheses. IFS represents the Islamic financial sector; CFS, conventional financial sector; IFI, Islamic financial institution; and CFI, conventional financial institution. The intra-sector systemic risk transmissions are represented by $\Delta CoVaR^{IFS|IFI}$ for the Islamic sector and $\Delta CoVaR^{CFS|CFI}$ for the conventional sector. Cross-sector systemic risk transmissions are denoted as $\Delta CoVaR^{CFS|IFI}$ for the transmission from Islamic to the conventional sector, and $\Delta CoVaR^{IFS|CFI}$ for the transmission from conventional to the Islamic sector. *, **, *** denote significance at the 10, 5 and 1% level, respectively.

employs ΔCoVaR to estimate systemic risk across a sample of 376 publicly listed financial institutions from 12 countries, covering the period from 2000 to 2019.

Our findings indicate that Islamic institutions exhibit lower systemic risk compared to conventional ones, highlighting their relative stability within the financial sector. Additionally, our analysis reveals that Islamic institutions contribute slightly more to systemic risk within their own sector compared to conventional institutions. In contrast, the results indicate that conventional institutions transmit significantly more systemic risk to the Islamic sector, establishing the Islamic sector as a net importer of systemic risk. The results are robust to using the alternative method of dynamic conditional correlations to estimate ΔCoVaR, and the use of CDS spread-based CoRisk measure.

In further analyses, our country-based systemic risk analysis, Pakistan emerged as the country with the highest intra-sector and cross-sector systemic risk, followed by Bahrain in Islamic intra-sector risk transmission and Malaysia in overall systemic risk. The structural ties between Islamic banks and conventional banks in Malaysia and Bahrain may increase systemic risk, while Jordan's regulation of fully autonomous Islamic banks presents a contrasting model. Our analysis of systemically important financial institutions showed that conventional banks dominated the list of those with the highest systemic risk, while Islamic banks demonstrated lower risk profiles. Conventional institutions transmitted more systemic risk to Islamic banks than vice versa, highlighting their interconnectedness and suggesting that risk levels are heightened when the two operate separately. Finally, we found that larger financial institutions generally exhibit higher systemic risk, with conventional institutions showing significantly greater risk compared to their Islamic counterparts. This difference is attributed to the characteristics of conventional banks, including their reliance on interest-based operations and higher leverage, rather than size alone. Overall, these analyses emphasize the intricate nature of systemic risk within dual-banking systems and the critical factors that influence financial stability.

This study suggests several policy implications for regulators. First, incorporating alternative financial institutions, such as Islamic banks, can enhance economic resilience and stability by mitigating potential systemic risks and reducing the likelihood of financial crises. Second, the Basel Committee should consider integrating the market-based ΔCoVaR measure of systemic risk for Islamic banks alongside the current VaR methodology, which only accounts for their standalone market risk. Third, the contribution of conventional financial systems to systemic risk requires closer monitoring. Finally, regulatory frameworks for large conventional and Islamic financial institutions should be strengthened to manage their systemic risk contributions effectively. From the perspective of investors and the general public, a dual-banking system that meets diverse needs can provide greater resilience and better protection against unforeseen systemic shocks.

Future research could investigate the specific characteristics of Islamic financial institutions that influence their systemic risk. Additionally, comparisons could be made between the systemic risk profiles of IFIs and other faith-based financial systems, such as those operated by Catholic organizations. This study could also be replicated in other regions with dual financial systems, like the EU and the UK. Furthermore, the impact of Covid-19 as an exogenous shock on systemic risk in dual financial environments warrants exploration. We plan to pursue these avenues in our next research endeavors.

Appendix I

Systemic risk estimation via quantile regression: estimation results

The quantile regression estimation results for systemic risk measures, based on equity losses and lagged state variables, are presented in Table 6. The first column outlines the variables, where system returns represent market equity losses and the rest are the lagged country-specific state variables. The remaining columns report the regression estimated parameters and standard errors for the time-varying systemic risk of the aggregate sector and segregated Islamic and conventional sectors. The significance of the coefficients indicates that state variables effectively proxy for the time variation in the conditional moments of equity losses (systemic risk quantiles), revealing significant time-varying systemic shocks for each sample and sector.

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Code availability N/A.

Declarations

Conflicts of interest The authors have no relevant financial or nonfinancial interests to disclose.

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