Management of Islamic Finance: Principle, Practice, and Performance

Islamic Banks' Resilience to Systemic Risks: Myth or Reality-Evidence from Bangladesh
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CHAPTER 2

ISLAMIC BANKS' RESILIENCE TO SYSTEMIC RISKS: MYTH OR REALITY-EVIDENCE FROM BANGLADESH

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ABSTRACT

This chapter investigates the presence of a difference in the systemic risk level between Islamic and conventional banks in Bangladesh. The authors compare systemic resilience of three types of banks: fully fledged Islamic banks, purely conventional banks (CB), and CB with Islamic windows. The authors use the market-based systemic risk measures of marginal expected shortfall and systemic risk to identify which type is more vulnerable to a systemic event. The authors also use $\Delta CoVaR$ to identify which type contributes more to a systemic event. Using a sample of observations on 27 publicly traded banks operating over the 2005–2014 period, the authors find that CB is the least resilient sector to a systemic event, and is the one that has the highest contribution to systemic risk during crisis times.

Keywords: Systemic Risk Measures; Marginal Expected Shortfall; Systemic Risk; Delta Conditional Value at Risk; Risk Vulnerability; Islamic Banks; Bangladesh; Conventional Banks

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1. INTRODUCTION

Healthy financial systems enhance the development and prosperity of the economy. To ensure the sustainability of the economic prosperity, regulatory bodies oversee and organize financial institutions and practices, particularly banking institutions, owing to their crucial intermediary role in the financial system. However, in spite of those regulating efforts, financial crisis does occur, the case of the 2007–2008 global financial crisis is just an example, which eventually left a stressful negative effect on the economic system of the country or countries influenced. This last global financial crisis clearly revealed the fragility of the conventional financial system in front of systemic events. The resulting global economic recession and the failure of main banking institutions highlighted the importance of sound risk management and mitigation practices, and stressed the importance of systemic risk identification and assessment in the process of macro prudential policies improvement.

The crisis also directed the attention toward the difference in the crisis effect between Islamic and conventional banks. In spite of business model restrictions, Islamic banks were found to be in a better position in terms of the crisis resilience in comparison with conventional banks; in addition to a time shift (time lag) in the crisis effect for Islamic banks (Khediri, Charfeddine, & Youssef, 2015). In a speech of the governor of the Malaysian central bank, Aziz (2008) pointed out that Islamic banks resilience is a result of being protected from high exposure to excessive leverage and risk taking, as a result of its business model feature, and specifically being equity- or asset-based with a risk-sharing ability. However, since Islamic banks are rooted in the real economic side because their transactions are being backed by real assets, their resilience to a systemic event is challenged from another perspective. Islamic banks were found to be affected by the crisis in its second round as it reached the real economic side, specifically when real estate tumbled down (Kammer et al., 2015). Betz, Oprica, Peltonen, and Sarlin (2014) pointed out that the presence of a strong connection to the real economy will increase the system exposure to contagion effects. Thus, the stability and resilience of Islamic banks are challenged in a novel way. Nevertheless, the recorded variation in the crisis impact on Islamic banks spur a debate regarding the influence this model exerted on stabilizing the financial system.

In this chapter, the main aim is to empirically assess Islamic banks' stability by evaluating its systemic risk vulnerability, and its strength to support the stability of a fragile financial system under a systemic event. We achieve this objective with a comparative systemic risk study that evaluates the systemic risk of the Islamic banking model (IB) against its counterparts, the conventional one (CB), and the hybrid between the previous two, which is the conventional banking system that offers Islamic banking services via an Islamic window (CBw).

This chapter used the context of Bangladesh to obtain evidence about the systemic risk of each type of banks. Islamic banking sector in Bangladesh has been largely characterized as "mostly underplayed" or "regulated under conventional banking laws." Islamic banks in Bangladesh have not received necessary legal support from the government vis-à-vis the Central Bank, particularly in terms

of having separate Islamic banking act to govern this massive sector (Ahmad & Hassan, 2007; Rashid & Nishat, 2009). According to the most recent annual report published by Bangladesh Bank (2016), a total of 57 commercial banks are directly regulated by the Central Bank, of which 40 are private commercial banks, 6 are nationalized (govt. owned) commercial banks, 2 are development financial institutions, and 9 are foreign commercial banks. Around 64% of the industry assets and deposits are controlled by the private commercial banks, whereas around 27% of the industry assets and deposits are managed by government-owned nationalized commercial banks. Analyses on the capital-to-risk-weighted assets ratio show that over the years since 2008 until 2016, the ratio has dropped from 11.6% to 10.8%. Government-owned banks and the development financial institutions carried the highest proportion of nonperforming loans, with an industry average of 9.2%. The report states that there are 24 Islamic institutions offering Islamic banking services either being solely Islamic banks or being an Islamic entity of the conventional bank. The report shows that Islamic banks are suffering from excess liquidity (116.6% in 2016) with an average of 86.7% of investment-to-deposit ratio. Overall bank performance in Bangladesh has been impacted by several risk factors, including credit risk, and also operating cost of the bank (Mujeri & Younus, 2009; Sufian & Habibullah, 2008). Extant studies have also found market size as an important determinant of bank's riskiness and profitability (Jahangir, Shill, & Haque, 2007).

The remaining part of this chapter is organized as follows: in Section 2, the theoretical basis for the uniqueness of risk features of Islamic banks is discussed. Section 3 reviews empirical evidence for the stability of Islamic banks. Section 4 discusses systemic risk definitions and measurements and comments on the literature is provided in Section 5. The methodology is outlined in Section 6. Section 7 present and discusses the results and Section 8 concludes.

2. THEORETICAL BASIS FOR THE UNIQUE RISK FEATURES OF ISLAMIC BANKS

From a theoretical perspective, an Islamic bank is a financial institution that is engaged in all banking activities at a zero-interest rate in keeping with Islamic Shariah rules (see e.g., Shafique, Faheem, & Abdullah, 2012). Instead of the interest rate, the Islamic bank receives a fee or a rate of return depending on the transaction performed. In addition, the Islamic bank deposits are based on a special type of partnership agreements while its investments are equity-based or asset-based, where the transaction is backed by real assets. The bank is not allowed to take excessive uncertainty (i.e., Derivatives and gambling are not allowed), or to finance any activity that is not allowed in Islam (non-halal) such as alcohol production or distribution.

Islamic banks are exposed to the generic risks that are similar to conventional banks but are at the same time exposed to unique risks, which are specific to the features of the Islamic banking business model. Unique Islamic banking risks include rate-of-return risk, displaced commercial risk, equity investment risk,

and Shariah noncompliance risk. In order to understand those unique risks, it is essential to comprehend the main principles upon which Islamic banking resides, along with the main contracts used within its transactions, and the risks that those instruments imply. The Islamic financial system is based on principles that emerge from the Islamic transaction rules known as Fiqh Al-Muamalat, that are part of the Islamic Shariah rules. In the following, we discuss Islamic finance principles with more details in connection with the main Islamic banking instruments and their implied risks within Islamic banking.

2.1. The Prohibition of Interest and Usury (Riba)

Interest or Riba is defined as any agreed-upon payment or receipt in excess of principal in a loan agreement, which is forbidden by the Islamic Shariah rules (Greuning & Iqbal, 2007; Obaidullah, 2005; Tiby, 2011). In other words, it is not allowed to use interest or any guaranteed positive predetermined rate or amount that is paid based on the maturity and the amount of the transaction principal regardless of the realized performance of the transaction (Iqbal, 1997). The debt contract that are conducted on the basis of no interest are referred to as *Qard al-Hassan*, which is a debt of goodwill and benevolence, to be repaid at the original amount according to a predetermined contract conditions that include no interest or other benefits, whether in explicit or implicit terms. However, an extra amount over the principal may be voluntarily given by the debtor to the lender without any predetermined provision or agreement (Visser, 2009). Current deposits in Islamic banks are an example of *Qard Al-Hasan*.

From a theoretical perspective, the prohibition of interest is expected to expose Islamic banks to market, operational, and liquidity risk. Operational risk stems from the direct or indirect loss resulting from inadequate or failed internal processes, people, and systems, or from external events. Liquidity risk emerges from Islamic banks' limitation in terms of the availability of their interbank market and money market transactions. Greuning and Iqbal (2007) pointed out that Islamic banks are subject to two types of liquidity risk: lack of access to funding sources and lack of available liquidity in the market, which makes liquidity risk management a critical task for Islamic banks. They also denoted several factors that contribute to Islamic banks' higher exposure to liquidity risk, including limited money market instruments that are Shariah-based and limited interbank and secondary market trading ability. As a result, the Islamic bank may maintain a high level of cash to meet the current deposits' withdrawals and will be reluctant to engage in long-term investments to avoid the high illiquidity of these investments. The Islamic banking regulating bodies with the help of the Islamic scholars have supplemented the financial markets with securities that are called sukuk, and Islamic notes as equivalent instruments to conventional bonds and notes respectively, in order to reduce the liquidity and funding limitations, in addition to the continuous efforts to resolve the interbank market activation.

Islamic Shariah requires that all transactions be backed by tangible real assets. This is referred to as asset-backed financing, which leads to the integration of the Islamic banking activities with the real economy. The profit is achieved based

on the difference between the monetary values of assets over time. This indicates that Islamic Shariah rules take into consideration what the conventional system refers to as the time value of money but confines this concept to become an asset-time value expressed in monetary units, instead of the money for money as in the use of interest rate on the money principal. Therefore, the Islamic Shariah allows the same real asset to be sold on spot at a value that is different from the value of the same asset if sold on installment basis (Obaidullah, 2005; Usmani, 2002). As a consequence, for this restriction, the Islamic banks' transactions are dependent on illiquid assets (real assets and inventories) in comparison with conventional banks.

Moreover, the bank is under the risk of the change in the value of the underlying asset, especially that the Shariah rules require the bank to have the asset in his possession when a trade financing arrangement is initiated. For other contracts of partnership or leasing, the possession of the asset remains with the bank until the contract maturity date. This increases the exposure of the Islamic bank to market risk, which arises from the unfavorable changes of the assets market value. It is essential for Islamic banks to manage the volatility of their transaction arrangements through the entire time frame of the contract to control for the market risk and its components, including mark-up risk, price risk, leased assets value risk, currency risk, securities price risk, rate-of-return risk, equity investment risk, benchmark risk, hedging risk, and business environment risk (Greuning & Iqbal, 2007).

2.2. Islamic Financial Arrangements

Partnership, sale, and leasing contracts in addition to trust accounts (safe keeping) (Wadiah) and interest-free loans (Qard Hasan) are the main contracts allowed in Islamic law to promote social justice between market participants as they pursue their aim to maximize their welfare and wealth. Under the Islamic Shariah restrictions, Islamic banks are allowed to conduct their business transactions with their depositors and clients using these contracts. Partnership (equity-based) can be a profit–loss sharing (PLS) (Musharuka) contract where both parties contribute to capital and share the realized profit or loss of the transaction (Khan & Ahmed, 2001), or profit-sharing (trust financing) (Mudarabah) where one party provides the capital and the other provides the effort. In Mudarabah, profits are shared as agreed on in the contract, while losses are absorbed by the party that provides capital. As for the sale contracts, the main form used by Islamic banks is the mark-up or cost-plus transaction (Murabahah) based on selling an asset at a clearly declared mark-up rate, following the rules of fairness and transparency between traders. Lease-based contracts are similar to financial leasing where the bank leases assets to the client but keeps the ownership of the underlying assets till the end of the contract. The assets can be sold at low price or transferred to the lessee after that. In a trust account (Wadiah), the bank does not use the money without prior authorization from the depositor, while in interest-free loan (Qard Hasan), the bank uses the funds at its own risk without the need for authorization from the depositors.

Mudarabah partnership arrangement with depositors is a unique specificity of Islamic banks. This arrangement may reduce the mismatch between the assets and liabilities that is commonly found in conventional banks, but at the same time it implies unique risk sources. With the Mudarabah features, the Islamic bank encounters risk of uncertainty of returns to depositors. Losses of the bank investments will be passed to depositors. If losses or low returns occur, the Islamic bank is exposed to clients' withdrawal risk, which leads the bank into displaced commercial risk (i.e., the risk of deposit withdrawal). One type of depositors of Islamic banks are called "investment accounts holders" who are actually equity holders. They provide protection to Islamic banks in disturbance times when the profit rates decline, in contrast to conventional banks' obligation to compensate their depositors regardless of their actual outcome. However, depositors may choose to relocate their money in case of low return from Islamic bank to other banks or investments.

To further understand the risks that this feature implies, consider the liability side of the Islamic bank balance sheet. Mudarabah partnership arrangements in the liability side include two types; savings and investment deposits but do not include current deposits. From the Islamic point of view, the current deposits can be considered a trust account (wadiah) or an interest-free loan (Qard Hasan). In both cases, current deposits' principal is guaranteed to be repaid on demand and the depositor does not gain any return of any type from these deposits.

As for savings deposits, they generally have relaxed conditions on the minimum balance and withdrawal without a prior notice. The bank provides a low return to the account holder. The bank usually invests the funds in short-term low-risk investments, pay depositors a low portion of the profit based on the minimum maintained balance for the time period with the principal, return not being guaranteed, and the bank is the partner responsible for managing the funds. The losses are totally absorbed by the fund provider or the client, in addition, the depositors will have a withdrawal cost as they do not receive any profits for the period in which the withdrawal is made.

Investment deposits are similar to term deposits in the conventional banks but based on Mudarabah with two subtypes; restricted to one project and unrestricted, where the deposit is used to finance the pool of investments of the bank. The investors are entitled to a stated share of profit while losses are borne by depositors only. The depositors' return from these deposits is usually higher than the return from savings accounts with the principal and return also not guaranteed. In general, the investment time period is usually longer than the savings account, during which withdrawals are not allowed without prior notice. The investment account holders have to endure a withdrawal cost as explained previously. The bank can utilize the investment deposits within a pooled investment portfolio that is applied to different operations and projects (for unrestricted investments) or is formally authorized to invest only in specific projects (for restricted or special investments). In case of a realized loss, they are absorbed by the fund provider (the account holder) unless it is proved that the loss occurred as a result of the bank misconduct. However, if the funds are provided by both the client and the bank as in a PLS contract (Musharukah), the loss is absorbed

by both the account holder and the bank, in accordance with the proportion that each of them contributed to capital (Iqbal, Ahmad, & Khan, 1998; Obaidullah, 2005). This can occur in restricted investment accounts.

From the previous discussion, we note that the partnership arrangements may help the Islamic banks to be more flexible during downturn times, but at the same time they imply additional risks. The response of the bank depends on how Islamic banks foresee the relationship with depositors. If the bank perceives the depositors as risk averse, this will increase the probability of withdrawal risk, and thus the Islamic bank will be disciplined to have lower risk taking and lending appetite (Khan & Ahmed, 2001). However, if the bank perceives depositors as loyal to endure losses, this will decrease the probability of withdrawal risk, and the Islamic bank will have a more aggressive lending strategy, which will transfer credit risk to the investment deposit holders (Sundararajan & Errico, 2002).

Islamic banks try to mitigate withdrawal risk, which leads them to not fully commit to the partnership rules of Shariah. They smooth the return provided to investment account holders to control for the withdrawal risk by matching market competitive rates regardless of realized performance (Obaidullah, 2005). The logic that Islamic banks follow is that poor returns to investment account holders may stimulate withdrawals that will cause a liquidity shortage and even a solvency crisis. Matching of market rates practice creates the displaced commercial risk, which is unique to the Islamic banking model.

Displaced commercial risk is defined as the risk that equity holders will be deprived of part of their returns to investment depositors to control for withdrawal risk, as part of Islamic banks practice of smoothing the returns of the investment account holders (AAOIFI, 1999). In other words, this means that Islamic banks distribute profits to their investment account holders using the positive competitive market rate as a benchmark, even if they have realized losses, through using part of the profits that are entitled to equity holders, which are kept in a special reserve account called profit equalization reserve. Thus, the displaced commercial risk is also linked to benchmark yield risk, interest-rate risk, and rate-of-return risk. However, even with the presence of this unique risk source, the arguments continue regarding Islamic banks' higher ability to bear losses under crisis as they can share those losses with the investment account holders, even if they try to avoid doing so (Ahmed, 2002; Ali, 2007; Cihak & Hesse, 2010; Khan, 1987).

However, partnership arrangements on the assets side have the same previously explained sharing mechanism, but the bank will be the provider of funds, fully or partly. The partnership financing transactions of Mudarabah are perceived by Islamic banks to bear high risk to the degree that Islamic banks are found to avoid this mode in extending credit to their clients. Instead they rely more on the use of mark-up financing modes (Murabaha), which are mainly mark-up trade-based transactions. Islamic banks also use a diminishing Musharakah, which ends with the complete ownership by the partner who purchases the share of the bank in a particular project by a redeeming mechanism arranged between both of them. The equity investment risk of partnership financing arises due to partner's behavior or the business activity is especially related to the rate-of-return risk, displaced commercial risk, and credit risk.

In real world, the balance sheet composition of Islamic banks reflects that they have approximately 20% of their total assets in partnership-based investments, which leaves nearly 80% of total assets in nonpartnership investments (Bourkhis & Nabi, 2013). This practice is meant to avoid the complexity of partnership arrangements, structuring and management (Aggarwal & Yousef, 2000; Baele, Farooq, & Ongena, 2014; Chong & Liu, 2009; Dar & Presley, 2000; Errico & Farahbaksh, 1998; Mills & Presley, 1999; Siddiqi, 2006; Sundararajan & Errico, 2002), especially that Islamic banks cannot reduce the credit risk by requesting a collateral in this type of financing (Errico & Farahbaksh, 1998). However, it is also claimed that this behavior of Islamic banks does not reduce the withdrawal risk in comparison with conventional banks (Khan & Ahmed, 2001; Sundararajan & Errico, 2002).

2.3. Restrictions on Money for Money Transactions

Islamic finance recognizes money as a medium of exchange for a real asset and not a commodity itself. Any exchange of money for money of the same or different type is called *Bai' Al-Sarf* and is subject to special roles. These transactions should always be on the spot. If the exchange is of the same type of money (i.e., gold for gold) the transaction should be of equal unit of measurement. The subject matter of these contracts shall be money, which is known, in existence, deliverable and owned by the contracting parties.

As a consequence for this restriction, the bank is under the risk of the change in the value of money. This exposes the Islamic bank to risk and it is essential for Islamic banks to manage the volatility of their transaction arrangements in the present and future, to control for the market risk and its components, including price risk, value risk, currency risk, securities price risk, rate of return risk, equity investment risk, benchmark risk, hedging risk, and business environment risk (Greuning & Iqbal, 2007).

2.4. Prohibition of Excessive Uncertainty (Gharar) and Speculative Behavior (Maysir)

Gharar refers to excessive or deceptive uncertainty or lack of information available to one party in a transaction contract. Maysir refers to games of chance (gambling) and is involved in contracts where the ownership of a good depends on the occurrence of a predetermined, uncertain event in the future. Islamic Shariah rules prohibits excessive uncertainty and gambling so as to not allow one party of the contract to acquire profits at the expense of the other party against the fairness and equity principles for the two parties. The Islamic contracts are considered to be sacred duties and must have clear certainty in their clauses, which means that the contract parties should be protected from being deceived through ignorance or the presence of unclear essential elements of the transaction. This rule does not allow the bank to sell goods or assets that are not in his possession, which implies uncertainty in the quality, the ability to deliver, and the fair price of the transaction. This also indicates the prohibition of gains based on a game

of chance, as in the case of derivatives and options, which are foreseen as pure speculative transactions.

From a logical point of view, every business decision will include some level of speculation or uncertainty, but the rationality of Islam accepts this as long as the decisions are taken using all relevant valuable information, to reduce the risk of asymmetric information and to reduce moral hazards. Maysir and Gharar are often two interrelated actions, in which the presence of one dictates the presence of the other. Based on this rule, it is forbidden to invest a small amount of money for the hope of winning or earning a large undeserved sum, and if the investor does not achieve this sum, he will lose the total value of his investment. However, if the investor achieves the high earnings, the other party of the contract will be in a deficit position that is proportional to the difference between the small initial investment and the investor earnings, such as in the case of gambling and also some types of life insurance contracts (Obaidullah, 2005).

Since derivatives are constrained under this rule, the Islamic banks appear to have a conservative risk-taking ability. If we add up to this, the asset- or equity-based rules that connect them to real economy, then the stability of the Islamic bank is expected to be higher than the conventional bank, due to the constraints on their leverage level and exposure to speculative behavior (Bourkhis & Nabi, 2013). Nevertheless, prohibition of *gharar* and *maysir* limits the Islamic bank in terms of investment opportunities, risk management tools, and access to liquidity.

2.5. Prohibition of Shariah Non-Halal (Haram) Transactions

This rule refers to the prohibition of all transactions that are not accepted according to Islamic Shariah standards and are classified as non-halal or haram. Interest-based activities are examples of the prohibited transactions; other haram items include pork and alcohol production and selling, financing casinos, etc. Islamic banks are monitored through the Shariah Supervisory Board, in addition to central banks and regulating bodies, and in case the bank violates any of the Islamic finance rules the bank will expose itself to the Shariah noncompliance risk, which may cause the bank to be denied having or providing certain Islamic finance instruments or may even cause the withdrawal of its Islamic activities' license by the Islamic banking regulating bodies.

3. EMPIRICAL EVIDENCE FOR THE STABILITY OF ISLAMIC BANKS

Islamic banking assets grow rapidly in size and importance within Islamic and even non-Islamic countries (see e.g., Thomson Reuters, 2015), including Europe (Cattelan, 2013; di Mauro et al., 2013; Khan & Porzio, 2010; Lewis & Algaoud, 2001, chapter 6,) and America (di Mauro et al., 2013; Tacy, 2006). The Islamic banking system is rapidly diffusing not only through the increasing establishment of fully fledged Islamic banks (banks that are fully dedicated to offer Islamic

banking services), but also through the integration of Islamic banking services within conventional banks, through an Islamic banking window. Islamic banking started in Egypt in the year 1963 (Kumru & Sarntisart, 2016), to service the Islamic population demand for Shariah banking services. Since then, Islamic banking has continued to grow and expand worldwide, especially in Muslim countries. Imam and Kpodar (2013) investigated the expansion pattern of Islamic banking. They found that the share of the Muslims in the population and the income per capita along with the level of economic integration with Middle East countries are the main factors that support this expansion.

In general, Islamic banks have maintained stronger asset growth compared to conventional banks during the crisis period of 2007 (Hasan & Dridi, 2011). Islamic finance assets maintained a double-digit annual growth rate since 2007, and expanded to USD1,086 b in 2011 (Financial Times, 2011), to reach an overall total value of USD 1.88 trillion by 2015 (IFSB, 2016), from which Islamic banking assets account for nearly 80% of Islamic finance assets (IFSB, 2016; TheCityUK, 2015). The Islamic banking assets have been approximated to around USD1.6 trillion by the end of 2015 (IFSB, 2016). The annual growth rate of the Islamic banking assets, during the 2007–2009 period was reported to be approximately 20% (IFSB, 2014). Nevertheless, the compound annual growth rate slowed down to 16% between 2010 and 2014 (Ernst & Young, 2015). However, in spite of the impressive growth record that this industry is achieving, its share from the global banking assets is small, at approximately 1% (Pinner & LinYan, 2013; Kammer et al., 2015).

Imam and Kpodar (2016) found that despite the relatively small size of Islamic banking activities within the overall financial system, Islamic banking activities has a positive effect on economic growth. From a theoretical point of view, the Islamic banking model was argued to be similar to many countries' reform proposals for the banking system, including USA, and that it may be better able to absorb shocks that disturb the payment mechanism and thus showing a higher ability in maintaining the financial system stability (Khan, 1986, 1987). Djennas (2016) points out that "countries that adopt the principles of Islamic finance are strongly positioned to avoid various situations of crisis and economic downturns." The debate on whether this model will be better able to withstand a negative systemic event chock intensified in terms of the model performance and risks, especially after the late crisis. However, the differences between the Islamic and the conventional banking systems has been actively investigated by scholars even prior to the late crisis, with two underlying main viewpoints: the first claims that Islamic banking practices are similar to the conventional ones (see e.g., Chong & Liu, 2009; Khan, 2010; Kuran, 2004; Nomani, 2006, chapter 8), while the other claims the presence of differences in both practices and business models (see e.g., Ariffin, Archer, & Karim, 2009; Iqbal & Llewellyn, 2002; Solé, 2007; Sundararajan & Errico, 2002).

Nevertheless, considering the crisis period itself, and starting from the noticeable performance differences, Islamic banks were found to have a higher performance level during the crisis period with higher profits, better capitalization, and higher asset quality (see e.g., Abedifar, Molyneux, & Tarazi, 2013;

Al-Hares, AbuGhazaleh, & El-Galfy, 2013; Beck, Demirgc-Kunt, & Merrouche, 2013; Bourkhis & Nabi, 2013; Hasan & Dridi, 2011; Khediri et al., 2015; Olson & Zoubi, 2008; Wijnbergen & Zaheer, 2013), and lower disintermediation ratio (Beck et al., 2013). However, the two models' differences were found to be more apparent for small-size banks rather than large-size ones (Abedifar et al., 2013; Beck et al., 2013). The negative effect of increased size on the stability and performance of Islamic banks is contributed to the weakness and limitations of the risk management practices in Islamic banks (Beck et al., 2013; Cihak & Hesse, 2010).

Furthermore, in terms of equity market data, Islamic banks were found to have a limited crisis effect in comparison with conventional banks (Kenourgios, Naifar, & Dimitriou, 2016), with a better stock market performance (see e.g., Ashraf & Mohammad, 2014; Beck et al., 2013; Ho, Rahman, Yusuf, & Zamzamin, 2014; Narayan & Bannigidadmath, 2015), and a slower drop down in stock prices during crisis times (Alexakis, Pappas, & Tsikouras, 2016). However, Islamic stocks profitability is foreseen as risk compensation rather than mispricing (Narayan, Phan, Sharma, & Westerlund, 2016). Moreover, publicly traded Islamic banks were found to have lower deposit insurance premiums without an increase in this cost during the crisis period (Grira, Hassan, & Soumar, 2016).

Performance measures based on efficiency, from the other side, result in mixed conclusions. Bader, Mohamad, Ariff, and Hassan (2008) compared Islamic and conventional banks efficiency, within the Organization of Islamic Conference (OIC) countries, using a stochastic frontier approach, but found no difference in terms of efficiency between Islamic and conventional banks. Within the same countries, Abdul-Majid, Saal, and Battisti (2010) found Islamic banks to be less technically efficient using a distance function, but Bader et al. (2008) found no difference between Islamic and conventional banks efficiency based on data envelopment analysis. In addition, Ghannouci, Fiordelisi, Molyneux, and Radic (2012) did not find a difference in technology or cost efficiency between the two models. Another comparison was provided by Beck et al. (2013), in which Islamic banks were found to be relatively more efficient than conventional banks, but this does not hold true as they confine the analysis to dual-banking systems, where the two models compete within the same market, in which Islamic banks were found to have higher overhead costs along with slightly higher value for the cost-to-income ratio (less cost effective).

The previous performance findings casted doubts on the current functionality of the conventional banking system and pointed out the Islamic banks' potential in supporting the stability of the financial system in front of systemic risk events. Nevertheless, the systemic risk-positive relation to bank size and inverse relation to bank capital during crisis times (Laeven, Ratnovski, & Tong, 2016), may contribute to the explanation of these differences, but this does not convey the whole spectrum that Islamic banking features has in terms of systemic risk contribution. Grais and Kulathunga (2007, chapter 4) argue that Islamic banks' business model and regulatory framework may have imposed capital requirements that supported stability and confined contagion risk.

Several empirical studies infer the stability of Islamic banks through risk analysis. Pappas, Ongena, Izzeldin, & Fuertes (2016) used survival models and found

that Islamic banks have a significant lower failure risk than conventional ones, with the risk being based on both banks specific and macroeconomic variables. Baele et al. (2014) indicated that in Pakistan, loan-default rates of conventional banks are almost twice those of Islamic ones. Using *z*-score indicator for insolvency risk and stability, Shahid and Abbas (2012) also found that small Islamic banks in Pakistan are more stable than both small conventional and large Islamic banks, while large conventional banks being more stable than large Islamic ones. Another case for Pakistan is the work of Wijnbergen and Zaheer (2013), in which they found that Islamic banks are more stable than conventional banks, and also, for the conventional banks that have both Islamic and conventional branches, Islamic branches are more stable unless their size is small.

Gamaginta and Rokhim (2015) found that in Indonesia, there is no significant difference in the level of stability between the small banks of the two banking models during the crisis period, however, the stability of conventional banks with an Islamic banking window is higher than that of the fully fledged Islamic banks. Cihak and Hesse (2010) applied multiple variations of *z*-score indicator and found that bank size affects its risk level, in which small Islamic banks are financially stronger than small conventional ones, whereas large-size conventional banks are stronger than Islamic ones. Masood, Niazi, and Ahmad (2011) found that small Islamic banks are more stable than large ones despite the higher income diversity of the latter. In spite of the higher credit risk level that Islamic banks have, they are still more stable than the conventional banks, with a lower overall risk level (Ali, 2012). Abedifar et al. (2013) pointed out that Islamic banks are more stable than conventional ones, but the significance of the difference vanishes for large banks. Beck et al. (2013) found a lower distance to insolvency for Islamic banks and confirmed the size effect but highlighted large cross-country differences of the considered banks.

In the same context, Daly, GhorbelZouari, Frikha (2013) measured the resilience of bank performances and found that small-size Islamic banks are financially stronger and more resilient but large-size conventional ones are stronger. Rajhi and Hassairi (2013) found that Islamic banks are in general more stable than conventional ones but this is not held for small Islamic ones, with the main insolvency cause being both credit risk and income diversity. Altaee, Talo, and Adam (2013) pointed out that no difference is found in terms of the stability of Islamic and conventional banks within the Gulf Cooperation Council (GCC) countries. Belouafi, Bourakba, and Saci (2015, chapter 5) commented on the results of the empirical research using *z*-score, in which they pointed out that *z*-score indicator does not consider the specificity of Islamic banks, in terms of being asset-based, in addition to their profit and loss sharing ability with their investment account holders.

In relation to market risk, Boumediene and Caby (2009) applied EGARCH and GARCH asymmetric models. They found that conventional banks show high volatility in their returns during the crisis period, while Islamic banks started from a low level of volatility but had a substantial increase during the crisis as a result of their link to the real economy. Al-ali and Yousfi (2015) also applied GARCH, EGARCH GJR-GARCH models to banks in Jordan. They found that

Islamic banks were more stable than conventional banks. Fakhfekh, Hachicha, Jawadi, Selmi, and Cheffou (2016) used an FIEGARCH model for the two banking models within the GCC countries and found that conventional banks volatility is more responsive to bad news, with their volatility being more persistent after a shock, in addition, Islamic banks are more resilient but at a degree that is sample-dependent, with Saudi Arabia Islamic banks being the most resilient ones.

Furthermore, Hasan and Dridi (2011) found that the better credit and asset growth allowed Islamic banks to receive more favorable risk assessment from external rating agencies. A related study concluded that profit sharing within Islamic banking can reduce market risk. However, Islamic banks need to develop risk-mitigation techniques to be effectively stable in front of future financial crisis (Karim, Lee, Karim, & Jais, 2012). Imam and Kpodar (2013) suggested that Islamic banks can complement, rather than substitute, conventional banks, allowing for the diversification of the banking sector, which may be helpful to the overall financial stability. Nevertheless, the same authors also indicated that interest rates have a negative influence on Islamic banks as they are used as benchmarks in paying returns to depositors. The same was confirmed by the Malaysian banks case, which was investigated by Chong and Liu (2009), who found that Islamic banks' deposits have a return that follows the interest rate on the conventional banks' deposits.

However, Abedifar et al. (2013) found that Islamic banks are less sensitive to the changes of the domestic interest rates. Bourkhis and Nabi (2013) pointed out that Islamic bank practices have deviated from the original Islamic finance model toward the conventional one, which puts their resilience under the pressure of the financial crisis. Weill (2011) found that Islamic banks have lower price markups than conventional banks in 17 OIC member countries. In terms of credit risk, Abedifar et al. (2013) indicted that Islamic banks generally have lower credit risk in comparison to conventional banks, and the effect is prominently apparent for small, based in Muslim population dominated countries, and leveraged banks. Beck et al. (2013) indicated a negative relationship between Islamic bank size and credit risk and suggested that it is possibly related to the lack of benefits from diversification and scale economies. In Pakistan, Wijnbergen and Zaheer (2013) argue that the Islamic banks' response to monetary contraction is similar to large banks, in which they maintain their lending level disregarding their actual liquidity positions. Thus, the monetary policy credit channels may be less strong as the Islamic banking system increases its size and importance. Also, Khan and Khanna (2012) found that Islamic banks' deposits have higher growth rate than conventional ones even during the recent financial crisis, despite the fact that those Islamic banks have lower credit scores.

4. SYSTEMIC RISK DEFINITIONS AND MEASUREMENTS

To date, there is no consensus on the definition of systemic risk. Benoit, Colletaz, Hurlin, and Perignon (2017) referred to systemic risk as a macroeconomic event that causes simultaneous severe losses for market participants who diffuse

through the system. Billio, Getmansky, Lo, and Pelizzon (2012a) considered the systemic risk of a financial system that comprises a network of connected institutions, with business linkages that allow for the transfer and magnification of liquidity, insolvency, and loss problems during financial crisis. Kaufman and Scot (2003) provided a literature review for the definitions of systemic risk. The available concepts are categorized into three main definition clusters: the first cluster has pointed out the systemic risk as a likelihood of a large unexpected major macroeconomic level shock that has an adverse effect on the business system and the economy as a whole, with funds being misallocated rather than directed to the most productive institutions. The second and third definition clusters have identified systemic risk as microeconomic level events and have taken into consideration the propagation and diffusion of the adverse shock along with the spillover effect from the individual institution unit to other business units.

The first cluster of definitions, such as the ones provided by Bartholomew and Whalen (1995), and by Mishkin (1995), did not specify the process by which the shock effects are spreading to individual business institutions, or the sequence of its movement between the different types of institutions; neither do they specify the ones that will be mostly affected. In the second cluster of definitions, such as in the case of Bank for International Settlement (1994), Kaufman (1994), Crockett (1997), George (1998), and the Board of Governors of the Federal Reserve System (2001), the systemic risk has been characterized as the probability of having a cumulative loss event that takes a chain reaction diffusion pattern from one business institution to other participants within a network of institutional system. In this case, these definitions pointed out the correlation and direct causation that exists within a network of financial institutions and financial markets in identifying systemic risk. The third cluster of definitions is concerned about the spillover of an external adverse shock and the correlation effect without stressing the direct causation within the network; rather its focus is on indirect linkages.

These definitions underline the resemblance between network units and their risk exposure from third party. Thus, one unit failure will undermine the value of other units that are subject to the same drastic event, with a probability of loss that is positively correlated to the degree of similarities, creating a wave of uncertainty between investors in this system, and thus will lead to a common shock accompanied by intensified sharp liquidity problems. This cluster also distinguishes between direct and indirect causes of systemic risk, in addition to random systemic risk caused by irrational investors' behavior that lack an information base, and their opposite information-based ones, such as in the case of the definitions provided by Kaminsky and Schmukler (1999), Aharony and Swary (1996), Kaminsky and Reinhart (2000), and Kaufman (1994).

The systemic importance guidance report of IMF/BIS/FSB (2009) asserted that the late 2008 financial crisis pointed out the need to develop instruments that can inspect the existence of systemic risk at its startup, in an early stage, in order to enable the regulating bodies to take the actions that help them in containing its expansion, in other words, supervising conditional correlations. Billio, Getmansky, and Pelizzon (2012b) pointed out that during market failure, the correlations increase. Thus, to estimate systemic risk, two stages for the financial crisis

should be considered; the first is the run-up phase, in which the crisis builds up, the second is the crisis-phase in which it erupts. The two stages are important and none of them should be neglected when measuring systemic risk (Brunnermeier & Oehmke, 2013). In addition, the financial system itself is represented as a connected network of financial institutions that includes firms with spillovers that are capable of undermining the system as a whole, in case of their default.

The Financial Stability Board (2011) identified systemically important financial institutions (SIFIs) as "financial institutions whose distress or disorderly failure; because of their size, complexity and systemic interconnectedness, would cause significant disruption to the wider financial system and economic activity." Benoit, Colletaz, Hurlin, and Perignon (2013) classified the practice of risk management into two approaches to determine the contribution of each firm to the system risk. The approaches differ in the source of data that is used in the analysis. The first one exploits the data provided by the financial institution to the regulator, the second one exploits publicly available market data. The first is referred to as the supervisory approach, variables regarding the firm size, liquidity, leverage, complexity, interconnectedness, and substitutability are used in this approach (see e.g., Basel Committee on Banking Supervision, 2013; FSOC, 2012; Gouriéroux, Héam, & Monfort, 2012; Greenwood, Landier, & Thesmar, 2015; IMF/BIS/FSB, 2009).

The second approach is based on the assumption that publicly available data reflect the information about the publicly traded firm, and thus, it utilize variables as stock returns and Credit Default Swap (CDS) spreads in its measures. Systemic risk measures included in this approach are Value-at-Risk measure (VaR), delta conditional value at risk (ΔCoVaR), expected shortfall (ES), marginal expected shortfall (MES), systemic risk (SRISK), and component expected shortfall (CES). At the firm level, VaR is the most common measure in this category that is used to measure the risk of each financial unit in isolation from the system. Q-VaR measures maximum loss in monetary units within a q-confidence interval (Jorion, 2007; Kupiec, 2002). Using VaR includes limitations as it is not considered a coherent risk measure, it ignores the measurement of the 1% worst case loss, it fails to detect portfolio concentration risk, and it does not differentiate between the diverse outcomes in the q-tail (Artzner, Delbaen, Eber, & Heath, 1999).

An upgrade to VaR is the ΔCoVaR measure that was introduced by Adrian and Brun- nermeier (2016) and which accounts for the losses that exceed the VaR measure. CoVaR is a measure of systemic risk that allows overriding the idiosyncratic risk and determining the risk spillovers between financial institutions or financial systems. CoVaR can be used to specify the VaR of the financial system return conditional on a tail event observed for a financial firm as it becomes under financial distress and its stock returns deteriorate to become at its bottom 5% probability level. ΔCoVaR reflects the contribution of a financial unit to the risk level of a second financial unit or to the financial system. It represents the difference between the VaR of the financial system (or institution) conditional on a financial institution being under financial distress, and the VaR of the financial system (or institution) conditional on the financial institution being in its median state.

Another extension for VaR is the ES, which takes into account the loss distribution in the q-tail; it represents the expected loss conditional on being in the q-tail. This measure outperforms VaR as it gets along in the tail with the coherent risk measure of average VaR (Fllmer & Schied, 2011). However, its shortcoming is that it is difficult to estimate the loss distribution in the 1% tail without having theoretical distributions in the form of parametric assumptions regarding the tail distribution. This means that, in case of extreme risk situations, it lacks a reality-based defined reliable measures for tail-events' probabilities. These assumptions turn the ES measure to a stable multiple of VaR instead of being a precise indicator for potential tail risk, another down turn is that ES cannot be used in back testing such as in the case of VaR (Rowe, 2012).

A modified version of ES is MES, which refers to the expected loss or decline in equity values when the market drops under a specified threshold within a determined time horizon. MES was proposed by Acharya, Pedersen, Philippon, and Richardson (2017) and was extended by Brownlees and Engle (2012) to a conditional one. MES extends the concept of ES to account for the marginal contribution of the financial institution to the financial market systemic risk and is considered an extension of the concept of marginal VaR proposed to the ES by Jorion (2007). MES allows to assess the sensitivity of the financial system risk to a unit change in the financial firm ES, in other words, it is the one-day loss expected if market returns are less than a given threshold (originally −2%). However, MES does not account for the idiosyncratic characteristics of the firm such as size and leverage, which means that it does not account for the too big to fail (TBTF). As a small firm may be assessed to be more systemically risky than a big one, MES is in favor of too interconnected to fail (TITF). Higher MES indicates higher vulnerability to market risk and imply higher contribution ability to market fall (Acharya et al., 2017).

Another systemic risk measure is SRISK, which was introduced by Brownlees and Engle (2012) and Acharya, Engle, and Richardson (2012). SRISK is an estimate of the amount of the expected capital shortfall that the financial institution needs to avoid in order to survive during a financial crisis. SRISK is used to determine the most systemically risky institutions, which are the ones with higher expected capital shortfall during a financial crisis (Acharya et al., 2012; Brownlees & Engle, 2012). SRISK further extends MES as it uses the average of the future expected loss of the system due to a crisis over the next six months, which is referred to as the long-run marginal expected shortfall (LRMES). SRISK takes into account the idiosyncratic characteristics as it considers leverage and size of the financial institution in its calculation, which can be seen as a compromise between the TITF and the TBTF paradigms. The measure combines high frequency market data (daily stock prices and market capitalization) and low frequency balance sheet data (leverage) to provide a daily forecast SRISK index, but this means that it assumes the liabilities of the firm to be constant at least on quarterly basis for the crisis period.

The previously mentioned systemic risk measures can be enhanced to better describe the systemic risk level of a specified system. Brunnermeier and Oehmke (2013) stated the need to have a systemic risk measure at the overall system level

that can be allocated to individual firms according to each firm's total contribution to overall systemic risk. The risk allocation methods available include Proportional Allocation (Urban, Dittrich, Klppelberg, and Stlting, 2003), With and Without Allocation (Matten, 1996; Merton & Perold, 1993), Euler or Gradient allocation (Patrik, Bernegger, & Regg, 1999; Tasche, 2000), and Shapley Value Allocation (Tarashev, Borio, & Tsatsaronis, 2009; Tsanakas, 2009).

An appropriate allocation will equate between the overall systemic risk and the sum of individual firms' risks. It will also motivate the individual firms to select the appropriate marginal amount of systemic risk, however, this is challenged by the nonlinear relationship between the two goals and the notion that one firm selection of marginal contribution is affected by other institutions' risk level within the financial network (Brunnermeier & Cheridito, 2014). Keeping this in mind, the systemic risk measure should distinguish the individually large interconnected SIFIs that have negative risk spillovers on other institutions, along with the cluster of smaller institutions that are correlated in a way that will threaten the system, which is known as the clone property (Brunnermeier, Crockett, Goodhart, Persaud, & Shin, 2009).

Those issues are partially addressed through the recently introduced CES measure that was provided by Banulescu and Dumitrescu (2015). CES measures the absolute contribution of the financial firm to the ES of the financial system. CES extends MES as it takes into account the firm size, but at the same time, relies in its calculation on market data only, which allows it to avoid the data frequency differences that are used in the calculation of SRISK, and also it combines between the two paradigms of TBTF and TITF.

The firm size in the calculation of CES is represented by the market capitalization weight of the financial institution relative to the financial system. CES is the multiplication of the financial institution market capitalization weight by its MES. The ES of the financial system is the sum of the CES of each institution included in the system at the specified point of time. This characteristic allows to decompose ES risk of the financial system into its institutional components and allows to provide a percentage for each institution from the financial system ES, which facilitates monitoring those institutions by the regulating authorities.

Another aspect of systemic risk measurement is the interconnectedness between the financial institutions within the financial system. Billio et al. (2012b) introduced several econometric measures of connectedness based on principal component analysis and Granger-causality networks. In a related article, Diebold and Yılmaz (2014) proposed Vector Autoregressive models, augmented with a least absolute shrinkage and selection operator (LASSO) type estimation procedure, aimed at selecting the significant links in a network model. Similarly, Hautsch, Schaumburg, and Schienle (2014) and Peltonen, Piloiu, and Sarlin (2015) proposed tail dependence network models aimed at overcoming the bivariate nature of the available systemic risk measures. The previous models are based on the assumption of full connectedness among all institutions, which make their estimation and interpretation quite difficult, especially when a large number of institutions are being considered. To seize this issue, Ahelegbey, Billio, and Casarin (2015)

and Giudici and Spelta (2016) have recently introduced correlation network models, which can fully account for partial connectedness, expressed in terms of conditional independence constraints. A similar line of research has been followed by Barigozzi and Brownlees (2014) who introduced multivariate Brownian processes with a correlation structure determined by a conditional independence graph.

5. COMMENTS ON SYSTEMIC RISK LITERATURE

From the previous literature discussion on the differences between Islamic and conventional banks, we recognize several points that have not been directly addressed. The first notice is the absence of a direct evaluation of the stability of Islamic banks, and its effect on stabilizing the financial system itself, from a systemic risk point of view, in terms of both, their exposure and contribution to the financial system systemic risk for many countries that have this model working side by side with the conventional banking model. Second, we notice that many studies oversee evaluating the difference in the financial system overall risk, between systems that include either Islamic, or conventional banks, and those that operate a hybrid of Islamic, conventional, and conventional banks with an Islamic window (services).

Furthermore, the literature lacks modeling Islamic banks interconnectedness within the financial system, whether for the stand-alone entities or for the hybrids. Finally, we notice that the literature, and especially regarding the inference of the stability of Islamic banks and their importance in supporting the general stability of the banking system, usually depends on individual unit level rather than the system level, despite the fact that the financial system comprises a network of financial institutions. However, to just limit the analysis to firm level is not enough since it does not fully represent the overall systemic risk for two main reasons; first, the aggregation of individual risks of the different institutions does not necessarily represent the overall system risk of the financial system; second, if two or more institutions have the same level of risk, this does not mean that they have the same contribution to the overall system risk, as one of them may have a higher risk spillover during financial crises.

However, from the discussion on systemic risk definitions and measurement, we notice an issue that still needs further consideration in the current spectrum of systemic risk measures, MES, SRISK, and ΔCoVaR. Those measures are estimated from a bivariate approach point of view, in which the systemic risk of a financial institution is conditioned on the market index, or on another institution, without taking into consideration the effect that arises from the presence of other institutions on the time-varying conditional correlation that results from the bivariate analysis process. Despite the conditional time-varying nature of this correlation, it is still considered a marginal one that captures both direct and indirect associations between two entities, without controlling for the other entities in the financial network, which does not cope with the multivariate nature of systemic risk.

6. METHODOLOGY

6.1. Data

The main goal of this study is to examine the presence of a difference in the banking institution systemic risk vulnerability and systemic risk contribution to the overall market risk, in relation to the banking institution model type, CB, IB, and CBw. To investigate this issue, we measure the systemic risk of each publicly traded banking institution in Bangladesh, while labeling each one according to the diversity of the provided banking services, as conventional banking, conventional banking with Islamic window, or fully fledged Islamic banking. We consider three successive periods: the pre-crisis period for the years 2005–2006, the crisis period for the years 2007–2008, and the post-crisis period for the years 2009–2014. We apply the market-based systemic risk measures of MES, SRISK, and ΔCoVaR. We test our institutions' systemic risk level against the market index return of Bangladesh for the same time period.

The analysis is based on a sample of daily return observations on 27 banks and bank holding companies that are included in Van Djik's Bankscope from January 2005 to December 2014. Quarterly data for book value of total assets and total liabilities for each bank are extracted from Bankscope. Daily closing stock prices and market capitalization are obtained from Thomson Reuters Datastream. The resulting sample includes 15 CB banking institutions, 8 CBw banking institutions, and 4 IB banking institutions.

Table 1 provides a description for the average leverage level of the three banking models for the pre-crisis, crisis, and post-crisis periods. The CB institutions have the highest overall leverage level for the three successive periods, followed by the CBw and the IB banking institutions. Within the same banking model, the CB model increased its leverage during the crisis period, but decreased leverage in the post-crisis one. The CBw almost doubled its leverage in the crisis period and further increased its level in the post-crisis one, while the IB had a low increase in its leverage level during the crisis period, and almost doubled its leverage in the post-crisis one. Fig. 1 depicts these results.

6.2. Risk Measures

In this chapter, the main systemic risk measures of MES, SRISK, and $\Delta CoVaR$ are estimated using the following specifications.

(a) *Marginal Expected Shortfall: MES*

Table 1. Leverage Ratio.

		Leverage Ratio		
Country	Type	Pre-Crisis	During-Crisis	Post-Crisis
Bangladesh	CB	2.00	2.22	3.29
	CBw	1.60	2.08	4.30
	IB	1.70	1.83	6.17

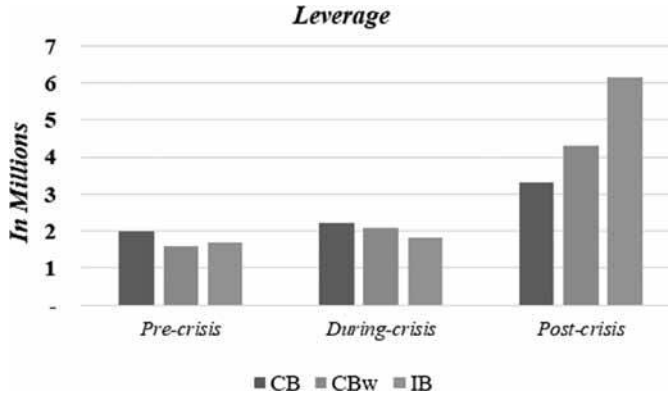

Fig. 1. Leverage Ratio.

The original *MES* measure was proposed by Acharya et al. (2017) and was extended by Brownlees and Engle (2012) to a conditional one. *MES* extended the concept of Expected Shortfall *ES* measure to account for the marginal contribution of firm *i* to the financial market portfolio systemic risk and is considered an extension of the concept of marginal VaR proposed to the ES by Jorion (2007).

MES allows to assess the sensitivity of the financial system risk to a unit change in the firm *ES*, in other words, it is the one-day loss expected if market returns are less than a given threshold *C* (originally $C = -2\%$). However, *MES* does not account for the idiosyncratic characteristics of the firm such as size and leverage, which means that it does not account for the TBTF logic. As a small firm may be assessed to be more systemically risky than a big one, *MES* is in favor of TIF logic. In addition, the sum of the firms' *MES* does not equal the financial system aggregate loss measured by *ES*.

We assume that the financial system aggregate risk is quantified by conditional *ES*, which quantifies the expected market loss conditioned on the return being less than $\alpha\%$ quantile level ($VaR\alpha$). In a general case, the loss is defined by the return exceeding the given threshold *C*. Formally, the conditional ES of the system with respect to the information available at time $t-1$ is defined as

$$ES_{m,t-1}(C) = -\mathbb{E}_{t-1}(r_{mt} \mid r_{mt} < C) = \sum_{i=1}^{N} w_{it} - \mathbb{E}_{t-1}(r_{it} \mid r_{mt} < C)$$

$MES_{it}(C)$ corresponds to the change in the market expected shortfall $ES_{mt}(C)$ as a result of one unit change in a financial institution weight w_{it}.This is denoted by the partial derivative of $ES_{m,t-1}(C)$ with respect to the firm weight w_{it} in the system portfolio (Scaillet, 2004).

$$MES_{it}(C) = \frac{\partial ES_{m,t-1}(C)}{\partial w_{it}} = -\mathbb{E}_{t-1}(r_{it} \mid r_{mt} < C)$$

This enables to redefine *MES* in terms of a weighted function of tail expectations for the market standardized residual and tail expectations for the firm standardized idiosyncratic residual:

$$MES_{it}(C) = \sigma_{it}\rho_{it}\mathbb{E}_{t-1}\left(\varepsilon_{mt} \mid \varepsilon_{mt} < \frac{C}{\sigma_{mt}}\right) + \sigma_{it}\sqrt{1-\rho_{it}^2}\,\mathbb{E}_{t-1}\left(\xi_{it} \mid \varepsilon_{mt} < \frac{C}{\sigma_{mt}}\right)$$

The higher the firm S_{it}, the higher is the individual contribution of the firm to the risk of the financial system.

(b) *Systemic Risk: SRISK*

The second measure that we use is *SRISK*, which was introduced by Brownlees and Engle (2012) and Acharya et al. (2012). *SRISK* further extends *MES* in order to take into account idiosyncratic firm characteristics as it accounts for the leverage and size of the financial institution, which can be seen as a compromise between the TITF and the TBTF paradigms.

SRISK index measures the expected capital shortage faced by a financial institution during a period of distress for the financial system when the market declines substantially. The measure combines high frequency market data (daily stock prices and market capitalization) and low frequency balance sheet data (leverage) to provide a daily forecast *SRISK* index, but it assumes that the liabilities of the firm are constant over the period of crisis.

We follow Acharya et al. (2012) in *SRISK* quantification, but we do not restrict *SRISK* to zero because negative values of *SRISK* are meaningful to us as they provide information on the relative contribution of the institution to systemic risk, while the original methodology is mainly interested in estimating capital shortages that by definition cannot take negative values.

SRISK quantification requires the use of $k = 8\%$ as the minimum fraction of the prudential capital ratio for total assets that each firm needs to hold, D_{it} as the book value of the firm's debt or total liabilities, market value of the firm equity as w_{it}, from which leverage is defined as $L_{\text{it}} = (D_{it} + W_{it})/W_{it}$. The average of the future expected loss of the system due to a crisis over the next six month is defined as *LRMES*, which is approximated using daily *MES* as $LRMES \simeq 1 - exp(-18 \times MES_{it})$, and the given threshold C is set to –40%. We start by defining *SRISK* as

$$\begin{aligned}
SRISK_{it} &= max\left(\left(Required\ \ Capital_{it} - Available\ \ Capital_{it}\right) \mid Crisis_{it}\right) \\
&= max\left(k\left(Debt_{it} + Equity_{it}\right) - Equity_{it}\right) \mid C_{it}\right) \\
&= max\left(\underbrace{k\left(D_{it} + \left(1 - LRMES_{it}\right)W_{it}\right)}_{Required\ \ Capital} - \underbrace{\left(1 - LRMES_{it}\right)}_{Available\ \ Capital}\right) \\
&= max\left(\left[kL_{it} - 1 + (1-k)\,LRMES_{it}\right]W_{it}\right)
\end{aligned}$$

From the previous, we note that higher leverage and market capitalization will increase *SRISK*. The firms with the largest *SRISK*, and hence capital shortfall, are assumed to be the highest contributors to the crisis and are the institutions considered as most systemically risky.

(c) *Delta Conditional Value at Risk: ΔCoVaR*

The third systemic risk measure that we use is *CoVaR*, which was introduced by Adrian and Brunnermeier (2016). The term Co in *CoVaR* stands for Conditional, Co-movement or Contribution as suggested by its developers. The term *VaR* stands for Value-at-Risk, which is the maximum loss within the given α%-confidence interval (Jorion, 2007; Kupiec, 2002), in other words, α is the probability level of the conditional probability distribution. However, the use of *VaR* includes limitations as it is not considered a coherent risk measure. It ignores the measurement of the 1% worst case loss, and it fails to detect portfolio concentration risk, and does not differentiate between the diverse outcomes in the q-tail (Artzner et al., 1999). The VaR_{α} measure for the return of an individual firm *i* in isolation from the financial system is defined as

$$Pr\left(r_{it} \leq VaR_{it}^{\alpha}\right) = \alpha$$

CoVaR is an upgrade to VaR that allows to override the idiosyncratic risk and determine risk spillovers between financial institutions. *CoVaR* is used to specify the *VaR* of the market portfolio return conditional on a tail event $C(r_{it})$ observed for firm *i* as it becomes under financial distress and its stock return deteriorates to become at its bottom 5% probability level. The *CoVaR* measure is defined as

$$Pr\left(r_{mt} \leq CoVaR_{it}^{m|C(r_{it})} \mid C\left(r_{it}\right)\right) = \alpha$$

ΔCoVaR of firm *i* reflects its contribution to systemic risk by assessing the difference between the VaR of the financial system conditional on firm *i* being under financial distress and the *VaR* of the system conditional on firm *i* being in its median state. Adrian and Brunnermeier (2016) use the quantile regression method in which they consider the financial distress $C(r_{it})$ or firm *i* loss to be equal to its *VaR*. They define the $\Delta CoVaR_{it}(\alpha)$ as

$$CoVaR_{it}\left(\alpha\right) = CoVaR_{t}^{m|r_{it}=VaR_{it}(\alpha)} - CoVaR_{t}^{m|r_{it}=Median(r_{it})}$$

Ergun and Girardi (2013) relaxed the financial distress equality assumption, as they consider the distress of firm *i* to be an event in which the losses exceed its *VaR*. Then the $\Delta CoVaR_{it}(\alpha)$ becomes

$$CoVaR_{it}\left(\alpha\right) = CoVaR_{t}^{m|r_{it}\leq VaR_{it}(\alpha)} - CoVaR_{t}^{m|r_{it}=Median(r_{it})}$$

The firms with the largest level of $\Delta CoVaR_{it}$ are perceived to have a higher contribution to the systemic risk level of a country's financial system.

7. RESULTS

In this section, we apply the systemic risk measures in order to test which of the banking models in Bangladesh has the highest systemic risk vulnerability and contribution.

Table 2 summarizes the results from the application of the MES measure. We compute the daily MES measure using the standard method of Acharya et al. (2017). The MES measure is calculated as averages over three successive subperiods, the pre-crisis, the crisis, and the post-crisis periods, for the three different bank types, CB, CBw, and IB, respectively. The figures show that the banking type that has the highest average vulnerability to systemic risk, as expressed by the MES measure through the three successive periods, is the CB, followed by the CBw, and the IB-banking types. This indicates a lower vulnerability of the Islamic banking model to the crisis effect. However, despite that the IB has the

Table 2. MES for the Banking Sector by Type of Bank and Subperiods.

Bank Name	Type	MES		
		Pre-Crisis	During-Crisis	Post-Crisis
Bank Asia Limited		0.80	0.61	0.92
BRAC Bank Limited		0.09	0.48	0.60
Dutch-Bangla Bank Limited		0.94	1.26	1.29
Eastern Bank Limited		0.64	0.65	0.91
IFIC Bank Limited		1.09	0.81	1.29
Mercantile Bank Limited		0.66	0.47	1.06
Mutual Trust Bank	*CB*	0.77	0.74	0.99
National Bank Limited		0.57	0.51	0.91
National Credit and Commerce Bank Ltd.		0.58	0.56	1.10
One Bank Limited		0.75	0.82	1.36
Pubali Bank Limited		0.25	0.23	0.62
Rupali Bank Limited		1.15	0.60	1.44
Standard Bank Limited		0.66	0.61	1.10
United Commercial Bank Ltd		0.77	0.75	1.48
Uttara Bank Limited		0.83	0.58	1.29
Average	*CB*	*0.70*	*0.65*	*1.09*
AB Bank Ltd		0.89	0.95	1.14
City Bank Ltd		0.79	0.42	1.14
Dhaka Bank Limited		0.63	0.58	1.03
Jamuna Bank Ltd	*CBw*	0.06	0.21	0.69
Premier Bank Ltd (The)		0.00	−0.12	0.21
Prime Bank Limited		0.43	0.47	0.72
Southeast Bank Limited		0.59	0.63	0.99
Trust Bank Ltd (The)		0.59	0.63	0.99
Average	*CBw*	*0.50*	*0.47*	*0.87*
Al-Arafah Islami Bank Ltd.		0.46	0.58	1.06
First Security Islami Bank Limited	*IB*	0.01	−0.05	0.50
Islami Bank Bangladesh Limited		0.50	0.40	0.61
Shahjalal Islami Bank Ltd		0.07	0.26	0.82
Average	*IB*	*0.26*	*0.30*	*0.75*

lowest MES level between the three banking types, yet it has the highest growth rate in its MES through the successive periods, which can be explained by the large increase in its leverage level in the post-crisis period as shown in Table 1.

In Table 3, we summarize the results from the application of the SRISK measure. We compute the longer horizon capital ES SRISK using the standard method of Acharya et al. (2012). The SRISK measure is calculated as averages over three successive subperiods, the pre-crisis, the crisis, and the post-crisis periods, for the three different bank types, CB, CBw, and IB, respectively. The use of SRISK as a systemic measure allows to consider the banking vulnerability to systemic crisis from a perspective that takes into account both the size and the leverage of the banking institution, which incorporates an important institutional idiosyncratic factor while MES estimation is not subject to the size effect.

Table 3. SRISK for the Banking Sector by Type of Bank and Subperiods.

Bank Name	Type	SRISK		
		Pre-Crisis	During-Crisis	Post-Crisis
Bank Asia Limited		93,155	94,939	130,965
BRAC Bank Limited		3,401	1,195	128,679
Dutch-Bangla Bank Limited		1,170,613	1,843,730	410,804
Eastern Bank Limited		45,903	63,559	114,507
IFIC Bank Limited		252,778	270,000	239,457
Mercantile Bank Limited		51,879	88,076	126,714
Mutual Trust Bank	*CB*	3,808	4,108	71,172
National Bank Limited		49,340	141,901	226,696
National Credit and Commerce Bank Ltd.		38,217	58,768	103,633
One Bank Limited		11	11	46,841
Pubali Bank Limited		92,429	126,280	160,774
Rupali Bank Limited		91,268	7,619	106,743
Standard Bank Limited		58,304	110,405	121,913
United Commercial Bank Ltd		31,026	25,170	158,685
Uttara Bank Limited		129,510	129,510	126,134
Average	*CB*	*140,776*	*197,685*	*151,581*
AB Bank Ltd		44,870	71,576	163,207
City Bank Ltd		16,363	21,771	104,073
Dhaka Bank Limited		82,025	122,363	121,460
Jamuna Bank Ltd	*CBw*	13,292	305,247	432,071
Premier Bank Ltd (The)		25,204	44,198	68,591
Prime Bank Limited		50,151	50,151	136,978
Southeast Bank Limited		221,375	331,235	207,907
Trust Bank Ltd (The)		221,375	331,235	207,907
Average	*CBw*	*84,332*	*159,722*	*180,274*
Al-Arafah Islami Bank Ltd.		11,469	53,202	117,144
First Security Islami Bank Limited	*IB*	0	0	93,700
Islami Bank Bangladesh Limited		47,834	68,626	295,735
Shahjalal Islami Bank Ltd		208,018	227,470	152,132
Average	*IB*	*66,830*	*87,325*	*164,678*

Table 4. *ΔCoVaR* for the Banking Sector by Type of Bank and Subperiods.

Bank Name	Type	ΔCoVaR		
		Pre-Crisis	During-Crisis	Post-Crisis
Bank Asia Limited		1.30	1.17	1.38
BRAC Bank Limited		0.21	1.10	0.97
Dutch-Bangla Bank Limited		0.87	1.13	0.98
Eastern Bank Limited		0.95	0.94	0.94
IFIC Bank Limited		1.26	1.23	1.17
Mercantile Bank Limited		0.74	0.65	1.00
Mutual Trust Bank	*CB*	1.28	1.31	1.47
National Bank Limited		0.80	0.79	0.83
National Credit and Commerce Bank Ltd.		1.46	1.22	1.38
One Bank Limited		1.02	1.27	1.37
Pubali Bank Limited		0.96	0.63	0.81
Rupali Bank Limited		1.04	1.10	0.99
Standard Bank Limited		1.01	1.05	1.25
United Commercial Bank Ltd		0.71	0.73	0.70
Uttara Bank Limited		0.78	0.87	0.85
Average	*CB*	*0.96*	*1.01*	*1.07*
AB Bank Ltd		1.15	1.16	1.07
City Bank Ltd		1.14	1.03	1.14
Dhaka Bank Limited		1.13	1.02	1.22
Jamuna Bank Ltd	*CBw*	0.41	0.73	0.89
Premier Bank Ltd (The)		0.04	0.51	1.05
Prime Bank Limited		1.07	1.09	1.20
Southeast Bank Limited		1.31	1.16	1.39
Trust Bank Ltd (The)		1.31	1.16	1.39
Average	*CBw*	*0.94*	*0.98*	*1.17*
Al-Arafah Islami Bank Ltd.		0.87	1.06	1.21
First Security Islami Bank Limited	*IB*	0.10	0.19	1.05
Islami Bank Bangladesh Limited		0.76	0.83	0.82
Shahjalal Islami Bank Ltd		0.15	0.84	1.26
Average	*IB*	*0.47*	*0.73*	*1.09*

The figures show that the banking type that is subject to the highest average of capital shortfall under systemic risk, as expressed by the SRISK measure through the pre-crisis and crisis periods, is the CB banking model, followed by the CBw and the IB, in a direct relation to its larger size than the other two. Nevertheless, the post-crisis periods point out that the CBw model is the one that has the highest average of SRISK, followed by the IB and the CB.

If we consider the growth rate in the SRISK measure for each banking model, we find that the CBw has the highest growth rate in its SRISK level during the crisis period, while the IB is the one that has the highest growth rate in the post-crisis period (despite its lower SRISK value upon neglecting the growth rate). This could be related to specificity of the CBw, knowing that this model is linked in its characteristics to both, CB and IB, which may have stimulated a rapid increase in its loss vulnerability as expressed by SRISK. However, the IB is rooted in its

business model in the real economic side, leaving it subject to larger loss possibility as the crisis materialized within the real economy.

To view the systemic risk of the three models from the perspective of the model contribution to the overall system risk, we use the ΔCoVaR measure. Table 4 summarizes the results from the application of ΔCoVaR measure. We compute the ΔCoVaR measure using the standard method of Adrian and Brunnermeier (2016). ΔCoVaR is calculated as averages over the three successive subperiods, the pre-crisis, the crisis, and the postcrisis periods, for the three different bank types, CB, CBw, and IB. The figures show that the banking type that is subject to the highest average of risk contribution to the market systemic risk level, as expressed by the ΔCoVaR measure through the pre-crisis and crisis periods, is the CB banking type, followed by the CBw and the IB. As for the post-crisis periods, the CBw banking type is the one that has the highest average of ΔCoVaR, followed by the IB and the CB.

This is in line with the previous conclusions of SRISK, the CBw sector has higher SRISK and higher ΔCoVaR in the post-crisis period. It is linked to both the CB and IB in a manner that increases its vulnerability and contribution to the overall system that is represented by the other two models.

Overall, the used systemic risk measures confirm that the highest systemic risk vulnerability is exerted by CB, followed by the CBw, and IB institutions. But taking both leverage and size into account sets the CBw sector as the higher systemic risk-level model in an indication to its linkage to the CB and IB, which may have reduced its business model diversification benefits.

8. CONCLUSIONS

The main goal of this study is to examine the difference between the banking institution model types based on their systemic risk vulnerability and systemic risk contribution to the overall market risk. We investigate this issue by measuring the systemic risk of each publicly traded banking institution in Bangladesh, while labeling each one according to the diversity of the provided banking services, as conventional banking, conventional banking with Islamic window, or fully fledged Islamic banking.

We consider three successive periods, the pre-crisis period for the years 2005–2006, the crisis period for the years 2007–2008, and the post-crisis period for the years 2009–2014. We apply the market-based systemic risk measures of MES, SRISK, and ΔCoVaR as the required information for the estimation of those measures is available for the three banking models. The provided analysis includes a sample of daily return observations on 27 banks and bank holding companies within the 2005–2014 timeline. The sample includes 15 CB banking institutions, 8 CBw banking institutions, and 4 IB banking institutions.

The results show that the CB banks have the highest vulnerability to systemic risk during the crisis and post-crisis periods, as indicated by MES and SRISK, while the CBw sector has the highest vulnerability and contribution in the post-crisis period. The Islamic sector shows a lower level than CBw, nevertheless, the

CBw has wider variability range in its values as it slides from the pre-crisis to the crisis period, while the IB has a wider variability range in its values as it slides from the crisis to the post-crisis period.

The results clearly indicate a higher stability of the Islamic banking model under the three measures during the crisis period in comparison to the CB and CBw banking models. Overall, this may be an indication of the model specificity, and the reliance in the Islamic banking transactions on real assets, which may have affected this model upon the crisis materialization in the real economy.

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