An Estimation of the Presence of Contagion in Islamic and Conventional Banks of Pakistan Using DCC-GARCH Model

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The current paper assesses the stability of conventional and Islamic banks in Pakistan. For this, study incorporated DCCGARCH methodology to estimate dynamic conditional correlation for sample of 1 Islamic and 8 conventional banks from March 31, 2006 to December 31, 2017. The results of empirical findings showed that conditional correlation has found to be increased for crisis periods between Islamic and conventional banks suggesting that effect of financial contagion is prevailing between both Islamic as well as conventional banks in Pakistan for study period. It has been observed that financial contagion is an important element for transmitting shocks between sample banks.
Keywords: Islamic Finance, Conventional banks, Contagion, Crisis, DCCGARCH, Pakistan

INTRODUCTION

Islamic Banking is the emergent topic of today's banking research as growth of Islamic finance remains quick than conventional banks across the globe. As Islamic finance system has been developed in past few years, resultantly the Islamic banks has experienced high competition with conventional system has as borrowers and investors have more alternatives available to choose for their investments. Concerning the co-existence inherent in of Islamic and conventional banking and differential features, the spread of contagion risk between them become a major concern during crisis periods (Chakroun & Gallali, 2016). As per the existing literature, the financial crises period is a perfect experimental background to recognize the connection between the banking business specially in the event of financial distress. Therefore, the repeated series of financial crises faced by financial institutions have raised numerous concerns about the ability of both banking systems to ome out from financial as well as economic shocks. In existing work, two of the factors have been discussed extensively as cause of the crisis, on one hand, the direct connection of financial institutions to USA markets causes a spread of US crisis to other markets. While, the inter-dependence of financial markets was considered as the second major reason which causes increased contagion between markets.

Most of the existing studies that have compared the stability of both banking systems were based on the assumptions that no interaction exists between them (Boumediene & Caby, 2013; Bourkhis & Nabi, 2013; Fakhfekh & Hachicha, 2014). For the sake of determining the co-existence of both banking business in dual banking economy, the present study is an attempt to observe the presence of contagion between both banking players to see whether a shockwave which hits either conventional or Islamic banking business is spread to the other systems or remains controlled.

Those who defined contagion reached at the conclusion that contagion `exists when significant correlations tend to increase during periods of financial crisis (Lee & Kim, 1993; King & Wadhwani, 1990). There is abundant existing literature which addressed the presence of contagion costs of crises on equity financial markets. The initial literature on empirical estimation of the financial contagion have assumed relative studies by employing Pearson's correlation among markets during normal and crisis periods. In this respect, different authors have applied different methodologies to assess how shocks are transmitted cross border. For this purpose, among most common methodologies, ARCH and GARCH, cointegration techniques cross-market correlation have been used extensively.

The comparative stability analysis of Islamic and conventional banks gains more importance when the crisis period is included into the analysis period. Indeed, the crisis create a network and encourage a series of inter-related institutions failure resultantly establishes a valid assessment for the stability of Islamic banks. Theoretically it is assumed that under complex economic conditions, the principle of Profit & Loss Sharing enables banks involve in Islamic financing to sustain their net worth. Logically, any disturbance that may cause losses on asset balance will have to be absorbed by the liability balance (Nabi, 2012). In this context, the current paper empirically investigated the presence and transmit of contagion between banks in Pakistan. So, DCCGARCH model is applied to evaluate the dynamic correlation to measures financial contagion. By employing from Islamic and conventional banks for 31st of March, 2006 to 31st of December, 2017, the study addressed the dynamic dependence of contagion risk between two banking models.

LITERATURE REVIEW

In existing literature divergent techniques have been adopted for measurement of financial contagion. Keeping this in scenario, Hamao et. al., (1990) conducted their empirical studies on the New York, Tokyo and London Stock Exchanges. They employed ARCH methodology and analyzed the stock price volatility in each market and their possible spread to

another markets. The results of the study found the volatility transmission effects that spread from New York to Tokyo. Further, the price volatility was spread from London to Tokyo but study found did not evidences of price spread from Tokyo to New York or London. Further, other group of researchers conducted the volatilities in stock prices and their transmission effects and find out that on average the contagion effects are multidirectional. These studies found that the contagion impact negatively on the volatilities in the banking sector. Such results showed that the impact of volatility on returns tend to be contagious. On these grounds almost all studies suggested that banking system might characterize a significant basis of contagion in unpredictable periods (Tai, 2004; Baba et. al., 1991).

Kenourgios, et. al., (2007) in their study, to prove the presence of contagion anticipated a multivariate copulas approach. They applied AGDCC approach in order to determine the level of correlations between different stock markets and showed that there exists a strong inter-dependence among selected markets during crisis periods. They further asserted that presence of contagion is dependent on behavioral reasons and not due to changes in macroeconomic factors. Similarly, Rahman et. al., (2009) inspected the interaction of macroeconomic variables with Malaysian market performance of conventional capital using VAR model. The study showed that capital market of Malaysia has a strong dynamic collaboration with investments of industrial production and there exists a cointegrating between market returns and selected macroeconomic variables.

However, among others very few existing researches have emphasized on investigating the spread of crisis between conventional and Islamic finance. Nazlioglu et. al., (2013) examined the risk of contagion effects between DJI Index and global equity markets over the period of financial crisis. They employed an interconnection examination to discover the spread of risk established in the study of Hafner & Herwartz (2006) by employing impulse response function to relate reactions to temporary shocks in short term for Islamic and conventional equity markets. Their results indicated no risk spread between energy and agricultural commodity markets for pre-crisis period. Cihak & Hesse (2008) found that small units of Islamic banks are more financially strong than small units of commercial banks while large units of commercial banks are more financially strong compared to large units of Islamic banks. Karim et. al., (2010) studied the outcome of US crisis on the incorporation of Islamic equity markets over the period of 2006-08. The study failed to prove the presence of cointegration between Islamic markets during the crisis.

Boumediene and Caby (2013) studied Islamic banks stability during subprime crisis. According to the results of their studies, they showed that the volatility of Islamic banks is related to crisis and found to be increased during crisis period of 2007. They found that Islamic banks were affected by the crisis at the same level like conventional ones. The empirical estimations showed that the transfer of risk between Islamic financing equity markets and other 3 traditional markets suggests the presence of contagion across these equity markets. The volatilities of these markets are characterized by the short-term volatility and strong long-term volatility during the first period and the second period.

Kassab (2013) took into account the volatility structure and found the perseverance of instability in the Dow Jones Islamic Markets and Standard & Poor 500 index employing Generalized Autoregressive Conditional Heteroskedasticity. Further, Dewandaru, et. al., (2014) studied 16 several crises and showed that shocks were spread due to extreme links and the results of recent crisis exposed the important source of contagion. Further, the results revealed the facts that Islamic players are less susceptible to shocks due to lower leverage. The presence of contagion effects has been proved in the study of Fakhfekh & Hachicha (2014) who by employing DCCMGARCH model, showed that the correlation increases during normal and crisis time. This suggests the presence of a contagion effect.

Rizvi et. al., (2015) studied the effects of contagion on markets of Asia Pacific and US market for the period of 1996-14. The study mainly tried to insulate the impacts of worldwide crises. Their study found that most of the shocks during this period have been transmitted via extreme links while the recent crisis discovered essential sources of contagion. In the same line, in the study of Hashem & Giudici (2016), the stability of both banking system is compared. Their findings showed the presence of variances in systemic risk and hence stability during crisis times. In addition, country-specific effects played important role to address these differences. Based on the findings from previous studies, it would be imperative to see whether the same contagion effect prevail in Pakistan for both banking system in term of shock transmission.

RESEARCH METHODOLOGY

The basic aim of the study is to explore empirically the occurrence and transmission of contagion risk in Islamic and conventional banking of Pakistan during the period of March 31, 2006 to December 31, 2017. The development of Islamic banking has started in Pakistan in early 2002 when Meezan Bank officially started its operations in 2002. Further, remaining 4 Islamic banks came into existence after that period. Due to the reason, the sample data is consisted of the quarterly data from march, 2006 to March 2018. Sample data consist of 1 Islamic bank, meezan bank (IB) and 8 commercial banks including NBP (CB1), bank alfalah (CB2), standard chartered (CB3), united bank (CB4), habib bank (CB5), allied bank (CB6), askari bank (CB7) and faysal bank limited (CB8). These banks are selected because they are ranked top banks in Pakistan for the year 2018 based upon their performance.

The study employed DCCGARCH methodology to estimate the occurrence of financial contagion between conventional and Islamic banks. This study is based on the use of the DCCGARCH method advanced by Engle (2002) and employed by Latifa & Khoufi (2018). In line with the existing studies, the vector represents the expected returns for banking units. Where, $r_t = (r_{1t}; r_{2t})'$. A(L) denotes the lag polynomial function represented as follows:

Where, μ specifies the vector of performance in term of expected returns of banking units and e_t denotes the error terms vector. The assumption taken by the DCC is rest on the ground that that the provisional performance is distributed normally with zero mean and conditional covariance matrix is $H_t = E [r_t r_t' | I_{t-1}]$. While, covariance matrix is measured by:

With, $D_t = diag[\sqrt{h_{1t}}, \sqrt{h_{2t}}]$ represents the volatilities matrix from the univariate estimation of GARCH(1,1). Further, the specification (1,1) using DCC model could be found following stated steps. At first step, identification of the specification of GARCH (1,1) using:

$h_t = \alpha_0 + \alpha_1 \epsilon^2_{t-1} + \beta_1 h_{t-1}$ …………(1)

Where, α_0, α_1 and β_1 are parameters required to be estimated. The conditional correlation matrix of R_t and standardized distributions of ϵ_t is stated as follows:

With $\epsilon_t = D_t^{-1} r_t$. the matrix R_t is expressed as follows:

$R_t = Q_t^{*-1} Q_t Q_t^{*-1}$ …………..(2)

Where, Q_t is the temporal conditional volatility matrix ϵ_t and Q_t^{*-1} represents the inverse of the matrix Q_t. here, it is important to note that Q_t^{*-1} is calculated as follows:

So, based upon conditions, the DCC (1,1) is:

$Q_t = \omega + \alpha \epsilon_{t-1} \epsilon_{t-1}' + \beta Q_{t-1}$ ……………………(3)

Here, for this equation, $\omega = (1- \alpha - \beta) Q$ where Q shows the covariance matrix with unconditional standardized distributions, while ϵ_t, ω, α, and β are the parameters required to be tested. To conclude, the DCC will be:

$\rho_{12t} = q_{12t} / \sqrt{q_{11t} q_{22t}}$ …………(4)

So, the maximum likelihood estimator of the DCC in the words of Engle (2002) would be calculated as follows:

$L = -1/2 \sum (k \log (2\pi) + 2\log ([D_t]) + \log ([R_t]) + \epsilon_t' R_t^{-1} \epsilon$ ………(5)

The estimator of maximum likelihood used in DCCGARCH designates the degree of correlation between sample Islamic as well as conventional banks which tend to describe the causes and spread of financial contagion in Pakistan.

EMPIRICAL RESULTS

Table 1 showed the descriptive statistics found from employing dynamic conditional correlations (DCC) between Islamic banks and conventional banks in Pakistan. The results of table 1 showed that the DCC is relatively found to be low between both banking players. Still, it is important to note that dynamic conditional correlations have significant impact between Islamic banks and conventional banks. This high level is important to explain the presence of dynamic conditional correlation between both banks in which the presence of high level of contagion can be observed. However, a low level of DCC can be helpful to identify low dynamic dependence between Islamic as well as conventional banks signifying the presence of low level of contagion. So, based upon these results, it can be suggested that high or low level of DCC can be used to explicate the presence of financial contagion phenomenon between both banking players in Pakistan. It has also been observed that average value of the DCC between both banking players in Pakistan is found to be relatively low. The risk level defined by standard deviations between both banking system in Pakistan is between 0.4% and 29%. As for the

Table 1: Descriptive Statistics

Bank ID	Mean	SD
IB, CB1	0.0125	0.2896
IB, CB2	-0.0006	0.0143
IB, CB3	-0.0020	0.0256
IB, CB4	-0.0023	0.0145
IB, CB5	-0.0013	0.0235
IB, CB6	0.8577	0.0236
IB, CB7	0.8407	0.0055
IB, CB8	-0.0003	0.0045

As per the results of DCC in Figure-1, it is important to note that DCC between Islamic and other commercial banks in Pakistan reaches its highest level particularly between 2007 & 2009 (from quarters 5 to 12) after the spread of financial crisis of 2007-08.

Figure-1: Dynamic Condition Correlation Between banks in Pakistan
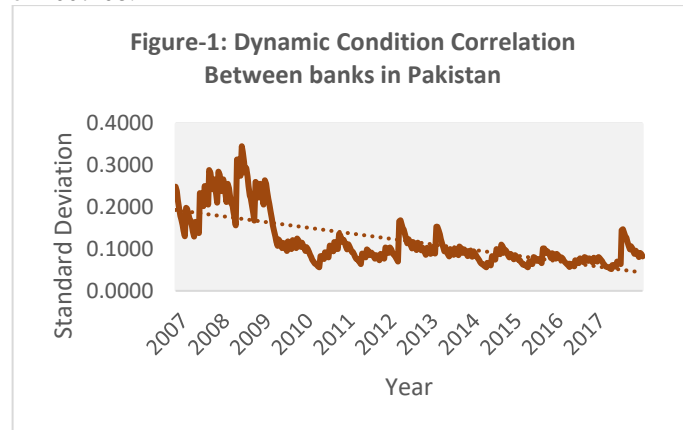
In Table-2, DCCGARCH(1,1) among each conventional and Islamic bank in Pakistan is examined. It can be seen from table-2 that the dynamic conditional correlation is found to be low for few and robust for other banks with an adverse or favorable sign. It is showed that level of dynamic condition correlation is helpful to explain the contagion phenomena presence between

Table-2 Estimate of Contagion and DCC

	Dynamic Condition Correlation	t-stat (DCC)
IB, CB1	0.7707	31.65***
IB, CB2	0.6609	50.33***
IB, CB3	-0.7779	206.84***
IB, CB4	0.0998	22.38***
IB, CB5	-0.0926	61.60***
IB, CB6	0.0646	14.077***
IB, CB7	0.6423	14.65***
IB, CB8	0.3625	3.58***

(*), (**), and (***) show level of significant at 1%, 5% and10%, respectively.

Islamic and conventional banks in Pakistan. These results document the persistence of financial contagion in the Pakistani banking system for the employed study time period.

Moreover, the results of the DCCGARCH model proved that the 2008 crisis has exaggerated mostly developed economies and also emerging markets. In addition to that, the crisis has mainly disturbed the syndicated loan markets of emerging economies. Due to which the rise in interbank rates have been experienced across the Asian markets especially during second half of the crisis. Keeping in view this situation, it would be important to consider that the crisis effected financial institutions and financial market simultaneously. As is the case, financial institutions in Pakistan have not been affected by the financial crisis to the extent it hit other Asian economies but

still the direct exposure to US real estate markets and products brought some contagious effects on Pakistan markets as well.

CONCLUSION

The aim of the paper is to empirically investigate the occurrence of the financial contagion and its correlation between Islamic and conventional banks in the financial market of Pakistan. To quantify financial contagion, the DCC-GARCH approach has been employed. From the empirical results it is clear that the dynamic conditional correlation found to be relatively weak for some banks and strong for others banks with significant adverse or favorable effects in Pakistan. The strong level tends to explain the high level of contagion dynamic dependence while, the weak level dictates the low level of dynamic dependence between sample banks with a low level of contagion. So, in many cases the level of dynamic conditional correlation is explained by the presence of financial contagion.

It is also important to note that Islamic services does not prevailed in an isolated financial environment, but an economy like Pakistan, Islamic financing is facing an environment where there exists inter-dependence with other international financial markets the exposure of which can bring repetitive and unpredictable contagion. Here, Islamic financing is also required to adopt such measures which may mitigate the effects of such shocks on the economy's real sector. Based on the output of current study, it is recommended that Islamic systems should have to assume sensible risk mitigation practices and Shariah-based hedging instruments to safeguard the stability of Islamic banks during the times of economic panics and financial crisis.

References

Baba, Y., Engle, R. F., Kraft, D. F., & Kroner, K. F. (1991). *Multivariate Simultaneous Generalized ARCH (Unpublished MS thesis)*. Department of Economics, University of California, San Diego.

Betz, F., Oprică, S., Peltonen, T. A., & Sarlin, P. (2014). Predicting Distress in European Banks. *Journal of Banking & Finance*, *45*(C), 225-241.

Boumediene, A., & Caby, J. (2013). The financial volatility of Islamic banks during the subprime crisis. *Bankers, Markets & Investors*, *126*, 30-39.

Bourkhis, K., & Nabi, M. S. (2013). Islamic and conventional banks' soundness during the 2007-2008 financial crisis. *Review of Financial Economics*, *22*(2), 68-77.

Cihak, M., & Hesse, H. (2008). Islamic Banks and Financial Stability: An Empirical Analysis *(IMF Working Paper No. WP/08/16)*.

Chakroun, M. A., & Gallali, M. I. (2016). Contagion between Islamic and Conventional Banking: A GJR DCC-GARCH and VAR Analysis. *International Business Research*, *9*(10), 115-126.

Engle, R. (2002). Dynamic conditional correlation: a simple class of multivariate generalized autoregressive conditional heteroskedasticity models. *Journal of Business and Economic Statistics, 20*(3), 339-350.

Fakhfekh, M., & Hachicha, N. (2014). Return volatilities and contagion transmission between Islamic and conventional banks throughout the subprime crisis: evidence from the DCC-MGARCH model. *International Journal of Managerial and Financial Accounting, 6*(2), 133-145.

Hafner, C. M., & Herwartz, H. (2006). A Lagrange multiplier test for causality in variance. *Economics Letters, 93*(1), 137-141.

Hamao, Y., Masulis, R. W., & Ng, V. (1990). Correlations in Price Changes and Volatility across International Stock Markets. *The Review of Financial Studies, 3*(2), 281-307.

Hasan, M., & Dridi, J. (2010). The Effects of the Global Crisis on Islamic and Conventional Banks: A Comparative Study *(IMF Working Paper No. WP/10/201)*.

Hashem, S. Q., & Giudici, P. (2016). Systemic Risk of Conventional and Islamic Banks: Comparison with Graphical Network Models. *Applied Mathematics*, 7, 2079-2096.

Kassab, S. (2013). Modeling volatility stock market using the ARCH and GARCH models: Comparative study index (SP Sharia VS SP 500). *European Journal of Banking and Finance*, *10*, 72-77.

Kenourgios, D., Samitas, A., & Paltalidis, N. (2007, June). Financial Crises and Contagion: Evidence for BRIC Stock Markets. Paper presented at the European Financial Management Association Annual Conference, 27th-30th June 2007, Vienna, Austria.

Khoufi, W. (2018). Contagion between Islamic and Conventional Banks in Malaysia: Empirical Investigation Using a DCC-GARCH Model.

King, M., & Wadhwani, S. (1990). Transmission of Volatility between Stock Markets. *The Review of Financial Studies, 3*(1), pp. 5-33.

Latifa, M. B. Khoufi, W. (2018). Contagion between Islamic and Conventional Banks in Malaysia: Empirical Investigation using a DCC-GARCH Model. *Journal of King Abdulaziz University: Islamic Economics., 31*(1), 167-178.

Lee, S. B., & Kim, K. J. (1993). Does the October 1987 Crash Strengthen the Co-Movements Among National Stock Markets? *Review of Financial Economics, 3*(1), 89-102.

Nabi, M. S. (2012). Dual Banking and Financial Contagion. *Islamic Economic Studies, 20*(2), 29-54.

Nazlioglu, S., Erdem, C., & Soytas, U. (2013). Volatility spillover between oil and agricultural commodity markets. *Energy Economics, 36*(C), 658-665.

Ng, A. (2000). Volatility Spillover Effects from Japan and the US to the Pacific-Basin. *Journal of International Money and Finance, 19*(2), 207-233.

Rahman, A. A., Sidek, N. Z. M., & Tafri, F. H. (2009). Macroeconomic determinants of Malaysian Stock market. *African Journal of Business Management, 3*(3), 95-106.

Rizvi, S., Shaista, A., & Alam, N. (2015). Crises and Contagion in Asia Pacific – Islamic v/s Conventional Markets. *Pacific-Basin Finance Journal, 34*(C), 315-326.

Tai, C.-S. (2004). Can bank be a source of contagion during the 1997 Asian crisis? *Journal of Banking and Finance, 28*(2), 399-421.