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The dependence and dynamic correlation between Islamic and conventional insurances and stock market: A multivariate short memory approach

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Abstract. *This study examines the dependence and the dynamic conditional correlation among Islamic and Conventional Insurances and Stock market with Qatar and Abu Dhabi. The main objective of this article is to study how the dynamics of correlations between the major return series evolved from January, 2006 to August, 2018. To this end, we adopt a dynamic conditional correlation (DCC) model into a multivariate GARCH with symmetric effect and the dynamic conditional correlation (DCC) model into a multivariate GJR-GARCH with asymmetric framework. Empirical results indicate the evidence of time-varying co-movement, a high and low persistence of the conditional correlation in the short run.*

Keywords: DCC-GARCH, DCC-GJR-GARCH, asymmetries, short memory, Islamic insurances, conventional insurances and stock market.

JEL Classification: C13, C22, C32, C52.

1. Introduction

Modeling volatility is an important issue of research in financial markets. Leptokurtosis and volatility clustering are common observation in financial time series (Mandelbrot, 1963). It is well known that financial returns have non-normal distribution which tends to have fat-tailed. Mandelbrot (1963) strongly rejected normal distribution for data of asset returns, conjecturing that financial return processes behave like non-Gaussian stable processes (commonly referred to as “Stable Paretian” distributions).

The coexistence of hybrid insurance structures, including conventional and Takaful insurance companies, is essential to provide various insurance services to Muslims and others with religious restrictions. The accessibility of conventional insurance products in predominantly Muslim countries has become questionable in the eyes of Sharia because of the ban on Riba (Interest), Gharar (Uncertainty) and Maisir (Gambling) in operations of 'insurance.

Takaful insurance is an alternative to conventional insurance for insurance products to meet the needs of a growing Muslim population (Akhter et al., 2017). Practical insurance operations based on Islamic Takaful insurance refer to dual structures. On the one hand, the shareholders seek to maximize the profits and the returns on investment of the shareholder company. On the other hand, there are participants (Mushtarik) who make contributions (Ishtirak) to the Takaful community fund which led to the creation of the “subscriber fund”. In case of insufficient funds in the pool, the shareholders' fund is required to provide a loan (qard al hassan).

The rapid growth of Takaful insurance companies is evident over the past two decades. Sharia-compliant stocks are considered innovations in the insurance industry because they operate differently from their conventional counterparts. Although it has overcome many challenges, opponents of Islamic finance argue that ethical investment criteria based on the Islamic principle can lead to monitoring costs, the availability of a narrower investment universe and potential limited growth and diversification. (Guyot, 2011).

To determine the relationship between Islamic and conventional stock market indices, previous studies (Jawadi et al., 2014; Hammoudeh et al., 2014; Naifar, 2016; Shahzad et al., 2017) have assumed that this dependence provides mixed results.

In the financial econometrics’ literature, it is well documented that assessing linkages among Islamic and conventional insurances could have crucial implications from numerous viewpoints. For example, Mohamed et al. (2016) in their study compare the dynamics of the volatility of Islamic and conventional banking indices in the GCC countries. They have developed an econometric framework suitable for studying two main properties: persistence and asymmetry. To this end, a long-memory EGARCH model was estimated and applied to recent daily Islamic and conventional banking indexes, making it possible to measure the persistence of volatility during periods of stability and crisis. Consequently, this study brings several observations. First, the analysis highlights volatility and large cluster effect, suggesting evidence of extreme financial risk. Second, volatility exhibits significant persistence which is much higher for conventional banks than for Islamic banks and is also higher during periods of crisis as opposed to normal periods. Third, the distribution of volatility is significantly skewed, and bad news seems to affect volatility patterns more strongly than positive news. Conventional banks also react more strongly to a negative shock than to positive news. In addition, conventional banks are more sensitive to the arrival of bad news than Islamic banks.

In the other hand, Nouredine and Wael (2018) examined the volatility behavior of insurance stock returns on a sample made up of twenty Saudi insurance companies. The data are collected from Thomson Reuters and cover the period from September 10, 2010 to April 26, 2015. They studied the conditional dependencies between the stock market returns of the insurance activity sectors using the DCC-GARCH. Their results indicate a significant variability over time in the dependence structure between stock market returns. There is a positive link between Takaful and conventional equity returns, with the exception of health and life insurance. The sign and the intensity of the dependence differ according to the specific insurance activity considered.

The main objective of this work is to explore the symmetric and asymmetric dynamics in the correlations among Islamic and conventional insurances and Stock market for Qatar and Abu Dhabi. From a theoretical viewpoint, Boero et al. (2011) define asymmetric dependence phenomenon as the different degrees of co-movements during periods of appreciation and depreciation. In addition, they argue that asymmetric dependence can perhaps be explained by currency portfolio rebalancing activities.

The layout of the present study is as follows. Section 2 presents the empirical methodology. Section 3 provides the data and a preliminary analysis. The empirical results are displayed, analyzed and discussed in section 4, while section 5 reports the concluding remarks.

2. Econometric methodology

The present study investigates the dynamics correlations among Islamic and conventional insurances and stock market from Qatar and Abu Dhabi. The period span from January, 1, 2006 to August, 26, 2018. We provide a robust analysis of dynamic linkages among stock market and each insurance that goes beyond a simple analysis of correlation breakdowns. The time-varying DCCs are captured from a multivariate student-t-GARCH-DCC model which takes into account short memory behavior and symmetric effect and the multivariate student-t-GJR-GARCH-DCC model which takes into account short memory behavior and asymmetric effect.

The main objective of this article is to study the Co-movements existing between the Returns of Islamic and conventional insurance and the returns of the market from Qatar and Abu Dhabi. To do this, we use a DCC-GARCH model of symmetrical type and a DCC-GJR-GARCH model of asymmetric type in case of asymmetry.

Various empirical studies state that the assumption of a constant conditional correlation is restrictive. Thus, CCC can be generalized by the instability of the conditional correlation matrix presented by the following equation:

$H_t = D_t R D_t$

Where:

$$D_t = \begin{bmatrix} h_{1t}^{1/2} & \dots & 0 \\ \dots & \dots & \dots \\ 0 & \dots & h_{Nt}^{1/2} \end{bmatrix}$$

D_t – is a diagonal matrix;

R: f_{ij} – the constant conditional correlation matrix;

$h_{it}^{1/2} = \sigma_{it} = \varepsilon_{it}/Z_{it}$ – the standard deviation.

Dynamic conditional correlation is introduced by Engle (2002). These DCC models assume that the variance matrix –covariance H_t is decomposed into D_t (conditional standard deviations) and R_t (conditional correlation matrix). We note that Rt and D_t are characterized by an unstable dynamic. Engle (2002) proposed the DCC (m, n) - GARCH (p, q) process in the modeling of dynamic correlations.

The model is presented as follows:

$A(L)r_t \,/\, F_{t-1} = \mu_t + \varepsilon_t$

$\varepsilon_t \sim N(0, H_t)\ \forall\ t = 1,2,3,\dots,T$

$H_t = D_t R_t D_t$ and $\varepsilon_Z = H_t^{1/2} Z_t$

Where: A(L) is a delay polynomial;
$r_t = (r_1, r_2, r_3, \dots, r_n)'$ – vectors of asset returns;
μ_t – the conditional mean vector of r_t;
$H_t = \{H_{ij}\}_t \forall\ j = 1, \dots, n$ – is the variance-covariance matrix of r_t;
ε_t – is the vector of the residues;
$R_t = \{f_{ij}\}_t$ – is the dynamic correlation matrix;
$D_t = \text{diag}\,\{\sqrt{h_{it}}\}$ – is the diagonal matrix of dimension (n x n).

On the financial side, the GJR-GARCH model highlights the leverage and asymmetric effect of volatility. Generally, the coefficients of the correlations are specified by an instability and they are random. Thus the DCC-GJR-GARCH model highlights the instability of conditional correlation, the interest of which is to study the transmissions of returns and volatility of Islamic, conventional stocks and market returns.

The econometric procedure adopted in this work is used to use the standardized residuals of the GJR-GARCH model (1,1) according to the multivariate context for the application of the DCC models.

3. Data and preliminary analysis

The data in the sample used include the daily stock returns of the two insurance categories in two countries, namely Qatar and Abu Dhabi, as well as their stock market indices as a measure of market risk. For conventional insurance we take parallel Islamic insurance of the same number for the same nation. The study period runs from January 2006 to August 2018. Data are obtained from stock exchanges in the sample countries and from the Data-Stream database. The following table summarizes the database.

Table 1. *Database*

Country	Stock index	Conventional insurance	Islamic insurance
Qatar	Qatar Stock Exchange Index (QSE)	-Doha Insurance (DIN) -Qatar Insurance (QIN)	-Alkhaleej Takaful Group (ALTG) -Qatar Islamic Insurance (QIIN)
Abu-Dhabi	Abu Dhabi Securities Exchange (ADX)	Abu Dhabi National In. (ADNI)	Abu Dhabi National Takaful (ADNT)

For each insurances and stock market, the continuously compounded return is computed as $r_t = 100 \times ln(p_t/p_{t-1})$ for $t = 1,2, \ldots, T$, where p_t is the price on day t. Summary statistics for insurances and stock market returns are displayed in Table 2 (Panel A). From Table 2 (QATAR), QSE is the most volatile, as measured by the standard deviation of 12.1464%, while QIIN is the least volatile with a standard deviation of 2.3356%. Besides, we observe that QSE has the highest level of excess kurtosis, indicating that extreme changes tend to occur more frequently for the stock market. In addition, all insurance returns exhibit high values of excess kurtosis.

Table 2. *Descriptive statistics of return series (Qatar).*

	QIN	ALTG	DIN	QIIN	QSE
Panel A: descriptive statistics					
Mean	0.0072	-0.0376	-0.0276	-0.0303	-0.2149
Maximum	45.6940	13.3700	22.1338	10.2461	9.4219
Minimum	-56.0396	-18.2024	-16.4202	-12.1038	-691.1349
Std. Deviation	2.4229	2.4502	2.4991	2.3356	12.1464
Skewness	-2.0306*	-0.2296*	-0.0368	-0.1274*	-66.448*
	0.0000	0.0000	0.3082	0.0004	0.0000
Excess Kurtosis	178.32*	7.7543*	9.6106*	7.5874*	4469.8*
	0.0000	0.0000	0.0000	0.0000	0.0000
Jarque-Bera	6.0845e+006*	11540.0*	17666.0*	11022.0*	3.8244e+009*
	0.0000	0.0000	0.0000	0.0000	0.0000
Panel B: Serial correlation and LM-ARCH tests					
LB(20)	127.764*	38.6167*	102.976*	31.9982**	0.3190
	0.0000	0.0074	0.0000	0.0433	1.0000
$LB^2(20)$	952.322*	687.806*	556.933*	849.922*	0.0044
	0.0000	0.0000	0.0000	0.0000	1.0000
ARCH 1-10	188.80*	36.682*	39.262*	38.160*	0.0002
	0.0000	0.0000	0.0000	0.0000	1.0000
Panel C: Unit Root tests					
ADF test statistic	-41.3351*	-39.5617*	-43.4145*	-39.049*	-39.192*
	-1.9409	-1.9409	-1.9409	-1.9409	-1.9409

Notes: Insurances and stock market returns are in daily frequency. Observations for all series in the whole sample period are 4591. The numbers in parentheses are p-values. ***, **, and * denote statistical significance at 1%, 5% and 10% levels, respectively. $\boldsymbol{LB}(\mathbf{20})and\boldsymbol{LB}^{\mathbf{2}}(\mathbf{20})$ are the 20th order Ljung-Box tests for serial correlation in the standardized residuals, respectively.

To accommodate the existence of “fat tails”, we assume student-t distributed innovations. Furthermore, the Jarque-Bera statistic rejects normality at the 1% level for all return series. Moreover, all insurance return series and stock market are stationary, I (0). In addition, return series exhibit volatility clustering, revealing the presence of heteroskedasticity and strong ARCH effects.

From Table 3 (Abu Dhabi), ADNT is the most volatile, as measured by the standard deviation of 2.9561%, while ADX is the least volatile with a standard deviation of 0.9549%. Besides, we observe that ADNI has the highest level of excess kurtosis, indicating that extreme changes tend to occur more frequently for the conventional insurance. In addition, all insurance returns exhibit high values of excess kurtosis. To accommodate the existence of “fat tails”, we assume student-t distributed innovations. Furthermore, the Jarque-Bera statistic rejects normality at the 1% level for all return series. Moreover, all insurance return series and stock market are stationary, I (0). In addition, return series exhibit volatility clustering, revealing the presence of heteroskedasticity and strong ARCH effects.

Table 3. *Descriptive statistics of return series (Abu Dhabi).*

	ADNT	ADNI	ADX
Panel A: descriptive statistics			
Mean	-0.0015	-0.0365	0.0003
Maximum	18.2321	13.9761	7.6294
Minimum	-20.1568	-10.5360	-8.6792
Std. Deviation	2.9561	2.4429	0.9549
Skewness	0.0507	0.0011	-0.2084*
	0.1605	0.9738	7.9963e-009
Excess Kurtosis	12.508*	19.375*	13.035*
	0.0000	0.0000	0.0000
Jarque-Bera	29923.0*	71796.0*	32530.0*
	0.0000	0.0000	0.0000
Panel B: Serial correlation and LM-ARCH tests			
LB(20)	25.7983	32.2265**	113.418*
	0.1725	0.0409	0.0000
$LB^2(20)$	421.772*	293.933*	1621.77*
	0.0000	0.0000	0.0000
ARCH 1-10	19.991*	17.919*	71.332*
	0.0000	0.0000	0.0000
Panel C: Unit Root tests			
ADF test statistic	-39.9143*	-40.2099*	-40.3248*
	-1.9409	-1.9409	-1.9409

Notes: Insurances and stock market returns are in daily frequency. Observations for all series in the whole sample period are 4591. The numbers in parentheses are p-values. ***, **, and * denote statistical significance at 1%, 5% and 10% levels, respectively. $\boldsymbol{LB(20)}$ and $\boldsymbol{LB^2(20)}$ are the 20th order Ljung-Box tests for serial correlation in the standardized residuals, respectively.

4. Empirical results

4.1. Symmetric or asymmetric effects

Engle and Ng (1993) propose a set of tests for asymmetry in volatility, known as sign and size bias tests. The Engle and Ng tests should thus be used to determine whether an asymmetric model is required for a given series, or whether the symmetric GARCH model can be deemed adequate.

In practice, the Engle-Ng tests are usually applied to the residuals of a GARCH fit to the returns data.

Define S_{t-1}^{-} as an indicator dummy variable such as:

$$S_{t-1}^{-} = \begin{cases} 1 & if \ \hat{z}_{t-1} < 0 \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

The test for sign bias is based on the significance or otherwise of ϕ_1 in the following regression:

$$\hat{z}_t^2 = \phi_0 + \phi_1 S_{t-1}^{-} + \nu_t \quad (2)$$

where: $\nu_t$is an independent and identically distributed error term. If positive and negative shocks to $\hat{z}_{t-1}$ impact differently upon the conditional variance, then ϕ_1 will be statistically significant.

It could also be the case that the magnitude or size of the shock will affect whether the response of volatility to shocks is symmetric or not. In this case, a negative size bias test would be conducted, based on a regression where S_{t-1}^{-} is used as a slope dummy variable. Negative size bias is argued to be present if ϕ_1 is statistically significant in the following regression:

$$\hat{z}_t^2 = \phi_0 + \phi_1 S_{t-1}^{-} z_{t-1} + \nu_t \quad (3)$$

Finally, we define $S_{t-1}^{+} = 1 - S_{t-1}^{-}$, so that S_{t-1}^{+}picks out the observations with positive innovations. Engle and Ng (1993) propose a joint test for sign and size bias based on the following regression:

$$\hat{z}_t^2 = \phi_0 + \phi_1 S_{t-1}^{-} + \phi_2 S_{t-1}^{-} z_{t-1} + \phi_3 S_{t-1}^{+} z_{t-1} + \nu_t \quad (4)$$

Significance of ϕ_1 indicates the presence of sign bias, where positive and negative shocks have differing impacts upon future volatility, compared with the symmetric response required by the standard GARCH formulation. However, the significance of ϕ_2 or ϕ_3 would suggest the presence of size bias, where not only the sign but the magnitude of the shock is important. A joint test statistic is formulated in the standard fashion by calculating TR^2 from regression (4), which will asymptotically follow aχ^2 distribution with 3 degrees of freedom under the null hypothesis of no asymmetric effects.

Table 4 reports the results of Engle-Ng tests for each return series (Qatar). First, the individual regression results show that the residuals of the symmetric GARCH model for the QIN, QIIN and QSE series do not suffer from sign bias and/or positive size bias, but they do exhibit negative size bias. Second, for the ALTG series, the individual regression results show that the residuals of the symmetric GARCH model do not suffer from positive size bias sign bias, but they do exhibit significant negative size bias and sign bias test. Third, the individual regression results show that the residuals of the symmetric GARCH model for the DIN series do not suffer from sign bias test, but they do exhibit negative size bias and/or positive size bias. Finally, the $\chi^2(3)$ joint test statistics have p-values of 0.0516, 0.0208, 0.0155, 0.0374 and 0.0731, respectively, demonstrating a very rejection of the null of no asymmetries. The results overall would thus suggest motivation for estimating an asymmetric volatility model for these particular series

Table 4. *Tests for sign and size bias for each return series (Qatar)*

Variables	QIN			ALTG		
	Coeff	StdError	Signif	Coeff	StdError	Signif
ϕ_0	0.9723*	0.1475	0.0000	1.0872*	0.0762	0.0000
ϕ_1	0.1856	0.1182	0.1951	-0.3435*	0.1293	0.0079
ϕ_2	0.0136***	-0.0942	0.0818	-0.2611*	0.0943	0.0056
ϕ_3	0.0745	0.1656	0.6525	-0.0965	0.0832	0.2460
$\chi^2(3)$	10.7908***	-	0.0516	9.7462**	-	0.0208

DIN			QIIN			QSE		
Coeff	StdError	Signif	Coeff	StdError	Signif	Coeff	StdError	Signif
0.7528*	0.1164	0.0000	0.9675*	0.0766	0.0000	0.8703**	0.5479	0.0498
0.1924	0.1355	0.1555	-0.0866	0.1318	0.5108	-0.7577	0.7262	0.2968
-0.1320***	0.0789	0.0947	-0.1798**	0.0971	0.0810	-0.1785***	0.5773	0.0873
0.2676	0.0973	0.0059	0.1292	0.0831	0.1201	-1.1064	3.8051	0.7712
10.3862**	-	0.0155	14.0369**	-	0.0374	11.1164***	-	0.0731

Note: The superscripts *, ** and *** denote the level significance at 1%, 5%, and 10%, respectively.

Table 5 reports the results of Engle-Ng tests for each return series (Abu Dhabi). First, the individual regression results show that the residuals of the symmetric GARCH model for the ADNI series do not suffer from sign bias and/or positive size bias, but they do exhibit negative size bias. However, for the ADX series, the individual regression results show that the residuals of the symmetric GARCH model do not suffer from positive size bias sign bias, but they do exhibit significant negative size bias and sign bias test. The $\chi^2(3)$ joint test statistics have p-values of 0.4013, 0.0032 and 0.0000, respectively, demonstrating a very rejection of the null of no asymmetries from ADNI and ADX. The results overall would thus suggest motivation for estimating an asymmetric volatility model for the two-particular series. For ADNT we estimate a symmetric GARCH model.

Table 5. *Tests for sign and size bias for each return series (Abu Dhabi)*

Variables	ADNT			ADNI			ADX		
	Coeff	StdError	Signif	Coeff	StdError	Signif	Coeff	StdError	Signif
ϕ_0	0.9374*	0.0937	0.0000	0.9414*	0.0824	0.0000	0.5114*	0.1494	0.0006
ϕ_1	0.4334	0.3801	0.2542	-0.4645	0.4262	0.2758	0.8998*	0.1775	0.0000
ϕ_2	-0.0119	0.1578	0.9397	-0.4984*	0.1616	0.0020	0.2419**	0.0978	0.0134
ϕ_3	0.0766	0.1380	0.5785	0.1188	0.1169	0.3098	0.0741	0.1441	0.6070
$\chi^2(3)$	2.9376		0.4013	13.7669*		0.0032	36.9670*		0.0000

Note: The superscripts *, ** and *** denote the level significance at 1%, 5%, and 10%, respectively.

4.2. Estimation results from multivariate short memory models

The results of the estimates of the DCC-GARCH and DCC-GJR-GARCH models are reported in Tables 6 and 7. By focusing on the analysis of the Co-movements existing between the returns of Islamic, conventional stocks and the market returns relating to Qatar. The effects of delayed and standardized shocks as well as the effects of delayed conditional dynamic correlations are analyzed through parameters a and b. The statistical significance of these two parameters for each pair of returns shows the evidence of dynamic correlations. The constant conditional correlation is obtained when a = 0 and b = 0.

The results reported in Table 6 indicate that the parameters a and b are positive and verify the sum a + b < 1 for each pair considered. When this sum is very close to 1, then there is a strong persistence of the shock over a short horizon. We also admit that the coefficients of dynamic correlations (rho 21) are of the order of 0.00023, 0.0464, 0.0476 and -0.00012. Thus, the returns (ALTG) and (DIN) are characterized by a strong interdependence with the market.

Regarding the returns of Islamic and conventional stocks and their interdependence between the Abu Dhabi market, we see that the parameters a and b are positive and statistically insignificant. We admit that the sum of a + b <1 for the two pairs considered. This sum is far from unity. This result demonstrates the existence of a weak persistence of the shock over a short horizon.

On reading the results reported in Table 7, we see that the dynamic correlation coefficients (rho 21) are around 0.0219 and 0.0167. We note that these correlation coefficients are significant at the 1% threshold. Thus, the returns of Islamic and conventional stocks are characterized by a strong interdependence with the market.

Table 6. *Results of multivariate short memory models (Qatar)*

	ρ(QIN- QSE)		ρ(ALTG- QSE)		ρ(DIN- QSE)		ρ(QIIN- QSE)	
	coefficient	t-prob	coefficient	t-prob	coefficient	t-prob	coefficient	t-prob
Panel A: Estimates of Multivariate DCC								
Rho21	0.00023	0.5723	0.0464*	0.0052	0.0476*	0.0000	-0.00012*	0.0069
a	0.0002*	0.0000	0.0015	0.3606	0.0005	0.9998	0.0001*	0.0000
b	0.5617***	0.0787	0.9958*	0.0000	0.6161	0.2026	0.1387*	0.0000
v	2.0312*	0.0000	2.3796*	0.0000	2.2955*	0.0000	2.0157*	0.0000

Note: The superscripts *, ** and *** denote the level significance at 1%, 5%, and 10%, respectively.

Table 7. *Results of multivariate short memory models (Abu Dhabi)*

	ρ(ADNT- ADX)		ρ(ADNI- ADX)	
	Coefficient	t-prob	coefficient	t-prob
Panel A: Estimates of Multivariate DCC				
Rho21	0.0219*	0.0015	0.0167*	0.0019
a	0.0003	1.0000	0.0006	0.9991
b	0.1591	0.9494	0.2677	0.9900
v	2.1507*	0.0000	2.1198*	0.0000

Note: The superscripts *, ** and *** denote the level significance at 1%, 5%, and 10%, respectively.

5. Conclusion

The present study examines the dynamic correlations between Islamic and conventional insurances with Qatar and Abu Dhabi and stock market such as QSE and ADX. Specifically, we employ a multivariate GARCH-DCC with symmetric effect and the multivariate GJR-GARCH-DCC with asymmetric effect, during the period from January, 2006 to August, 2018, focusing on the estimated dynamic conditional correlations among the stock markets and each insurance. This approach allows investigating the second order moments dynamics of stock market and insurances taking into account short range dependence behavior, symmetries and asymmetries. We extended the above univariate GARCH and GJR-GARCH models to a bivariate framework with dynamic conditional correlation parameterization in order to investigate the interaction between Islamic and conventional insurances and stock markets for Qatar and Abu Dhabi. Our results document strong evidence of time-varying co-movement and asymmetric effect.

The above findings could be important for further understanding the relationship between insurances and stock market and could be useful to investors and other market participants, such as, financial managers, analysts and firms in order to manage their investments and minimize their portfolio risks.

The results of this study should be useful to financial researcher-analysts. Regulatory authorities should keep an eye on high volatility to protect investors in the insurance sector from the activities of speculators.

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