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Volatility Behavior of Sukuk Market: An Empirical Analysis of the Dow Jones Citigroup Sukuk Index

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Abstract: The aim of the study is to examine the volatility behavior of *sukuk* market under consideration of structural breaks. The Dow Jones Citigroup *Sukuk* Index (DJCSI) for the period 2007-2011 is used as a proxy of global *sukuk* market. The main finding indicates that structural breaks significantly alter the volatility behavior of *sukuk*. It indicates that the volatility during pre-crisis and contemporaneous period is more sensitive to market events compared to the post-crisis period. The findings imply that in order to realize more rational and efficient *sukuk* market, the needed policies are greater transparency, information disclosure and better incentives to attract investors to increase their trading activities in the secondary market. Future research might develop a risk-return forecasting model incorporating the volatility behavior of *sukuk* market.

Key words: *Sukuk* · Structural breaks · Volatility · DJCSI · Islamic capital market

INTRODUCTION

Studying volatility behavior of *sukuk* market is very important for market participants since it affects risk management strategy. Volatility is not the same as risk. But since it is interpreted as uncertainty, it becomes a key input to many investment and policy decisions. In investment market participants not only consider expected returns, but also expected risk. High volatility indicates greater uncertainty and hence could mean huge losses or gain. The tradeoff between risk and return become basic decision in portfolio management. According to modern portfolio theory, the basic strategy to create efficient portfolio is to maximize return for a given risk or to minimize risk for a given level of expected return. Since investors and portfolio managers have certain levels of risk and return expectation, a good forecast of asset prices volatility over the investment holding period is a good starting point for assessing investment risk.

Market participants employ variety of econometric methods to develop risk-return modeling and forecasting to capture the behavior of market to obtain profit from their investment. However, these models may provide misleading predictions in case of important events such as wars, economic crises, policy changes and regime shifts, which fundamentally alter behavior of market. In financial market, change in market behavior due to changes in fundamental market structure is referred to as structural change or structural break. Ignoring the presence of structural changes may lead to misleading conclusions drawn in explaining the actual financial market behavior.

The issue of structural breaks in financial time series has been the subject of an extensive investigation. The structural breaks have very important consequences for forecasting and understanding business cycles. Perron [1] argued that if structural breaks are not dealt with appropriately, one may obtain spurious results. The unawareness of structural breaks in the asset prices may bring severe impacts to investment performance as well as risk control to the volatile financial markets. The main issue in the study of structural breaks is that we not only need to know that breaks exist, but also the exact dates (location) of the breaks. Previous study assumed that the number and location of breaks are determined

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exogenously. This method may lead to misleading or wrong conclusion since each market has different speed and sensitivity in response to structural changes. Therefore, identifying and locating structural breaks endogenously would be more appropriate to capture market behavior in response to structural change. The issue of how to estimate the number and location of multiple endogenous structural breaks is being intensely researched, for example research by Kramer *et al*. [2] Andrews *et al*. [3] and Bai and Perron [4, 5]. This study employs the Bai and Perron method to test for multiple structural breaks in the mean levels of the *sukuk* price.

In finance, volatility refers to a measure for variation of price of a financial instrument over time. It is measured using standard deviation and variance. In econometric models, variance of the disturbance term is assumed to be constant over time. However, financial and economic time series exhibit periods of high volatility followed by periods of low volatility. This means that the expected value of disturbance term can be greater at certain periods compared to others. Additionally, these riskier times seem to be concentrated and followed by periods of lower risk (lower volatility) that are again concentrated. In other words, the large changes in asset returns seem to be followed by other large changes and vice versa. This situation is known as volatility clustering. In this situation, the assumption of a constant variance is inappropriate. Various models have been developed to explain the behavior of inconstant variance and volatility clustering. One of them is Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH). This model has several advantages over the pure GARCH model [6]. First, the equation for the conditional variance is in log-linear form which implies that the value of conditional variance can never be negative. Hence, it is permissible for the coefficients to be negative. Second, this model uses standardized value that allows for more natural interpretation of the size and persistence of shocks. Third, this model allows for asymmetries or leverage effect.

Batra [7] used EGARCH augmented by structural break analysis to examine return volatility in the Indian stock market. The paper indentified that balance of payment crisis in 1991 have significant impact on stock return volatility. Cunado et al. [8] analyzed the volatility of Spanish stock market. The result suggests that volatility has behaved in a different manner due to the opening of the Spanish economy. Nguyen [9] examined the presence of structural changes in the volatility of emerging market countries. Empirical results showed that structural breaks detected in emerging market volatility coincide with the dates of the first American Depository Receipt and Country Fund introduction and with dates of huge increases in the United States capital flows into emerging countries. Su [10] analyzed the Chinese stock market volatility before and during the global financial crisis 2007-2008. The result show that during the crisis the Chinese stock market was more volatile and bad news produces stronger effect than good news. The studies of volatility have been conducted almost exclusively in the context of conventional stock and bond markets. However, empirical works on *?ukûk* market are limited. Therefore, the aim of this study is to investigate the volatility behavior of *sukuk* market under consideration of structural breaks.

MATERIALS AND METHODS

Data: This study uses the Dow Jones Citigroup *Sukuk* Index (DJCSI) as a proxy of the global *sukuk* market. The sample used in this study is the daily data of the DJCSI from 3 January 2007-28 February 2011 (1,079 observations). Data are sourced from the Bloomberg database. The DJCSI follows the general methodology of the family of Citigroup fixed income indexes and the Dow Jones Islamic Market Index (DJIM) methodology for *Shariah* compliance screening securities [11].

Identifying and Locating Structural Breaks: In order to identify and locate the structural breaks, this study follows the sequential procedure of Bai and Perron [4-5], as discussed in Zeileis *et al*. [12]. The general framework of this method is locating the breaks one at a time, conditional on the breaks that have already been located. Thus, the procedure locates the first break and tests for its significance against the null hypothesis of no break. If the null hypothesis is rejected, then look for the second break conditional on the first break being the one already found and test for the existence of that second break against the null of one single break and so on. Furthermore, Bai and Perron [4] suggested using Bayesian Information Criterion (BIC) instead of Akaike Information Criterion (AIC) for model selection in selecting the number of breakpoints. They argued that the AIC usually overestimates the number of breaks but the BIC is a suitable selection procedure in many situations.

Volatility Modeling: The EGARCH (q,p) model with additional explanatory variables can be presented in the following form:

$$\log(h_t) = \gamma + \sum_{j=1}^{q} \zeta_j \left| \frac{u_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{j=1}^{q} \xi_j \frac{u_{t-j}}{\sqrt{h_{t-j}}} + \sum_{i-1}^{p} \delta_i \log(h_{t-i}) + \sum_{i=1}^{m} u_k X_k$$

which says that the value of the variance scaling parameter (h_t) depends on past values of the shocks, which are captured by lagged residual term (u_{t-j}) and on past value of itself, which are captured by the lagged h_t term (h_{t-i}). Where X_k is a set of explanatory variables that might help to explain the variance. In this study, the structural breaks used as explanatory variables in the model to investigate its effect on volatility of *sukuk* price.

This technique consists of two steps. First, the identified structural breaks will be treated as dummy variables in the variance equation of the EGARCH model to test which breaks have significant effect on volatility. Second, the sub-sample will be developed based on the significant breaks from previous step and then the EGARCH model will be applied on each sub-sample to investigate the behavior of price volatility.

RESULTS AND DISCUSSION

Structural Breaks in *Sukuk* Market: In order to identify the structural change, log values of the DJCSI (LDJCSI) is regressed in an Ordinary Least Square (OLS) model by fitting a constant to the data. The Residual Sum of Square (RSS) and the Bayesian Information Criterion (BIC), with a trimming parameter of h_t and a maximum of $m = 5$ breaks, are used to select the number of breakpoints. The result of RSS and BIC are presented in Figure 1.

Figure 1 indicates both the RSS and the BIC reach minimum value at approximately three and four breaks. Hence, the BIC is used to develop a model with three breakpoints. The three breakpoints are identified at observations 463, 624 and 910 dated 13 October 2008, 28 May 2009 and 16 July 2010, respectively. The results are visualized in Figure 2. The LDJCSI show upward trend in the first 200 observations (or during 2007) and relatively stable until observation 450s (or September 2008). However, afterwards the market experienced drastic dropping started from end September 2008 to January 2009, a period where the first break identified. A possible event associated with the first break is the collapse of financial institutions such as Fannie Mae, Freddie Mac, Lehman Brothers and insurer American International Group, in September 2008 due to subprime crisis. Other possible event directly related to the *sukuk* market was the default of the first United States's *sukuk*, East Cameron Gas Company's (ECG), valued at USD165.7 million in October 2008.

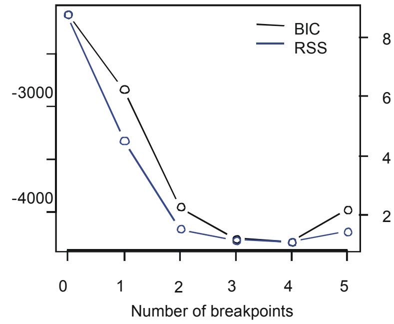

Fig. 1: The Results of BIC and RSS

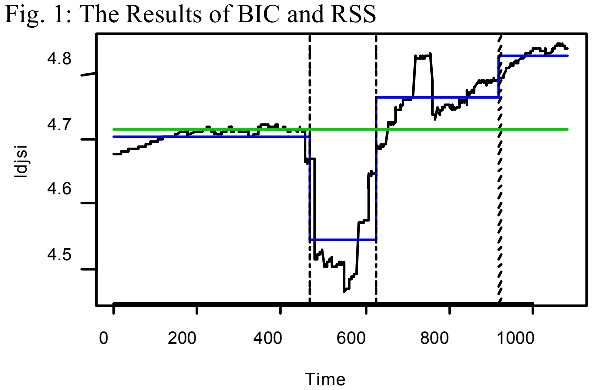

Fig. 2: Fitted model of structural breaks on LDJCSI

For the second break, there are no specific events that can be associated with the *sukuk* market directly. A possible explanation is that the *sukuk* market recovered along with the recovery of the overall financial markets. In addition, a trend of rising oil prices after hitting its lowest point in January 2009 has also raised expectation that *sukuk* market will recover in line with increasing investment demand from petrodollars. Although *sukuk* have gained popularity in financing, a series of high-profile *sukuk* defaults in the Gulf Corporation Countries (GCCs) and the United States have put a test to the viability of *sukuk* as alternative financing instruments [13].

At the end of 2009, the *sukuk* market was shocked by uncertainties associated with the ability of Nakheel Company to repay USD 3.52 billion of *sukuk* due in December 2009. Nakheel is the developer's company operating under Dubai World, which manages various businesses on behalf of the Dubai government. On 25 November 2009, the Dubai government announced that the company intends to extend maturities until at least 30 May 2010. A public statement on 30 November 2009 which claimed that the Dubai World debts are not guaranteed by the government increases uncertainty [14]. Consequently, market reacted negatively when DJCSI dropped to 114.36 on 30 November 2009 from 120.36 on

Table 1: Estimated EGARCH(1,1) Model of the LDJSI under Structural Breaks

	Without Breaks		With One Break		With Two Breaks		With Three Breaks	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
α	0.0604 *	0.0003	0.0088 **	0.0043	-0.0235 *	0.0056	0.0143 *	0.0015
β	0.9871 *	0.0000	0.9982 *	0.0009	1.0050 *	0.0012	0.997 *	0.0003
γ	-0.8345 *	0.0211	-16.7586 *	0.0028	-14.6996 *	0.0060	-6.6432 *	0.3071
ζ	0.0678 *	0.0116	0.7860 *	0.0033	0.8804 *	0.0065	0.9696 *	0.0208
ξ	-0.2356 *	0.0100	0.7815 *	0.0044	0.6887 *	0.0058	0.6348 *	0.0211
δ	0.9162 *	0.0022	-0.2465 *	0.0015	-0.0442 *	0.0005	0.5338 *	0.0231
D1			5.0762 *	0.0204	4.9550 *	0.0361	2.7201 *	0.1177
D2					3.6790 *	0.0579	1.7219 *	0.0841
D3							0.1320	0.1236

* and ** denote statistically significance at the 1% and 5% level respectively

27 November 2009. Hence, Nakheel's *sukuk* crisis and Dubai World's debt renegotiation is a possible event associated with the third break.

Volatility Behavior of *Sukuk* Market: To investigate the effect of structural change on the volatility of *sukuk* price, the EGARCH(1,1) model is applied for the full sample. In this study, the conditional mean equation for LDJSI follows the autoregressive lag 1 or AR(1) process. The model was chosen based on the BIC after examining the auto-regressive moving average (ARMA) models of order (0,0) to (5,5). The next step, the identified breakpoints are treated as dummy variables and applied as explanatory variables in the conditional variance equation of the EGARCH(1,1) model. One, two and three breakpoints are applied sequentially to investigate which breakpoints affect the volatility significantly. The results of estimation and statistical verification of the EGARCH model with and without structural breaks for the LDJCSI are shown in Table 1.

Based on Table 1, almost all estimated parameters of the EGARCH models are statistically significant at 1% level except for constant of the mean equation (α) at 5% level. From estimated parameters of dummy variables, only the third break is not statistically significant. This means that only the first and second breaks have significant effect on the volatility.

The ARCH (ζ) effects tend to increase dramatically after structural breaks are included in the model. It indicates that the effect of shock from the previous period is more pronounced in the subsequent period. In other words, there are tendency of large price changes (of either positive or negative), to be immediately followed by further large price changes (of either positive or negative). Conversely, the GARCH (δ) effects tend to decrease and even have a negative value after the first and second breaks are included in the model. It indicates that persistence of volatility tends to change from long to shorter memory. It implies low volatility persistence which means that the impact of last period's forecast variance will decay very fast. The asymmetric (leverage) effects captured by the parameter ξ change from negative to

Table 2: Estimated EGARCH(1,1) Model for Sub-samples of The LDJCSI

	Full Sample 1/3/2007 - 2/28/2011		Sub-sample 1 1/3/2007 - 10/12/2008		Sub-sample 2 10/13/2008 - 5/27/2009		Sub-sample 3 5/28/2009 - 2/28/2011	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
α	0.0604 *	0.0003	0.0873 *	0.0011	0.1182 *	0.0007	0.0354	0.0261
β	0.9871 *	0.0000	0.9814 *	0.0002	0.9738 *	0.0000	0.9926 *	0.0055
γ	-0.8345 *	0.0211	-2.3472 *	0.3209	-4.8901 *	1.2089	-6.2581 *	0.1670
ζ	0.0678 *	0.0116	0.8582 *	0.0428	-0.7174 *	0.1941	-0.0237 *	0.0035
ξ	-0.2356 *	0.0100	0.5268 *	0.0386	0.8565 *	0.2332	-0.1476 *	0.0029
δ	0.9162 *	0.0022	0.8745 *	0.0238	0.4114 *	0.1453	0.4231 *	0.0146

*, ** and *** denote statistically significance at the 1%, 5% and 10% level respectively

positive values after structural breaks are included in the model. This means positive shocks are more volatile than negative shocks.

The above analysis suggests that the structural breaks have significant effects on the volatility behavior of the *sukuk* prices. The study further investigates the volatility behavior under each regime established by the structural breaks. Three sub-samples are developed based on the two breaks that are statistically significant. Using 2008 financial crisis as the event describing the breaks, we can categorize the three sub-samples into pre-crisis, during crisis and post-crisis regimes. The same process mentioned above is conducted using EGARCH model on each regime. The results of all estimation for the full and sub-samples are presented in Table 2. Almost all estimated parameters of the EGARCH models are statistically significance at 1% level, except for the constant of the mean equation (α) of sub-sample 3. The results imply the existence of ARCH/GARCH effects both for the full sample and each regime under structural changes.

The ARCH (ζ) parameters in regime 1 and 2 are relatively big compared with those in the full sample and regime 3. It means that in these regimes shocks from the previous period has explosive and immediate effect on the subsequent period. It indicates that the volatility in the pre-crisis and during crisis is very sensitive to market events compared to the post-crisis period.

The leverage parameter (ξ) is relatively big and has positive sign in regime 1 and 2 which indicates that in the pre and during crisis period 'good news' generate more volatility than 'bad news'. In contrast, the post-crisis period displays opposite behavior. The phenomenon which is contrary to the behavior of most financial markets may be explained as follow. During pre-crisis period, *sukuk* market was characterized by steady growth, which indicated the high demand for *shariah*-compliant investment products while supply is relatively limited. These conditions led to high expectations of market participants to the *sukuk* market, so the 'good news' in the market will be responded more than the 'bad news'. Other reason is due to the unique structure of *sukuk* where investors feel confident that *sukuk* is more secure and resilient to crisis compared with other products in the conventional market. In addition, *sukuk* investors tend to apply a ‘buy-and-hold strategy’, given the overwhelming demand for them, therefore only few of them enter the secondary market. Meanwhile, the secondary market still remains a niche segment with almost all trading done at the institutional level. S*ukuk* market follows the behavior of most financial markets during post-crisis period implying that investors behave rationally in response to information in the market. This also indicates that *sukuk* market moves to a more efficient condition.

CONCLUSION

The paper concludes that the structural breaks associated with the recent global financial crisis significantly alter the volatility behavior of *sukuk* market. The results suggest that the volatility in the pre-crisis and during crisis is very sensitive to market events compared to the post-crisis period and positive shocks are more volatile than negative shocks. The findings have important implications for the industry. First, since *sukuk* market was affected by the crisis, it is important to understand how shocks are transmitted between Islamic capital market and the rest of the world. Second, market participants should consider information and events that occurred in both conventional and Islamic market when making investment decisions. Therefore, in order to realize more rational and efficient *sukuk* market, needed policies are those that could improve transparency and information disclosure. The policies also must be able to create better incentives to attract investors to increase their trading activities in the secondary market thereby increasing the liquidity of *sukuk* market, which in turn drives the market to become more efficient.

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