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GARCH-M Analysis of Sukuk Indices Post the 2008 Financial Crisis: Empirical Study on Different Sukuk Ratings

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Abstract

The higher the volatility (as a proxy of risk) during the crisis, the higher the probability of sukuk defaults. The investigation of the sukuk market's efficiency in the sample period of study is essential since volatility will impact long-term market efficiency. The daily data of historical prices from 2006 to 2015 for all sukuk indices by different ratings (DJSUK3AT, DJSUK2AT, DJSUK1AT, and DJSUK3BT) have been collected from the Bloomberg database (Saturdays and Sundays excluded). The GARCH-in-Mean (GARCH-M) model has been implemented to identify sukuk market efficiency types. The highest quality rating (AAA) and excellent rating (AA) of sukuk (DJSUK3AT and DJSUK2AT) were recorded as the best leading market indicator based on the market efficiency analysis. Hence, the study of sukuk market efficiency is significant to investors and issuers since the results can be used as indicators in identifying the best situation to invest in and issue the sukuk.

Keywords: Sukuk, Efficiency, GARCH-M Model, Ratings, Financial Crisis

Introduction

Despite the economic challenges posed by the COVID-19 pandemic, global sukuk issuance increased by 21.2 percent year on year in the first quarter of 2021, reaching USD42.3 billion. With a market share of 42.4 percent, Malaysia led the global issuance (USD17.9 bil). The Malaysian government sukuk market has exhibited impressive growth over the years. The primary sukuk market is expected to grow, with issuances primarily coming from Malaysian corporates as well as GCC and MENA sovereigns (IIFM Sukuk Report, 2016; MIFC Sukuk Report, 2017; RAM Group, 2021). A problem may arise from overly high volatility, as excessive volatility induces instability in the capital market. High volatility may contribute to a crash or crisis in the financial securities industries (Okpara, 2011; Guo, 2012; Bhowmik, 2013).

The 2008 global financial crisis was the first real test for sukuk. The crisis proved damaging to the nascent sukuk market, and several issuances slumped to their lowest level

during this crisis. However, the sukuk investment universe has staged a strong comeback since 2009 and has fully recovered. This has proven the resilience of the sukuk market's performance. The Dow Jones Sukuk Index (DJSI) has improved from unimpressive performance and has entirely recovered from the crisis. This has led to markedly lower volatility given by the higher creditworthiness of the investment universe. The quality of sukuk index performance considers both return and risk. Its superior performance is further enhanced with lower volatility and a higher Sharpe ratio (Islamic Finance News, 2013; CIMB-Principal Islamic Asset Management Sdn Bhd, 2013). Price volatility and uncertainty have an impact on the financial sector's performance, particularly in terms of sukuk returns. Records show that during the 2007/2008 global financial crisis, the sukuk market's return fell from USD46.65 billion in 2007 to only USD15.8 billion in 2008. (Ahmad & Radzi, 2011). The drop in total global sukuk issuance following the 2008 global financial crisis created a difficult situation for sukuk investors (Rahim & Ahmad, 2016).

According to the Securities Commission Malaysia (2011), the default rate for Malaysian sukuk was relatively low at 0.46 percent in 2008 during that particular year of the global financial crisis. Sukuk investors did not expect the unprecedented volatility markets or the severe deterioration in the amounts of a broad range of asset classes during the crisis. Nevertheless, the most troubling aspect of the crisis was the fall in investors' confidence and trust. Equally important, high market volatility during the global financial crisis has classified sukuk as a risky investment (Salah, 2009). Higher risk triggered higher volatility as the proxy of risk, and it is critical to study the issue in order to avoid sukuk default. During the crisis, sukuk with higher ratings are unlikely to default or vice versa. From 2002 to 2009, approximately 24 domestic sukuk defaulted with 96 percent in Bai' Bithaman Ajil and Murabahah structures (Zakaria et al., 2012). Sukuk defaults will happen when sukuk investors make bad sukuk investments. The increasing number of defaulted sukuk forms a concern in this study. The higher the volatility (as a proxy of risk) during the crisis, the higher the probability of sukuk defaults. The issue of sukuk default has gained particular attention in recent years, especially after the financial crisis that hit the world economy.

Section 2 of this study describes the introduction to sukuk and Efficient Market Hypothesis. In Section 3, the data collection used in this study is discussed. Section 4 discusses the methodology. The results and empirical analyses are presented in Section 5. The conclusion of this research can be found in Section 6.

Literature Review

Definitions of Sukuk

Islamic finance and financial markets have many international norm-setters. Among the most significant are the Accounting and Auditing Organisation for Islamic Financial Institutions (AAOIFI) and the Islamic Financial Services Board (IFSB). The Securities Commission Malaysia (SC) guides sukuk issuances in Malaysia. Sukuk that discussed in this section, is based on Malaysia's Securities Commission for two main reasons. According to the literature, the definition of SC is considered to be the most extensive and all-encompassing definition compared to other meanings. Second, Malaysia has recently been the principal driver of sukuk issuance, and the pattern continues.

The Securities Commission Malaysia (2019) defines sukuk as "certificates of equal value which evidence exclusive ownership or investment in the property using Sharia principles and concepts approved by the Shari'ah Advisory Council (SAC)." Meanwhile, the AAOIFI defines sukuk as "a certificate of equal value, representing undivided interests in the ownership of

the underlying assets (applicable to both tangible and intangible assets), usufruct, services, or investment, particularly ventures or some special investments" (AAOIFI, 2008). According to IFSB, sukuk refers to "a certificate that represents the holder's proportionate ownership in an entire part of an underlying asset where the owner assumes all rights and obligations to such asset."

Consequently, sukuk (sometimes referred to as 'Islamic bonds' since, is like shares, which are largely tradable with securities that can easily be rated) can be defined more specifically as 'Islamic investment trust certificates.' Whereas the bonds are proof of the debt the borrower owes to the bondholders, the sukuk certificates prove the investor's equity interest in the underlying sukuk estate, company, venture, or project entitles them to obtain a share of the profits generated by it.

Overview of Sukuk Market

Sukuk market has grown rapidly in recent years. Lower oil prices are the main driver for sovereign sukuk issuance in the Gulf region due to the increased budget deficit. Islamic Financial Services Board (IFSB, 2017) reports that global Islamic banking assets reached USD 1.5 Trillion in 2016. The market share of sukuk is estimated at 17%. The IFSB data also shows that new sukuk issuances have experienced a 16.3% increase in volume to USD 74.8 billion in 2016. Malaysia is the largest sukuk outstanding market in 2016, specifically accounting for a 46.4% share of the total market. Saudi Arabia, the United Arab Emirates (UAE), and Qatar have market shares of 17.4%, 10.5%, and 5.9%, respectively. Currently, there are eight countries that are not among the members of the Organization of the Islamic Cooperation (OIC), have outstanding sukuk, and they are France, Germany, Luxembourg, the United Kingdom, Singapore, Hong Kong, South Africa, and the United States (Smaoui & Ghouma, 2020).

Global *Sukuk* issuance increased from around 19.84% p.a. or USD145.702 billion in 2019 to USD 174.641 billion in 2020. The steady issuance volume during 2020 was mainly due to sovereign sukuk issuances from Asia, Gulf Cooperation Council (GCC), Africa and certain other jurisdictions. Malaysia continued to dominate the sukuk market even though countries like Indonesia, UAE, Saudi Arabia and Turkey increased with good volume.

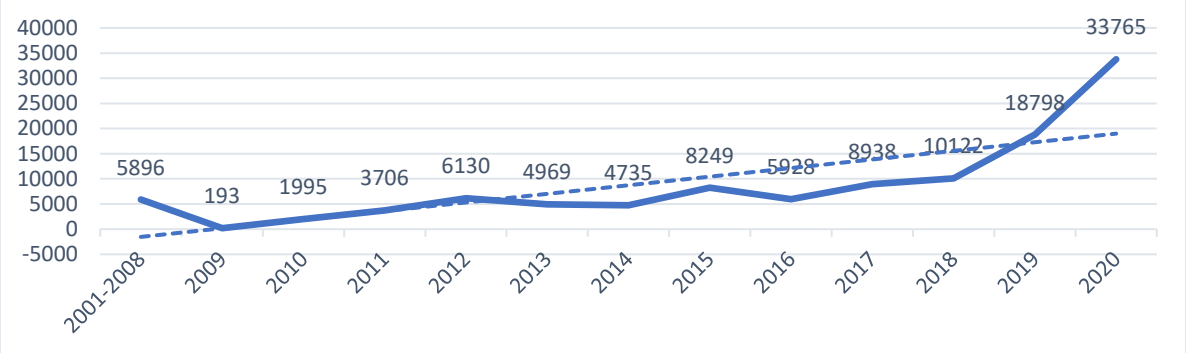


Figure 1: Global FIs Sukuk Issuances (Jan 2001 – Dec 2020)
All Tenor, All Currencies, in USD Millions
Source: IIFM (2021)

In 2020, sukuk issuances by financial institutions (FIs) showed strong performance. The issuance volume recorded a new high to date of USD 33.76 billion, a whopping issuance

increase of USD 15.00 billion or 80% p.a. compared to the previous year. The FIs were active sukuk issuers since their inception, and initially, the issuances were on a floating profit rate basis, which suited their balance sheet management. However, starting in 2010, FIs became more active as issuers for liquidity management purposes and met the Basel Capital Adequacy requirements by issuing Tier 1 (Perpetual) and Tier 2 sukuk. Several FIs based in various jurisdictions have mostly issued Tier 1 Sukuk (IIFM, 2021). The international sukuk market, though it accounts for approximately 24% of overall Global Sukuk issuances since inception, is a natural attraction and driver of the sukuk market from a global perspective.

According to Table 1, the UAE maintained its volume and value leader position in the international sukuk market with a share of 27.01%, closely followed by Malaysia with a share of 25.77%, Saudi Arabia with a share of 19.67%, Indonesia with a share of 6.38%, Bahrain with a share of 4.69% and with a share of Turkey 5.09%. Together with Saudi Arabia, Qatar, UAE, Oman & Bahrain, the five GCC countries commanded over 59.07% of the entire international sukuk issuances since inception.

Table 1
Regional Break-up of International Sukuk Issuance
(Jan 2001 – Dec 2020)

ASIA & FAR EAST	**Number of Issues**	**Amount USD Millions**	**% of Total Value**
China	1	97	0.03%
Hong Kong	5	3,196	0.96%
Indonesia	24	21,203	6.38%
Japan	3	190	0.06%
Malaysia	174	85,633	25.77%
Pakistan	4	3,600	1.08%
Singapore	4	711	0.21%
Total	**215**	**114,630**	**34.49%**
GCC MIDDLE EAST	**Number of Issues**	**Amount USD Millions**	**% of Total Value**
Bahrain	109	15,589	4.69%
Kuwait	21	5,177	1.56%
Oman	5	4,219	1.27%
Qatar	25	16,195	4.87%
Saudi Arabia	78	65,353	19.67%
United Arab Emirates	138	89,764	27.01%
Total	**376**	**196,297**	**59.07%**

Source: IIFM Sukuk Report (2021)

Sukuk Development in Malaysia

The sukuk sector of the Malaysian Government has seen impressive development over the years. The outstanding value of sukuk issued in Malaysia indicates an average annual growth rate of 13 per cent over the last decade, compared with 4 per cent for traditional bonds. As of the end of June 2017, the outstanding value of the local currency (LCY) sukuk amounted to RM718.4 billion, which was opposed to RM534.0 billion for traditional bonds. After 2014, outstanding sukuk exceeded the outstanding bonds by more than half. The proportion has slowly risen as quasi-government and business industries have preferred to sell sukuk rather than traditional bonds.

The Government of Malaysia has gradually stepped up the percentage of government investment issues (GII) relative to Malaysia's government securities (MGS) to turn the country into an international Islamic stock market. As of the end of June 2017, a total of RM67.0 billion of government securities had been released, of which 46 per cent were sukuk, compared to just 27 per cent at the end of 2006. Owing to the higher rate of issuance of Islamic Government securities over the last decade, the overall outstanding volume of Islamic Government securities rose from 11 per cent (RM21.6 billion) of overall issuance at the end of 2006 to 44 per cent (RM291.4 billion) at the end of June 2017 (Bond Pricing Agency Malaysia, 2017).

Meanwhile, the current global economy has been characterised by rapid growth in Islamic finance, especially sukuk. In addition to the peculiar characteristics of sukuk, i.e. an Islamic fund that is secure, not engaged in reckless trading, and typically has low exchange volatility, sukuk is found as less risky than traditional bonds. The flintstone is that the issuers are no longer from Islamic nations, but rather from Western, African and other Asian countries, for example, the United Kingdom, South Africa, Luxembourg and Hong Kong, which are former issuers of traditional instruments (Qizam & Fong, 2019). The complexity and uncertainty of the growth of sukuk can be traced in recent years. Attributable to the oil price uncertainty, it resulted in a revenue decrease of USD 300 billion, pushing the Gulf Cooperation Council (GCC) countries' deficit budget and providing prospective prospects and fresh obstacles for development in sukuk. Because of these circumstances, most GCC countries are trying to turn to the capital and bond market, especially by issuing both bonds and sukuk. Optimistically, for the coming years, this scenario is projected to be an annual sukuk rise of 10 percent a year and a favourable difference between supply and demand for sukuk, i.e. USD 143 trillion (2017), USD 178.4 billion (2018), USD 221.1 billion (2019), USD 256.9 billion (2020), USD 271.3 billion (2021) (Thompson Reuters, 2017).

Literature Review on Market Efficiency

Numerous studies have researched market efficiency. The researcher of this study also examines other types of markets in countries that are not issuing sukuk. These include studies on the foreign exchange market, exchange rates, stock markets, and others. As for South Africa, Bulgaria, Romania, and India have not expressed interest in Islamic financial instruments yet, they represent a non-Muslim investor base.

Black and McMillan (2006) use an asymmetric GARCH-M model to examine whether returns exhibit a positive (negative) risk premium resulting from a negative (positive) shock and the relative size of any premium. They apply monthly returns on value and growth stock portfolios for the U.S. over the sample periods from 1975 to 2000. They suggest that, following a shock, volatility and expected future volatility are heightened, thus leading to a rise in required return rates that depresses current prices. Worthington and Higgs (2006) also

measure the weak form efficiency of the market in Asia (1986 to 2003) through its ten emerging markets and five developed equity markets. All tested markets present weak form efficiency, excluding Taiwan and Australia.

Cooray and Wickremasinghe (2007) examine the efficiency in India, Sri Lanka, Pakistan and Bangladesh. They employ unit root tests and conclude the presence of weak form efficiency in these markets. Then, Verma and Rao (2007) examine the weak form efficiency of Bombay Stock Exchange (BSE100) Index companies for three years. The serial correlation and run test exhibit that the market was not in a weak form of efficiency for the first two years, but the third-year results indicate it as a weak form of efficiency. Next, Mishra and Paul (2008) examine the Indian stock and foreign exchange market's integration and efficiency. They conclude that the Indian stock and foreign exchamarketsrket are weak form efficiency. Then, from 1990 to 2000, Asiri (2008) measures the behaviour of stock prices in the BSE and the weak form efficiency of 40 listed companies. It was discovered that BSE followed the random walk theory, thus confirming the trend for all daily stock prices and sectors. All tests also supported the efficiency of BSE in the weak form. These authors conclude that the stock markets and stock exchange for India, Sri Lanka, Pakistan and Bangladesh have recorded as weak forms efficient.

Chander et al (2008) studied empirical evidence on weak stock market efficiency for the Indian scenario. Both parametric and nonparametric tests conclude the weak form stock market efficiency. Their results signal that trading strategies based on historical prices cannot rely on abnormal gains consistently, except when these coincide with underlying drifts in the stock price movements. Lazar (2009) examines the weak-form efficiency of the Indian capital market. The ADF and Phillips-Perron (PP) tests show that the Indian capital market is weak-form efficient. Finally, a study by Mittal and Jain (2009) deals with testing a weak form of efficiency and the EMH on the Indian stock market in a random walk. They examine the existence of seasonal anomalies in the Indian stock market. The result highlights that the anomalies did not exist in the market and could be considered informational efficient. As a result, these researchers support India as a weak form of market efficiency.

Mahmood et al (2011) examine the Chinese stock market's efficiency after the Asian and global financial crisis. They apply the EMH of random walk by using ADF, DF-GLS, PP, and KPSS tests on stock market return to separately check the unit root in the data series for both Shenzhen and Shanghai stock exchanges. The Chinese stock market was proven to be weak-form efficient as it exhibited the trend during both tested periods. Ntim et al (2011) test the weak form efficiency of 24 African continent-wide stock price indices from 1986 to 1989. Based on ranks and signs, the 32 stock price indices were examined. The returns from most African continent stock price indices present weak form efficiency.

Meanwhile, Haroon (2012) tests the Karachi Stock Exchange's weak-form efficiency (KSE), covering the 1991 to 2011, and finds that it is not weak-form efficient. Both descriptive statistics and nonparametric tests show the absence of weak-form efficiency. Therefore, it proves that the Karachi Stock Market is not weak (Omar et al., 2013) when using the same method as (Haroon, 2012). Birau (2013) published a comparative study between Romanian and Hungarian capital markets regarding the weak form of EMH. The BET and BET-C indices were considered for the Romanian stock market and BUX and BUMX indices for the Hungarian capital market with daily data between January 2007 and December 2011. In conclusion, none of the countries had a weak form of efficient capital markets.

Konak and Seker (2014) researched how FTSE 100 evolved and sustained the efficient market hypothesis. According to their analysis, between 2001 and 2009, the FTSE 100 index

respected the random walk theory and sustained the weak form of EMH. Cicek (2014) tests weak and semi-strong efficiency in the Turkish foreign exchange market. In testing for the weak form efficiency, the study uses a unit root test and finds out that the Turkish foreign exchange market is weak-form efficient. However, the study finds that the Turkish foreign exchange market does not confirm the semi-strong form of efficiency.

Hasan (2015) argues that the Dhaka Stock Exchange is inefficient in a weak form as historical stock prices cannot achieve superior gains. Besides, if the connection between stock prices and economic variables exists, Bangladesh's stock market will lose its informational efficiency in semi-strong form and become more volatile. Equally important, Charfeddine and Khediri (2015) use the GARCH-M model and Kalman filter, thus showing that the Gulf Cooperation Council (GCC) markets have different time-varying degrees of efficiency. Moreover, they showed evidence of structural breaks in all GCC markets. At the same time, they observed that the recent financial stocks such as the Arab Spring and subprime crises significantly impacted the time path evolution of market efficiency.

Tuyon and Ahmad (2016) employ a long span of Bursa Malaysia stock market data from 1977 to 2014 and the different economic development phases and market states. The efficiency tests show trends of an adaptive pattern of weak market efficiency across various economic phases and market states. Andrianto and Mirza (2016) mention that the Indonesian stock market could be categorised as weak-form efficiency. The statistical testing showed that the daily stock price movement was a random walk, and there was no correlation between the present day and the previous day. However, Andika et al. (2016) discovered that foreign exchange markets for the Asian-5 countries were efficient within countries but inefficient. They conclude that investors in the Asian-5 market could not make abnormal returns by using the information within foreign exchange markets.

Bhuiyan et al (2017) investigate whether sukuk can offer any advantage in terms of global diversification. They examine the volatilities and correlations of bond indices of emerging counties such as South Korea, Singapore, China, India, Indonesia, and Malaysia with the Thomson Reuters BPA Malaysia Sukuk Index by applying wavelet coherence and Multivariate GARCH analyses. The sukuk market offers significant portfolio diversification opportunities for fixed-income investors in the mentioned sample countries. Global and regional investors can benefit from portfolio diversification through investing in sukuk markets, but portfolio diversification is not feasible domestically. Bala and Takimoto (2017) use multivariate-GARCH (MGARCH) models and their variants to analyse stock volatility spillovers in emerging and developed markets (DMs) that impact the Global Financial Crisis (2007-2009) on stock market volatility experiences. The Emerging Markets (EM) correlations are lower than DM correlations and are intensely growing during financial crises.

Sheikh et al (2020) investigate the possibility of volatility contagion between conventional and Shariah indices. They use ARDL cointegration and MGARCH family models, specifically DCC and BEKK. The results clearly distinguish between Shariah and conventional indices, implying a potential for portfolio diversification. ARDL models, on the other hand, advocate for weak cointegration among indices, particularly during the financial crisis. Furthermore, the BEKK model predicts little volatility contagion during this period. Finally, Aslam et. al (2021) justify volatility in all corporate sukuk returns of varying maturities. It was discovered that smaller tenure sukuk had higher volatility than larger tenure sukuk. Furthermore, negative news and events have a greater impact on the volatility of the sukuk return than positive news.

This section does not focus solely on the literature review of sukuk market efficiency due to the limited research in this area. The author also examines other types of markets in countries not issuing sukuk. These include studies of the foreign exchange market, exchange rates, stock markets, and countries with a non-Muslim investor base that has not expressed interest in Islamic financial instruments.

Data Collection

The study employed four sukuk indices for the analysis by comprising four elements from Dow Jones Sukuk Index. The Bloomberg database collects daily data on historical prices from 2005 to 2015 for all indices (Saturdays and Sundays excluded). Therefore, the four indices included in the sample have different launching dates, as shown in Table 1.

Table 1
Sukuk Indices

	List of Sukuk Indices	Launch Date	N
1	Dow Jones Sukuk AAA Rated Total Return Index	28th April 2006	2,424
2	Dow Jones Sukuk AA Rated Total Return Index	28th Feb 2007	2,236
3	Dow Jones Sukuk A Rated Total Return Index	28th April 2006	2,424
4	Dow Jones Sukuk BBB Rated Total Return Index	31st Aug 2007	2,104

Source: Authors' collection

Dow Jones Sukuk AAA Rated Total Return Index (DJSUK3AT)

The Dow Jones Sukuk AAA Rated Total Return is designed to track the performance of global Islamic fixed-income securities, also known as sukuk. The index includes U.S. dollar-denominated, AAA-rated sukuk that have been screened for Sharia compliance (Bloomberg, 2018).

Dow Jones Sukuk AA Rated Total Return Index (DJSUK2AT)

The Dow Jones Sukuk AA Rated Total Return is designed to track the performance of global Islamic fixed-income securities, also known as sukuk. The index includes U.S. dollar-denominated, AA-rated sukuk that have been screened for Sharia compliance (Bloomberg, 2018).

Dow Jones Sukuk A Rated Total Return Index (DJSUK1AT)

The Dow Jones Sukuk A Rated Total Return is designed to track the performance of global Islamic fixed-income securities, also known as sukuk. The index includes U.S. dollar-denominated, A-rated sukuk that have been screened for Sharia compliance (Bloomberg, 2018).

Dow Jones Sukuk BBB Rated Total Return Index (DJSUK3BT)

The Dow Jones Sukuk BBB Rated Total Return is designed to track the performance of global Islamic fixed-income securities, also known as sukuk. The index includes U.S. dollar-denominated, BBB-rated sukuk that have been screened for Sharia compliance (Bloomberg, 2018).

Methodology

Based on the selected sukuk indices, this study investigates the types of sukuk market efficiency prior to, during, and after the 2008 global financial crisis. To that end, the GARCH-in-Mean (GARCH-M) model is used to identify sukuk market efficiency types, as shown in Table 1. The Generalised Autoregressive Conditionally Heteroscedasticity in Mean model (GARCH-M (1,1) model) allows the error term variance to vary over time, contrasting with the classical regressions that assume constant variance. Also, the GARCH-M model allows the testing for the presence of a risk premium in the markets. The GARCH-M (1,1) model is stated as follows:

$$r_t = \beta_0 + \beta_1 r_{t-1} + \delta h_t + e_t$$
$$e_t \sim N(0, h_t)$$
$$h_t = \alpha_0 + \alpha_1 h_{t-1} + \alpha_2 e_{t-1}^2$$

The β_0 is the intercept and the β_1 is the slope. Both β_0 and β_1 represent an AR (1) model. The δ represents the risk premium parameter in the conditional model when trade-off between volatility and return prevails. Returns volatility is measured by conditional variance h_t, which is described as a function of a squared value of past residuals (e_{t-1}^2), presenting the ARCH factor, and an autoregressive term (h_{t-1}) reflecting the GARCH character of the model. The sum of $\alpha_0 + \alpha_1$ represents the degree of volatility persistence in the model. If the sum of $\alpha_0 + \alpha_1$ is very close to 1, it suggests a cluster of volatility and the impact of volatility clustering will become more relevant (Eagle et al., 1990).

Bollerslev et al (1992) stated that volatility clustering indicates that the market is volatile for a week or two before calming gradually for several subsequent weeks. The estimation process is vital to identify the selected sukuk indices as the proxy for analysing the types of efficiency of the sukuk market. Overshooting can be interpreted as the presence of an abnormally high level of volatility. The classification of sukuk market efficiency is shown in Table 2. In this case, instability is indicated by adding the root of the autoregressive model of $\alpha + \beta$; the rule of thumb, in this sense if:

Table 2
Classification of Sukuk Market Efficiency

	ARCH term (α) + GARCH term (β)	**Types of Sukuk Market Efficiency**
1.	$\alpha + \beta < 0.5$	Strong form efficiency
2.	$0.5 \leq \alpha + \beta < 0.75$	Semi-strong form efficiency
3.	$0.75 \geq \alpha + \beta < 1$	Weak form efficiency
4.	$\alpha + \beta > 1$	No efficiency or inefficient market

Sources: Ojo and Azeez (2012) and Sheefeni (2015)

Hypothesis

Efficient Market Hypotheses (EMH) categorise market efficiency into three types: weak, semi-strong, or strong form efficiency. Sukuk data are analysed in pre, during, and post-2007/2008 global financial crisis period periods to test the second hypothesis as follows:

i. Null Hypothesis (H_0):
Sukuk market is inefficient based on EMH classification, and it does not follow a random walk theory after the 2007/2008 global financial crisis.

ii. Alternative Hypothesis (H_1)

There is a different type of sukuk market efficiency (inefficient, weak-form, semi-strong form, and strong form) as categorised by the efficient market hypothesis (EMH) and the market follows random walk theory for pre, during, and after the 2007/2008 global financial crisis.

H_1: Sukuk indices show a weak form efficient market after the crisis.

Results and Discussion

Descriptive Statistics

Table 3 shows the basic descriptive statistics for the four sukuk indices' daily market return, selected differently according to ratings. The most significant maximum value among these four sukuk indices is DJSUK1AT, 0.0843. All the maximum returns values are positive, while all minimum returns indicate negative results. The statistics show that the average value of the sample is positive and vigorous. Data are collected daily, excluding Saturdays and Sundays. The highest number of observations are DJSUK1AT and DJSUK3AT, with 2,489 observations (2005-2015). The lowest number of observations is DJSUK3BT, which is 1,993 observations (2007-2015).

Table 3
Descriptive Statistics

Descriptive Statistics for Daily Market Returns of the 14 Selected Sukuk Indices										
Variables	Mean	Median	Max	Min	Std. Dev	Skewness	Kurtosis	Jacque Berra	Probability	Observation
DJSUK1AT (9/30/2005-5/12/2015)	0.0002	0.0002	0.0843	-0.1694	0.0053	-12.8879	523.6297	28,179,591	0.0000	2,489
DJSUK2AT (2/28/2007-5/12/2015)	0.0002	0.0001	0.0289	-0.0253	0.0019	-0.6689	62.6646	315,354.4	0.0000	2,125
DJSUK3AT (9/30/2005 - 5/12/2015)	0.0001	0.0001	0.0377	-0.0485	0.0019	-2.9005	246.6739	6,161,376	0.0000	2,489
DJSUK3BT (8/31/2007-5/12/2015)	-0.0000	0.0001	0.0786	-0.1007	0.0048	-7.1683	231.9902	4,371,484	0.0000	1,993

Source: Authors' calculation

This study aims to look at the state of sukuk market efficiency before, during, and after the 2008 financial crisis using sukuk indices and the GARCH-M (1,1) model. Market efficiency is classified based on the ARCH term (α) and GARCH term (β). The market categorisation follows EMH's viz. strong, semi-strong, weak, and inefficient market.

The differences between the GARCH-M model from the other GARCH-family are the risk premium parameter, λ, and the standard deviation coefficient. A positive risk premium indicates that the return is proportional to its volatility. In other words, an increase in conditional variance as a proxy for greater risk causes an increase in mean return or performance. Furthermore, the higher the conditional variance of returns, the more massive the compensation required to persuade the agent to hold the long-term asset. Based on this theoretical premise, it is critical to identify two unambiguous common risks that determine the risk premium for sukuk with both market risk and information asymmetry risk. Also,

identifying sukuk risk premium will provide an opportunity for further development in the Islamic sukuk pricing criteria.

In establishing the relationship between risk and return for the GARCH-M model, λ was employed as the coefficient for estimating this relationship. The risk-return coefficient of the GARCH-M (1,1) model was positive and significant in the majority of the models (positive risk premium). If λ is positive or negative and statistically significant, an increased risk of an increase in conditional variance will rise or fall in the mean return. In this sense, λ can be said to be a time-varying risk premium. A statistically positive relationship indicates that investors are compensated for consuming greater risk. However, a negative relationship signifies an investor's reaction to factors other than the standard deviation of equities of their historical mean.

Figure 3 shows the graphs of the GARCH-M (1,1) model for Dow Jones Sukuk by different ratings (sukuk ratings; AAA, AA, A, and BBB). These graphs show similar trends with high volatility during the 2008 global financial crisis. Figure 3 shows the graphs of the GARCH-M model of Dow Jones Sukuk by different ratings.

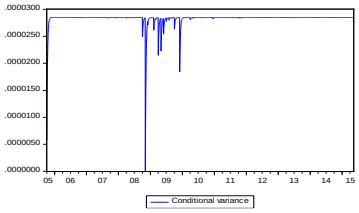
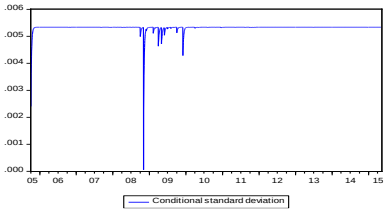
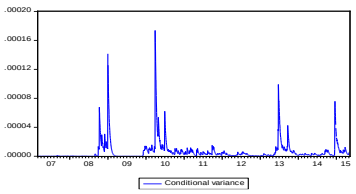
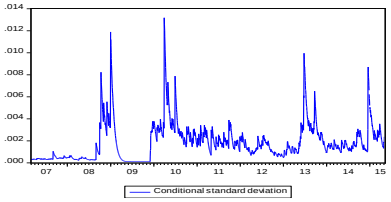
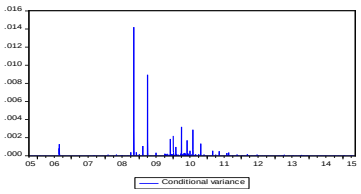
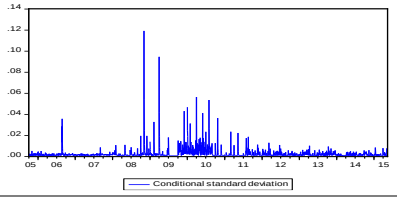
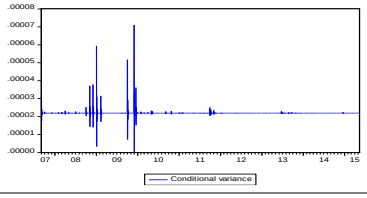
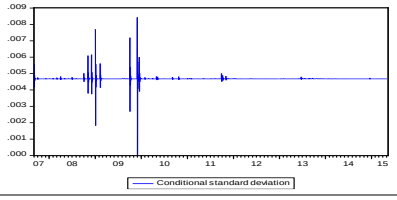
	Conditional Variance	Conditional Standard Deviation
DJSUK1AT (Dow Jones Sukuk A Rated Total Return)		
DJSUK2AT (Dow Jones Sukuk AA Rated Total Return)		
DJSUK3AT (Dow Jones Sukuk AAA Rated Total Return)		
DJSUK3BT (Dow Jones Sukuk BBB Rated Total Return)		

Figure 3: GARCH-M(1,1) Model of Dow Jones Sukuk Indices by Different Ratings
Source: Authors' calculation

Table 4
Summary of Results for GARCH-M (1,1) Model (Post-Crisis)

GARCH-M(1,1) Model for the Post-Crisis (2009-2015)							
Parameter	$\emptyset$ (Constant)	λ (Risk premium)	ω (Constant)	α (ARCH effect)	β (GARCH effect)	$\alpha + \beta$	Types of Sukuk Market Efficiency
DJSUK1AT	-0.0269 (-120.9437) ***	-0.0024 (-122.2579) ***	-0.0000 (70.2917) ***	2.4204 (59.8136) ***	-0.0331 (-79.31379) ***	2.3873	Inefficient market
DJSUK2AT	0.0000 (-0.6240)	**0.1859 (6.0950) *** **	-0.0000 (5.4551) ***	**0.1501 (43.7538) *** **	**0.8997 (806.2441) *** **	1.0500	**Inefficient market**
DJSUK3AT	0.0000 (-1.2053)	-0.1476 (-5.1435) ***	-0.0000 (15.2189) ***	3.5206 (26.5068) ***	0.1561 (6.8462) ***	3.6768	Inefficient market
DJSUK3BT	0.0013 (4.0014) ***	-0.3514 (-5.8096) ***	-0.0000 (28.6493) ***	0.0453 (8.1933) ***	0.9458 (340.2659) ***	0.9911	Weak-form

Note: ***, **, and * respectively represents significant at the 1%, 5% and 10%
*α and β are significant for DJSUK1AT, DJSUK2AT, DJSUK3AT and DJSUK3BT.
Source: Authors' calculation

Table 4 shows the results of the GARCH-M (1,1) model after the 2008 global crisis. These results show the differences and changes in sukuk indices after the crisis. There are three sukuk indices with an inefficient market, and only DJSUK3BT shows a weak-form of market efficiency. With this, the table records that only DJSUK2AT shows positive values and significance of risk premium. It supports the positive relationship between risk and return. Otherwise, the DJSUK1AT, DJSUK3AT, and DJSUK3BT show a significant negative result, which indicates as disapproving of higher risk theory with a higher return.

Higher volatility leads to significant variations of return, hence higher risk. In a positive risk-return relationship, if an investor is a risk lover, an increase in risk will increase return and demand for sukuk. For the summary, only sukuk indices with significant α, β and λ coefficients are considered. Positive and significant risk premium results (λ coefficient) indicate a positive relationship between risk and returns. In short, the higher the risk, the higher the returns. An inefficient market is when investors do not have enough information about the securities in that market to decide what to buy or how much the price to pay. For example, markets in developing nations may be inefficient because issuing firms may not be needed to report relevant details under securities laws. Also, few analysts that follow the securities are being traded there. Similarly, there can be inefficient markets for new companies, particularly those in new industries that are not widely analysed. An inefficient market is the opposite of an effective one where investors who want to use it have vast knowledge accessible.

Conclusion

Market efficiency means prices can vary between t and t +1 due to surprising news arrival. This means it is almost as likely to observe a rise or fall in prices today after price increases yesterday. It is difficult for the trader or investor to use the information on past

prices to predict future prices. According to Imafidon and Arowoshegbe (2015), if the markets are inefficient market, an investor will be better off trying to spot winners and losers in the market and correct the identification of miss-priced assets, which will enhance the overall performance of the portfolio. The capital market will be inefficient if the investor's trading strategy could beat the market.

In terms of an inefficient market, here is where investors may not have sufficient information on shares in that market to decide what to purchase or the price to pay. For example, markets in developing nations may be inefficient because issuing companies may not be needed to report relevant details under securities laws. Besides, few analysts that follow the securities are being traded there. Similarly, there can be inefficient markets for new companies, particularly for new companies in new industries that are not widely analysed. An inefficient market is the opposite of an effective one where vast knowledge is open for investors who want to use it.

For the post-2008 crisis period, all four indices were analysed. Further inspection of positive and significant risk premium (λ) results narrow the selection to only the DJSUK2AT index. The results can be summarized as follow:

Table 5
Summary of Results for GARCH-M (1,1) Model (Post-Crisis)

GARCH-M(1,1) Model for the Post-Crisis (2009-2015)						
Parameter	λ (Risk premium)	α (ARCH effect)	β (GARCH effect)	$\alpha + \beta$	ARCH term ($\boldsymbol{\alpha}$) + GARCH term ($\boldsymbol{\beta}$)	Types of Sukuk Market Efficiency
DJSUK1AT	**Negative & significant**	2.4204 (59.8136) ***	-0.0331 (-79.31379) ***	2.3873	$\alpha + \beta > 1$	Inefficient market
DJSUK2AT	**Positive & significant**	**0.1501 (43.7538) *** **	**0.8997 (806.2441) *** **	1.0500	$\alpha + \beta > 1$	**Inefficient market**
DJSUK3AT	**Negative & significant**	3.5206 (26.5068) ***	0.1561 (6.8462) ***	3.6768	$\alpha + \beta > 1$	Inefficient market
DJSUK3BT	**Negative & significant**	0.0453 (8.1933) ***	0.9458 (340.2659) ***	0.9911	$0.75 \geq \alpha + \beta < 1$	Weak-form

Note: ***, **, and * respectively represents significant at the 1%, 5% and 10%
*α and β are significant for DJSUK1AT, DJSUK2AT, DJSUK3AT and DJSUK3BT.
Source: Authors' calculation

A statistically positive risk premium (λ) indicates that investors are compensated for taking on more risk, and it supports the positive risk-return relationship.

This study's findings back up the Efficient Market Hypothesis' classification of different types of sukuk market efficiency. Markets follow the Random Walk theory during the sample period. Besides, identifying sukuk risk premium will provide an opportunity for further development in the Islamic sukuk pricing criteria. Hence, the study of sukuk market efficiency is significant to investors and issuers since the results can be used as indicators in identifying the best situation to invest in and issue the sukuk.

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