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UNDERSTANDING THE EFFICIENCY OF *SUKUK* INDICES: THE ROLE OF THE GARCH-IN-MEAN MODEL IN DIFFERENT *SUKUK* RATINGS

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ABSTRACT

Significant developments have occurred in the *sukuk* market in the Islamic capital markets. The deterioration of the economic situation during the 2008 global financial crisis affected the value of *sukuk* investment, particularly in the world's largest *sukuk* market, Malaysia. Following the 2008 crisis, the global decline in the issuance of *sukuk* has resulted in a 33 per cent decline in the total number of *sukuk*, creating a complex situation for *sukuk* investors, as *sukuk* are classified as risks and ultimately increase the number of *sukuk* that fail. The importance of the *sukuk* as the key capital market instrument of the Islamic Capital Market can be ascertained from this IIFM *Sukuk* report, where the global outstanding *Sukuk* in 2022 were USD 0.794 trillion or 24.43% of the total net worth of the industry. High volatility affects long-term effectiveness. The higher the volatility during the crisis (as a risk estimate), the greater is the likelihood of *Sukuk*'s default. This study examined the efficiency of the Ukrainian market using daily historical price data from 2006 to 2015 and extracted some of the UK indices of different ratings DJSUK3AT, DJSUK2AT, DJSUK1AT, and DJSUK3BT from the Bloomberg database (excluding Saturdays and Sundays). The research uses the GARCH-in-Mean (GARCH-M) model to identify the types of efficiency of the *sukuk* market. The highest quality and excellence ratings (AAAs) for DJSUK3AT and DJSUK2AT have been recognised as the best market indicators based on market efficiency analysis. Generally, the *sukuk* market is considered inefficient, which should raise concerns among investors and issuers. Therefore, the efficiency of the *sukuk* market research is essential, as it can serve as an indicator for determining the best situation for investing and issuing *sukuk*. The empirical contribution of the study highlights the importance of *sukuk* for encouraging investors to invest in *sukuk*, which ultimately leads to economic growth and investment.

KEYWORDS: SUKUK, EFFICIENCY, GARCH-IN-MEAN, SUKUK RATINGS, CRISIS

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ABSTRAK

Pasaran *sukuk* dalam pasaran modal Islam telah mengalami evolusi dan pembangunan yang ketara. Keadaan ekonomi yang merosot semasa krisis kewangan global 2008 telah menjejaskan nilai pelaburan *sukuk*, khususnya Malaysia sebagai pasaran *sukuk* terbesar dunia. Penurunan 33 peratus dalam jumlah terbitan *sukuk* global selepas krisis 2008 mendorong situasi yang rumit di kalangan pelabur *sukuk* kerana *sukuk* diklasifikasikan sebagai pelaburan berisiko dan akhirnya meningkatkan bilangan keingkaran *sukuk*. Kepentingan *sukuk* sebagai instrumen pasaran modal utama Pasaran Modal Islam boleh dipastikan daripada laporan *Sukuk* IIFM ini, yakni *Sukuk* terkumpul global pada 2022 ialah USD 0.794 trilion atau 24.43% daripada jumlah nilai bersih industri. Sememangnya, turun naik yang tinggi menjejaskan kecekapan jangka panjang. Semakin tinggi turun naik (sebagai proksi risiko) semasa krisis, semakin tinggi kebarangkalian *sukuk* mungkir. Kajian ini menilai kecekapan pasaran *sukuk* dalam tempoh sampel kajian adalah penting kerana turun naik akan memberi kesan kepada kecekapan pasaran jangka panjang. Menggunakan data sejarah harga Daily dari 2006 hingga 2015 untuk semua beberapa indeks *sukuk* mengikut penilaian berbeza iaitu (DJSUK3AT, DJSUK2AT, DJSUK1AT dan DJSUK3BT) yang telah dikumpulkan daripada pangkalan data Bloomberg (tidak termasuk Sabtu dan Ahad dikecualikan). Penyelidikan ini menggunakan model GARCH-in-Mean (GARCH-M) telah dilaksanakan untuk mengenal pasti jenis kecekapan dalam pasaran *sukuk*. Penarafan kualiti tertinggi (AAA) dan penarafan cemerlang (AA) *sukuk* (DJSUK3AT dan DJSUK2AT) direkodkan sebagai penunjuk pasaran utama terbaik berdasarkan analisis kecekapan pasaran. Secara keseluruhannya, pasaran *sukuk* dianggap sebagai pasaran yang tidak cekap. Oleh itu, kajian tentang kecekapan pasaran *sukuk* adalah penting kepada pelabur dan penerbit, kerana hasilnya boleh digunakan sebagai penunjuk untuk mengenal pasti situasi terbaik untuk melabur dan menerbitkan *sukuk*. Sumbangan empirikal kajian ini menonjolkan kepentingan *sukuk* untuk menggalakkan pelabur melabur dalam *sukuk* dan akhirnya meningkatkan pertumbuhan ekonomi dan pelaburan.

KATA KUNCI: SUKUK, KECEKAPAN, GARCH-IN-MEAN, PENARAFAN, KRISIS

1. INTRODUCTION

The 2008 global financial crisis was the first real test of *sukuk*. The crisis caused damage to the new *sukuk* market, and some problems fell to the lowest level during the crisis. Since 2009, however, the universe of *sukuk* investments has recovered strongly and fully. This shows the strength of the *sukuk* market performance. The Dow Jones *Sukuk* Index (DJSI) has recovered fully from its poor performance and crisis. As a result, volatility has declined considerably due to the higher creditworthiness of the investment universe. The quality of the performance of the *Sukk* index considers both the yield and the risk. The score's low volatility and high sharpness further increased high performance (Islamic Finance News, 2013; CIMB-Principal Islamic Asset Management Sdn Bhd., 2013). Volatility and price uncertainty, particularly regarding the returns on *sukuk*, significantly impact the financial sector's performance. During the 2007/08 global economic crisis, the return of the *sukuk* market fell from USD 46.65 billion in 2007 to USD 15.58 billion in 2008 (Muhammad *et al*., 2011). Following the global financial crisis of 2008, the total number of *sukuk* projects worldwide remained low, and the situation of *sukuk* investors became difficult (Rahim & Ahmad, 2016).

Sukuk defaults occur when *Sukuk* investors make poor investments. The study concerns the growing number of *sukuk* without insurance. The greater the crisis's volatility (risk estimation), the greater is the likelihood of a *sukuk* failure. In recent years, especially since the financial crisis affecting the world economy, the issue of *sukuk* default has attracted considerable attention. The study, which differs from previous research, focuses on the efficiency of different *sukuk* rating *sukuk* indices and uses the GARCH-in-mean method to measure the efficiency of the global financial crisis before, during and after 2007/2008.

This document is divided into seven sections. The first section is the introduction. The second section describes the literature review. The third section describes this theory. Section 4 deals with the data collection used in this study. Section 5 describes the methodology. Section 6 presents the results and empirical analysis. The results of this study are in section 7.

2. LITERATURE REVIEW

Origins of Sukuk

The word "*sukuk*" is a classic Arabic word, and the plural form of the word is "sakk". *Sakk* is a legal document or instrument representing obligations under Islamic law or "Sharia". A *sakk* (single to *sukuk* and means “deed” or “instrument”) was used to describe any document representing financial liability. Hilda & Azhar, 2010 From the Islamic point of view, the emergence of *Sukuk* is based appropriately on Hadith to explain the facts of this historical concept. Imam Malik's Al-Muwatta records a reference to the word *Sukuk*: "Yahya told me that Malik learned that *Sukuk* had been given to people during the time of Marwan ibn al-Hakam for the goods of the market of Al-Jar. People had bought and sold *Sukuk*s between them before the goods were delivered. Zayd bin Thabit and one of his companions, Rasulullah (saw), went to Marwan and said, "Marwan! What’s the right amount of currency? He said, "I am seeking refuge in Allah! What is that? He said, "It's a *sukuk* that people buy and sell until they deliver the goods." Consequently, Marwan sent guards to chase them, keep them away from the people, and return them to the owner (Bank Islam Malaysia Berhad, 2012; Shahida & Sapiyi, 2013).

Definitions of Sukuk

The Securities Commission of Malaysia (2019) defines *sukuk* as “an equal-value certificate that proves exclusive ownership or investment of property using *Shariah* principles and concepts approved by the *Shariah* Advisory Committee (SAC).” In addition, AAOIFI (2008) defines *sukuk* as “equal-value certificates representing unaffected interests in the ownership of the underlying assets (whether or not applicable), raw materials, services or investment, in particular, enterprises or certain special investments” (AAOIFI, 2008). According to IFSB, the *sukuk* refers to “a certificate that represents the proportional ownership of the holder on the entire portion of the underlying asset, in which the holder takes all rights and obligations to such asset”.

Consequently, *sukuk* (sometimes called 'Islamic bonds' because they are shares, mainly available for trading with easily rated securities) can be defined more specifically as 'Islamic investment trust certificates'. While bonds prove that the borrower has debts to the bondholders, *sukuk* certificates prove that the investor's share of a *sukuk* property, company, enterprise, or project gives them the right to share its profits.

Overview of the Sukuk Market

Short-term *Sukuk* issuance by jurisdictions in the Far East, the GCC, Africa, Asia, the IILM, Turkey, Bangladesh, etc., led to the growth of the short-term *Sukuk* market by 2022. Short-term issuance increased by 62.695 billion US dollars compared to 54.172 billion US dollars issued in 2021, resulting in an increase of 15.73 % in 2022. In the case of financial institutions and specific companies, the issuances were intended to support their liquidity management or financing requirements. In the first half of 2023, the *Sukuk* market seems stable or indicates moderate growth. However, global inflation pressure and rising benchmark interest rates will likely keep equities unchanged to moderate growth. Furthermore, the 2023 *Sukuk* issuance pipeline indicates a stable year for the *Sukuk* market (IIFM *Sukuk* Report, 2023).

The total global issuance (long-term and short-term) was USD 142,715 billion, confirming *Sukuk*'s dominant position as a critical financing instrument. As indicated in Figure 1 below, global *sukuk* issuance declined slightly in 2021 to about 2,96 % per year or 188.121 billion US dollars, compared to 18,715 billion US dollars in 2022. The volume of issuance in 2022 is mainly due to the sovereign issuance of *Sukuk* from Asia, the Group of Central Asian Countries, Africa and some other jurisdictions, while Malaysia continues to dominate the whole *Sukuk* market, while the issuance of

Saudi Arabia and Indonesia continues to increase and increase with good volumes. The *Sukuk* issued by other countries such as Bahrain and Turkey are also regularly issued.

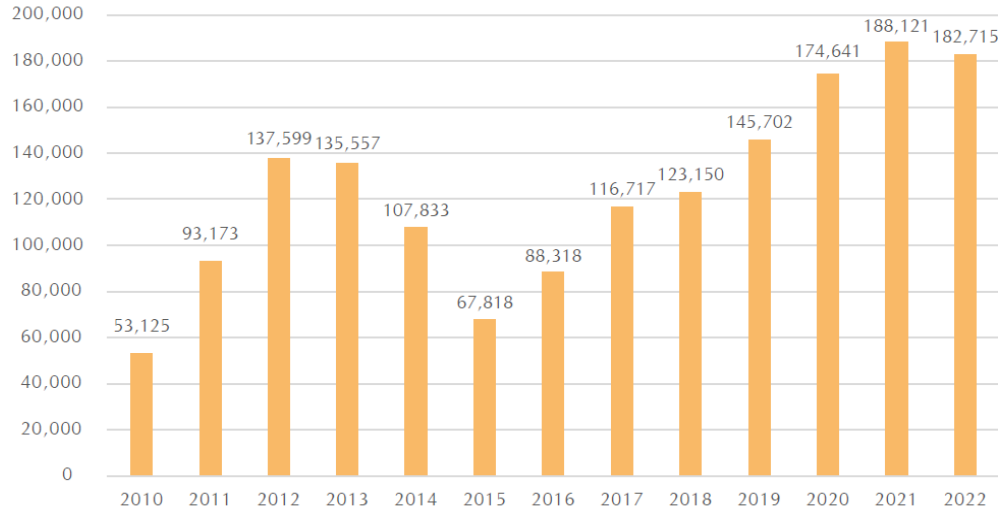


FIGURE 1: TOTAL GLOBAL *SUKUK* ISSUANCE USD 1.79 TRILLION (JAN 2001 - DEC 2022)
Source: IIFM *Sukuk* Database

According to the IIFM *Sukuk* Report (2023), the Malaysian Ringgit is the dominant currency as Malaysia has a deep local currency domestic market with the issuance of 47.00% (MYR 847.526 billion) since its inception. *Sukuk* issuance denominated in USD is 22.00% (USD 401.948 Billion) of the global *sukuk* market. It is promising to see that the *sukuk* have been issued in 27 different currencies, including USD, Malaysian Ringgit, Indonesian Rupiah, Saudi Rial, Turkish Lira, and Bahraini Dinar. Table 1 shows the regional break-up of global *sukuk* issuances for 2022 for all tenures and all currencies.

TABLE 1: REGIONAL BREAK-UP OF GLOBAL *SUKUK* ISSUANCES FOR THE YEAR 2022, ALL TENURES, ALL CURRENCIES

ASIA & FAR EAST	Number of Issues	Amount USD Millions	% of Total Value
Bangladesh	179	2,499	1.368%
Brunei Darussalam	59	1,544	0.845%
Indonesia	135	21,612	11.83%
Malaysia	775	67,264	36.81%
Pakistan	43	6,034	3.30%
Total	1,191	98,954	54.16%
GCC & MIDDLE EAST	Number of Issues	Amount USD Millions	% of Total Value
Bahrain	24	3,025	1.66%
Kuwait	1	500	0.27%
Qatar	6	6,318	3.46%
Saudi Arabia	48	42,643	23.34%
United Arab Emirates	6	3,500	1.92%
Total	85	55,986	30.64%
ASIA & FAR EAST	Number of Issues	Amount USD Millions	% of Total Value
Egypt	2	278	0.15%
Gambia	118	16	0.01%
Nigeria	4	369	0.20%
South Africa	2	35.34	0.21%
Senegal	3	561	0.31%
Tanzania	2	5	0.003%

Total	131	1,264	0.73%
EUROPE & OTHERS	Number of Issues	Amount USD Millions	% of Total Value
Turkiye	34	10,011	5.48%
Total	34	10,011	5.48%
SUPRANATIONAL	Number of Issues	Amount USD Millions	% of Total Value
Supranational	39	16,500	9.03%
Total	39	16,500	9.03%
GRAND TOTAL	1,480	182,715	100%

Source: IIFM *Sukuk* Database

Previous Studies on Market Efficiency

Numerous studies have focused on market efficiency. This researcher also studied other types of markets in countries without *sukuk*. These include foreign exchange market studies, exchange rates and stock markets. Market efficiency refers to how prices reflect all available and relevant information. If the market price of an investment represents its actual value, it is efficient. Evidence suggests that bonds and *sukuk* markets are more efficient than stock markets (Hossain *et al*., 2018). Kim and Lee (2008) investigated the one-month return of the United States Treasury Bill, NYSE, AMEX and NASDAQ with the asymmetric GARCH-M and Markov switching models. They found an increase in the surplus stock's value, and asymmetric volatility movements were weakened during the boom period. They also suggested that investors become more risk-averse during the growth period. Rahman, Omar, and Kassim (2013) explored the influential factors of *sukuk* spreads using the GARCH family. They found a negative correlation between changes in the *sukuk* spreads for long-term and short-term *sukuk* and interest rate variables. The factor representing the presence of the 2007/2008 crisis is insignificant in all cases, while stock market volatility is only significant on the lower grade of *sukuk* spreads.

Konak and Seker (2014) examined the evolution of the FTSE 100 and whether it maintained an efficient market hypothesis. According to their analysis, the FTSE 100 index followed random walking theories between 2001 and 2009 and maintained the weak form of EMH. Cicek (2014) tested the efficiency of weak and medium-sized Turkish exchange rates. The study tested weak form efficiency using unit root tests, which found that Turkish foreign exchange markets had weak form efficiency. However, the research found that the Turkish foreign exchange market did not confirm semi-strong efficiency. Using three bilateral exchange rates, Mabakeng and Sheefeni (2014) tested the weak efficiency of Namibia's foreign exchange markets. Their research uses ADF, PP, and KPSS unit root tests. They found that the past cannot be used to predict the current value, which made it effective in a weak form.

Hasan (2015) stated that the stock exchange in Dhaka is weak and inefficient, as historical stock prices cannot achieve superior gains. In addition, if there is a link between stock prices and economic variables, Bangladesh's stock market will lose its semi-powerful information efficiency and become more volatile. Charfeddine and Khediri (2016) also used the GARCH-M model and the Kalman filter, showing that the GCC market's efficiency rate varies over time. Furthermore, it demonstrates structural changes in all GCC markets. Meanwhile, they pointed out that recent financial investments, such as the Arab Spring and the low-quality loan crisis, have significantly impacted market efficiency evolution over time. Tuyon and Ahmad (2016) used Bursa Malaysia stock market data from 1977 to 2014 and used various stages and market countries. Efficiency tests show trends in the adaptive patterns of weak market efficiency at various economic stages and market conditions. Andrianto and Mirza (2016) pointed out that the Indonesian stock market could be classified as low efficiency. Statistics tests showed that daily stock prices are random, and no correlation exists between today's and the previous day's movements. However, Putra *et al.* (2016) found that the five foreign exchange markets within the country are efficient but inefficient. They concluded that investors in the five Asian markets could not make abnormal profits with the help of information from the foreign exchange market. The GARCH-M model and the Kalman filtering method used in the study of the Gulf Cooperation Council (GCC) markets show a different degree of efficiency in time. All GCC

markets also have evidence of structural breakdowns. For these markets, the financial shocks of the Arab Spring and the subprime crisis have changed the path to market efficiency (Charfeddin & Khediri, 2016).

Putra *et al.* (2016) found that the foreign exchange markets of five Asian countries were efficient within the country but inefficient between the countries. They concluded that investors in Asian markets five could not make abnormal returns using information in the foreign exchange markets of the countries. Afterwards, Ayodele and Maxwell (2017) studied semi-strong efficiency theory on Nigeria's stock markets. They used daily returns from the Nigerian stock market from 2005 to 2013. The sample consisted of 80 companies that maintained their quota status. The study found that the input index coefficient significantly differed from zero, indicating that investors based on published information outperform the market and render the market semi-strong inefficient.

Bhuiyan *et al.* (2018) examined whether the *sukuk* can benefit from global diversification. They used wave coherence and multivariate GARCH analysis to investigate the volatility and correlations of the indices of bond funds in emerging economies such as South Korea, Singapore, China, India, Indonesia and Malaysia with the Thomson Reuters BPA Malaysia *Sukuk* index. The *sukuk* market offers opportunities for portfolio diversification for fixed-income investors, as shown in the above examples. Investors worldwide can benefit from portfolio diversification by investing in *sukuk* markets, but international portfolio diversification is impossible. Bala and Takimoto (2017) used the multivariate GARCH model (MGARCH) and its variations to analyze stock volatility in emerging markets and developing markets (DMs), which influenced the volatility experience of stock markets during the 2007-2009 global financial crisis. The correlation of emerging markets (EMs) is lower than that of DMs and increases enormously during economic crises.

Sheikh *et al.* (2020) explored the possibility of volatile transmission between conventional and *Shariah* indices. They use the ARDL Co-Integration Model and the MGARCH Family Model, especially DCC and BEKK. The results clearly distinguish *Shariah* from traditional indices and provide opportunities for portfolio diversification. In addition, the ARDL model advocates weak index integration, particularly in the context of the financial crisis. Furthermore, the BEKK model predicts that volatility may spread relatively little during this period. Based on the present study, AIBIM's index operates in an inefficient market, while EX-MYR's and MFC*SUKUK*'s indices operate in an inefficient market after the 2008 financial crisis. Investors and speculators participate in high-value, high-risk ventures in an inefficient environment, leading to speculative bubbles. Speculators and traders tend to believe that they can accurately predict price fluctuations. However, speculators lose more often than gain (Ahmad *et al.*, 2020). Alam *et al.* (2021) justified the volatility of all business *sukuk* returns of different maturity. Smaller *sukuk* are found to have higher volatility than larger *sukuk*. Furthermore, negative news and events have a more significant impact on the volatility of the return of the *sukuk* than positive news. Abd Rahim and Ahmad (2023) reported that the GARCH-in-Mean (GARCH-M) model has been implemented to identify *sukuk* market efficiency types. Based on the market efficiency analysis, the highest quality rating (AAA) and excellent rating (AA) of *sukuk* (DJSUK3AT and DJSUK2AT) were recorded as the best leading market indicators.

3. THEORY

Efficient Market Hypothesis (EMH)

Market efficiency is the coherence of market prices, containing all available information. Therefore, arbitration is not necessary. In other words, the market is essential; there is no correlation between price gains, and investors cannot precisely determine how to sell and buy financial assets. Investors and decision-makers can change their predictions and quote anytime using the available information (so no decision is made). EMH helps solve the issue of individual price returns and simplifies financial mathematics. However, doctors know EMH is unrealistic (Amy-Drissa & Garcin, 2021). As proposed in the EMH hypothesis, current stock prices fully reflect information on company values. Information cannot be used for profit. Fama (1965) argued that competitiveness in an efficient market would result in a complete and rapid effect of the latest information on essential and fundamental

values in actual prices. Most investors are interested in detecting low-value securities with rising future value, which may outperform other securities. Most investors, including investment managers, believe they can choose products relevant to the market. Various forecasting and valuation techniques guide individual investment strategy decision-making. In the case of efficient markets, the efficient market hypothesis (EMH) says prices always entirely reflect the information available for their evaluation. Furthermore, the ability of a particular stock exchange to incorporate information into the price demonstrates its competence. EMH can be defined more accurately in information articles. From price information, Fama (1965) divided information elements into three levels based on their speed: weak EMH, semi-strong EMH, and strong EMH.

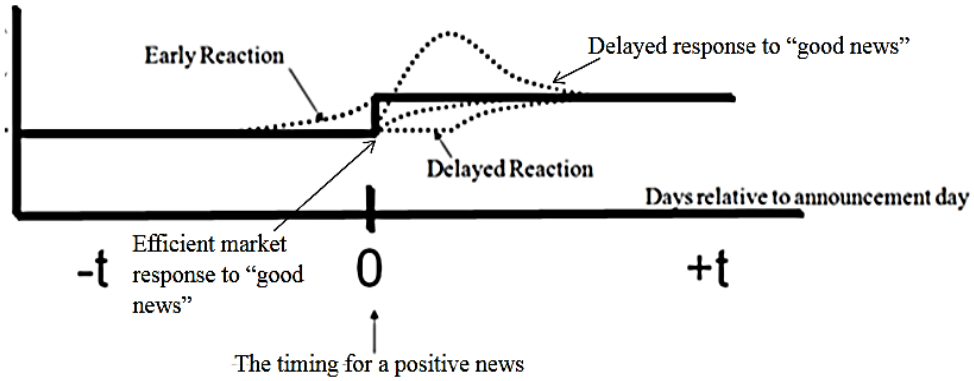


FIGURE 2: EFFICIENT MARKET HYPOTHESIS (EMH)
Source: Fama (1965)

i. *Weak-Form Market Efficiency*
Security prices represent all knowledge of the changes in the past market in a weak form. Therefore, investors cannot forecast the value of potential securities by assessing historical values and obtaining better results (returns) than stock market indices. This is because the capital market does not have a memory. After all, stock market indices have already absorbed historical information on the current stock price value. Stock markets are practised in their poor nature, but they sense the correlation between security prices over time. In the productive capital market, there is no significant correlation between security prices over time (Fama, 1965, 1970).

ii. *Semi-Strong-Form Market Efficiency*
The market is semi-significant if the defence price represents information found in the past price series and all information available to the public. This ensures the product is easily and unbiasedly applied to all public announcements in newspapers, business forecasters and annual accounts. Current security rates already limit some public-access information. For example, if a company raises its dividends, it can investigate how to adjust the share price of the company. Semi-strong efficient market theory suggests that share prices represent events and information quickly. Investors cannot overcome markets using such information (Fama 1965, 1970).

iii. *Strong-Form Market Efficiency*
Public and private knowledge is expressed in shares, and there is a powerful form of market efficiency. This methodology is the most detailed case, as private knowledge cannot be analyzed due to the difficulty of rigorous testing of the theory of valuable markets (Fama 1965, 1970). According to Fama (1998), market efficiency contributes to the persistence of long-term returns of the problem literature. In line with market efficiency theory, deviations are the product of chance, and an obvious overreaction to knowledge is the same as a reaction. The continuity of irregular return before the event is the same as the reversal after. Especially after market efficiency predictions, it is likely that apparent variations may be due to methods because most long-term return irregularities disappear with rational technological changes.

Capital Market Theory

Capital Market theory implies that security risks are the basis for expected returns. The current value of future cash flows, which include many elements such as volatility, liquidity and risk of bankruptcy, is indicated in the cost of security. The irregularity of new information is shared, assuming prices are changing. The cost is based on reasonable assumptions and is random and unpredictable. Dickman and Morse (1986) described the ideal capital market as an effective market where the prices of securities sold on the market fully reflect the currently available information and respond immediately in an impartial manner to new information. Such a definition includes vague, uncertain definitions such as "complete reflection", "available information", and "unbiased fashion". One solution to this uncertainty is associating the actual price behaviour with the price changes. The theory of capital markets is based on several hypotheses. It includes the fact that all investors are Markowitz's efficient investors, who prefer investments based on expected returns and risks. Perfect competition explains that all economic agents operate without market power over prices. Investors can borrow or lend any value at risk-free interest rates. All investors have similar expectations for returns. All investments are infinitely divisible. Finally, there are no transaction costs or taxes, no inflation, no changes in interest rates, and the capital markets are balanced.

4. DATA COLLECTION

The study used four *sukuk* indices to analyse four elements of the Dow Jones *Sukuk* Index. The Bloomberg database collects daily data on historical prices from 2005 to 2015 for all indices (excluding Saturdays and Sundays). Therefore, the four indices included in the sample have different start dates and many daily observations, as shown in Table 2.

TABLE 2: *SUKUK* INDICES

	List of *Sukuk* Indices	Launch date	N
1.	Dow Jones *Sukuk* AAA-rated total return index	28 April 2006	2,424
2.	Dow Jones *Sukuk* AA Rated Total Return Index	28 Feb. 2007	2,236
3.	Dow Jones *Sukuk* A Rated Total Return Index	28 April 2006	2,424
4.	Dow Jones *Sukuk* BBB Rated Total Return Index	31 Aug. 2007	2,104

Source: Authors' Collection

i. *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 AAA-rated US dollar-denominated *sukuk* screened for *Shariah* compliance (Bloomberg, 2018).

ii. *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 AA-rated, US dollar-denominated *sukuk* screened for *Shariah* compliance (Bloomberg, 2018).

iii. *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 *sukuk* in the US dollar, A-rated, which has been screened for *Shariah* compliance (Bloomberg, 2018).

iv. Dow Jones Sukuk BBB Rated Total Return Index (DJSUK3BT)

The BBB-rated Dow Jones *Sukuk* Total Return is designed to track the performance of global Islamic fixed-income securities, also known as *sukuk*. The index includes *sukuk* rated in US dollars, BBB-rated, and screened for *Shariah* compliance (Bloomberg, 2018).

5. METHODOLOGY

Based on selected *sukuk* indices, this study explores the types of *sukuk* market efficiency before, during and after the 2008 global financial crisis. The GARCH-in-Mean (GARCH-M) model is used to identify the types of market efficiency of *sukuk*. The Bloomberg database collects daily historical prices of the four *sukuk* indices above from 2005 to 2015. Generalised regressive conditional heteroscedasticity in the average model (GARCH-M (1,1) model) allows error term variation to vary over time, contrary to classical regression, which assumes constant variation. In addition, the GARCH-M model allows a market risk premium to be tested. The GARCH-M (1,1) model is described 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 the trade-off between volatility and return prevails. 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 volatility cluster, and the impact of volatility clustering will become more relevant (Eagle, Ito, and Lin, 1990).

Bollerslev, Chou and Kroner (1992) found that the volatility cluster indicates that the market has been volatile for one week or two before gradually calming down for several weeks. The estimation process is essential to identify the selected *sukuk* indices as a proxy for analysing the efficiency of the *sukuk* market. Overshooting can be interpreted as an abnormally high level of volatility. Table 3 shows the efficiency classification of the *sukuk* market:

TABLE 3: 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 before, during, and after the 2007/2008 global financial crisis to test the second hypothesis.

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

ii. Alternative Hypothesis (H_1):
The efficient market hypothesis (EMH) categorises different types of *Sukuk* market efficiency (inefficient, weak form, semi-strong form, and strong form). The market followed random walk theory before, during, and after the 2007/2008 global financial crisis.

H_{1a}: *Sukuk* indices show a weak-form efficient market before the crisis.
H_{1b}: The *Sukuk* indices show an inefficient market during the crisis.
H_{1c}: The *Sukuk* indices show a weak-form efficient market after the crisis.

6. RESULTS AND DISCUSSION

Descriptive Statistics

Table 4 shows basic descriptive statistics of the daily return of the four *sukuk* indices selected differently according to the rating. The highest of these four *sukuk* indices is DJSUK1AT,0.0843. All maximum returns are positive, and all minimum returns are negative. The statistics show that the average value of the sample is positive and active. Data are collected daily except Saturday and Sunday. Between 2005 and 2015, DJSUK1AT and DJSUK3AT collected the most significant observations, with 2,489 observations. The lowest number of observations was 1,993 (2007-2015).

TABLE 4: DESCRIPTIVE STATISTICS

Descriptive Statistics for Daily Market Returns of the 4 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

Results and Discussion

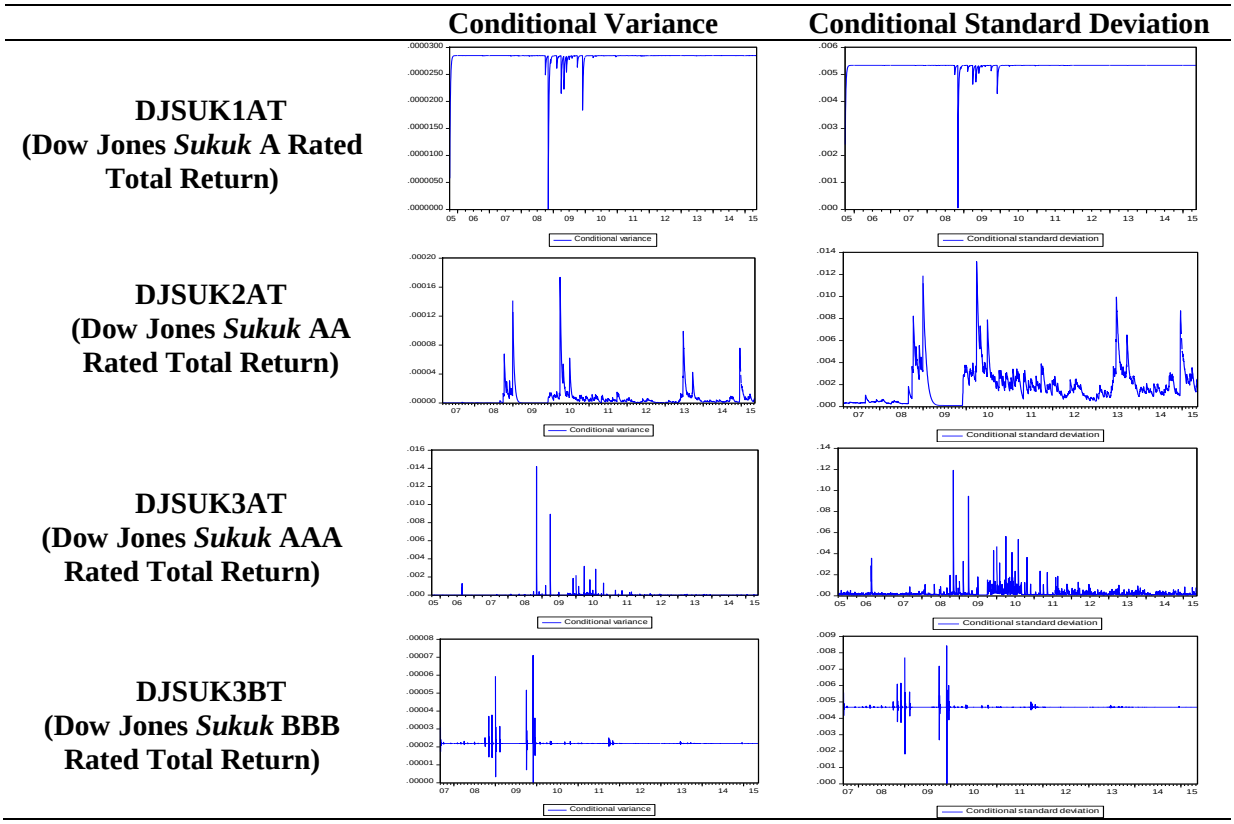
The study uses the *sukuk* index and the GARCH-M (1,1) model to study the efficiency of the *sukuk* market before, during and after the 2007/2008 global financial crisis. Market efficiency is classified according to the ARCH term (α) and the GARCH term (β). The market categorisation follows the definition of a strong, semi-strong, weak, and inefficient market by EMH.

The differences between the GARCH-M model and 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, increased conditional variation as a proxy for higher risk causes an increase in average return or performance. In addition, the higher the conditional variation of the returns, the greater the compensation needed to persuade the agent to retain the long-term assets. Based on this theoretical assumption, it is crucial to identify two clear common risks that determine *sukuk* risk premiums in markets and information asymmetries. Furthermore, identifying risk premiums for *sukuk* will enable the further development of Islamic *sukuk* price criteria.

When establishing the relationship between risk and return for the GARCH-M model, λ was used as the coefficient to estimate this relationship. The risk-return coefficient of the GARCH-M (1,1) model was positive and significant in most models (positive risk premium). If λ is positive or negative and statistically significant, an increased risk of an increase in conditional variance will increase or fall in mean return. In this sense, λ can be said to be a time-varying risk premium. The statistically positive relationship shows that investors are compensated for more risk. However, negative relationships mean investors' reactions to factors other than the difference in stock prices from their historical average.

Figure 3 shows the graphs of the GARCH-M (1,1) model for Dow Jones *Sukuk* indices 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: GARCH-M(1,1) MODEL OF DOW JONES *SUKUK* INDICES BY DIFFERENT RATINGS



Source: Authors' Calculation

TABLE 5: SUMMARY OF RESULTS FOR GARCH-M (1,1) MODEL (PRE-CRISIS)

GARCH-M (1,1) Model of the Pre-Crisis (2005-2006)							
Parameter	**∅ (Constant)**	**λ (Risk premium)**	**ω (Constant)**	**α (ARCH effect)**	**β (GARCH effect)**	**$\alpha + \beta$**	**Types of *Sukuk* Market Efficiency**
DJSUK1AT	0.0002 (2.6078)***	-57.4564 (-0.2951)	-0.0000 (1.1593)	-0.0091 (-5.0549) ***	0.5621 (1.4742)	0.5530	Semi-strong form
DJSUK3AT	-0.0001 (-12.7458) ***	**410.0453 (20.0577)*** **	-0.0000 (39.7866)***	**0.2385 (20.6013) *** **	**-0.9639 (-76.4111) *** **	-0.7254	**Inefficient Market**

Note: ***, **, and *, respectively, represent significant at 1%, 5%, and 10%
Note: DJSUK2AT and DJSUK3BT have yet to be launched before the crisis.
Source: Authors' Calculation

Table 5 summarises the results for the GARCH-M model of the pre-crisis, 2005 until 2006. The results in Table 5 recorded that the DJSUK3AT shows an inefficient market during the pre-crisis, with the $\alpha+\beta>1$. The efficient market hypothesis (EMH) explains that an inefficient market means a market in which prices inadequately reflect the available information (Fama, 1965, 1970). The sum of $\alpha + \beta$ for DJSUK3AT is negative, indicating an inefficient market. The risk-return coefficient in the GARCH-M (1, 1) model shows that only one of the two models has a positive and significant risk premium (λ), which is DJSUK3AT, 410.0453, significant at the 0.01 level. This result supports the positive relationship between risk and return. The result also supports the principle in a financial market, where high risk suggests higher returns. A positive relationship between risk and return means investors require higher returns for holding risky assets.

TABLE 6: SUMMARY OF RESULTS FOR THE GARCH M (1, 1) MODEL (DURING THE CRISIS)

GARCH-M(1,1) Model for the During-Crisis (2007-2008)							
Parameter	**$\emptyset$ (Constant)**	**λ (Risk premium)**	**ω (Constant)**	**α (ARCH effect)**	**β (GARCH effect)**	**$\alpha + \beta$**	**Types of *Sukuk* Market Efficiency**
DJSUK1AT	-0.0004 (-0.0314)	-0.4102 (-0.0020)	-0.0000 (0.6846)	-0.0023 (-3.0957) ***	0.6266 (1.1492)	0.6243	Semi-strong form
DJSUK2AT	0.0002 (8.9071)***	-8.6875 (-0.5294)	-0.0000 (0.5610)	**0.0481 (29.2736) *** **	**0.9892 (1,492.9400) *** **	1.0373	**Inefficient Market**
DJSUK3AT	0.0006	-107.5094	-0.0000	0.1500	0.6000	0.75	Weak Form
DJSUK3BT	-0.000296 (-0.0919)	-10.9967 (-0.1696)	-0.0000 (1.1958)	-0.0186 (-13.5949) ***	0.5807 (1.6565)	0.5621	Semi-strong form

Note: ***, **, and *, respectively, represent significant at 1%, 5%, and 10%
Source: Authors' Calculation

Table 6 shows that there is only DJSUK2AT with significance α and β, which explains the inefficient markets during the crisis that follows α+β>1. DJSUK2AT shows α+β = 1.0373. Meanwhile, DJSUK3AT shows a weak form of efficiency during the crisis. DJSUK3AT records positive value of α and β, but insignificant results. These results indicate that these *sukuk* indices were affected by the 2008 global financial crisis since market efficiency changed when the crisis occurred. In contrast to DJSUK3AT, it is changed from an inefficient market before the crisis to weak-form efficiency during the crisis. DJSUK1AT and DJSUK3BT show semi-strong form efficiency during the crisis. DJSUK1AT remained stable with semi-strong form efficiency and did not change during the crisis. However, only DJSUK2AT recorded significant results during the crisis.

TABLE 7: SUMMARY OF RESULTS FOR GARCH-M (1, 1) MODEL (POST-CRISIS)

GARCH-M(1,1) Model for 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, represent significant at 1%, 5%, and 10%
*α and β are significant for DJSUK1AT, DJSUK2AT, DJSUK3AT and DJSUK3BT.
Source: Authors' Calculation

Table 7 shows the results of the 2008 global crisis and the results of the GARCH-M (1,1) model. These results show differences and changes in the *sukuk* index after the crisis. There are three *sukuk* indices that are inefficient in the market, and only DJSUK3BT shows a weak form of market efficiency. Therefore, the table only records DJSUK2AT and shows the positive value and significance of the risk premium. It supports the positive relationship between risk and return. In other words, DJSUK1AT, DJSUK3AT, and DJSUK3BT show significant negative results, indicating that they disagree with the risk theory, which states that the higher the risk, the higher the return.

Higher volatility leads to significant variations in return, hence higher risk. In a positive risk-return relationship, if an investor is a risk lover, an increase in risk will increase the return and demand for *sukuk*. In summary, only *sukuk* indices with significant α, β and λ coefficients are considered. The positive results of the essential risk premium results (λ coefficient) indicate a positive relationship between risk and returns. In short, the higher the risk, the higher the return. An inefficient market occurs when investors lack sufficient information on the securities in these markets to decide what to buy or how much to pay. For example, developing market economies may be inefficient because providing the appropriate details to the issuing company under securities law is unnecessary.

7. CONCLUSION

Before the 2008 crisis, only the DJSUK3AT index has a positive and significant risk premium (λ), thus supporting the conjecture of high-risk-high-return. DJSUK3AT records the significance of α, β and λ coefficients. This index shows an inefficient market before the 2007/2008 global financial crisis. DJSUK3AT is a *sukuk* index with AAA ratings, the best *sukuk* rating compared to AA, A and BBB *sukuk* ratings. However, the best rating of the *sukuk* index shows an inefficient market and does not reflect any public or private information.

Due to surprising news, market efficiency means prices vary between t and t+1. This means today's prices are almost as likely to rise or fall as yesterday's. It is difficult for traders or investors to use past price information to predict future prices. However, in this case, DJSUK3AT records inefficient markets and does not reflect any information. After yesterday's price rise, investors do not need to watch price rises or declines today. In other words, previous data cannot be used to predict future prices. If markets are inefficient, investors will try to identify winners and losers in markets and correct the assessment of assets at high prices, improving portfolio performance. Capital markets will be inefficient if investor trading strategies can beat the market. DJSUK3AT's emerging markets are intuitively the most inefficient in the history of high transaction costs and economic turmoil.

In the crisis periods of the 2007-2008 records, only DJSUK2AT reported significant (α+β) coefficients. It is inefficient but does not show a substantial risk premium (λ) result. This implies that higher risk will not promise higher returns during the crisis. As a result, many risk-averse investors avoid investing their money in a high-risk investment during the crisis. For the post-2008 crisis period, all four *sukuk* indices were analysed. Further inspection of the positive and significant risk premium (λ) results narrows the selection to only the DJSUK2AT index. A statistically positive risk premium (λ) indicates that investors are compensated for taking on more risk and supports the positive risk-return relationship. The findings support the Efficient Market Hypothesis' classification of different types of *sukuk* market efficiency. During the sample period, the markets followed the Random Walk theory. Furthermore, identifying the *sukuk* risk premium will allow further development of the Islamic *sukuk* pricing criteria.

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