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Forecasting Volatility Using Bootstrap MCEWMA Following Sukuk Ijarah Issuances

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Abstract: The aim of this study is to estimate Sukuk volatility using volatility forecasting model which is: Moving Centerline Exponential Weighted Moving Average (MCEWMA) for the period between 2008 and 2011. This research also aims to estimate the best method to find out the Sukuk volatility by Sukuk Ijarah structure for the period between 2008 and 2011. It is also important to examine the best performance between the real model of MCEWMA and the hybrid model of Bootstrap MCEWMA (BMCEWMA). This study focuses on FTSE Bursa Malaysia Emas Shari'ah Index (FBM EMAS) and FTSE Bursa Malaysia Hijrah Shari'ah Index (FBM Hijrah). The sources of data come from data stream, bloomberg database, securities commission Malaysia and Bursa Malaysia. The results show the hybrid model of Bootstrap MCEWMA is better than the real Model. It concludes that the application of BMCEWMA is better than MCEWMA. The researcher advices policy makers to guide regulators, investors and issuers to the best Sukuk that remained stable during a crisis. This analysis will provide valuable information and guidelines to issuers, policy makers, regulatory bodies and investors to Islamic bonds.

Key words: Sukuk, volatility, bootstrap, Shari'ah indexes, MCEWMA

INTRODUCTION

Volatility is an important parameter for financial risk management. The forecasting of volatility or variance can be regarded as a problem of financial modeling. The main objective of this study is to measure the market volatility following the issuances of Ijarah Sukuk in Malaysia. It is also important to provide a measure that can be used in managing financial risks. Returns of Sukuk can be statistically viewed by its volatility. This study uses volatility model, namely Moving Centerline Exponentially Weighted Moving Average (MCEWMA) that has been introduced by Efron (2003). However, Safiih and Hila (2014) reported that errors for in-control and out-of-control observation, specifically MCEWMA gave an inaccurate estimation where the chart shown a non-accuracy or invalidity of monitoring the change of volatility point of securities. Thus, this study constructs a new chart which is the bootstrap approach of MCEWMA (BMCEWMA) to get more robust results to forecast volatility on Shari'ah indexes following Ijarah issuances in Malaysia. This hybrid approach has to be used on the real chart MCEWMA to reduce the inherent error. By decreasing error value, the estimation of the base model and control chart is said to be more accurate.

The main contribution of this study is to give an analysis of market volatility following Sukuk Ijarah structure to contribute valuable information and guidelines to issuers, policy makers, regulatory bodies and investors to Islamic bonds. This study adds to the literature, since empirical work on the information content of Ijarah issues is relatively few.

Literature review

Definitions of Sukuk: Sukuk is an Arabic name for financial certificates which in economic terms are akin to conventional bonds. Unlike conventional bonds, Sukuk need to have an underlying tangible asset transaction either in ownership or in a master lease agreement. It represents ownership of underlying assets, usufructs (benefits), services or investment. The money that a Sukuk holder gets represents a share in the profit of the underlying asset. The SCM (2011) defines Sukuk as a financial document or certificate which represents the value of an asset evidencing an undivided pro rata ownership of an underlying asset. Islamic securities are securities issued pursuant to any Shari'ah principles and concepts approved by the SC's Shari'ah Advisory Council (SAC).

The Malaysian Debt. Securities Sukuk in 2009 reports that Islamic securities are securities issued pursuant to any Shari'ah principles and concepts approved by the SC's Shari'ah Advisory Council (SAC). The approved

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Shari'ah concepts and principles for the purpose of structuring, documenting and trading of Islamic securities are:

Musyarakah (profit and loss-sharing): This is a partnership arrangement between two parties or more to finance a business venture where all parties contribute capital either in the form of cash or in kind for the purpose of financing the business venture. Any profit derived from the venture will be distributed based on a pre-agreed profit-sharing ratio but a loss will be shared on the basis of equity participation.

Mudharabah (profit-sharing): Mudharabah is a special kind of partnership where one partner gives money to another for investing in a commercial enterprise. The parties are a rabb al-mal or investor who solely provides the capital and a mudharib or entrepreneur who solely manages the project. If the venture is profitable, the profit will be distributed based on a pre-agreed ratio. In the event of a business loss, the loss is borne solely by the provider of the capital.

Ijarah (leasing): This is a manfaah (usufruct) type of contract where a lessor (owner) leases out an asset or equipment to its client at an agreed rental fee and pre-determined lease period upon the aqad (contract). The ownership of the leased equipment remains in the hands of the lessor.

Bai' Bithaman Ajil or BBA (deferred-payment sale): This contract refers to the sale and purchase transaction for the financing of an asset on a deferred and instalment basis with a pre-agreed payment period. The sale price will include a profit margin.

Istisna' (purchase order): This is a purchase contract for an asset where a buyer will place an order to purchase the asset that will be delivered in the future. In other words, the buyer will require a seller or a contractor to deliver or construct the asset that will be completed in the future, according to the specifications in the sale and purchase contract. Both parties in the contract will decide on the sale and purchase prices as they wish and settlement can be delayed or arranged based on the schedule of work completed.

Murabahah (cost-plus sale): This contract refers to the sale and purchase transaction for the financing of an asset where the cost and profit margin (mark-up) are made known and agreed to by all parties involved. The settlement of the purchase price can be either on a deferred lump-sum basis or an instalment basis which will be specified in the agreement.

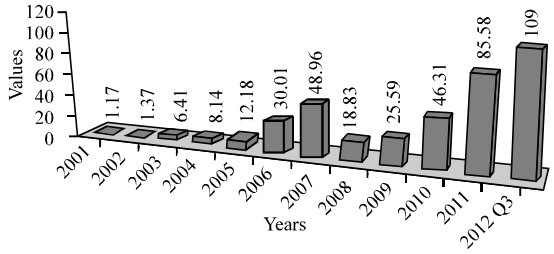

Fig. 1: Evolution of Sukuk global issues between 2001 and 2012 in billion ($); Zawya (2014)

This study only focuses on the Sukuk Ijarah structure as the highest number of Sukuk issuance in Malaysia nowadays. Malaysia is the largest Sukuk market in the world by 68.3%, the highest percentage among other countries.

Sukuk development in Malaysia: Recently, there has been an increase in the issuance of Islamic capital market securities (Sukuk) by corporate and public sector entities amidst growing demand for alternative investments. Although, the size of the market is modestly by global standards, the Sukuk market is experiencing remarkable growth, increasing at an average rate of growth of 40% per annum (Saad and Mohamad, 2012). The Sukuk market is the fastest growing and a promising segment of Islamic finance. Indeed, the issuance of Sukuk is increasing considerably worldwide, especially in Malaysia, United Arab Emirates (UAE) and Saudi Arabia. The global value of Sukuk issues exceeds 109 billion dollars in 2012. Figure 1 shows the evolution of Sukuk global issues between 2001 and 2012. There was an increasing trend of Sukuk issuance from 2009 onwards.

The Malaysian capital market has significant growth prospects. The Securities Commission (SC) Malaysia estimates the size of Malaysia's Capital Market that comprises stock market capitalization and debt securities to more than double from RM2.0 trillion in 2010 to RM4.5 trillion by 2020. Further, analysis indicates there are strong upside prospects for the Malaysian Capital Market. It is estimated that the internationalization of the stock market can increase the potential size of the Malaysian capital market by another 30% to RM 5.8 trillion in 2020 based on benchmarks for regional financial centers. The most important effect of achieving critical mass is the facilitation of volume strategies and higher efficiency of increased economies of scale (ADB, 2011).

Sukuk contribute ~90% to the Islamic Capital Market. The Malaysian Sukuk Market took off in 1990 when the world's first Sukuk was issued by a non-Islamic

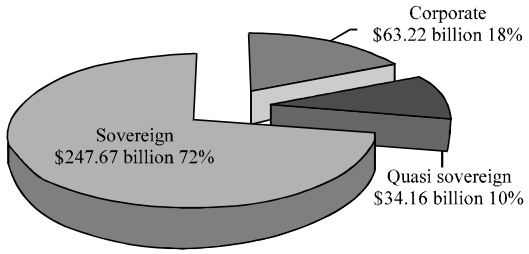

Fig. 2: Global Sukuk issued by issuer types (Jan. 2010 to Sep. 2013); Zawya (2014)

corporation, Shell MDS, RM 125 million of al-Bai' Bithaman Ajil. The market faced a liquidity crunch not only from the global financial crisis and the debate on the compliance of some of the Sukuk structures with Islamic Law. Despite the challenging market environment, Malaysia continued to be the top world issuer. Figure 2 shows the global Sukuk issued by issuer types from January 2010 to September 2013.

Sovereign and quasi-sovereign issuers from Malaysia, Indonesia and Pakistan maintained high issuance volumes mostly in their domestic markets. However, despite the growth in the number of Sukuk issuances, there is a slight drop in value issued due to Malaysia's larger than normal issuances last year. For the first 9 months of 2013, around 70% of Sukuk issued were from government institutions compared to 65% in 2012 while power and utilities beat the financial sector with 9.2% compared to 3.7% last year. Financial sector issuance dropped to 9% compared to 12% last year and the transport sector also plunged to 2.3% from 11.2%, mostly due to unfavorable market conditions (Zawya, 2014).

Despite the significant drop in Sukuk volume in Malaysia in 2013, the country still dominates value and volume of Sukuk globally. Malaysia issued USD 54.33 billion Sukuk in the first 9 months of 2013, followed by Saudi Arabia (USD 8.69 billion), UAE (USD 5.17 billion) and Indonesia (USD 5.03 billion). Malaysia stood out in terms of domestic market issuance in Asia, followed by Indonesia. Pakistan also suffered from a significant drop in Sukuk volume compared to last year. Table 1 shows the global aggregate Sukuk issued a breakdown by country from January 1996 to September 2013.

Forecasting volatility: There have been a lot of empirical studies to test volatility in the stock markets globally. Recently, the global Sukuk market and the mainstream fixed income markets are affected and have caused dislocation by the global market sentiment and volatility. Research has proved that stock markets have become more volatile in the recent times due to the emergence of "New economy" stocks which are valued highly as compared to their "Old economy" counterparts on the expectations of giving very high returns in the future. Nevertheless, Sukuk is better insulated compared to its conventional benchmarks due to its defensive nature and buy-and-hold investor base. However, the high volatility caused Sukuk investors not investing in Sukuk although, they are still interested to invest. There are only the risk-averse investors will invest in the Malaysian stocks because of its relatively low volatility and slower mean-reversion process (Saiti, 2013).

Table 1: Global aggregate Sukuk issued by country (Jan. 1996 to Sep. 2013)

Countries	No. of issues	Amount issued ($ million)
Malaysia	2438	324,576.9
UAE	73	47,876.4
Saudi Arabia	64	39,296.0
Indonesia	216	19,924.1
Qatar	19	19,245.6
Bahrain	273	13,918.5
Pakistan	57	6,348.9
Turkey	9	5,469.7
Brunei Darussalam	95	4,980.7
Kuwait	22	2,992.4
Singapore	9	984.2
United States	3	765.7
United Kingdom	5	279.1
China	3	274.7
Yemen	2	251.5
Sudan	3	220.9
Germany	2	190.9
Gambia	242	149.2
Iran	4	132.8
Jordan	1	120.3
Japan	1	100.0
Kazakhstan	1	73.3
France	1	0.7
Grand total	3,543	488,172.0

Zawya (2014)

Guo (2012) defines the volatility is an important parameter for financial risk management. He compares the result of mean square error get to know the GARCH Model is better than EWMA Model in both the case of Petro China and TCL. Volatility is the degree to which asset prices tend to fluctuate. It is the variability or randomness of asset prices such as the dispersion of returns of an asset from its mean return. Stock market volatility measures the size and frequency of fluctuations in a broad stock market price index (Karmakar, 2006).

Volatility plays a very important role in any financial market around the world. The volatility is a statistical measure of the deviation or dispersion of returns for a given share or market index. Its value can be estimated by using some deviation measure like mean of differences, variance or standard deviation between returns from that same share or market index. Accurate forecasting of volatility is essential for asset and derivative pricing models and other financial applications. The goal of any

volatility model is to be able to forecast volatility (Minkah, 2007). Risk is commonly associated with volatility. As the volatility of a financial instrument goes higher, the same happens to its risk (Tan *et al*., 2011). Thapar (2006) explained that as the evidence from the heavy tails and non-negligible probability of occurrence of extreme values, the extreme returns show high variability. The implication of volatility clustering is that the volatility shocks today influences the expectation of the volatilities of many future periods ahead.

The three main purposes of forecasting volatility are for risk management for asset allocation and for taking bets on future volatility. In order to forecast volatility in the stock market, the time series has been used to estimate volatility. There are few literature reviews showed the outcome of Generalized Autoregressive Conditional Heteroskedasticity (GARCH) provides a more accurate analysis than EWMA (Korkmaz and Aydin, 1999). The nonparametric procedures include ARCH filters and smoothers designed to measure the volatility over infinitesimally short horizons (Andersen *et al*., 2002). The recently-popularized realized volatility measures for (non-trivial) fixed-length time intervals. Galdi and Pereira (2007) explore three models to estimate volatility: EWMA, GARCH and Stochastic Volatility (SV). The results suggest that Value at Risk (VaR) calculated considering EWMA was less violated than when considering SV and GARCH for a 1500 observation window.

Safiih and Hila (2014) showed the base model used to estimate the investment volatility which is they used volatility of Sukuk Musyarakah is more accurate using the Hybrid Bootstrap Model. Their results indirectly suggest that hybrid chart is more effective and provide better performance than the real chart MCEWMA. Paul said that bootstrapping is another way to do simulations where he construct artificial samples by sampling of the actual data. The advantage of the bootstrap is then that it does not have to try to estimate the process of the errors and regressors. The real benefit of this is that he does not have to make any strong assumption about the distribution of the errors. This study will focus on the bootstrapping of MCEWMA.

MATERIALS AND METHODS

Data: This study employs a considered to monitor individual observations of each firm that issue Sukuk around the event date for the selected Sukuk issues. Sukuk issuance data in Malaysia are obtained from the Bloomberg database, the Securities Commission of Malaysia, Bursa Malaysia and Zawya Sukuk. The sample period between 2008 and 2011 contains 189 events of Ijarah issuances for the period between 2008 and 2011. The Sukuk data that are collected in this study are the listed companies that issue Sukuk in Malaysia. Daily data on closing prices from FTSE Hijrah Shari'ah and FTSE Emas Shari'ah index. These indexes are Islamic indexes in Malaysia.

Real MCEWMA Model: In this study, a mean process is considered to monitor individual observations with the assumption of dependent and in correlated distributed. Thus, the base model and residual of MCEWMA can be given by:

$$W_i = \lambda x_i + (1-\lambda) W_{i-1} \tag{1}$$

With:

$$e_i = x_i - W_{i-1} i = 1,2,\ldots\ldots,m \tag{2}$$

where, $W_i = x_0$ and $x_i.x_i$ refers to the ith observation data. While λ (0, 1) and in this study, an alternative method of calculating the value of λ is used and is known as optimization the λ. By using the base model (Eq. 1) as the center line, the control limits for the prediction of one-step-ahead can be given by:

$$CL_{x_{i+1}} = W_i \pm L_e \sigma_e \tag{3}$$

where, L_e known by the parameter of control limit and the selection of the value of L_e is totally depends on the λ value.

Bootstrapping the base model of MCEWMA: In this study, the hybridization of bootstrap approach in base model (Eq. 1) is centered around the method of sampling with replacement using residual (Eq. 2). This hybridization produced a hybrid control chart where the basic model named by Bootstrap MCEWMA (BMCEWMA). This study focuses to examine the performance of whole chart BMCEWMA in terms of effectiveness and efficiency control chart for in-control process. This estimation is selected to be used in this study which is the numerical estimation. Basically, it uses to examine effectiveness of base model where is evident in two kinds of methods which are confidence interval and error estimation. By considering three types of interval method, namely student's t-confidence interval, Bootstrap Percentile (BP) and Biased Corrected and Accelerate (BCa).

The BP and Bca selection are motivated by the advantages of these two methods in which BP is the basic method for estimating bootstrap intervals while BCa is a method that can improve BP interval estimation. The main reason for selecting different methods is to find the

differences in the effectiveness of the hybrid model when using those interval methods. In theory, a model that gives the shortest interval estimation is said to be a more effective model. This is because short interval giving the idea that model estimation is closer to real interval estimation. Therefore, the lower and upper limit $\left[\hat{\theta}_{\downarrow}B \times \hat{\theta}_{\downarrow}A\right]$ can be given by:

$$\text{Student's-t confidence interval} = \left| \begin{matrix} \hat{\theta} - t^{\alpha}_{n-1} \times \\ \hat{R}P,\ \hat{\theta} + t^{\alpha}_{n-1} \times \hat{R}P \end{matrix} \right| \quad (4)$$

$$\text{Bootstrap Persentile (BP)} = \left| \hat{\theta}^{50}, \hat{\theta}^{950} \right| \quad (5)$$

$$\text{Bias Corrected and accelerated (BCa)} = \left| \hat{\theta}^{\alpha_1}, \hat{\theta}^{\alpha_2} \right| \quad (6)$$

where, t^{α}_{n-1} in Eq. 4 represent a value of percentage αth for student's t distribution with n-1 degree of freedom. In this study, α is valued at α = 0.05 and standard error estimation, $\hat{R}P$ can be calculated using the discussion in (Efron, 2003). From Eq. 5, the length of this interval based on percentile on mean estimation of bootstrap replicates, B on 100^{α}th where α = 0.05 and 1-α = 0.95. In other word, upper and lower limit of BP refers to the interval lengthen from 50th trough 950th replication. While α_1 and α_2 in Eq. 6 refers to normal confidence interval with $\alpha_i = \alpha$ and α_2 = 1-α, respectively.

Moreover for error estimation, this study will use Mean Square Error (MSE) and Root Mean Square Error (RMSE). In theory, a model that gives the smallest estimated value is said to be more efficient and automatically show the effectiveness of the model itself. By taking the idea of small errors in the base model, it clearly shows that the model gives a more accurate estimation. Thus, error estimation is used in this study can be given by:

$$\text{MSE} = \frac{\Sigma_{i=1}^{N}\left[e_i^B - E\left(e^B\right)\right]^2}{N}, \qquad \text{RMSE} = \sqrt{\frac{\Sigma_{i=1}^{N}\left[e_i^B - E\left(e^B\right)\right]^2}{N}} \quad (7)$$

where for both MSE and RMSE refers to differences of real error, e_i^B with expected of error estimation, E (e^{i}B).

RESULTS AND DISCUSSION

This study compares the performance of the real model (MCEWMA) and the hybrid model (BMCEWMA) in term of effectiveness or efficiency base model estimation. Both real and hybrid models are applied on daily returns information of Sukuk Ijarah issuances between 2008 and 2011. This study sets the value of λ = 0.94 is used in both the real and hybrid model. The objective of this study applying the hybrid chart to Sukuk Ijarah data is to see the effectiveness of base model estimation which is basically used for estimating the of investment. There is also important to look at the effectiveness of hybrid charts. Figure 3 and 4 show the results of volatility (MCEWMA) following Sukuk Ijarah issuances on different Shari'ah indexes.

Figure 3 and 4 show these both indexes give the same trend of market volatility following Sukuk Ijarah issuances

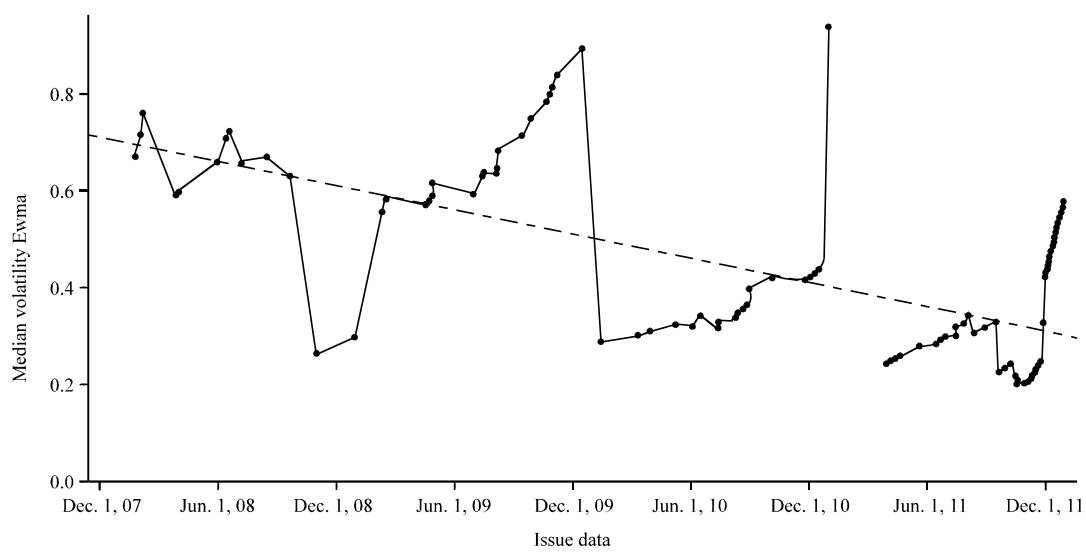

Fig. 3: Forecasting volatility (MCEWMA) following Ijarah issuances (2008-2011). FTSE Emas Shari'ah index; researchers calculation

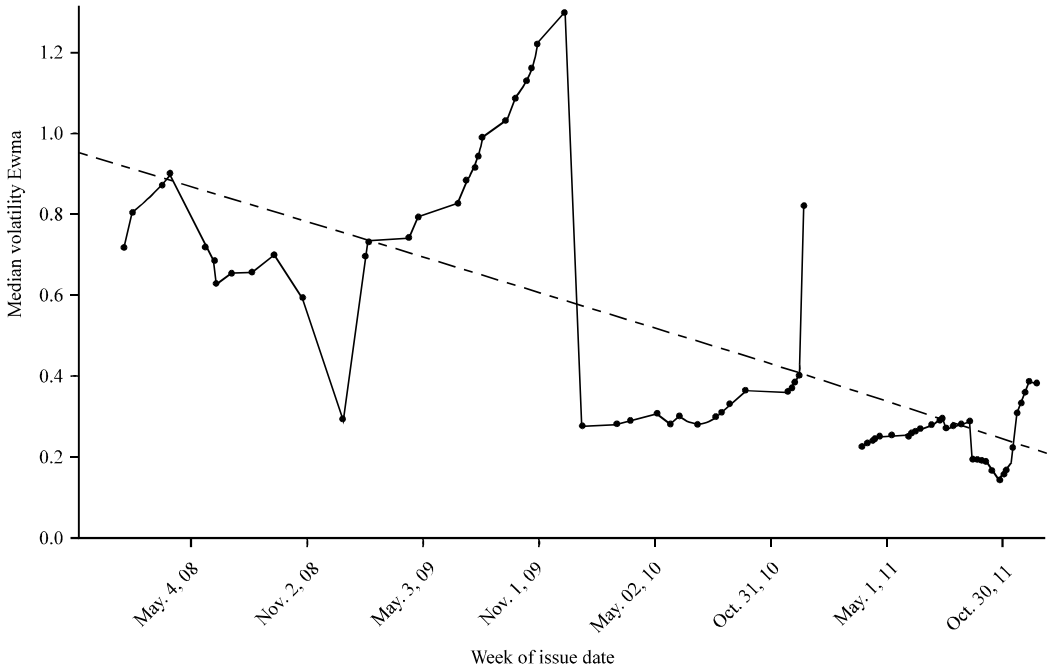

Fig. 4: Forecasting volatility (MCEWMA) following Ijarah issuances (2008-2011). FTSE Hijrah Shari'ah index; researchers calculation

in Malaysia. These both graphs show the trend after the 2008 global financial crisis which also affected local indexes in Malaysia. Because of this, only the risk-averse investors will invest in the Malaysia stocks. The investor will often lose out on higher rates of return. Investors looking for "safer" investments will generally stick to index funds and government bonds which generally have lower returns. In this situation, investors have low confidence to invest. Risk neutral is when the investors are in the middle of the continuum where risk-seeking investors are at one end and risk-averse investors are at the other extreme. Risk-seeking investors are those who search for greater volatility and uncertainty in investments in exchange for anticipated higher returns. They are investors with high confidence levels and will agree to both invest and issue Sukuk. For the first results, numerical estimation for interval method can be referred in Table 2.

Base on Table 2, the estimate for the standard intervals (Student's t confidence interval) using a hybrid model give a shorter interval. Table 2 shows the length of the BMCEWMA-t = 0.0003932 compared to the real model, MCEWMA-t which is more lengthen, 0.0009712 that clearly show in Fig. 5 for the FTSE Emas Shari'ah Index. Then, Table 3 shows the length of the BMCEWMA-t = 0.00097 compared to the real model, MCEWMA-t which is more lengthen, 0.00100 that clearly show in Fig. 6 for the FTSE Hijrah Shari'ah index. The differences showed in these two models proved that the bootstrap approach fixed the interval estimation and gives a good performance of the hybrid model.

Table 2: Interval estimation of the real and hybrid model (Emas Shari'ah index)

	Estimated value, interval limits		
Base model	Lower	Upper	Length
MCEWMA-t	0.0051490***	0.0061202***	0.0009712
BMCEWMA-t	0.0030618***	0.0034550***	0.0003932
BMCEWMA-BP	0.0041662***	0.0056468***	0.0014806
BMCEWMA-BCa	0.0052232***	0.0060867***	0.0008635

Table 3: Interval estimation of the real and hybrid model (FTSE Hijrah Shari'ah index)

	Estimated value, interval limits		
Base model	Lower	Upper	Length
MCEWMA-t	0.0050995***	0.0060979***	0.00100
BMCEWMA-t	0.0051235***	0.0060918***	0.00097
BMCEWMA-BP	0.0034781***	0.0059384***	0.00246
BMCEWMA-BCa	0.0050766***	0.0061335***	0.00106

***: Show 1% significant in 2-tailed; researchers calculation

In Fig. 5 and 6, a plot of interval estimation for Student's t method in Fig. 5a and 6a and also a plot of Bootstrap Percentile (BP) and Bias Corrected and accelerate (BCa). Based on these two plots, we found that Bootstrap Interval Method (BP and BCa) that gave short length compared to the standard interval which show a lengthen interval either for real or hybrid model.

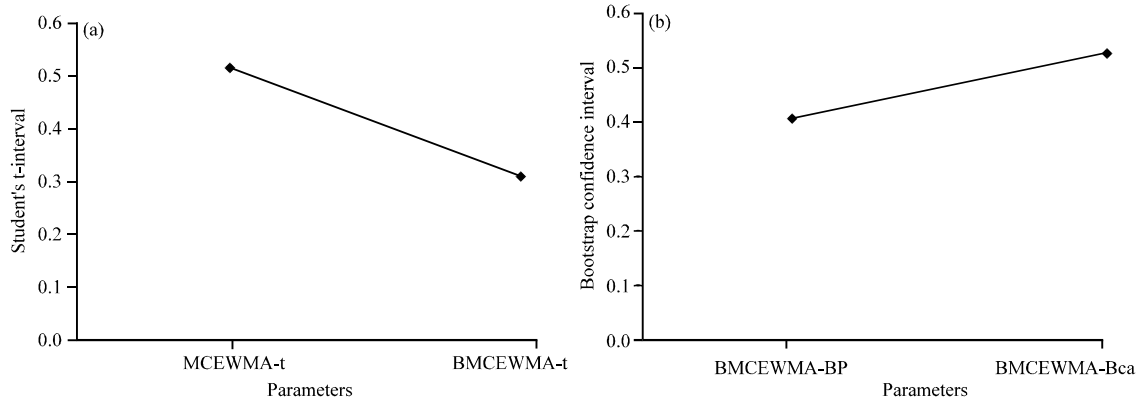

Fig. 5: Interval estimation of: a) Standard interval; student's-t; b) Bootstrap Interval Method (FTSE Emas Shari'ah index); researchers calculation

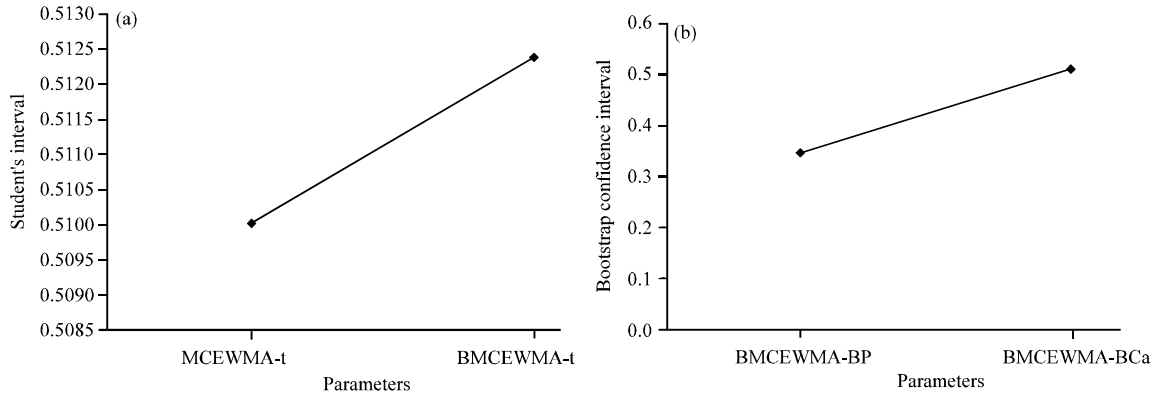

Fig. 6: Interval estimation of: a) Standard interval; student's-t; b) Bootstrap Interval Method (FTSE Hijrah Shari'ah index); researchers calculation

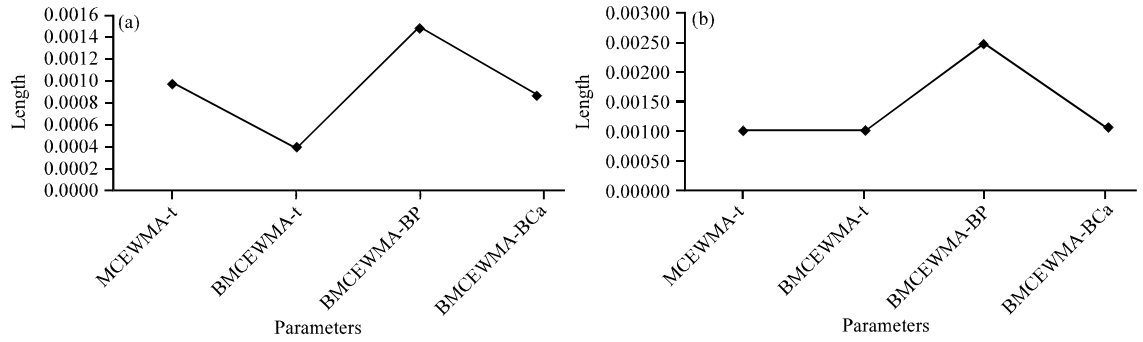

Fig. 7: Interval estimates for base and hybrid model; researchers calculation: a) FTSE Emas Shari'ah index; b) FTSE Hijrah Shari'ah index

Significant difference on the length value shows that the Bootstrap Percentile Interval Method gave a good performance compare to the Student's t estimation in both indexes. To consider these results, the BMCEWMA Model gives a better performance when using the Bootstrap Interval Method. Both indexes show that BP estimation gives a long length interval compare to BCa for BMCEWMA Model referred to Table 2 and 3. These

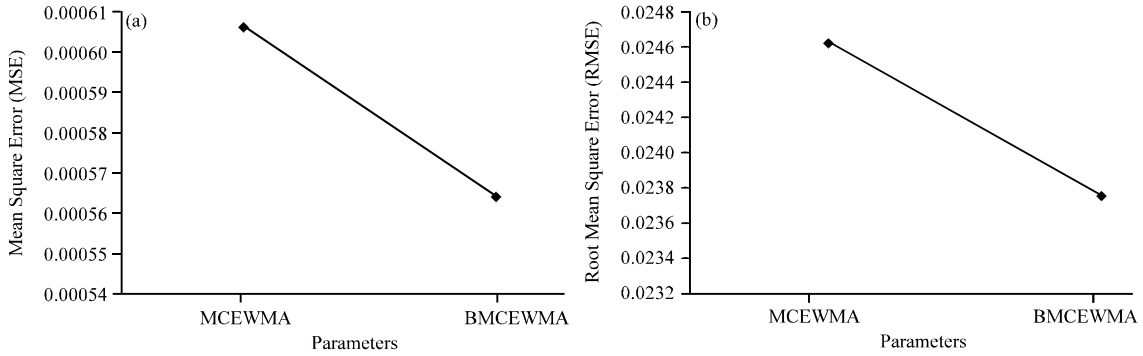

Fig. 8: Plot of error estimation: a) MSE; b) RMSE (FTSE Emas Shari'ah index); researchers calculation

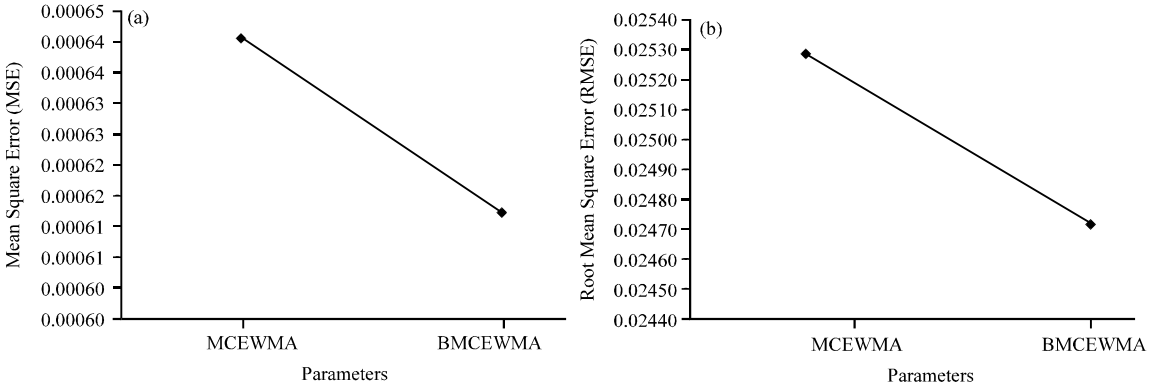

Fig. 9: Plot of error estimation: a) MSE; b) RMSE (FTSE Hijrah Shari'ah index); researchers calculation

Table 4: Error value for real (MCEWMA) and hybrid model (BMCEWMA)

	Estimated value (Shari'ah index)			
	FTSE Emas		FTSE Hijrah	
Base model	MSE	RMSE	MSE	RMSE
MCEWMA	0.000606	0.024616	0.000640	0.025304
BMCEWMA	0.000564	0.023749	0.000612	0.024747

Researchers calculation

results suggest that the percentile bootstrap method is not considered giving a good performance of the hybrid model. However, the BMCEWMA Model shows a better performance when using BCa interval estimation. Figure 7 shows the comparison of two indexes for interval estimates of base (MCEWMA) and hybrid model (BMCEWMA).

Thus, the estimation of the effectiveness of the real and hybrid models is seen in the results of the Mean Square Error (MSE) and Root Mean Square Error (RMSE). The good performance of the model is based on the theory of the effectiveness estimation model as discussed in the previous study. Table 4 shows the results of error value for both real and hybrid models. The results show that the bootstrap model provides the smaller error value compared to the real model. Figure 8 and 9 shows the plot results of MSE and RMSE for the real and hybrid models on both two Shari'ah indexes.

Based on such a significant error reduction in Fig. 8 and 9 show the bootstrap approach in the real base model of control charts fixing the estimation of real model and provide a more accurate estimation of the model. Both indexes show the value of the error in bootstrap model are smaller than the value of error for real model. This small error value also indicates that the hybrid model is more effective and gives good performance compared to the real model.

CONCLUSION

This study introduces a bootstrap approach to the base model of MCEWMA chart and this new model applies to returns of Sukuk Ijarah issuances data for the period between 2008-2011. Numerical estimation results indicate that the hybrid model provides more efficiency in interval and error estimation on both FTSE Emas Shari'ah index and FFTSE Hijrah Shari'ah index. The hybrid model also gives a short length of interval and smallest error value compare to real model, MCEWMA on both indexes.

The bootstrapping approach fixed the real model estimation and indirectly gives the accuracy of the hybrid model estimation. This accuracy is shown that the base model for BMCEWMA control chart gives a better performance than MCEWMA. The estimation of volatility is more accurate using the hybrid model. The hybrid chart is more effective and provide better performance than the real chart MCEWMA. In conclusion, this analysis will provide valuable information and guidelines to both muslim or non-muslim issuers, policy makers, regulatory bodies and investors about the volatility market following Sukuk issuances.

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