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Volatility Estimation of Islamic and Conventional Stock Prices Using GARCH Method

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Abstract: Volatility estimation of the Islamic and conventional stock prices brings significant guidance for investors. Hence, this study focused on modeling in financial and it is one of the factors that have an effect on volatility, persistency, and performance of their portfolio management. This study aimed to observe the stock prices trend, volatility, and persistency of the Islamic and conventional stock prices in Malaysia. This objective can be achieved by selecting and applying GARCH methods which include ARCH, GARCH, and EGARCH to investigate the behavior of stock return volatility for Islamic and conventional stocks covering the period from October 2007 until October 2021. Incorporating the proposed volatility model of this study can significantly improve the investor's view towards Islamic and conventional stock prices.

Keywords: Volatility, Persistency, Islamic, Conventional, ARCH, GARCH, EGARCH

1. Introduction

The stock market applies to public markets for publishing, purchasing, and selling securities that trade over-the-counter or on a stock exchange. Stocks, also known as equities, reflect fractional ownership of a business, and the stock market is a marketplace for investors to purchase and sell those investible assets. A well-functioning capital exchange is regarded as essential development because it allows businesses to quickly access capital from the public.

According to [1], in a financial system, capital from investors is raised through capital markets using financial instruments like debt, equity and derivatives. Raising capital is equally important to both conventional stock and Islamic stock. There are five main principles in the Islamic Finance fundamentals better known as Shariah rules which include the prohibition of interest (Riba), excessive

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uncertainty (Gharar), speculation (Maysir), risk and return sharing and investing in 'unethical' industries.

The Autoregressive Conditional Heteroskedasticity (ARCH) model and its derivative Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model are the most widely used models for predicting and modeling financial volatility. Both models can capture volatility clustering and leptokurtosis, according to [3] and [4]. As a result, they've been regularly used in studies of financial markets analysis. However, they both fail to account for the leverage impact. In order to monitor the asymmetric shocks of the conditional variance, [7] suggested one of the extended ARCH models by employing Exponential Generalized Autoregressive Conditional Heteroscedasticity, also known as (EGARCH) model. The EGARCH model was designed to address three primary problems in the GARCH model by capturing asymmetric properties between returns and volatility.

According to [1] Malaysia has a strong Islamic financial system. After the establishment of the Malaysia International Financial Center (MIFC) in August 2006, the Islamic market has grown in response to increased demand for Islamic investment goods. The correlations between Islamic and conventional stocks can be intense when the market crash.

The capital market has been regularly utilized as one of the pointers of a country's financial advancement as it basically demonstrates the accessibility of long-haul subsidizing to help the expected development of the business area. The funding for companies and other institutions, it also serves as a venue for investment. The Islamic stocks market is based on Islamic laws or known as Shariah principles while the conventional stock is not. Therefore, the data under the Shariah compliance is also known as Islamic stocks as well. Islamic finance points up risk-sharing while interest-based loans are strictly prohibited.

A gain or drop in stock value tends to have a proportional influence on the economy, primarily via the money market. An increase in stock prices promotes investment and raises credit demand, resulting in increased interest rates across the economy by [2]. Because the variation of inflation responds positively to interest rate volatility, a high-interest rate is a possible hazard to the economy by [3]. This change could complicate the formulation of monetary policy and, as a result, jeopardize the monetary authorities' price stability goal. As a result, economic managers should pay close attention to the development of an adequate volatility model for capturing changes in stock returns. More importantly, a realistic volatility model of asset returns assists investors in risk management and portfolio modifications.

1.1 Stocks

Islamic and Conventional stocks investments are similar under one aspect which investors purchase shares and sell them at an increased price. In general, Islamic stocks instruments tend to minimize and manage systematic risk, while conventional stocks always separate risk from underlying assets. According to [1] these two stocks has similarities such as leptokurtic and have negative returns and experienced strong correlation and positive relationship. It shows the correlation between the data set. Refer to previous study, although making investments in the stock market is allowed in Islam in principle, the shariah sets out certain rules and regulations for it which differentiates an Islamically compliant stocks market from a conventional stocks market.

This study used data from two categories of stock prices. The first sample data has been selected under Islamic stock prices data type. Two companies have been selected which are Petronas Gas and AXIATA Group. Another two companies have been selected under conventional stock prices data type which are Public Bank and Malayan Bank. All data have been selected for the period from October, 2007 until October, 2021.

1.2 Volatility Estimation

Measuring and estimating stock price volatility is an important subject in finance and investment decisions. As a result, researchers have proposed a number of mathematical and statistical models for capturing stock return volatility in global financial markets. From the previous research [3] and [4], who advocated the use of both ARCH and GARCH models, respectively. This section will give a quick rundown of the most important empirical findings from both developed and emerging markets experts.

According to [6] volatility reveals the number of errors in financial variable modeling. If this volatility can be effectively modeled and forecasted, it has the potential to become a substantial critical variable. Asset appraisal and risk management both employ volatility. With the increasing frequency of financial crises, it has come increase.

Modeling volatility in financial markets is the factor that affects on pricing, risk and portfolio management [5]. The study implies ARCH, GARCH and EGARCH to investigate the behavior of stock return volatility for Amman Stock Exchange (ASE) which covering the period from January 1 2005 until December 31 2014. Moreover, the results from the study reveals evidence for leptokurtosis, long memory, skewed to left (fat-tailed), and persistence of volatility. However, asymmetric effect was detected so the researcher applied EGARCH (1,1) model so that it can give the estimation of future volatility for the Amman Stock Exchange (ASE).

2. Materials and Methods

2.1 Materials

This study uses the daily closing prices of MSCI and FTSE portfolios where both indices represent Islamic and conventional stocks markets. Two companies from both portfolios were selected. Petronas Gas and AXIATA Group were selected from MSCI portfolios, and it represents Islamic stock prices data. While Public Bank and Malayan Bank were selected from FTSE Bursa Malaysia KLCI to represent the conventional stocks market. All data were selected for the period from October 1, 2007 until October 31, 2021 have sample sizes of 3477 observations. Due to the non-stationarity and non-normality of series, price indices were transformed into return series:

$$R_t = \ln P_t - \ln P_{t-1} \quad \text{Eq. 1}$$

Where:

R_t represents the daily returns of the stock prices

P_t represents the daily prices of the stock prices

2.2 Methods

This study used models of volatility to estimate the volatility of all data. The Autoregressive Conditional Heteroskedasticity (ARCH) models were used in this study. The main study in this field is credited to the study of [3] who conducted a study modeling conditional volatility by using the ARCH process.

Hence, to overcome the cons that were found while applying ARCH models, another study was introduced by [4] to modify the version of ARCH models, which is symmetric Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model. Furthermore, GARCH has

probability distributions that are “heavy-tailed” or “outlier-prone”. The GARCH processes have heavy tails, which is Gaussian. Therefore, we can model heteroskedasticity and heavy-tailed distributions of financial market data using GARCH models.

Moreover, this study used the Exponential Generalised Autoregressive Conditional Heteroscedasticity (EGARCH) model used to examine asymmetric volatility during the crisis in the study by [5]. The EGARCH model can demonstrate the influence of significant shocks on volatility, as well as quantify asymmetric and symmetric distributions to determine the major characteristics of stock return.

2.3 Equations

Based on statistical, the general form of the ARCH model is:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 \qquad \text{Eq. 2}$$

Where:

α_0 = Mean

ε_{t-i} = Coefficient of the variance

However, in order to overcome the limitations found while using ARCH models, particularly the inability to illustrate volatility clustering, GARCH model was used to model heteroskedasticity and heavy-tailed distributions of financial stock prices. GARCH model can be defined as:

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \beta_j \sigma_{t-j}^2 \qquad \text{Eq. 3}$$

Where:

σ_t^2 = The notation of variance

$\alpha_i \varepsilon_{t-i}^2$ = ARCH component

$\beta_j \sigma_{t-j}^2$ = GARCH component.

This study continue with EGARCH model which to examine asymmetric volatility during the crisis Nelson The conditional variance of EGARCH model is specified generally as:

$$\ln(\sigma_t^2) = \omega + \sum_{j=1}^{p} \beta_j \ln(\sigma_{t-j}^2) + \sum_{i=1}^{q} \alpha_i \{ | \frac{\varepsilon_{t-i}}{\sigma_{t-i}} | - \sqrt{\frac{2}{\pi}} \} - \gamma_i \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \qquad \text{Eq. 4}$$

The EGARCH formula has several advantages, the first of which is that the parameters are guaranteed to be positive because the model employs the log of the variances. Second, there are no limitations on the parameters contained in the formula, which are ω, β, γ. Furthermore, the value of gamma (γ), which is an indicator of leverage effect (asymmetric) and must be both negative and significant, must be positive and smaller than 1, to ensure that the stationery assumption is still valid.

ARCH, GARCH and EGARCH models will be used to measure the correlation of the residual series in order to study the volatility and estimation of the Islamic and conventional stock prices in Malaysia.

The GARCH model is used to measure the volatility of stock returns and EGARCH is to describe the crisis happens in stock markets.

3. Results and Discussion

In this chapter, the analytical output of all the methods have been determined and generated by using EViews 10. EViews 10 is used to access to powerful statistical, forecasting, and modeling tools. This sections report the results for descriptive statistics, Augmented Dickey-Fuller (ADF) test, ARCH (1,1), and GARCH (1,1) and EGARCH (1,1) for the top two of Islamic and conventional stock prices dataset in Malaysia. The used of ADF test is to test whether the time series given is stationary or non-stationary. The (1,1) in parentheses is a typical notation in which the first number refers to the number of autoregressive lags, or ARCH terms, in the equation, while the second number refers to the number of moving average lags, also known as the number of GARCH terms.

3.1 Results

Table 1 represents the descriptive statistics for daily observations of Public Bank and Malayan Bank during the period of October, 2007 to October, 2021 that contains mean, median, standard deviation (SD), skewness, kurtosis, max, min and Jarque-Bera (JB) results.

Table 1: Descriptive statistics of daily return series of conventional stocks

	Public Bank	**Malayan Bank**
Mean	0.038788	0.024371
Median	0	0
SD	1.047526	1.187972
Kurtosis	39.07447	11.931130
Skewness	1.589945	-0.493569
Minimum	-11.086239	-12.733939
Maximum	17.019730	8.934555
JB Test	< 2.2e-16	< 2.2e-16

Table 1 represents descriptive statistics of the daily return series of conventional stocks. Public Bank and Malayan Bank have a positive value of the mean. Based on the standard deviation value, Public Bank stocks is the most volatile market compared to Malayan Bank since it has the higher value of SD. Public bank stocks is the most volatile market compared Malayan bank with 1.047526. The result is supported by the largest difference between Public Bank return series' minimum and maximum values.

By referring to the kurtosis, skewness and JB test, each series's distribution can be determined. The skewness for Public Bank stocks is positively skewed thus implying that there are more negative returns and fewer gains for the period October 2007 to October 2021. The JB test is significant at 5% level for all indices which is illustrating that the data are not normally distributed.

Table 2: Descriptive statistics of daily return series of Islamic stocks

	Petronas Gas	**AXIATA Group**
Mean	0.027322	0.009169
Median	0	0
SD	1.211350	1.861644
Kurtosis	10.431541	51.386698
Skewness	0.703529	-2.554305
Minimum	-9.123113	-36.721522

Maximum	12.026868	13.846978
JB Test	< 2.2e-16	< 2.2e-16

Table 2 represents descriptive statistics of the daily return series of Islamic stocks, Petronas gas and AXIATA Group. It shows that the mean value for each return is positive. Based on the standard deviation value, AXIATA Group and Petronas Gas return series are high with regards to the number of observations. Based on the standard deviation value, Petronas gas stocks is the most volatile market compare to AXIATA Group with 1.211350 while AXIATA Group with 1.861644.

By referring to the kurtosis, skewness and JB test, each series's distribution can be determined. The skewness for Petronas Gas stocks is greater than zero which shows that the return series are positively skewed thus implying that there are more negative returns and fewer gains for the period October 2007 to October 2021. The JB test is significant at 5% level for all indices which is illustrating that the data are not normally distributed.

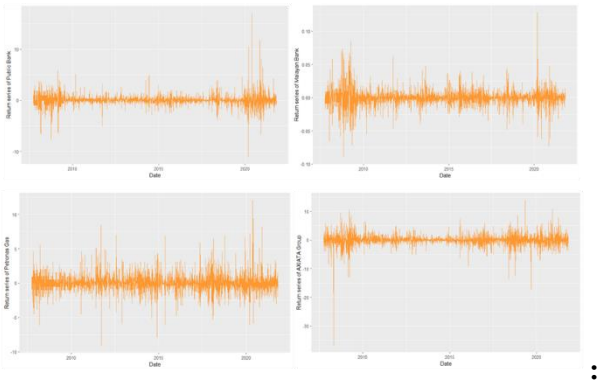

Figure 1: Relative Daily Returns

Figure 1 shows the relative daily return of conventional and Islamic stock prices. The graph shows the visualization volatility of all stock prices. All stock prices have different lowest returns. Generally, all stock prices have volatility clustering from late 2019 to 2020. In summary, the study finds that at mid-year of 2011, each of the stock prices was experiencing extreme volatile returns around the same period except for AXIATA Group. Moreover, the figure also shows that all stocks were significantly affected by the recent global crisis early of the year 2020, which is the 2020 stock market crash due to the Covid-19 outbreak.

Table 3: Unit root test

Company	ADF test statistic	Prob.*
Islamic Stock		
Petronas Gas	-38.64100	0.0000
AXIATA Group	-59.40429	0.0001
Conventional Stock		
Public Bank	-39.23270	0.0000
Malayan Bank	-57.71016	0.0001

Table 3 represents the result of unit root test. The Augmented Dickey-Fuller (ADF) test is employed to all data series which includes Petronas Gas, AXIATA Group, Public bank and Malayan bank. The main result based on this test is that ADF is statistically significant at 5% level. This indicates to reject the null hypothesis and accept that the returns are stationary. That all confirm the non-existence of autocorrelation.

Table 4: Model selection conventional stocks

STOCKS Conventional Stocks		ARCH	GARCH	EGARCH
PUBLIC BANK	AIC	6.717110	2.829763	2.280531
	Schwarz Criterion	6.720652	2.840402	2.292944
	Hannan-Quinn	6.718375	2.833562	2.292944
	α		0.495097	
	β		0.045097	
MALAYAN BANK	AIC	6.134158	3.154566	2.730808
	Schwarz Criterion	6.137706	3.165234	2.743255
	Hannan-Quinn	6.135425	3.158375	2.735253
	α		0.539458	
	β		0.089458	

Table 4 represents the result of ARCH and GARCH family models for conventional stocks which includes two companies, Public bank and Malayan bank. The statistical value of AIC, Schwarz Criterion and Hannan-Quinn will be valued in the table. For conventional stock prices, the autoregressive conditional heteroskedasticity (ARCH) modeling is applied on the residuals which to capture the volatility clustering. Based on the result, there is an ARCH effect in the return of conventional stocks. Based on the result, there is an ARCH effect in the return of conventional stocks. Moreover, for the GARCH result shows GARCH as the best model with the results all 3 criterion. Thus, the result of GARCH has more significance for the conventional stock prices.

Refer to the previous study by [10] the analytical output of α and β need to be observe as to proof the persistent of the stock prices. The value of α and β from the GARCH result showed in the table. For Public bank data, the sum of the two main parameters of the variance equation is with value 0.540194 close to unity, both data are persistence in the volatility shocks. The result of EGARCH (1,1) for conventional stock prices. Based on AIC, Schwarz Criterion and Hannan-Quinn, the results suggest EGARCH model to be a better indicator for volatility estimations. EGARCH model is the best model for conventional stock prices.

Table 5: Model selection Islamic stocks

STOCKS Islamic Stocks		**ARCH**	**GARCH**	**EGARCH**
PETRONAS GAS	AIC	6.050601	3.192322	3.038316
	Schwarz Criterion	6.054147	3.202959	3.050727
	Hannan-Quinn	6.051867	3.196120	3.042747
	α		0.510278	
	β		0.060278	
AXIATA GROUP	AIC	9.229192	4.072287	3.718286
	Schwarz Criterion	9.302734	4.082591	3.730700
	Hannan-Quinn	9.300456	4.075751	3.722720

α	0.474109
β	0.024109

Table 4.4 shows the result of ARCH and GARCH family models for Islamic stocks which includes two companies, Petronas Gas and AXIATA Group. The statistical value of AIC, Schwarz Criterion and Hannan-Quinn will be valued in the table. For Islamic stock prices, the autoregressive conditional heteroskedasticity (ARCH) modelling is applied on the residuals which to capture the volatility clustering. Based on the result, there is an ARCH effect in the return of Islamic stocks. Moreover, for the GARCH result it shows GARCH as the best model with results all 3 criterions. Thus, the result of GARCH has more significance for the Islamic stock prices.

In addition, the value of α and β from the GARCH result will be valued. The value of α and β from the GARCH result showed in the table. For Petronas gas data, the sum of the two main parameters of the variance equation is with value 0.570556 close to unity, both data are persistence in the volatility shocks. The result of EGARCH (1,1) for conventional stock prices. Based on AIC, Schwarz Criterion and Hannan-Quinn, the results suggest EGARCH model to be a better indicator for volatility estimations. EGARCH model is the best model for conventional stock prices.

4. Conclusion

This study examined different GARCH models to observe the volatility estimation of the Islamic and conventional stock prices. FTSE Bursa Malaysia KLCI and MSCI Malaysia Islamic Index was used as the main stock indexes and it represents the conventional and Islamic stock prices respectively. There are 4 companies have been selected from the index which are Petronas Gas and AXIATA Group (Islamic stocks) and Public bank and Malayan bank (conventional stocks). That 4 stock prices being indicator and the prices were transformed to log returns. Descriptive statistics represents that all the returns the presence of skewness in the series along the period. Moreover, the sum of α and β shows that Petronas Gas, Public Bank and Malayan Bank are volatile and persistent. However, for AXIATA Group the data are less volatile and not persistent. EGARCH (1,1) is the best model with results of three criterion for both Islamic and conventional stock prices. However, EGARCH (1,1) is a better way to describe the asymmetric phenomenon of shocks in the stock market.

The goal of this study is to find the most fit marginal distribution process. The study find EGARCH process with orders (1,1) is the most effective at estimating the volatility. Therefore, it can be said with full certainty that the EGARCH (1,1) process is the best predictor of volatility for the Islamic and conventional stock prices. Higher and advanced GARCH model can be considered in a future study to provide more reliable result. Finally, note that this study approach can be extended to other GARCH models to have a clearer view of volatility.

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