Detecting The Expected Rate of Return Volatility of Financing Instruments of Indonesian Islamic Banking through GARCH Modeling (G*eneralized Autoregressive Conditional Heteroscedasticity*)

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Abstract

Objective - Islamic banks are banks which its activities, both fund raising and funds distribution are on the basis of Islamic principles, namely buying and selling and profit sharing. Islamic banking is aimed at supporting the implementation of national development in order to improve justice, togetherness, and equitable distribution of welfare. In pursuit of supporting the implementation of national development, Islamic banking often faced stability problems of financing instruments being operated. In this case, it is measured by the gap between the actual rate of return and the expected rate of return. The individual actual RoR of this instrument will generate an expected rate of return. This raises the gap or difference between the actual rate of return and the expected rate of return of individual instruments, which in this case is called the abnormal rate of return. The stability of abnormal rate of return of individual instruments is certainly influenced by the stability of the expected rate of return. Expected rate of return has a volatility or fluctuation levels for each financing instrument. It is also a key element or material basis for the establishment of a variance of individual instruments. Variance in this case indicates the level of uncertainty of the rate of return. Individual variance is the origin of the instrument base for variance in the portfolio finance that further a portfolio analysis. So, this paper is going to analyze the level of expected RoR volatility as an initial step to see and predict the stability of the fluctuations in the rate of return of Indonesian Islamic financing instruments.
Methods – Probability of Occurence, Expected Rate of Return (RoR) and GARCH (Generalized Autoregressive Conditional Heteroscedasticity).
Results - The expected RoR volatility of the murabaha and istishna financing instruments tend to be more volatile than expected RoR volatility of musharaka and qardh financing instruments.
Conclusions – The uncertainity of Musharaka and qardh financing instruments tend to be more stable than other Islamic financing instruments.

Keywords : Islamic Financing Instruments, Expected rate of return, GARCH

Abstrak

Tujuan - Bank syariah ialah bank yang dalam aktivitasnya, baik penghimpunan dana maupun penyaluran dananya memberikan dan mengenakan imbalan atas dasar prinsip syariah yaitu jual beli dan bagi hasil. Perbankan Syariah bertujuan menunjang pelaksanaan pembagunan nasional dalam rangka meningkatkan keadilan, kebersamaan, dan pemerataan kesejahteraan rakyat. Dalam mencapai tujuan menunjang pelaksanaan pembangunan nasional, perbankan syari'ah sering dihadapkan pada masalah kestabilan instrumen pembiayaan yang dijalankannya, dalam hal ini diukur melalui kesenjangan antara tingkat pengembalian sebenarnya (*actual rate of return)* dengan tingkat pengembalian yang diharapkan (*expected rate of return*). *Actual RoR* individual instrumen ini nantinya akan menghasilkan suatu *expected rate of return* (tingkat pengembalian yang diharapkan). Hal ini menimbulkan adanya kesenjangan atau selisih antara *actual rate of return* dan *expected rate of return* individual instrumen, yang dalam hal ini disebut *abnormal rate of return*. Kestabilan *Abnormalrate of return* dari individual instrumen ini tentunya dipengaruhi oleh kestabilan *expected rate of return*. *Expectedrate of return* memiliki suatu volatilitas atau tingkat fluktuasi untuk setiap instrumen pembiayaan, serta merupakan unsur utama atau bahan dasar pembentukan suatu *variance* individual instrumen. *Variance* dalam hal ini menunjukan tinggi rendahnya ketidakpastian dari tingkat pengembalian tersebut. Dari *variance* individual instrumen inilah asal bahan dasar *variance* portofolio pembiayaan dalam suatu analisis portofolio yang lebih lanjut. Sehingga dari hal tersebutlah akan dilakukan suatu analisis terhadap tingkat volatilitas *expected RoR* sebagai langkah awal untuk melihat dan memprediksi kestabilan dari fluktuasi *rate of return* instrumen pembiayaan syariah Indonesia.
Metode – Probability of Occurrence, Expected Rate of Return (R0R) dan GARCH (G*eneralized Autoregressive Conditional Heteroscedasticity*).
Hasil - Volatilitas *expected RoR* dari instrumen pembiayaan *mudharabah,murabahah* dan *istishna* cenderung lebih fluktuatif dibanding volatilitas *expected RoR* dari instrumen pembiayaan *musyarakah* dan *qardh*.
Kesimpulan - Ketidakpastian instrumen pembiayaan *musyarakah* dan *qardh* cenderung lebih stabil dari instrumen pembiayaan syariah lainnya.

Kata kunci : Islamic Financing Instruments, Expected rate of return, GARCH

1. Introduction

Islamic banking effort for diversifying the financing product to become portfolio of financing (a combination of more than one financial instrument) is very important to improve the return or refund of Islamic banks, so that the growth of Islamic banking in Indonesia may increase and the share of Islamic banking assets will be no longer far below conventional banks. However, an obstacle in the business establishment of this financing portfolio is the need to examine the behavior of the return of each Islamic financing instruments, namely how the expectations of return of each instrument before the instruments combined with other instruments (a combination of two, three, four, or five financing instruments). Whether expected rate of return of each form of financing shows a stable behavior or unstable behavior.

Financing return is not the only obstacle in this case, but also the risk which is a measure of the uncertainty of the expected rate of return to be earned in the future of the financing portfolio. Islamic banking will certainly avoid the high risk of finance in contracting the finance portfolio to investors. It is also important to consider the level of fluctuations (volatility) of the gap between the actual rate of return and the expected rate of return of Islamic financing instruments, considering the monthly time series data in the financial sector or financial (rate of return) very high level of volatility. This gap is called the abnormal rate of return. The high volatility is characterized by a phase in which the fluctuation is relatively high and then becomes and then returns to its high fluctuation. In other words, the data has no constant average and variant. Thus, the volatility of the abnormal rate of return of Islamic financing instruments is also a measure of uncertainty as additional consideration to establish the financing portfolio in this study to look at the volatility of the expected rate of return as the element. By this, the research problems raised in this research is how the fluctuation level of expected rate of return volatility which is an element of uncertainty (variance) of the Islamic bank financing instruments in Indonesia during the period of 2004 (March) until 2014 (April) ?

Engle (2001) in a paper entitled "The Use of ARCH / GARCH Models in Applied Econometrics" said the GARCH model can be used as a technique to construct an equation that measures the volatility (foresee or predict the variance) of the stock return and portfolio.

Alessandro (2007) in a paper entitled "An Out-of-sample Analysis of Mean-Variance Portfolios with Orthogonal GARCH Factors" wrote that the GARCH model, both the mean and variance models used to predict the return and risk over several periods ahead. Based on consideration of forecasting the return and risk of the portfolio, it will be considered where the best portfolio.

Research conducted by Savickas in the paper entitled "Event-Induced Volatility And Test For Abnormal Performance" wrote that the GARCH model is the best model that can capture the effect of volatility of stock return data, compared to other methods such as the method of mean rank and standardized cross-sectional.

Research conducted by Otavio Alberto (2005) in peper titled "Brazilian Market Reaction to Equity Issues Announcements" wrote that the GARCH method is better in estimating for return of a stock than the OLS estimates.

2. Methodology

This study uses secondary data measured in time series. Islamic Banking in Indonesia in this study is Islamic Commercial Bank (BUS) and Islamic Business Unit of a Conventional Bank (UUS), Islamic Rural Bank (BPRS). Source data is taken from Bank Indonesia, that is Islamic Banking Statistics (SPS) and on the website of Bank Indonesia (www.bi.go.id) and the Financial Services Authority (OJK) published every month. Time period in this study is from March 2004 until April 2014, using historical monthly data. The software used in this study is a Microsoft Office Excel 2007 and Eviews 6.0.

This study consists of several variables, namely the equivalent rate of return variable of each financing instruments of Islamic banking.

This study uses a quantitative approach. First of all, the events probability of each financing instrument will be identified. Of the likelihood and the actual rate of return obtained here will be expected rate of return of Islamic financing instruments. Then the econometric analysis will be conducted to support the analysis of return and risk, in this case the analysis is to detect the volatility of portfolio returns through modeling ARCH/GARCH (p, q).

The expected return of one and more than one financial instrument is defined as follows :

$$E(R_i) = \sum_{i=1}^{N} p_i r_i \tag{1}$$

Where p_i is probability of occurrence of return, and r_i is rate of return (*RoR*) instrument. Because Islamic finance theory states that future profits should not be ascertained, then this calculation uses historical data as a predictor (good predictor-proxy) for the probability of occurrence (p_i) above.

Econometric analysis using time series data in this case is to obtain the data seris portfolio return volatility of financial instruments of Islamic banking in Indonesia, through modeling ARCH / GARCH. The steps are described below.

2.1 Stationarity Test Data Through the Unit Root Test

The first step that must be done in the estimation of the economic model with time series data is to test the stationarity in the data or also called a stationary stochastic process. Stationarity test data can be performed by using the Phillips-Perron test at the same level (level or different) to obtain a stationary data.

2.2 Box-Jenkis Method (ARIMA)

Box-Jenkins models is one of the techniques of data time series forecasting models based only on the observed behavior of variable data. This model is technically known as a model autoregressivi integrated moving average (ARIMA). The main reason for the use of this model movements in economic variables studied such as the movement of exchange rates, stock prices, returns, inflation is often difficult to explain by economic theories. The Box-Jenkins models terdirir of several models: autoregressive (AR), moving average (MA), autoregressive-moving average (ARMA) and autoregressive integrated moving average (ARIMA).

Autoregressive Model

AR model shows the predicted value of the dependent variable *yt* is only a linear function of the number of actual y_t earlier. For autoregressive models of order *p*, observation y_t is formed from the weighted average of past observations, *p* periods back and deviation of the current period. For example, the value of the variable Y_t is only influenced by the value of the variable or inaction of the previous period, the first such models called autoregressive model of the first level or abbreviated AR (1). AR model equation (1) can be written as follows:

$$y_t = \phi_1 y_{t-1} + \delta + e_t \tag{2}$$

Where : y = dependent variable

y_{t-1} = first lag of y

In general, the form of a general model of autoregressive (AR) can be expressed in the following equation:

$$y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + ... + \phi_p y_{t-p} + \delta + e_t$$

(3)

Where: y_t = dependent variable

y_{t-p} = p^{th} lag of y

e_t = residual (*error term*)

p = level of AR

Residuals in equation (3) is as OLS model has the characteristics of an average value of zero, constant variance and not interconnected. AR model thus shows that the predicted value of the yt dependent variable is only a linear function of the number of actual yt previous.

Moving Average Model

Model MA stated that the predictive value of the dependent variable yt is only affected by the residual value of the previous period. Model MA has a magnitude of the order which is denoted by the letter 'q', so that the model is usually written by the MA (q). This model assumes that each observation is formed from the weighted average deviation (disturbance) q periods backwards. For example, if the value of the dependent variable yt is only affected by the residual value of the previous period, the so-called first-level model of the Supreme Court or abbreviated with MA (1). Model MA (1) can be written in the form of the following equation:

$$y_t = \mu + e_t - \theta_1 e_{t-1}$$

(4)

Where : e_t = residual

e_{t-1} = first lag of residual.

In general, the form of the moving average (MA) model can be expressed in the form of the following equation :

$$y_t = \mu + e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} - \theta_3 e_{t-3} - ... - \theta_q e_{t-q}$$

(5)

Where : θ_1, θ_2, ..., θ_q = parameters which can be positive or negative.

In this case, it is assumed also that:

$e_t \sim iid\ N(0,\sigma_e^2);$ covariances $\gamma_k = 0, k \neq 0$

Or $E(e_t) = 0; E(e_t^2) = Var(e_t) = \sigma_e^2; E(e_t, e_{t-k}) = 0$

With these assumptions, the mean of the MA process is not dependent on the time that is $E(y_t) = \mu$. Model MA is the dependent variable y prediction model based on a linear combination of the previous residual whereas the AR model to predict the y variable is based on the value of y the previous period.

Autoregressive-Moving Average Model

Sometimes stationary random process that can not be modeled by an AR (p) or MA (q) process because has both characteristics. Therefore, this kind of process that needs to be approached with a model mixture of autoregressive and moving average, known as ARMA model (p,q). This model is expressed in the form:

$$y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + ... + \phi_p y_{t-p} + \delta + e_t - \theta_1 e_{t-1} - ... - \theta_q e_{t-q} \quad (6)$$

Because the process is assumed to be constant over time, then the mean will be constant over time (not bound by time).

For the ARMA (1,1), the model is as follows :

$$y_t = \phi_1 y_{t-1} + \delta + e_t - \theta_1 e_{t-1}$$

(7)

2.3 Selecting ARIMA Model

The best ARIMA models selection using measurement that is used as goodness model indicator for ARCH/GARCH models as follow:

a. Akaike's Information Criterion (AIC) with the formula: $\log\left(\frac{RSS}{n}\right) + \frac{2k}{n}$

(8)

b. Schwarz Criterion (SC) with the formula: $\log\left(\frac{RSS}{n}\right) + \frac{k}{n}\log n$

(9)

Where :

RSS = residual sum of squares

k = number of independent variables

n = number of observation.

Selection of the best model selected by comparing the value of the AIC or SC values in the can, the minimum value or the smallest is the best model. It also uses Adjusted R^2 value of the largest, with the following formula:

$$\overline{R}^2 = 1 - \frac{RSS/(n-k)}{TSS/(n-1)} = 1 - (1 - R^2)\frac{n-1}{n-k} \qquad (10)$$

Where : *RSS = Residual sum of squares*

TSS = *Total sum of squares*

The AIC criterion gives greater weight than $\overline{R}^2$ in the case of the addition of the independent variables. According to this criterion, a good model if the smallest AIC value. While the criteria for SC gives greater weight than AIC. SC that's Low indicates a better model. There are several advantages of AIC and SC criteria compared with $\overline{R}^2$. First, both of these criteria can be used for in-sample forecasting (whether in accordance with the existing data) as well as out-of-sample forecasting (whether in accordance with the values that occur in the future). Second, these criteria can also be used for nested model selection and non-nested models.

2.4 ARCH and GARCH Model

Time series data, especially the data in financial sector, has a high degree of volatility. Volatility measures the average fluctuations of time series data, but it is developed further with the emphasis on the value of variation (statistical variables that describe how far the changes and fluctuations in the value distribution of the average value) of financial data. That is, the value of volatility as the value of the variance of the fluctuations (return data).

The presence of high volatility is certainly difficult for researchers to make estimates and predictions of the movement of these variables. High volatility shown by a phase in which the fluctuation is relatively high and then followed a low fluctuation and high return. In other words, the data is averaged and the variance is not constant. Sometimes a variant of error does not depend on the independent variable, but these variants change with the change of time. Application of financial data with the characteristics usually on modeling the return of capital markets, inflation and interest rates. Thus volatility patterns indicate heteroscedasticity because there are variants error whose magnitude depends on the volatility of the error in the past.

Autoregressive Moving Average (ARMA) Model is often used in the modeling of time series data. This model has a stationarity assumption on the data and constant residual variance (homoscedasticity). This assumption is not easily fulfilled on time series data data financially. The financial data has its own characteristics compared to the time series data in general, which shows high volatility following the period of time that shows volatility, variance for a long period of time the data is constant but there are some periods where the data variance is relatively high. This is called conditionally heteroskedastic. If detected, the conditionally heteroskedastic autoregressive moving average models (ARMA) no longer appropriate to use. The data get heteroscedasticity properties like this can be modeled by Autoregresive Conditional Heteroscedasticity (ARCH) which was introduced by *Robert Engle.*

ARCH method is a refinement of the ARMA method. At ARMA, the variance is not the center of attention when one uses the model is that we want to see a large deviation in the forecast, which means also the contribution of predictor variables that we input into the model works. For that ARCH is required to see the pattern of residual variance, so that we can evaluate and improve the return forecasts that we make, because this method further support the existence of other predictor variables are unknown or are not included in the model. ARCH designed specifically to produce models and forecasting (forecast) due to the presence of conditionals variance. There are several reasons underlying the establishment of ARCH models and forecast volatility:

1. The need to analyze the risks of the assets that we have or the value of an option.
2. forecasting confidence intervals are at different times, so to get the interval can be obtained from the model variance of the error.
3. a more efficient estimator can be obtained if heteroskesdatisitas can be handled first.

To explain how ARCH models formed, suppose we have the following linear regression model:

$$y_t = b_0 + b_1 x_{11} + b_2 x_{2t} + e_t \qquad (11)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2; \quad \sigma_t^2 = \mathrm{var}(e_t) \qquad (12)$$

Note that $\mathrm{var}(e_t)$ described by two components:

1. constant component : α_0

2. variable component : $\alpha_1 e_{t-1}^2$; that is called ARCH com;ponent.

On this model, e_t heteroscedasticity, *conditional* in e_{t-1}. By adding information "conditional" or "conditional" the estimator of $b_0, b_1,$ and b_2 become more efficient.

ARCH model above, where $\mathrm{var}(e_t)$ depends only on the volatility of the last period, as in $\sigma_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2$, that is called ARCH(1) model. While in general, when it $\mathrm{var}(e_t)$ depends on the volatility of the past few periods as $\sigma_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \alpha_2 e_{t-2}^2 + ... + \alpha_p e_{t-p}^2$ is called ARCH(p) model or written by :

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i e_{t-i}^2$$

(13)

In this model, in order to be a positive variance ($\mathrm{var}(e^2) > 0)$, then the restriction must be made, namely : $\alpha_0 > 0$ dan $0 < \alpha_1 < 1$.

Note the number of ARCH (p) above. With a relatively large number of p will result in the number of parameters to be estimated. The more parameters to be estimated can result in reduced precision of the estimator. To overcome these problems, so that the estimated parameters are not too much, the $\mathrm{var}(e_t)$ can be used the following models :

$$\sigma_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \lambda_1 \sigma_{t-1}^2$$

(14)

This model is called the GARCH (1,1) because σ_t^2 depend on e_{t-1}^2 and σ_{t-1}^2 each of which has a time lag. Similarly, ARCH models, in order to be a positive variance

($\mathrm{var}(e^2) > 0)$,then on this model should also be made restrictions, namely : $\alpha_0 > 0; \alpha_1$ and $\lambda_1 \geq 0;$ and $\alpha_1 + \lambda_1 < 1$.

As ARCH model, the GARCH model can also be estimated by Maximum Likelihood technique.

In general the, $\mathrm{var}(e_t)$ can be represented by the form :

$\sigma_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + ... + \alpha_p e_{t-p}^2 + \lambda_1 \sigma_{t-1}^2 + ... + \lambda_q \sigma_{t-q}^2$ or written by:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i e_{t-i}^2 + \sum_{i=1}^{q} \lambda_i \sigma_{t-i}^2$$

(15)

The Model above is called GARCH(p,q) model.

The model shows that the amount of $\text{var}(e_t)$ is estimated depending on e^2 and also depending on σ^2 in the past.

At the time series data of finance of the ARCH/GARCH element or a form of authoregressive of residual quadratic phase which is characterized by high fluctuations and then followed a low fluctuation and high return.

2.5 Steps in Determining ARCH / GARCH Model

Steps in determining the ARCH / GARCH model are as follows:

1. Identify the mean models

Determine the model parameters model of flats which have a significant predictor. Modeling of the average necessary to produce residual to be estimated changes, so this averaging models has an important role in modeling volatility. Volatility is highly dependent on the type of model averaging formed. Averaging can use regression models or ARMA, in this study the mean model using ARMA model.

2. Testing the conditional variance heterogeneity

The employed tests to detect the presence of the ARCH / GARCH is lagrange multiplier test (LM) or a pattern of squares residuals via correlogram, not using the Durbin-Watson test. This is because the Durbin-Watson test has some disadvantages. First, this test is only valid if the independent variable is random or stochastic. If this test to enter the independent variables that are non-stochastic like inserting variable inaction (lag) of the dependent variable as the independent variable called autoregressive models, the Durbin-Watson test can not be used. Second, the Durbin-Watson test is only valid if the relationship between the residual autocorrelation in the first-order or first-order autoregressive abbreviated AR (1). This test can not be performed for higher autoregressive models such as AR (2), AR (3), and so on. Third, this model can not be used in case a moving average (moving average) of residual higher order.

Based on the above weaknesses, the Breusch and Godfrey develop autocorrelation test is more commonly known as Lagrange Multiplier test (LM). To understand the LM test, it will be made the following simple regression model :

$$Y_t = \beta_0 + \beta_1 X_1 + e_t \tag{16}$$

We make assumption that residual models follow autoregressive models of order p or abbreviated AR (p) as follows :

$$e_t = \rho_1 e_{t-1} + \rho_2 e_{t-2} + ... + \rho_p e_{t-p} + v_t$$

(17)

Where v_t in this model have the characteristic that is $E(v_t) = 0; \mathrm{var}(v_t) = \sigma^2;$ and $\mathrm{cov}(v_t, v_{t+1}) = 0$.

So the null hypothesis of no autocorrelation in the model AR (p) can be formulated as follows :

$$H_0 : \rho_1 = \rho_2 = ... = \rho_p = 0$$
$$H_1 : \rho_1 \neq \rho_2 \neq ... \neq \rho_p \neq 0$$

If we accept H_0 then say no autocorrelation in the model. If the sample is large, then according Breusch and Godfrey, the model in equation (17) will follow the distribution of Chi-Squares df p is the17length of inaction as residuals in equation (2). Statistically calculated value of Chi-Squares can be calculated using the following formula :

$$(n-p)R^2 \approx \chi_p^2$$

(18)

If $(n-p)R^2$ which is a chi-squares (χ) calculated is more than critical value *chi-squares* (χ) at a certain degree of confidence (α), we reject the null hypothesis (H_0). This means least, there is a ρ statistically significantly different from zero. It shows that there is a problem of autocorrelation in the model, and vice versa. The determination of whether there is a problem of autocorrelation can also be seen from the value of the probability chi-squares (χ) . If the probability value is greater than the selected value then we accept H_0 which means do not exist autocorrelation, and vice versa.

In short, the LM test is used to detect the presence of ARCH processes, namely the residual variance heterogeneity influenced squared residual previous period or so-called residual variance heterogeneity conditional (conditional heteroscedasticity) in the time series. Hypotheses for LM test can also be formulated as follows :

H_0: ARCH error does not exist (indicated by the value of F statistic with the *probability* > α)
H_1: ARCH error exists (indicated by the value of F statitic with the *probability* < α)

Beside LM heteroscedasticty test, it also could be seen from residual and squared residuals through correlogram. If there is no autocorrelation on the residual but on the squared residual, it's mean that there is heteroscedasticity. Hypotheses that's used on the testing through correlogram as follows.

H_0: there is no autocorrelation (indicated value of Q Statistically ACF and PACF of the probability $> \alpha$)

H_1: there is autocorrelation (indicated value Q of the ACF and PACF Statistically the probability $< \alpha$)

3. Estimation of the parameters of ARCH / GARCH model

Determination of the alleged parameters by using the maximum likelihood method (maxsimum likelihood). If the residual is not normal then allegedly parameters with Maxsimum Quasi-likelihood method. Maximum likelihood, in the estimation process requires equality in the distribution of error is Normal $(0, \sigma^2)$. While in some cases, errors sometimes do not follow the model of the Normal distribution $(0, \sigma^2)$. Typically the data transformation to normality assumption is fulfilled in order inference estimator done right. However, to obtain the appropriate transformer often have difficulty. Therefore, the quasi-maximum likelihood method (QMLE) offered to resolve the error assumption is violated.

QMLE help reinforce the results of the maximum likelihood inference if an error assumption is violated. QMLE method is a method of estimation variance-covariance performed on the model parameters assuming the error is violated. Based on the variance-covariance value formed a new inference drawn up to determine the significance of the model parameter estimator. QMLE still utilizing the maximum likelihood method as a basis, so that the calculation of the variance-covariance quasi also the values resulting from the maximum likelihood method.

GARCH (p, q) process assumes that (Z_t) is i.i.d. random variable, namely $Z_t \sim N(0,1)$ so the likelihood function can be used. Assuming that the likelihood function is Gaussian, then the log-likelihood function is as follows: $L_T(\theta) = \frac{1}{2T}\sum_{t=1}^{T} l_t(\theta)$

where $l_t(\theta) = -\left(\ln \sigma_t^2(\theta) + \frac{\varepsilon_t^2}{\sigma_t^2(\theta)}\right)$.

(19)

Gaussian likelihood function does not require, in other words, the process (Zt) does not need to be Gaussian white noise, L_T-called quasi-likelihood function. In the use of quasi maximum likelihood (QML), the way to suppress the choice of heteroscedasticity consistent covariance (Bollerslev-Wooldridge) on the choice of model ARCH / GARCH in eviews 6.0. By using this option, the parameters which allegedly remained consistent and asymptotically still valid.

4. diagnosis models

Examination of the model is done by checking whether there are heteroscedasticty, using ARCH-LM test or correlogram case of the conditional variance heterogeneity test phase above. Ljung Box test is used to test the feasibility of the model. The model is feasible if the remnant had not had a pattern (random) or in other words having no autocorrelation lag between a remnant for all k.

5. Selection of the best model

If at this stage of the model diagnostics are some models that fit the selected best model. Criteria for the best model is to have a good size and the goodness of the model coefficients are real. Size used as an indicator of goodness models to models ARCH / GARCH as follows :

a. Akaike's Information Criterion (AIC) with the formula: $\log\left(\frac{RSS}{n}\right)+\frac{2k}{n}$ (20)

b. Schwarz Criterion (SC) with the formula: $\log\left(\frac{RSS}{n}\right)+\frac{k}{n}\log n$ (21)

where :

RSS = residual sum of squares

k = number of independent variables

n = number of observation.

Selection of the best model selected by comparing the value of the AIC or SC values in the can, the minimum value or the smallest dalah best model. Because the ARCH model estimation using the maximum likelihood method is not based on the evaluation of the regression line Adjusted R^2 but based on the log likelihood. Model selection criteria so that also uses the log likelihood great value.

3. Results and Discussion

3.1 Volatility of Expected Rate of Return (RoR)

Stationarity Test

In this study, expected rate of return variable of each financing instrument has been tested for its stationarity.

Table 1 Summary of the unit root test with constant use at the level of [I(0)]

Expected rate of return	*Phillips-Perron test statistic*	Prob.*
(1)	*(2)*	(3)
*Istishna**	-3.7355	0.0047
*Mudharabah**	-3.5885	0.0073
*Musyarakah**	-4.5806	0.0003
*Murabahah**	-5.3750	0.0000
*Qardh**	-5.6485	0.0000

Source: output *eviews 6*

* significant at $\alpha = 5\%$

Based on Table 1, the initial level [I (0)] of the Phillips-Perron test showed that on the whole there is no unit root variables, so the data is stationary, it is shown that the value of prob* or p-value less than α = 5 % (accept Ho) that is not contained unit root. By this, that variable expected rate of return volatility of istishna, mudaraba, murabaha, musharaka and qardh financing instruments calculation to be performed.

Volatility Calculation of Expected Rate of Return Financing Instruments

Volatility measures the average fluctuations of time series data, but it is developed further with the emphasis on the value of variation (statistical variables that describe how far the changes and fluctuations in the value distribution of the average value) of financial data. That is, the value of volatility as the value of the variance of the fluctuations (return data).

Calculations are performed with the ARCH/GARCH model volatility. In this study, modeling ARCH/GARCH is performed on expected rate of return variables that have high volatility characteristics. Expected rate of return is the value of the rate of return (RoR) which is expected. Changes in the expected rate of return in this study is not only seen for its value, but also its volatility or the speed of the rise and fall expected rate of return also observed. In determining the ARCH/GARCH model consists of two stages: determine the mean models and variance models.

High volatility shown by the presence of a phase in which the fluctuations are relatively high and followed a low fluctuation and high return. In Figure 1 below can be seen on all of the variables expected RoR of instruments of Islamic finance in Indonesia show signs of symptoms such volatility. From the pictures of these variables can be expected there are elements of ARCH/GARCH.

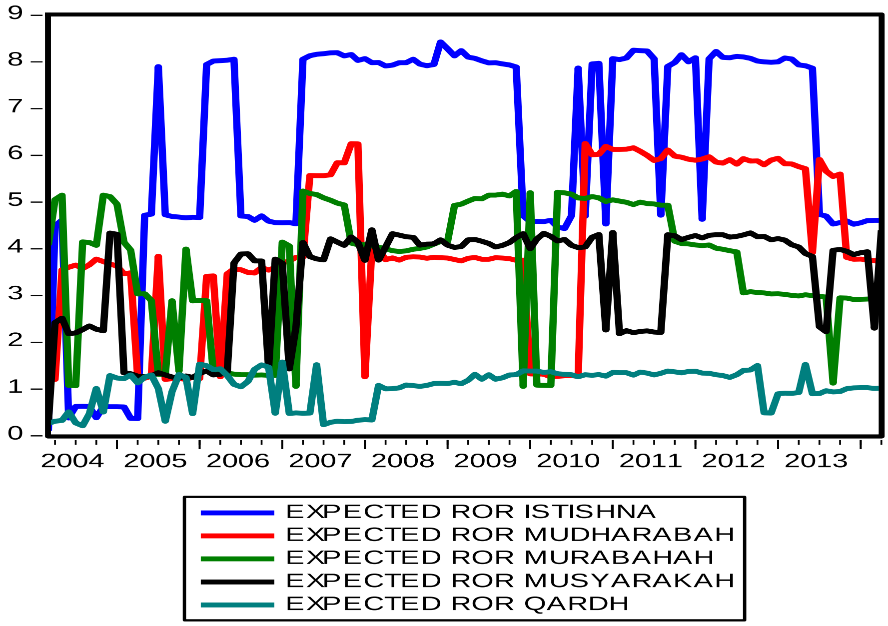

Figure 1 Expected RoR development of istishna, mudaraba, murabaha, musharaka, and qardh (in%) 2004 (March) - 2014 (April)

Source: Bank Indonesia

Expected rate of return of istishna is relatively higher than the mudaraba or murabaha. It also fits with some researchs suggesting that mudaraba and ijarah have positive effect on the profitability of Islamic banking in Indonesia.

Mean Model

The model is establishe by determining the mean equation of Autoregressive Moving Average (ARMA). Selection of the best equation is done by looking at the AIC and SC which are the lowest and the high value of adjusted R^2 values is. Because the analysis of time series requires that the data should be stationary then the ARMA processing using the data at the level expected RoR. The result of trial and error (trial and error) which has smallest value of AIC and SC and the highest value of Adjusted R^{2i} is summarized in the following table.

Table 2 Selection of the best ARMA models (mean models) of expected RoR variable of financing instruments

Expected rate of return	**ARMA**	**AIC**	**SC**	**Adj R^2**
(1)	**(2)**	**(3)**	**(4)**	**(5)**
Istishna	**ARMA(1,1)**	**3.3742**	**3.4435**	**0.7113**
	MA(1)	4.0362	4.0822	0.4597
	MA(2)	4.3809	4.3878	0.5729
Mudharabah	AR(1)	2.7196	2.7658	0.6715
	ARMA(2,1)	**2.7056**	**2.7986**	**0.6752**
	MA(1)	3.2591	3.3051	0.4461
	MA(2)	3.0414	3.1104	0.5580
Murabahah	**AR(1)**	**2.9547**	**3.0009**	**0.4043**
	MA(1)	3.1646	3.210	0.2596
	MA(2)	3.0573	3.1263	0.3403
Musyarakah	AR(1)	2.2354	2.2816	0.5659
	AR(2)	**2.1993**	**2,2690**	**0.5856**
	MA(1)	2.6006	2.6465	0.4075
	MA(2)	2.4870	2.5559	0.4754
Qardh	AR(1)	0.4209	0.4671	0.3778
	AR(2)	0.3497	0.4193	0.4102
	ARMA(2,2)	**0.2098**	**0.3259**	**0,4954**

Source : Bank Indonesia

Detection ARCH-*error*

After a mean models are formed, made an error in the detection of the presence of ARCH models. In this study, the detection of the presence or absence of ARCH-error is using the ARCH-LM test. ARCH-LM test results for ARMA equation of expected RoR financing instruments for the equation shows that the expected variable ARMA RoR murabaha, Musharaka and qardh statistics show obs * R-squared with smaller probability than α = 5%, while the expected variable RoR istishna and mudaraba statistics show obs * R-squared with smaller probability than α = 10%. Thus the hypothesis Ho is rejected, which states that there are elements of ARCH. Because of the mean models kelimat above variables, the resulting error contains elements that can be formed ARCH variance models.

Variance Model

As in the process of establishing the model mean, variance formation step models also through a process of trial and error. However, after testing the normality of the residual model of ARCH / GARCH that will be selected. Test results showed that all models of ARCH / GARCH has not normally distributed residuals. It is marked with a p-value or probability of the Jarque-Bera that less than 5% significance level, so that H_0 is rejected, stating that the residuals do not follow a normal distribution. To overcome this, the corrected standard errors in the subsequent estimation using the Bollerslev-Wooldridge correction (Bollerslev-Wooldridge robust standard errors and covariance) of the estimated quasi-maximum likelihood (QML). This is because although the residual abnormal, resulting estimation of maximum quasi-likelihood estimation (QML) remained consistent. So that the results of the estimated parameters remain valid even if not asymptotically normally distributed. Then proceed to test the significance of parameters. The final step in the determination of the variance of the model is to look at the value of the smallest AIC and SC, as well as the largest log likelihood.

Table 3 Selection of the Best ARCH/GARCH Model (Variance Model) of Expected RoR variable of Financing Instruments

Expected rate of return	**ARCH/GARCH**	**AIC (3)**	**SC (4)**	***Log-likelihood***
Istishna	GARCH(1,0)	3.3472	3.4627	-197.5
	GARCH(1,2)	**3.1758**	**3.33759**	**-185.14**
	GARCH(2,1)	3.3191	3.4808	-193.807
	GARCH(2,2)	3.1958	3.3806	-185.347
Mudharabah	**GARCH(1,0)**	**2.7145**	**2.8307**	**-157.87**
	GARCH(1,1)	2.7297	2.8691	-157.78
	GARCH(1,2)	2.7300	2.8927	-156.804
Murabahah	GARCH(1,0)	2.7742	2.8666	-163.8385
	GARCH(1,1)	**2.5743**	**2.6898**	**-150.747**
	GARCH(0,1)	2.9534	3.0458	-174.683
Expected rate of return	**ARCH/GARCH**	**AIC (3)**	**SC (4)**	***Log-likelihood***

Musyarakah	GARCH(1,0)	2.1130	2.2292	-121.78
	GARCH(1,2)	2.0441	2.2067	-115.645
	GARCH(0,2)	**2.0253**	**2.1646**	**-115.52**
Qardh	GARCH(1,0)	-0.4170	-0.2544	32.0214
	GARCH(2,2)	**-0.6288**	**-0.3966**	**47.734**
	GARCH(0,2)	0.1596	0.3454	-1.5771

Source: Bank Indonesia

In order to obtain the equation of ARCH / GARCH as follows:

To variance model of expected rate of return variables of *istishna*:

$h_t = 1,294 + 0,531\ e^2_{t-1} + 0,231\ \sigma^2_{t-1} - 0,298\ \sigma^2_{t-2}$ (22)

To variance model of expected rate of return variables of istishna *mudharabah*:

$h_t = 0,448 + 1,090\ e^2_{t-1}$ (23)

To variance model of expected rate of return variables of istishna *murabahah*:

$h_t = 0,570 + 1,363\ e^2_{t-1} + 0,317\ \sigma^2_{t-1}$ (24)

To variance model of expected rate of return variables of istishna *musyarakah*:

$h_t = 0,0511 + 1,928\ \sigma^2_{t-1} - 1,0142\ \sigma^2_{t-2}$ (25)

To variance model of expected rate of return variables of istishna *qardh*:

$h_t = 0,0004 + 1,596\ e^2_{t-1} + 1,1346\ e^2_{t-2} - 0,391\ \sigma^2_{t-1} + 0,149\ \sigma^2_{t-2}$ (26)

Where : $h_t = \sigma^2_t$ = variance of squared residuals at t-month

e^2_{t-p} = squared residuals in (t-p)-month

σ^2_{t-q} = variance of squared residuals in (t-q)-month

Checking ARCH / GARCH Model

Terms for good model is that the ARCH element does not exist in the residual of variance models and there is no autocorrelation in the error ARCH/GARCH models equation. ARCH-LM test results for ARCH/GARCH equation for expected RoR variable financing instruments for the equation shows that the GARCH (p, q) of expected RoR istishna, mudaraba, murabaha, musharaka, and qardh variables show statistics obs* R-squared with probability more greater than α = 5%. Thus the hypothesis Ho failed rejected stating there is no element of ARCH or no heteroskedasticity on the model.

Testing can be done by using the autocorrelation correlogram, or a unit root test. Test results showed that all the statistics Q (Q-Stat) of expected RoR istishna and qardh financing instruments variable is not statistically significant, with probability (prob) over $\alpha = 5\%$. This means that the error does not contain the autocorrelation. For expected RoR mudaraba, murabaha, and musharaka financing instruments variable, there is still a significant Q statistics on some initial lag. However, after testing the unit root test stationarity, were error models are stationary at level I (0) (statistically significant at $\alpha = 5\%$). Therefore concluded that the error of the model does not contain the autocorrelation.

3.2 Overview Volatility of Expected Rate of Return Financing Selected

Volatility of expected rate of return is a risk of instability or uncertainty of the expected rate of return financing instruments. ARCH/GARCH model volatility variable is used to form the expected rate of return based on the best model. To obtain the volatility of expected rate of return, first create the best ARIMA modeling each financing instrument as noted previously. Furthermore, the detection of whether the residual variance of the data expected RoR is not constant and varies from one period to another, or contain elements of heteroscedasticity. To detect this using ARCH-LM test. However, the residual variance not only depend on the residual period, but also depends on the residual variance ago period. So perform the modeling generalized autoregressive conditional heteroscedasticity (GARCH) as in the previous stage. From this is derived volatility GARCH of expected rate of return.

The movement of the volatility expected RoR can be seen in Figure 2 below. From this figure it is concluded that the expected RoR volatility of the financing instrument of mudharaba, murabaha, istishna tend to be more volatile than the expected RoR volatility of Musharaka and qardh financing instruments. This means that the expected RoR volatility of the musharaka and qardh financing instruments tend to be more stable than other instruments.

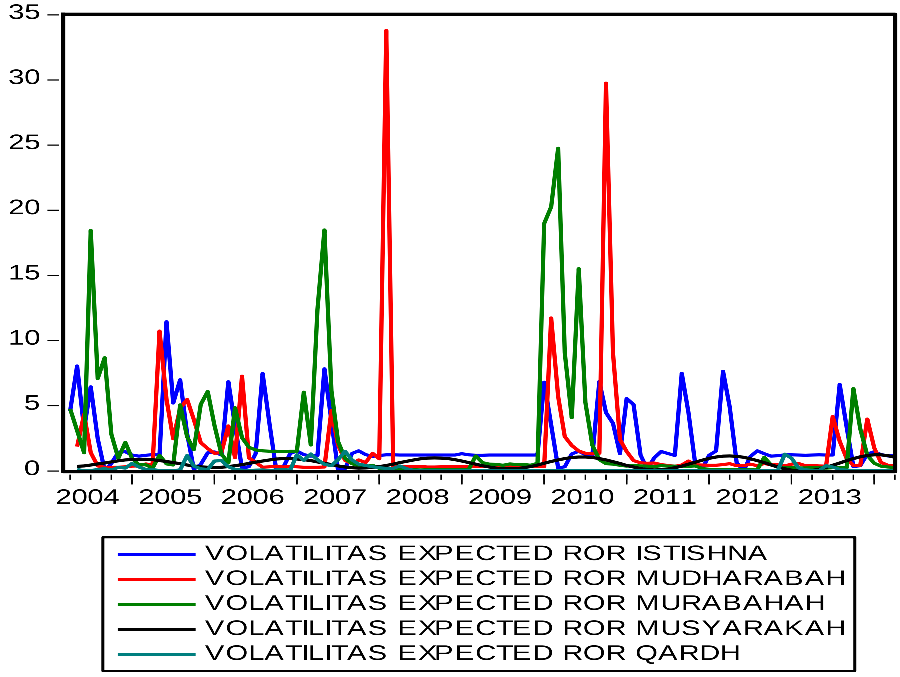

Figure 2 Selected Expected Rate of return volatility movement of Islamic banking financing instrument in 2004 (March) - 2014 (April)

4. Conclusion

Basicaly, volatility measures the average fluctuations of time series data, but it is developed further with the emphasis on the value of variation (statistical variables that describe how far the changes and fluctuations in the value distribution of the average value) of the expected rate of return data. This means that the value of volatility plays as the value of the variance of the fluctuations. Calculations are performed with the ARCH/GARCH model volatility. In this study, ARCH/GARCH modelling is conducted on the expected rate of return variable that has the characteristics of high volatility. Changes in the expected rate of return in this study is not only seen in value, but the volatility or the speed of the rise and fall expected rate of return also observed. In determining the ARCH/GARCH model consists of two stages: determine the mean and variance models.

Having analysed the movement of Expected RoR (Rate of Return) volatility, it is concluded that the expected RoR volatility of mudharaba, murabaha and istishna financing instruments tend to be more volatile than expected RoR volatility of Musharaka and Qardh financing instruments.

This means that abnormal RoR volatility of Musharaka and Qardh financing instruments tend to be more stable than other Islamic financing instruments.

Regardless of the factors that influence the volatility of the Islamic financing instruments, this result gives an idea of how stable the five Islamic financing instruments to be developed as well as anticipated in developing Islamic banking in Indonesia, whether it will be used for the basic preparation of diversification product or financing portfolio serve as an opportunity to invest.

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