Robust Diagnostics of Box-Jenkins statistical method in forecasting share price performance for Sharia-Compliant Oil and Gas sector in Malaysia Stock Exchange

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Abstract:

Malaysia economy is highly depends on oil and gas sector. Therefore, unstable dynamic behavior of crude oil price will affect the performance of share price in Malaysia Stock Exchange. This paper investigates the reliability of Box –Jenkins statistical method to forecast the share price performance for Oil and Gas sector in Malaysia Stock Exchange. In this research, one shariah-compliant company that is selected is Gas Malaysia Berhad. This company is one of the Oil and Gas companies that issued Initial Public Offerings (IPO) in year of 2013. The forecasting model shows the ARIMA (5, 1, 5) contributes 1.7 % error between forecast value and actual value. Therefore, the results concludes that the performance of Gas Malaysia Berhad can be forecast accurately using Autoregressive integrated moving average(ARIMA) model of (5,1,5).The contribution of this findings is to help Malaysian economic expert to understand the current and future behavior of Malaysian economy condition in oil and gas sector. In addition, the findings from this research will help investors to select the appropriate company for their investment decision analysis.

Keywords: Box-Jenkins statistical method, Oil and Gas sector, Initial Public Offerings, Malaysia Stock Exchange

1. Introduction

Initial Public Offering (IPO) for shariah-compliant companies is governed by the shariah law (Islamic law) which is in line with Al-Quran and As-Sunnah. According to shariah law, Islamic investment contract must emphasize profit and loss sharing and prohibit fixed-return known as interest (riba). Shariah law also prohibits activities related to uncertainty, risk and speculation. Thus, Islamic financial contract must follow the philosophy, ethics and objectives of Islamic law.

The evolution of Islamic finance in Malaysia has followed in the wake of innovations in the global financial service industry (Mohd Zin et al., 2011). A nature evolution of Islamic financial industry is Islamic capital market (ICM). ICM was introduced in Malaysian market in June 1997 by the Securities Commission of Malaysia. The first Islamic equity index introduce in Malaysia is RHB Unit Trust Management Bhd in May 1996. Then, follow by the launching of the Dow Jones Islamic Market Index (DJIM) in February 1999,

the Kuala Lumpur Shariah Index (KLSI) by Bursa Malaysia in April 1999 and the FTSE Global Islamic Index Series in October 1999 (Islamic Capital Market Fact Finding Report, 2004). Therefore, the evolutions of Islamic finance specifically on investment side in Malaysia give a significant impact on the performance of Islamic investment.

Parts of ICM, IPO for shariah-compliant companies are important component in economic growth in Malaysia. IPO shares are issues by private companies for raising a capital. Thus, shariah-compliant companies have a significant opportunity to raise a capital for expand their business. This is important stage for small companies to expand their business. While, investors have a big opportunities to invest their money in varies pool of investment. This situations can attracted a potential investors looking on the multiple capital markets as they are exposed to additional risk in IPO environment (internal (firm specific) and external uncertainties) which is affect the first day's initial returns (Sundarasen, et al., 2017).

Even, there are many companies started issues IPO shares but the main reason is either the companies can sustain generate a return in the long term investment or not. This is because most a companies are faced with the high risk and big challenge. Companies also faced with the challenge to maintain potential investors due to unexpected return. This is because in the unstable economic condition currently, it is important for shariah-compliant companies to plan their investment strategic in order to get an investors' royalty and at the same time can increase the market capitalization. Thus, it is important to forecast the return that investors can earn.

Measuring the risk and return in investment is the most gigantic task for the researchers and practitioners because it involve with more uncertainty condition. Therefore, this paper propose new insight on the forecasting method by investigate the performance of shariah-compliant companies using Autoregressive Integrated Moving Average (ARIMA) model. In this respect the ARIMA also known as the Box-Jenkins method that is one of the most popular forecasting methods. In this study, one shariah-compliant company that is Gas Malaysia Berhad was selected in order to forecast the share price performance. This company was issued Initial Public Offerings (IPO) in year of 2013. The main reason for examine the performance of oil and gas sector in Malaysia is due to more than 40 percent income of Malaysia is from oil and gas sector. Thus, Malaysian economy is highly depends on oil and gas sector. However, unstable dynamic behavior of crude oil price currently will affect the performance of share price in Malaysia.

Thus, the objective of this study is to develop forecasting model for oil and gas sector in Malaysia based on the previous data to forecast the future value using a share price of shariah-compliant companies that is Gas Malaysia Berhad. The data used in this study is from June 2012 until June 2017.

2. Literature Review

Worldwide various researchers have conducted empirical investigations to model the volatility by applying various symmetric and asymmetric models such as ARCH, GARCH, IGARCH, EGARCH, GRCH-

M, Q-GARCH, GJR- GARCH, PARCH and TARCH (Gupta and Kashyap, 2014). ARIMA is one of the models that develop based on the previous data to predict the future data. Many study found that ARIMA model is a good method to forecast the future value. ARIMA model are used in forecast data in varies areas such as in exchange rate, stock market, price index and others. Abu Bakar and Rosbi (2017) analyzing the currency exchange rate between Malaysian Ringgit and United State Dollar and found that the ARIMA (1, 1, 1) is suitable for clustering the data between January 2010 until April 2017. Stevenson (2007) examines issues relating to their application in a forecasting context. The results highlight the limitations in using the conventional approach to identifying the best-specified ARIMA model in sample, when the purpose of the analysis is to provide forecasts. The results show that the ARIMA models can be useful in anticipating broad market trends; there are substantial differences in the forecasts obtained using alternative specifications.

Going public is an important new phase in the life cycle of a company during and beyond which it aspires to recycle more productively financial and physical resources (Liu and Li, 2014; Liu et al., 2013). There are many factors influence the performance of IPO companies. Even there are many factors influence the performance of IPO companies in Malaysia, but study that focus on shariah-compliant companies is still lack of investigation. The first study regarding IPO for shariah-compliant campanies is Abdul Rahim and Yong (2010). They investigates the initial return patterns of Malaysian initial public offerings (IPOs) and whether shari'a-compliant status would alter such patterns and found that the initial returns of Malaysian IPOs drop substantially from 94.91 percent reported from the pre-crisis period of 1990-1998 to 31.99 percent, a level more comparable to that reported in advanced markets. Then, Abu Bakar and Uzaki (2014) investigate the performance of IPO for shariah-compliant companies and non shariah-compliant companies found that the average degree of IPO underpricing for shariah-compliant companies is 28.94 percent and a non shariah-compliant company is 27.18 percent. Current study regarding the performance of IPO (both companies: shariah-compliant and non shariah-compliant companies) in Malaysia market found that the average underpricing of 21.22 percent (Ammer and Ahmad-Zaluki, 2016).

Besides that, there is many study examine the performance of shariah-compliant companies listed on the Malaysian Stock Exchange. Study from Wan Ismail, et al. (2015) regarding the quality of report earnings in the corporate reports of Shariah-compliant companies listed on Bursa Malaysia found the robust evidence in shariah-compliant companies. Shariah-compliant companies have significantly higher earnings quality compared to other companies. The results provide support for the arguments that Shariah-compliant companies supply a higher quality of report earnings in order to attract foreign investment. Shariah-compliant companies also have greater demand for high-quality financial reporting because of their Shariah status. Then, shariah-compliant companies are great in scrutiny by regulators and institutional investors.

3. Research Methodology

The objective of this study is to develop forecasting model for oil and gas sector in Malaysia Stock Exchange. The importance of this research is to develop a robust and reliable statistical method in predicting

the stock price in of a company namely Gas Malaysia Berhad. Therefore, the research methodology in this study involved data selection process, Box-Jenkins statistical method and mathematical derivation of Autoregressive integrated moving average (ARIMA).

3.1 Data selection process

This study focused on the share price of companies that issued Initial Public Offering (IPO) in year 2012. In that year, there are two companies from oil and gas sector that issued IPO and comply with sharia-law. In this study, share price for Gas Malaysia Berhad is selected from June 2012 until June 2017.The share price for Gas Malaysia Berhad is collected daily using database of Datastream (Thomson Reuters). Then, the average share price for monthly is calculated.

3.2 Box-Jenkins statistical method

In time series, Box-Jenkins statistical method is autoregressive integrated moving average (ARIMA) models to find the best fit of a time-series model to past values of a time series (Verbeek, 2004). Figure 1 shows the flow of forecasting using Box-Jenkins approach.
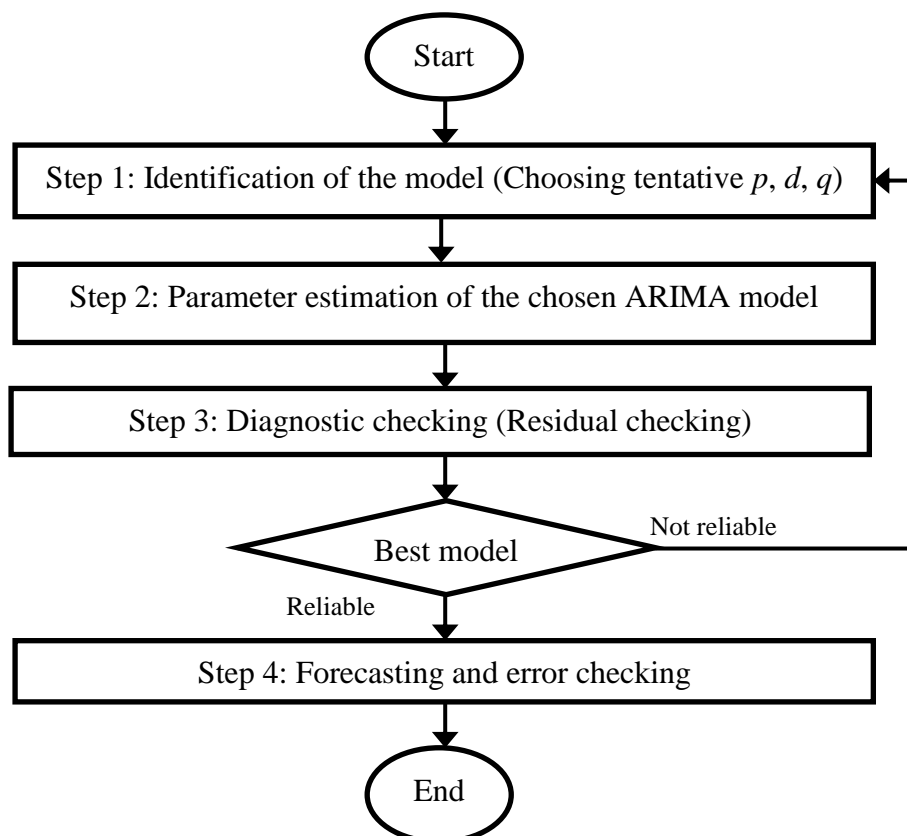

Figure 1: Forecasting procedure using Box-Jenkins approach

The Box–Jenkins forecasting model development starts with identification of autoregressive integrated moving average (ARIMA) model. In developing ARIMA model, stationary test need to be performed. Stationary can be assessed from a run sequence plot. The run sequence plot should show constant location and scale. It can also be detected from an autocorrelation plot. Specifically, non-stationarity is often

indicated by an autocorrelation plot with very slow decay. The Box-Jenkins methods implement differencing to achieve stationarity of data. A statistical stationary time series is one whose statistical properties such as mean, variance and autocorrelation are all constant over time.

Then, after stationarity has been addressed, the next step is to identify the order of the autoregressive and moving average terms. The order of autoregressive is represented by p, moving average is represented by q and diffrencing order is represented by d.

Next, the diagnostics checking need to be performed related to R-squared (coefficient of determination), Akaike information criterion and residual checking.

Finally, the ARIMA model will be used for forecasting procedure. In the forecasting procedure, error diagnostics need to perform in data range that known. Then , the forecasting will be performed in the future target of forecasting range.

3.3 Mathematical derivation of autoregressive integrated moving average (ARIMA)

The derivation of ARIMA model is involving the mathematical derivation of autoregressive (AR), moving average(MA) and autoregressive–moving-average (ARMA).

Firstly, the notation of autoregressive, AR (p) indicates an autoregressive model of order p. The AR (p) model is defined as:

$$X_t = c + \varphi_1 X_{t-1} + ... + \varphi_p X_{t-p} + \varepsilon_t$$

$$X_t = c + \sum_{i=1}^{p} \varphi_i X_{t-i} + \varepsilon_t \qquad (1)$$

where $\varphi_i, ..., \varphi_p$ the parameters of the model, c is constant, and ε_t is white noise.

Secondly, the notation of moving average, MA *(q)* refers to the moving average model of order q:

$$X_t = \mu + \varepsilon_t + \theta_1 \varepsilon_{t-1} + ... + \theta_q \varepsilon_{t-q}$$

$$X_t = \mu + \varepsilon_t + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i} \qquad (2)$$

where μ is the mean of the series, $\theta_1, ..., \theta_q$ are the parameters of the model, and $\varepsilon_t, \varepsilon_{t-1}, ..., \varepsilon_{t-q}$ are white noise error terms. The value of q is called the order of the MA model.

Thirdly, the notation ARMA (p, q) refers to the model with p autoregressive terms and q moving-average terms. This model contains the AR (p) and MA (q) models,

$$X_t = c + \sum_{i=1}^{p} \varphi_i X_{t-i} + \varepsilon_t + \mu + \varepsilon_t + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i}$$

where μ is the mean of the series is expected as zero,

$$X_t = c + \varepsilon_t + \sum_{i=1}^{p} \varphi_i X_{t-i} + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i} \qquad (3)$$

where $\varphi_i, ..., \varphi_p$ the parameters of the AR model, $\theta_1, ..., \theta_q$ are the parameters of the MA model, c is constant, and ε_t is white noise. The white noise ε_t is independent and has identical probability normal distribution. The model is usually referred to as the ARMA (p,q) model where p is the order of the autoregressive (AR) part and q is the order of the moving average (MA) part.

Finally, the derivation of ARIMA model is described as below procedure.

Given a time series of data X_t where t is an integer index and the X_t are real numbers. An ARMA (p, q) model is given by Equation (3).

$$X_t - \alpha_1 X_{t-1} - ... - \alpha_{p'} X_{t-p'} = \varepsilon_t + \theta_1 \varepsilon_{t-1} + ... + \theta_q \varepsilon_{t-q}$$

$$\left(1 - \sum_{i=1}^{p'} \alpha_i L^i\right) X_t = \left(1 + \sum_{i=1}^{q} \theta_i L^i\right) \varepsilon_t \tag{4}$$

where L is the lag operator, α_i are the parameters of the autoregressive part of the model, θ_i are the parameters of the moving average part and ε_t are error terms. The error terms ε_t are generally assumed to be independent, identically distributed variables sampled from a normal distribution with zero mean.

Referring to Equation (4), assume now that the polynomial $\left(1 - \sum_{i=1}^{p'} \alpha_i L^i\right)$ has a unit root (a factor $(1-L)$) of multiplicity d. Then it can be rewritten as:

$$\left(1 - \sum_{i=1}^{p'} \alpha_i L^i\right) = \left(1 - \sum_{i=1}^{p'-d} \alpha_i L^i\right) (1-L)^d \tag{5}$$

An ARIMA (p,d,q) process expresses this polynomial factorization property with $p = p'-d$, and is given by:

$$\left(1 - \sum_{i=1}^{p} \phi_i L^i\right) (1-L)^d X_t = \left(1 + \sum_{i=1}^{q} \theta_i L^i\right) \varepsilon_t \tag{6}$$

The Equation (6) can be generalized as follows,

$$\left(1 - \sum_{i=1}^{p} \phi_i L^i\right) (1-L)^d X_t = \delta + \left(1 + \sum_{i=1}^{q} \theta_i L^i\right) \varepsilon_t \tag{7}$$

This defines an ARIMA (p,d,q) process with drift $\delta/(1 - \Sigma\varphi i)$.

4. Result and Discussion

4.1 Data selection

In this study, share price data for Gas Malaysia is selected. The selected period are starting from June 2012 until June 2017 which is covering 66 months after IPO is issued. Figure 2 shows the dynamic movement of share price for Gas Malaysia Berhad. In the first month, the value of share price is MYR 2.4456. The maximum value of share price is MYR 3.992 in November 2013.The minimum value of share price is MYR 2.095 in August 2015. The value of share price in June 2017 is MYR 2.893.
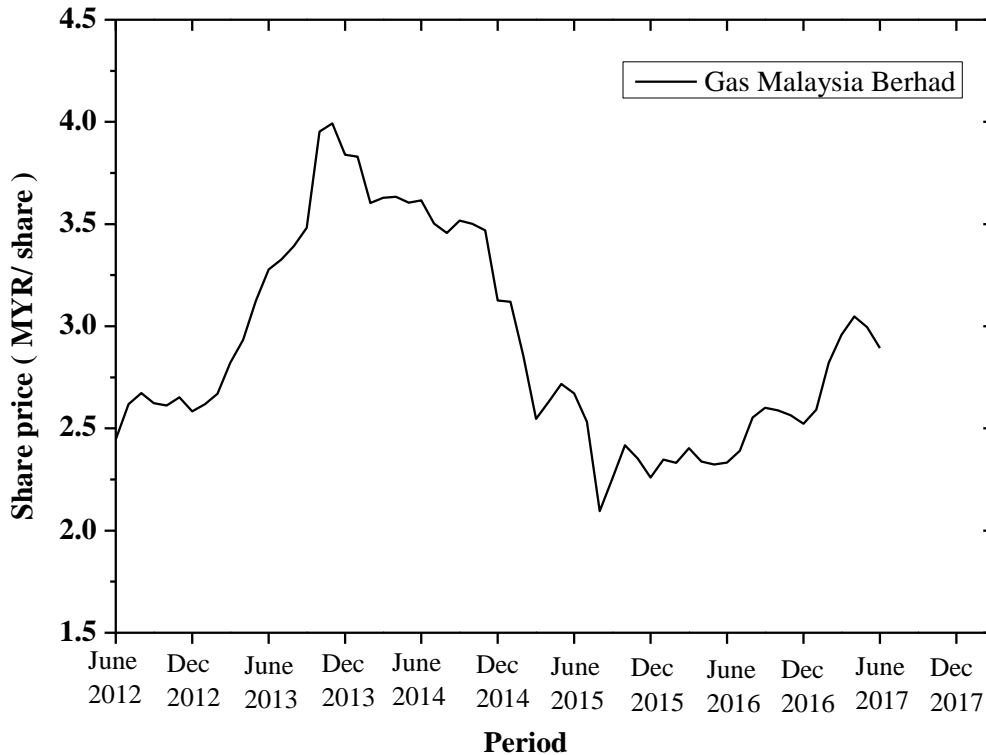
Figure 2: Dynamic movement of share price

4.2 Autoregressive integrated moving average (ARIMA) model analysis.

Then, this study using autocorrelation and partial correlation analysis to find appropriate model for Autoregressive integrated moving average (ARIMA) model. Figure 3 shows the result for ARIMA model analysis.

Figure 3 shows the appropriate ARIMA models for historical data of Gas Malaysia Berhad can be represented by 4 types of models. The models of ARIMA (p,d,q) are (1,1,1), (1,1,5), (5,1,1) and (5,1,5).These models are developed according to the combination of autocorrelation (AC) and partial correlation (PAC) analysis. Figure 2 shows there is significant spikes on first and fifth order.
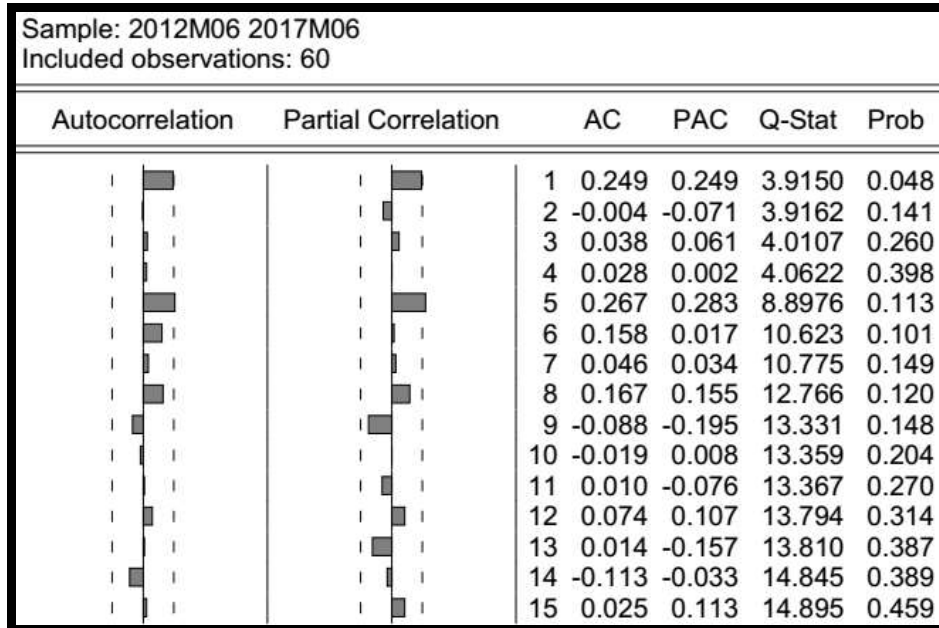
Figure 3: Correlogram for ARIMA model analysis

4.3 Diagnostics of Autoregressive integrated moving average (ARIMA) model.

In this section, this study analyzed four models of ARIMA as shown in Table 1. The result shows ARIMA (5,1,5) indicates highest value of R-squared. R-squared value is the proportion of the variance in the dependent variable that is predictable from the independent variables. Higher value of R-squared shows the particular model of ARIMA is more reliable in approximates the real data points. Therefore, ARIMA (5,1,5) shows the best value of goodness of fit of a linear model.

The Akaike information criterion (AIC) is a measure of the relative quality of statistical models for a given set of data. Value which is near to zero indicates better model with a relative small estimation of the information lost when a given model is used to represent the process that generates the data. Table 2 shows ARIMA (5,1,5) give smallest absolute value.

Table 1: Evaluation of ARIMA model

ARIMA Model (p,d,q)	R-squared	Akaike info criterion(AIC)
(1,1,1)	0.076	-1.020
(1,1,5)	0.153	-0.964
(5,1,1)	0.153	-0.967
(5,1,5)	0.296	-0.920

4.4 Validation of ARIMA (5,1,5) model.

In this section, the estimation of parameter for every variables for ARIMA (5,1,5) were estimated. Figure 4 shows the value for parameter estimation of model ARIMA (5,1,5). Therefore, ARIMA (5,1,5) can be represented by following equation:

$$\Delta y_t = c + \phi_1 \Delta y_{t-1} + \phi_2 \Delta y_{t-2} + \phi_3 \Delta y_{t-3} + \phi_4 \Delta y_{t-4} + \phi_5 \Delta y_{t-5}$$
$$+ \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \theta_3 \varepsilon_{t-3} + \theta_4 \varepsilon_{t-5} + \theta_5 \varepsilon_{t-5} + \varepsilon_t$$

$$\Delta y_t = 0.006815$$
$$+ (0.578322) \Delta y_{t-1} + (0.530859) \Delta y_{t-2} + (-0.610134) \Delta y_{t-3} + (-0.499025) \Delta y_{t-4} + (0.572777) \Delta y_{t-5}$$
$$+ (-0.266223) \varepsilon_{t-1} + (-0.869874) \varepsilon_{t-2} + (0.686328) \varepsilon_{t-3} + (0.830008) \varepsilon_{t-5} + (-0.561690) \varepsilon_{t-5}$$
$$+ 0.014045$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.006815	0.036221	0.188144	0.8516
AR(1)	0.578322	0.619001	0.934283	0.3548
AR(2)	0.530859	0.198788	2.670480	0.0103
AR(3)	-0.610134	0.415516	-1.468377	0.1485
AR(4)	-0.499025	0.254262	-1.962640	0.0555
AR(5)	0.572777	0.403239	1.420439	0.1619
MA(1)	-0.266223	11.78499	-0.022590	0.9821
MA(2)	-0.869874	10.67948	-0.081453	0.9354
MA(3)	0.686328	6.248154	0.109845	0.9130
MA(4)	0.830008	16.65663	0.049830	0.9605
MA(5)	-0.561690	6.911277	-0.081272	0.9356
SIGMASQ	0.014045	0.172675	0.081339	0.9355
R-squared	0.296149	Mean dependent var		0.007452
Adjusted R-squared	0.134850	S.D. dependent var		0.142454
S.E. of regression	0.132501	Akaike info criterion		-0.919564

Figure 4: Parameter estimation for ARIMA (5,1,5)

Then, residual diagnostics was performed for validation of ARIMA (5,1,5).A residual is the vertical distance between a data point and the regression line. Each data point has one residual. They are positive if they are above the regression line and negative if they are below the regression line. If the regression line actually passes through the point, the residual at that point is zero. The residual (e) can also be expressed with an equation. The residual (e) is the difference between the predicted value (ŷ) and the observed value.

Residual = Observed value – predicted value

$$e = y - \hat{y}$$

Figure 5 shows the residuals diagnostics test. There is no significant autocorrelation and partial correlation. Therefore, the residual is a white noise. White noise is a discrete signal whose samples are regarded as a sequence of serially uncorrelated random variables with zero mean and finite variance. This finding is validated by residual dynamic behavior in Figure 6.
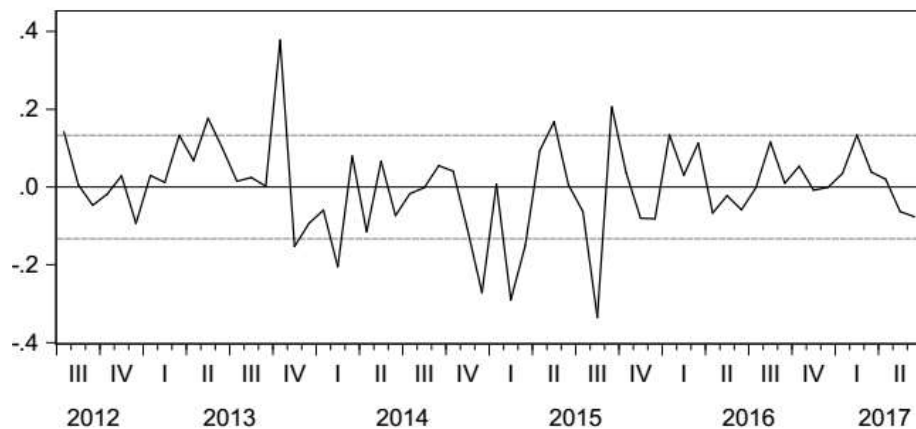
Figure 5: Residual diagnostics test

Figure 6: Residual dynamic behaviour

4.5 Error evaluation for forecasting data using ARIMA (5,1,5) model.

In this section, this study analyzed the error of forecasting a shown in Table 2. The mean absolute percentage error is 1.746 percentages. This value is relatively low that indicates ARIMA (5,1,5) is a reliable forecasting model. Result shows ARIMA (5,1,5) is suitable for forecasting share price of Gas Malaysia Berhad.

Table 2: Ex-post forecasting evaluation

Period	Actual share price (A)	Forecast share price (B)	Delta (A-B)	Error percentage (%)
March 2017	2.9582	2.9188	+0.0394	+1.4
April 2017	3.0485	2.9766	+0.0719	+2.4
May 2017	2.9952	2.9869	+0.0083	+0.3
June 2017	2.8927	2.9799	-0.0873	-2.9

Then, this study plotted the actual and forecast data for March 2017 until June 2017 in Figure 7. The forecast data using ARIMA (5,1,5) model shows there are small value of error percentage between forecast data and actual data. These errors are inside control ranges with tolerance of two standard deviations.
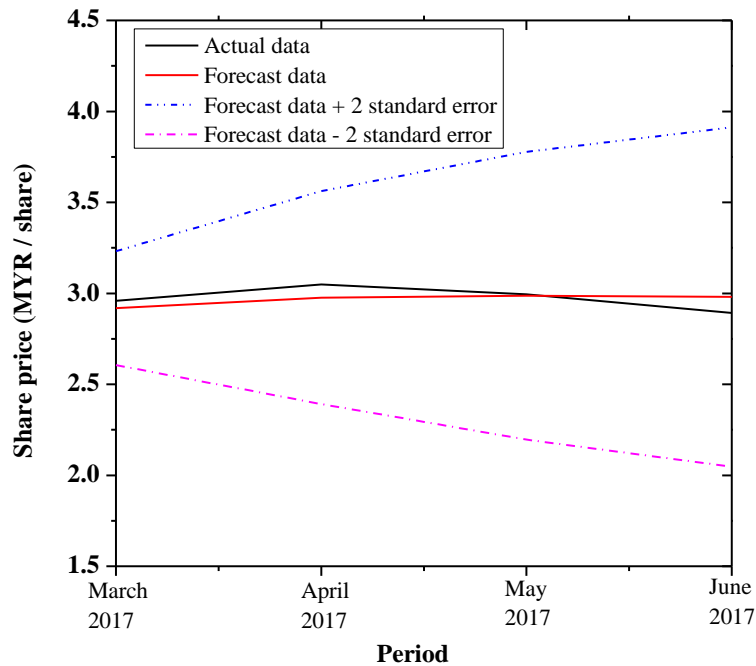

Figure 7: Validation of data forecasting.

4.5 Forecasting of future data using ARIMA (5,1,5) model.

This section shows the most important finding of this research. The historical data selected for developing forecasting model is selected from June 2012 until June 2017.Using historical data, this study develop forecasting model of ARIMA(5,1,5). Figure 8 shows the value of the forecasting of share price of Gas Malaysia Berhad.
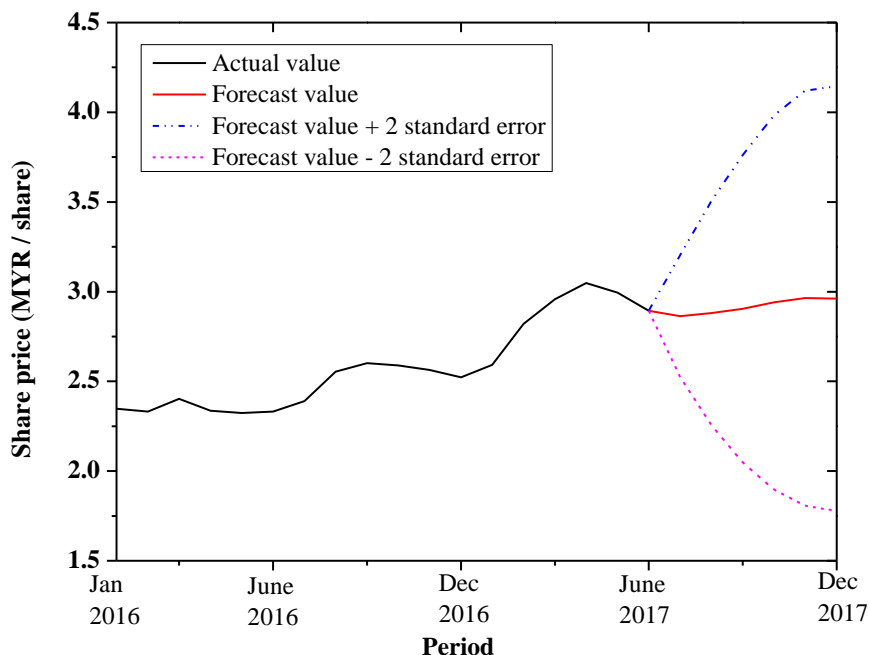

Figure 8: Forecasting of future value for share price

5. Conclusion

The objective of this study is to develop a reliable forecasting model for oil and gas sector in Malaysia Stock Exchange. The importance of this research is to develop a robust and reliable statistical method in predicting the stock price for a company namely Gas Malaysia Berhad. Therefore, the research methodology in this study involved data selection process, Box-Jenkins statistical method and mathematical derivation of Autoregressive integrated moving average (ARIMA).The important finding from this study are concluded as below.

(i) This study focused on the dynamic behavior of share price for companies that issued Initial Public Offering (IPO) in year 2012. In that year, there are two companies from oil and gas sector that issued IPO and comply with sharia-law. In this study, share price for Gas Malaysia Berhad is selected from June 2012 until June 2017.

(ii) The result shows ARIMA (5,1,5) indicates highest value of R-squared. R-squared value is the proportion of the variance in the dependent variable that is predictable from the independent variables. Higher value of R-squared shows the particular model of ARIMA is more reliable in approximates the real data points. Therefore, ARIMA (5,1,5) shows the best value of goodness of fit of a linear model.

(iii) The ARIMA(5,1,5) can be represented by following equation:

$$\Delta y_t = 0.006815$$
$$+ (0.578322)\Delta y_{t-1} + (0.530859)\Delta y_{t-2} + (-0.610134)\Delta y_{t-3} + (-0.499025)\Delta y_{t-4} + (0.572777)\Delta y_{t-5}$$
$$+ (-0.266223)\varepsilon_{t-1} + (-0.869874)\varepsilon_{t-2} + (0.686328)\varepsilon_{t-3} + (0.830008)\varepsilon_{t-5} + (-0.561690)\varepsilon_{t-5}$$
$$+ 0.014045$$

(iv) The mean absolute percentage error is 1.746 percentages. This value is relatively low that indicates ARIMA (5,1,5) is a reliable forecasting model. Result shows ARIMA (5,1,5) is suitable for forecasting share price of Gas Malaysia Berhad.

The contribution of this study is help Malaysian economic expert to understand the current and future behavior of Malaysian economy condition in oil and gas sector. In addition, the findings from this research will help investors to select the appropriate company for their investment decision analysis.

6. Future Research

The further research of this topic can be extending to study the determinants that contribute to the dynamic behavior of share price in oil and gas sector.

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