



LJUNG-BOX AUTOREGRESSIVE MODEL FOR THE RETURNS OF THREE NIGERIAN INSURANCE COMPANIES' STOCKS

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ABSTRACT

ANCHOR, MANSARD and STACO insurance companies' return pattern in Nigeria were analyzed using the statistical package for social science (SPSS). The data for this study was got from the daily closing prices of the stocks of these companies between 2006 and 2018. The daily returns were computed and the analysis done using Time Series. Stationarity were detected when the plots of the return series were plotted. The Autocorrelation and Partial Autocorrelation plots were used to identify the models as well as the order of the models for the three Insurance companies. The Autoregressive model of order two was fitted to the returns on ANCHOR and STACO stocks respectively. While MANSARD had Autoregressive model of order three fitted to it. The adequacy of the model was tested using Ljung-Box test by observing the residual plot. The results proved that the models suited the data.

Keywords: Insurance, Model, Price, Return, Stock

INTRODUCTION

Stock prices are important metrics of measuring stock market returns. Stock return is very important as it is the main objective in ordinary shares. Stock market returns are the returns or gain that the investor generates out of the stock market. Investors, both existing and potential ones regard return as the fundamental reason for investing in a particular firm. Stock return can be in the form of capital appreciation or depreciation (as obtained in the Nigerian Stock Exchange). Therefore the value attached to them matters a lot to both existing and prospective investors in the stock market.

The most common way of generating stock market return is through trading in the secondary market. In the secondary market an investor could earn stock market return by buying stock at a lower price and selling it at a higher price. Capital market serves as a place or arrangement where investors and investees interact. The share at which is being sold is determined by the corporate firm characteristics which usually affect the amount of capital a company can raise from the stock market.

Investing in stocks has its challenges, one of which is that returns are not guaranteed, which arises from the fact that no one can predict exactly how a stock will perform in future. Another challenge is that money can be lost through this measure since stock prices can change often, also if leverage is used to invest in stocks. Based on these challenges, the price movement of some selected insurance companies are investigated using Time Series analysis, return patterns detected, out of which reasonable deductions will be reached and the investors will be well informed on where they can safely invest. It is on this note that this work seeks to investigate the returns of the Nigerian Insurance Stocks by using Time Series analysis to check its stock price movement.

As the financial sector in Nigeria took a turn towards recapitalization process, the insurance industry under the direction of the National Insurance Commission underwent a full recapitalization process that ended with a more robust insurance industry.

The recapitalization of the insurance industry in Nigeria in July 2004 boosted the number of securities listed on the Nigerian Stock Exchange (NSE) thereby increasing the awareness and confidence about the Nigerian Stock Market. However since April 2008, Investors have been worried about the falling stock prices on the Nigerian stocks, although, this problem has been attributed to global economic meltdown Olowe (2009). It is on this note that this work seeks to investigate the returns of the Nigerian Insurance Stocks by using Time Series analysis to check its stock price movement.

Researchers have worked on stock exchange and some of their works are reviewed here. Lukacs (2002) examined the relationship between market capitalization of stock and the distribution of stock returns. A significant relationship was found between Market Capitalization and the distribution of stock. Tudor (2010) used the two-way fixed effect multiple regression to study the relationship between explanatory power on future stock returns of market, financial leverage and earnings to price ratio, return on assets and return on investment covering the period 2002 – 2008. A negative relationship was observed between size and stock return. Uwubanwem and Obayagbona (2012) studied the effect of company fundamentals (book-market value of equity, firm size, leverage and price earnings ratio) and returns on equity in the Nigerian Stock Market using a sample of eight firms with 11 years observation. The study found that firm size has no significant effect on stock market returns.

On the contrary view, Wajid, Arab, Madiha, Waseem and Shabeer (2013) opined that high levered firms are regarded as more risky for investment because, they have high chance of falling into the trap of bankruptcy, as such, potential investors avoid investing in such kind of firms. Consequently the demand for its share will fall and hence affect the stock price as well as stock returns. Khan and Ahmed (2013) studied the impact of capital structure and financial performance on the stock returns of Pakistan textile industry using Ordinary Least Squares method. They believed that the positive trend predicted is because majority of the firms are family-owned and the directors run the interest of majority of shareholders instead of stakeholders.

This work will examine the returns on the stock of three selected Nigerian Insurance Companies using the time series analysis approach to check its stock price movement, thereby making deductions concerning investing in the stocks of the Nigerian Insurance Companies.

MATERIALS AND METHOD

The secondary data used was collected for the daily closing prices of three insurance companies stocks for twelve years between 2006 and 2018 from the cash craft investment website. In order to fit the time series model, the daily return series was computed for daily closing prices, estimation and diagnosis and forecasting using the equation:

$$R_t = \ln \frac{P_t}{P_{t-1}} \text{----- (1)}$$

Where, P_t is the daily closing price for day t and P_{t-1} is the daily closing price at day $t-1$, $t = 2, \dots, n$ with n as the number of observations.

1 Autoregressive Model

The Autoregressive model of order P denoted by AR (P) is of the form

$$R_t = \phi_0 + \phi_1 R_{t-1} + \dots + \phi_p R_{t-p} + E_t \text{ --- (2)}$$

Where $\Phi_1, \Phi_2, \dots, \Phi_p$ are finite sets of weight parameters of the model, Φ_0 is a constant and E_t is the white noise.

The Autoregressive model of order one (P=1) and of order two (P=2) are given as:

$$R_t = \phi_1 R_{t-1} + E_t \text{ --- (3)}$$

$$R_t = \phi_1 R_{t-1} + \phi_2 R_{t-2} + E_t \text{ --- (4)}$$

2 Assumptions of Autoregressive Model

1. The random shocks are independently and identically normally distributed with mean zero and constant variance σ^2 .
2. Properties of the error term E_t are independent of R
3. The R series is weakly stationary with a requirement for stationarity AR (1) as $\Phi_1 < 1$.

3 Moving Average Model

A moving average model of order q, denoted by MA (q) is a process of the form:

$$R_t = E_t - \phi_1 E_{t-1} - \phi_2 E_{t-2} - \dots - \phi_q E_{t-q} \text{ --- (5)}$$

The model states that the values of the series at any period t is equal to the error, E_t corresponding to period t plus a constant multiple θ , of the error at the most immediate past period, t-1. The constant θ , is a parameter to be estimated from a sample data.

Assumptions of Moving Average Model

1. E_t are independently and identically distributed, each with a normal distribution having mean 0 and variance σ^2
2. The root of the auxiliary equation all lies inside a unit circle.

4 Model Formation for ARIMA

Autocorrelation: Is a quantity that measures the linear relationship between time series observation and the lag k time unit. Partial autocorrelation function at lag k [PACF(k)] is a quantity that measures the linear relationship between the time series that are k intervals apart with the effect of the intervening observation eliminated. ARIMA model can be identified through the conformity of the identification tool of the data to the identifiable ARIMA model.

Estimation: Is the efficient use of the data to make inference about the parameters of the identified

ARIMA model.

Diagnostic: The test statistic used to test and determine whether the first K sample autocorrelation to residual indicate adequacy of the model is Ljung-Box Statistics given as

$$Q = \frac{n(n+2) \sum R^2}{n-2} \text{ --- (6)}$$

Where n = number of observation, R = sample autocorrelation of residual separated by L time units. If $Q > X^2(k - np)$. It shows that the model is inadequate but if $Q < X^2(k - np)$, the model is adequate. Box-Jenkins and Reinsel (1994).

Forecasting: The fundamental aim of time series is the forecasting or prediction of values in order to develop a vital planning for a futuristic event. Future values are predicted based on previous and current observed values. An ARIMA model is chosen for forecasting because it has a minimum mean square during the fitting process.

RESULTS AND DISCUSSION

The analysis of data is presented as follows:

Table 1: Descriptive Statistics of the returns of the three selected Nigerian Insurance Companies

	N	Minimum	Maximum	Mean	Std. Dev.
ANCHOR	2604	-.58779	.58779	.0004058	.03649283
MANSARD	2604	-.58779	.58779	.0004058	.03649283
STACO	2604	-1.49962	1.49962	.0006008	.05448345

ANCHOR, MANSARD and STACO companies recorded positive value of mean returns, indicating a gain in their returns. The stationarity of the series was investigated by observing its time plot and it was found to be stationary. The model identification of the companies and time plot of the returns are presented in figures 1 below. It was observed that the series is stationary, hence no need for differencing. ACF and PACF are shown by figures 4 and 5 for ANCHOR Insurance Company. It revealed that the ACF plot and PACF had its peaks at lag 2.

TABLE 2: Model Estimation for AR (2) Model Fitted to ANCHOR Return Series

	Estimate	S.E	T	P-Value
Constant	0.000	0.001	0.508	0.611
AR(1)	0.046	0.020	2.375	0.018
AR(2)	0.065	0.020	3.309	0.001

The time series model fitted for ANCHOR is AR (2) which is given as

$$R_t = \phi_0 + \phi_1 R_{t-1} + \phi_2 R_{t-2} + E_t$$

From Table 2 using $\Phi_0 = 0.000$, $\Phi_1 = 0.046$, $\Phi_2 = 0.065$

$$R_t = 0.000 + 0.046R_{t-1} + 0.065R_{t-2}$$

Testing for the Significance of AR terms in the AR (2)

For ANCHOR we have: For AR (2) at lag 1 (Φ_1):

$$H_0 : \phi_1 = 0; H_1 : \phi_1 \neq 0$$

$$t = \frac{\phi_1}{S(\phi_1)} = \frac{0.046}{0.020} = 2.3.$$

The critical value = 1.96; since t-statistic = 2.3 > t-critical = 1.96, we reject H_0 . Hence AR (1) is significant in the model fitted to ANCHOR return series.

For AR (2) at lag 2 (Φ_2)

$$H_0 : \phi_2 = 0; H_1 : \phi_2 \neq 0$$

$$t = \frac{\phi_2}{S(\phi_2)} = \frac{0.065}{0.020} = 3.25$$

The critical value = 1.96, since t-statistic = 3.25 > t-critical = 1.96, we reject H_0 . Hence AR (2) is significant in the model fitted to ANCHOR return series. The Ljung-Box test was used to diagnose the fitted model for ANCHOR insurance company. The result shows that the model was within the confidence interval of 0.05.

Table 3: Model diagnostic check using Ljung-Box test.

	Statistic	Df	p value
Ljung-Box	20.021	16	0.219

The p-value of the Ljung-Box test is greater than 0.05, hence the AR (2) model was adjudged to be a good fit for ANCHOR returns.

Forecast for ANCHOR Insurance: The model fitted is

$$R_t = 0.000 + 0.046R_{t-1} + 0.065R_{t-2}$$

Where R_{t-1} is the return as at 25/07/2016 = -0.0138 and R_{t-2} is the return as at 26/07/2016 = 0.0000.

Forecast for 27/07/2016:

$$R_{27} = 0.000 + 0.046(0.0138) + 0.065(0.000) = -0.00063$$

Forecast for 28/07/2016:

$$R_{28} = 0.000 + 0.046(0.0000) + 0.065(0.00063) = 0.00004$$

The model Identification for MANSARD is presented in figure 2 and it reveals that the series is stationary. The ACF and PACF of the Return Series for Mansard Stock shown in figures 6 and 7 reveals that it has

cutoff at lags 1, 2, 3 respectively while ACF has its peak at lag 2.

Table 4: Model Parameter Estimates for AR (3) Fitted to Mansard Returns

	Estimate	S.E	T	P-Value
Constant	0.0004	0.001	0.658	0.511
AR(1)	0.049	0.020	2.518	0.012
AR(2)	0.079	0.020	4.054	0.000
AR(3)	0.052	0.020	2.655	0.008

The time series model fitted for MANSARD is AR (3) which is given as:

$$R_t = \phi_0 + \phi_1 R_{t-1} + \phi_2 R_{t-2} + \phi_3 R_{t-3} + E_t$$

Where $\Phi_0 = 0.004$, $\Phi_1 = 0.049$, $\Phi_2 = 0.079$, $\Phi_3 = 0.052$

$$R_t = 0.004 + 0.049R_{t-1} + 0.079R_{t-2} + 0.052R_{t-3}$$

Test for the Significance of the AR terms for AR (3) for Mansard: For AR (3) at lag 1 (Φ_1):

$$H_0 : \phi_1 = 0; H_1 : \phi_1 \neq 0$$

$$t = \frac{\phi_1}{S(\phi_1)} = \frac{0.049}{0.020} = 2.45.$$

The critical value = 1.96. We reject H_0 since t-statistic = 2.45 > t-critical = 1.96. Therefore AR (1) is significant in the model fitted to MANSARD return series. For AR (3) at lag 2 (Φ_2):

$$H_0 : \phi_2 = 0; H_1 : \phi_2 \neq 0$$

$$t = \frac{\phi_2}{S(\phi_2)} = \frac{0.079}{0.020} = 3.95.$$

The critical value = 1.96, we reject H_0 since t-statistic = 3.95 > t-critical = 1.96. Therefore AR (2) is significant in the model fitted to MANSARD return series.

For AR (3) at lag 3 (Φ_3):

$$H_0 : \phi_3 = 0; H_1 : \phi_3 \neq 0$$

$$t = \frac{\phi_3}{S(\phi_3)} = \frac{0.052}{0.020} = 2.5.$$

The critical value = 1.96, we reject H_0 since t-statistic = 2.5 > t-critical = 1.96, hence AR (3) term is significant in the model fitted to MANSARD return series.

Ljung-Box test was used to diagnose the fitted AR (3) model to the return series of MANSARD. The result of the Ljung-Box test shows that the model was within the confidence interval of 0.05.

Table 5: Model Diagnostic check using Ljung-Box test.

	Statistics	Df	P value
Ljung-Box	23.683	15	0.071

The p-value of the Ljung-Box test is greater than 0.05. The AR (3) is adjudged to be a good fit.

Forecast for Mansard: The model fitted is:

$$R_t = 0.004 + 0.049R_{t-1} + 0.079R_{t-2} + 0.052R_{t-3}$$

Where, R_{t-1} is the return as at 24/07/2016 = 0.000; R_{t-2} is the return as at 25/07/2016 = 0.000 and R_{t-3} is the return as at 26/07/2016 = 0.000

Forecast for 27/07/2016:

$$R_{27} = 0.004 + 0.049(0.000) + 0.079(0.000) + 0.052(0.000) = 0.0004$$

Forecast for 28/07/2016:

$$R_{28} = 0.004 + 0.049(0.000) + 0.079(0.000) + 0.052(0.0004) = 0.00042$$

The model Identification for STACO is presented in figure 3 and it reveals that the return is stationary. The ACF and PACF of the Return Series for STACO Stock shown in figures 8 and 9 reveals that ACF has its cutoff at lag 1 while PACF cutoff is at lags 1 and 2.

Table 6: Parameter estimate of returns for AR (2) fitted to STACO returns

	Estimate	S.E	t	P value
Constant	0.0006	0.001	0.857	0.391
AR(1)	-0.343	0.019	-17.595	0.000
AR(2)	-0.109	0.019	-5.595	0.000

The model identified is: $R_t = \phi_0 + \phi_1 R_{t-1} + \phi_2 R_{t-2} + E_t$
Where, $\Phi_0 = 0.0006$, $\Phi_1 = -0.343$, $\Phi_2 = -0.109$
 $R_t = 0.0006 - 0.343R_{t-1} - 0.109R_{t-2}$

Testing for the Significance of AR terms in the AR (2) for STACO.

For AR (2) at lag 1 (Φ_1):

$$H_0 : \phi_1 = 0; H_1 : \phi_1 \neq 0$$

$$t = \frac{\phi_1}{S(\phi_1)} = \frac{-0.343}{0.019} = -18.352$$

The critical value = 1.96. Since the absolute t-statistic = 18.352 > t-critical = 1.96, we reject Ho. Hence AR (1) is significant in the model fitted to STACO returns.

For AR (2) at lag 2 (Φ_2):

$$H_0 : \phi_2 = 0; H_1 : \phi_2 \neq 0$$

$$t = \frac{\phi_2}{S(\phi_2)} = \frac{-0.109}{0.019} = -5.74$$

But the critical value = 1.96, since absolute t-statistic = 5.74 > t-critical = 1.96, we reject Ho. Hence AR (2) is significant in the model fitted to STACO returns. Ljung-Box test was used to diagnose the AR (2) model

REFERENCES

- Box, G. E. P., Jenkins, G. M. and Reinsel, G. C., (1994). *Time Series Analysis Forecasting and Control. Third Edition*, Prentice Hall, Englewood cliff, N.J.
- Khan, N. and Ahmad, A. (2013). Firms Specific Characteristics and Stock Market Returns. *Research Journal*

fitted to the return series on STACO. The result of the Ljung-Box test shows that the model was within the confidence interval of 0.05.

Table 7: Model Diagnostic Check using Ljung-Box Test.

	Statistics	Df	P value
Ljung-Box	12.202	16	0.730

The P value of the Ljung-Box test is greater than 0.05, therefore, the model is adjudged a good fit.

Forecast for Staco: The model fitted is:

$$R_t = 0.0006 - 0.343R_{t-1} - 0.109R_{t-2}$$

Where R_{t-1} is the return as at 25/07/2016 = 0.000 and R_{t-2} is the return as at 26/07/2016 = 0.000.

Forecast for 27/07/2016:

$$R_{27} = 0.0006 - 0.343(0.000) - 0.109(0.000) = 0.0006$$

Forecast for 28/07/2016:

$$R_{28} = 0.0006 - 0.343(0.000) - 0.109(0.0006) = 0.00053$$

CONCLUSION

From the study, the ANCHOR, MANSARD and STACO have positive mean values, which implies that the three selected insurance companies recorded gains within the time of the study. Stationarity was found for ACF and PACF of the daily returns of the three companies, therefore, there was no need for differencing. Similarly, the daily returns as well as the stock prices changed on daily basis since former was dependent on the later. The models fit for the daily returns of three selected Insurance companies were AR (2) for ANCHOR, AR (3) for MANSARD and AR (2) for STACO respectively. The analyses of the returns of the three selected companies reveals that they have no trend but stationary meaning that the returns of the companies were not affected with change in time. Three models were identified to suit the returns on the stock of the three selected Nigerian Insurance Companies which were: AR (2) for ANCHOR, AR (3) for MANSARD and AR (2) for STACO. The forecast of the returns for ANCHOR were negative and positive for 27th and 28th July, 2016 respectively. For MANSARD and STACO their returns were positive for the next two days where the positive return indicated a gain and the negative return indicated a loss.

Lukacs, P. (2002). Stock returns distribution and market capitalization. *Hungarian Statistical Review*, 7.

Olowe, R. A. (2009). The Impact of the Announcement of the 2005 Capital Requirement for Insurance Companies on the Nigerian Stock market. *The Nigerian Journal of Risk and Insurance*, 6(1), 43-69.

Tudor, C. (2010). Firms specific factors as predictors of future returns for Romanian common stock: empirical evidence. *International business and Economics Department, Academy of Economics Studies from Bucharest, Romania*.

Uwubanmwun, A. E. & Obayagbona, J. (2012). Company fundamentals and returns in the Nigerian stock exchange. *JORIND*, 10 (2).

Wajid, K., Arab, N., Madiha, K., Waseem, K. Q. K. & Shabeer, A. (2013). The impact of capital structure and financial performance on stock returns: a case of Pakistani textile industry. *Middle-East Journal of Scientific Research*, 16 (2), 289-295

LIST OF FIGURES

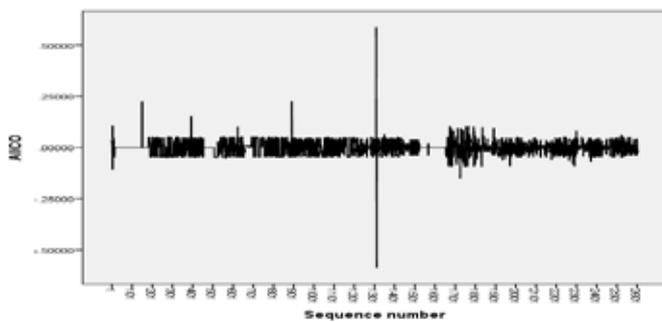


Fig 1: Plot of the Return series for ANCHOR

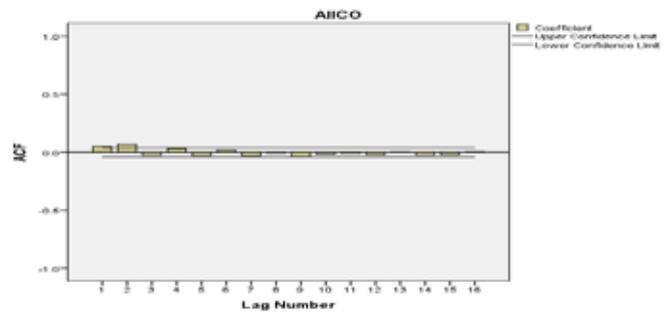


Fig 4: ACF plot for ANCHOR

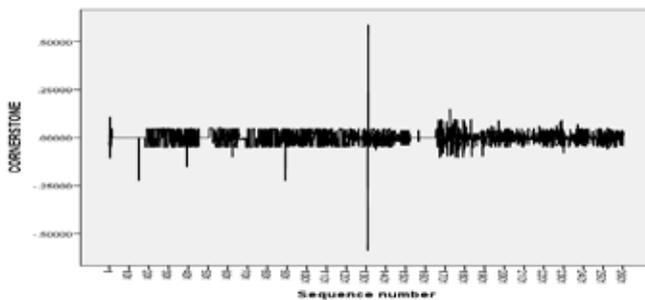


Fig 2: Plot of the Return series for MANSARD

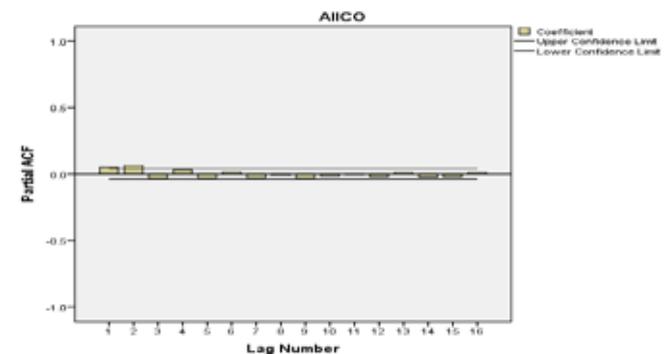


Fig 5: PACF Plot for ANCHOR

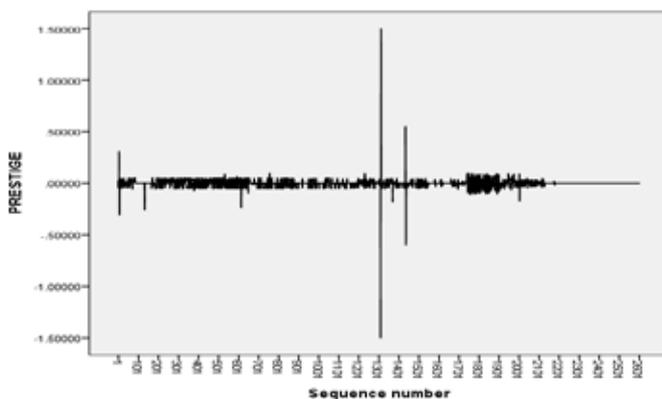


Fig 3: Plot of the Return series for STACO

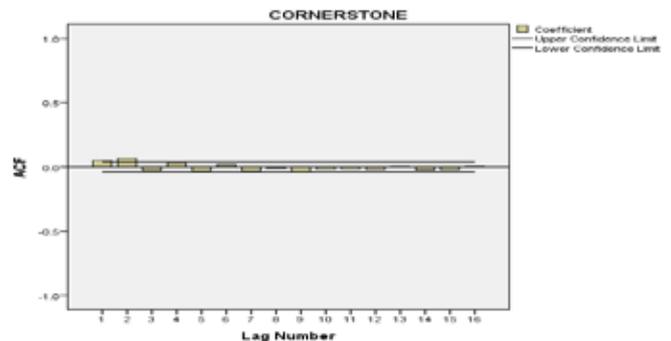


Fig 6: ACF Plot for MANSARD

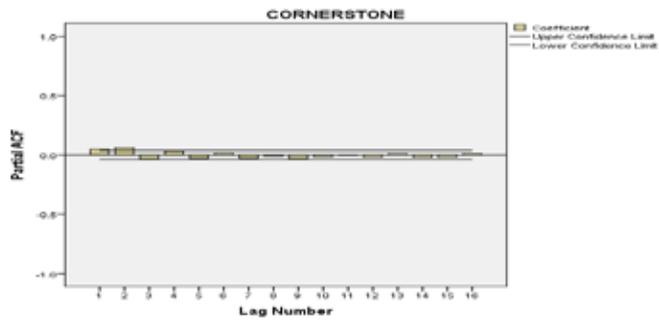


Fig 7: PACF Plot for MANSARD

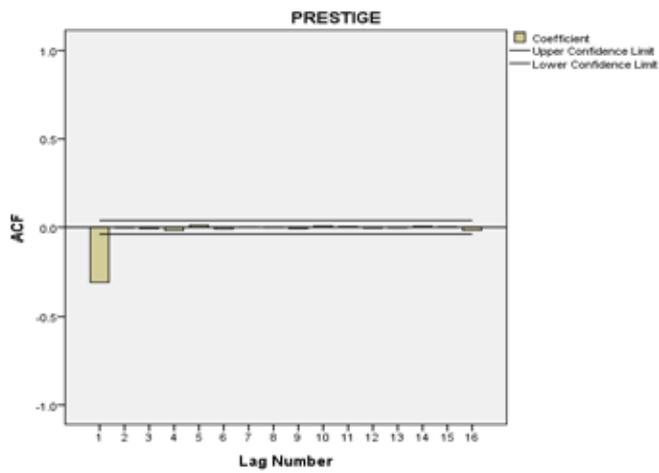


Fig 8: ACF Plot for STACO

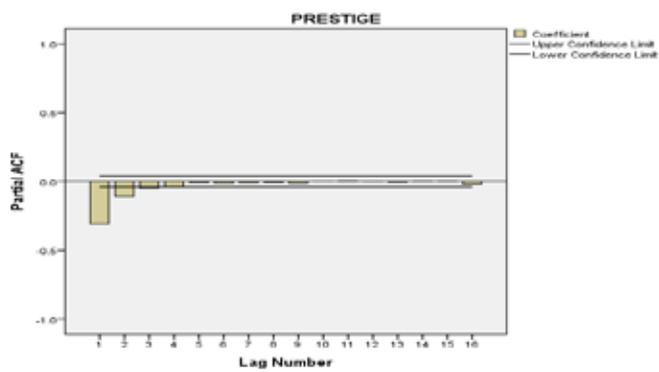


Fig 9: PACF Plot for STACO

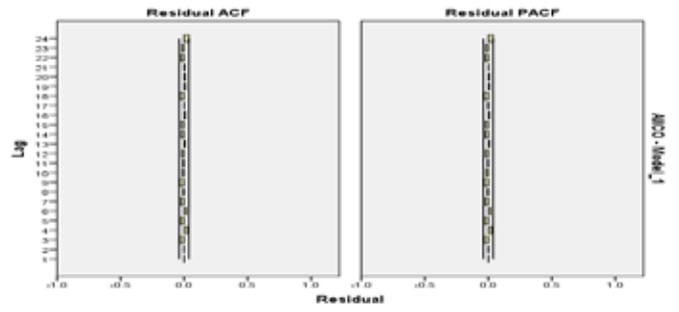


Fig 10: Residual Plot for ANCHOR

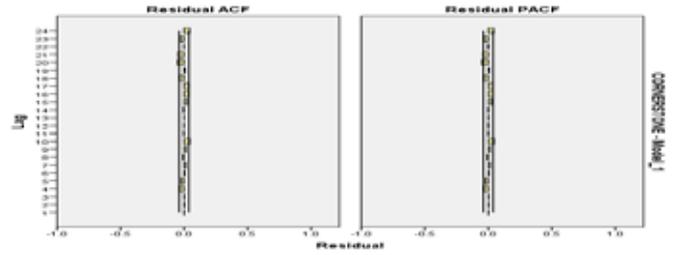


Fig 11: Residual Plot for MANSARD

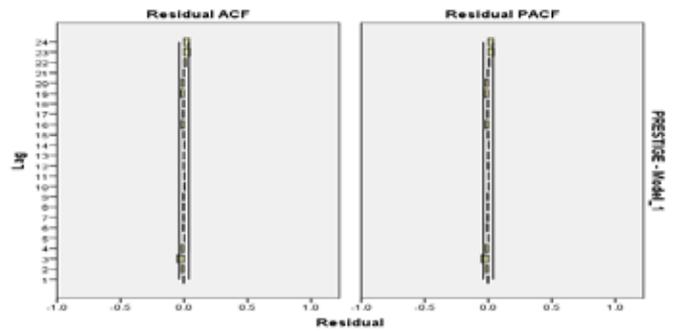


Fig 12: Residual Plot for STACO