



Forecasting Methods for Assets Prices

D. JAYEOLA

Department of Mathematical Sciences, Adekunle Ajasin University, Akungba Akoko, Ondo State, Nigeria

*Corresponding author E-mail address: dare.jayeola@aaau.edu.ng, darchid2002@yahoo.com

Abstract

Keywords:

GARCH, EGARCH, ARCH,
AIC, SIC
Asset,
Forecast..

The movements in Asset prices are very complex and therefore, seem to be unpredictable. However, one of the main challenges of the econometric models is to forecast such a seemingly unpredictable economical series. This paper investigates forecasting methods for assets prices and determines the best model for each asset price; gold and crude oil are used as case study. The forecasting method used is: ARCH family models, such as GARCH and EGARCH and. Analysis of the two ARCH family models are conducted, the two testing parameters used are Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC). The guidelines are, the lower the values of AIC and SIC better the model of the asset. Eventually, the study shows that each asset's price has its peculiar model for forecasting. Hence, GARCH model is best for forecasting crude oil price while EGARCH is best for forecasting gold price. Moreover, gold has strong market value and ability to withstand stress during economic recession; therefore, it can serve as hedge and safe haven.

Accepted: 20 Sept, 2020

© Science Research Annals. All rights reserved.

INTRODUCTION

Forecasting is fundamental to the risk management process in order to price assets derivatives, hedging strategies and estimating the financial risk of a firm's portfolio. In recent years, Autoregressive Conditional Heteroscedasticity (ARCH) type models have become popular as a means of capturing observed characteristics of financial returns like thick tails and volatility clustering. These models use time series data on returns to model conditional variance. An alternative way to estimate future volatility is to use options prices, which reflect the market's expectation of volatility. Analytical option pricing models can be used to back out implied volatility over the remaining life of the option given the observed market price. In the construction of volatility forecasts, energy market participants would like to know which model produces the most accurate forecasts, as well as, whether the complex time series

models enhance any significant volatility information beyond what contained in option prices. Davis and Lleo (2016) compared the relative information content and predictive power of implied volatility and ARCH family forecasts for asset futures. A similar study by Haggins *et al.* (2016) studied analysis for financial management of efficiency of options market in predicting volatility. Brealey *et al.* (2017) examined the prediction of financial volatilities for crude oil, gold and natural gas markets.

Finance is focused on intertemporal decision making under uncertainty and so forecasts of unknown future outcomes is integral to several areas of finance asset pricing requires forecasts of future cash. Risk management relies on forecasts of variances and covariance of returns on portfolios that frequently comprise large numbers of assets. Countless studies in corporate finance analyze firms' capital budgeting decisions which in turn depend on

projected cash flows and firms forecasts of the costs and benefits of issuing debt and equity. A large literature in banking analyzes the possibility of runs which reflects investors forecasts of both a bank's solvency and liquidity as well as their expectation of other agents (depositors) decisions on whether to run or stay put. While economic and financial forecasting share many methods and perspectives, some important features help differentiate the two areas. Competitive pressures and market efficiency mean that the signal-to-noise ratio in many financial forecasting problems particularly predictability of asset returns is very low compared to standard forecasting problems in macroeconomics in which the presence of a sizeable persistent component makes forecasting easier. The presence of weak predictors with low predictive power and the resulting importance of parameter estimation error is therefore the norm rather than the exception in financial forecasting. The possibility of readily trading on price forecasts makes the scope for feedback effective from forecasts to actual outcomes stronger in finance than in other areas of economics.

Model instability is therefore particularly important to financial forecasting; overstating and issues related to data mining have increasingly become a concern in financial forecasting due to the ease with which numerous forecasting models can be fitted to a given data set and the difficulty of generating new and genuinely independent data sets on which to test the forecasting performance. In particular, how should the performance of a forecasting model be evaluated when this model is selected as the best performer among a larger set of competing specifications? This situation generates a multiple hypothesis testing problem that, if not accounted for, can lead to findings of spurious predictability patterns and serious distortions in inference while volatility forecasting also features prominently in forecasting of macroeconomic variables. The risk management is concerned with forecasting the correlations between very large sets of variables and so gives rise to high dimensional forecasting problems. Moreover, access to high frequency data, sampled every few seconds during trading sessions for the most liquid assets, means that measures of realized variances can be constructed and used to forecast future risks. This type of data does not, as yet, have obvious counterparts in economics where measurements tend to be conducted at a lower frequency.

The Akaike information criterion (AIC) is an estimator of out-of-sample prediction error and thereby relative quality of statistical models for a given set of data. Given a collection of models for the data, AIC estimates the quality of each model, relative to each of the other models. Thus, AIC provides a means for model selection. In estimating the amount of information lost by a model, AIC deals

with the trade-off between the goodness of fit of the model and the simplicity of the model. In other words, AIC deals with both the risk of over fitting and the risk of under fitting. The Schwarz information criterion (SIC) is one of the most widely known and used tools in statistical model selection. The criterion was derived by Schwarz in 1978 to serve as an asymptotic approximation to a transformation of the Bayesian posterior probability of a candidate model. Although the original derivation assumes that the observed data is independent, identically distributed, and arising from a probability distribution in the regular exponential family, SIC has traditionally been used in a much larger scope of model selection problems. To better justify the widespread applicability of SIC, and then derive the criterion in a very general framework: one which does not assume any specific form for the likelihood function, but only requires that it satisfies certain non-restrictive regularity conditions. In this study, AIC and SIC are used to determine the best model in the Arch Family model, the lower the values of AIC and SIC, the better the model. The remaining parts of this paper is organized as follows: section two reviews literature, section three explains the methodology, results and discussions are considered in section four while section five concludes the paper.

LITERATURE REVIEW

Economists have long thought that forecasts are potentially useful as decision aids, and have devoted considerable efforts to develop and assess forecasting methods (Allaj, 2013). Forecasts can provide decision makers with technical and market support to help execute policies. In stock markets, forecasts are typically made for the prices of assets commodity outputs. Less work has been done on forecasting the primary inputs needed to produce the commodities. However, most important variable inputs are crude oil and gold, since crude oil and gold are used as measurement in stock market (Inces and Trafalis, 2017). With the recent price volatility in the fuel market, making wrong decisions in fuel purchasing can have a significant impact on the bottom line for farming firms or fuel providers. While the ability to anticipate short term fuel prices may be useful, very little work has been done to evaluate the ability to forecast asset price. The dearth of research on this topic requires examining the energy forecasting literature in order to design an approach to forecast asset prices.

Yanagihara *et al.* (2020) in his work titled, Bias Correction effect of the AIC for selecting variables in Normal Multivariate Linear Regression models. He considered two criteria; The Akaike Information Criterion, AIC and Takeuchi Information Criterion TIC. In his paper he also compared the performance of AIC and Akaike Information Criterion

Component, AICC. Both criteria may be viewed as estimators of the expected Kullback Leibler information. The bias of AIC and AICC are studied in the under fitting case, where none of the candidate models includes the true model (Schulmerich *et al.* 2015). Both normal linear regression and autoregressive candidate models are considered. The bias of AICC is typically smaller, often dramatically smaller, than that of AIC. A simulation study in which the true model is an infinite order auto regression shows that, even in moderate sample sizes, AICC provides substantially better model selections than AIC.

Manel and Chaker (2015) in their work titled; Forecasting of crude oil price, said as most important strategic resource around the world crude oil is the key commodity for the world economy. Therefore forecasting crude oil price has always been considered as a very challenging task which drew the interest of researchers. The price of oil is essentially determined by its supply and demand (Beidas-Strom and Pescatori, 2014). There appeared to be benefits from disaggregation and for searching for new causal variables. Greater volatility of oil prices could rekindle the integration of petroleum operations designed to save on transaction costs incurred in reducing uncertainty. More sophisticated, and hence more expensive, market instruments might be required to hedge risks. More complex contracts may need to be written among market participants compared with other commodities. Greater price volatility could account for the way the petroleum industry is in the vanguard of developing and applying modern asset valuation techniques (AL-Najjar, 2016).

Krylov (2015) work titled: Applied Analysis Concept Development on Financial Aspect. The Role of asset price, which explained their survey on Forecasting output and inflation. Although they mention some historical precedents, their review focused on developments within the past fifteen years. The section concludes with an attempt to draw some general conclusions from their literature.

Timmermann (2018) in his work titled Forecasting method in finance; he reviewed and highlighted some of the key challenges in financial forecasting Problems along with opportunities arising from the unique features of financial data. He analyzed the difficulty of establishing predictability in an environment with a low signal-to-noise ratio, persistent predictors, and instability in predictive relations arising from competitive pressures and investors learning. He discussed approaches for forecasting the mean, variance, and probability distribution of asset returns. Finally, He discovered how to evaluate financial forecasts while accounting for the possibility that numerous forecasting models

may have been considered, leading to concerns of data mining. However, improvement on this study is still ongoing.

MATERIALS AND METHODS

As discussed earlier that two models of ARCH family are considered in this study therefore two methodologies are considered; GARCH and EGARCH. The general form of ARCH model is given as:

$$\sigma_2^t = \beta_0 + \sum_i^q \beta_i \varepsilon_{t-i}^2 \quad (1)$$

where $i = 0, 1, \dots, q$ is conditional volatility, β_0 and β_i are non-negative constant and ε_{t-i} is noise of residual time series.

GARCH Model

In financial markets, volatility is known as a measure of uncertainty about the return provided by the stocks or stock indices. The volatility of many economic time series, especially financial time series changes over time. In some periods the daily stock returns exhibit high volatility while in other periods they exhibit low volatility, a commonly observed phenomenon in financial time series which is referred to as volatility clustering. It is assumed that a day of high volatility most likely to be followed by another day of high volatility within each state or over a short period of time. As such, linear models which assume homoscedasticity (constant variance) are inappropriate to explain such unique behavior of financial time series data. It is thus preferable to use models that examine behavior of financial time series allowing the variance to depend upon its history. GARCH is one of the non-linear type models that can account for many of the dynamic characteristics such as volatility clustering, leptokurtosis, asymmetries and leverage effect associated in a financial time series (Bollerslev, 1994).

$$\sigma_2^t = \omega_t + \sum_{j=1}^q \beta_j \varepsilon_{t-j}^2 + \sum_{i=1}^p \alpha_i \sigma_{t-j}^2 \quad (2)$$

where $i = 0, 1, \dots, p$ is conditional volatility, ω_i , α_i , and β_j are non-negative constants with $\alpha_i + \beta_j < 1$ it should be closer to unity for accuracy, ε_{t-j} is residual and it is lagged conditional volatility, β_j and ε_{t-1}^2 are ARCH component and α_i and σ_{t-j}^2 are GARCH components.

EGARCH Model

Asymmetric relationship in financial time series is called leverage effect which stated that volatility operates in diverse manner depending on the positivity and negativity of volatility that occur. In order to eradicate this asymmetry EGARCH model (Exponential generalized autoregressive conditional heteroskedacity) was developed for optimal forecasting. EGARCH model is divided into two parts; mean and variance models:

Mean equation:

$$\mu_t = r_t + \varepsilon_t \tag{3}$$

Variance equation

$$\text{Log} \sigma_t^2 = \alpha + \beta \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}^2} \right| + \omega \left(\frac{\varepsilon_{t-1}}{\sigma_{t-1}^2} \right) + \gamma \log(\sigma_{t-1}^2) + \varphi(z_t) \tag{4}$$

where μ_t is the dependent variable (excess return), σ_t is a vector of exogenous variables, ε_{t-1} is an error term, the one-step ahead forecast variance σ_{t-1}^2 (conditional variance) depends on the mean, $\alpha, \beta, \gamma, \text{ and } \varphi$ are the coefficients to be estimated and z_t is regressor term.

Data Analysis

The sample data were explored from monthly data of Gold and Crude Oil from yahoo finance DataStream. The data spans from 2000 to 2017. The actual data for this study are non-stationary. The non-stationary data were transformed to stationary by first differencing. In view of the study, the data were used to check the volatilities of the market prices and thereafter, the Akaike information criterion (AIC) and Schwartz information criterion (SIC) were analyzed, using Microsoft excel

RESULTS AND DISCUSSIONS

In this research, we have studied forecasting method for assets prices. Figures 1 and 2 show volatilities (market fluctuations) of both assets.

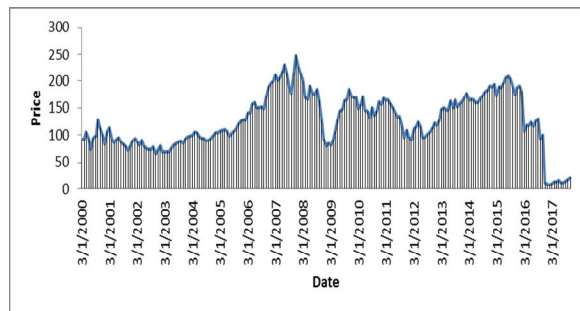


Figure 1: Volatility of Gold

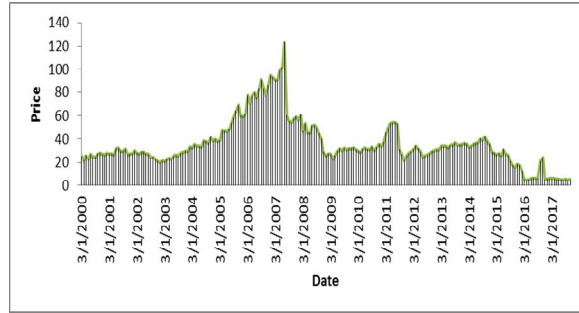


Figure 2: Volatility of Crude Oil

Volatility of price means fluctuations of prices in the market, most times investors relies on the volatility of price of assets to forecast future of such assets. Hence, this study concerns with forecasting, therefore it is imperative to show the volatilities of the two assets in consideration. Figure 1 shows the volatility of gold from the year 2000 to 2017. It shows that the price picked from #98 in 2000 and reached highest peak in the year 2007 at #250, though dropped in 2009, the fluctuations continue till 2017 when gold experienced the least price at less than #20 within the years considered. Though, following the trends after 2017, there is likelihood that the price of gold may pick up in 2018. Moreover, Figure 2 which presented volatility of crude oil, the price picked from #23 and got the highest price of about #120 in the year 2000, the fluctuations continue till 2017, this year crude oil equally experienced the least price less than #6 within the year considered. Looking at the trends forward, there is no tendency of the price picking up in 2018.

Table 1: GARCH model for Crude Oil

AIC	SIC	Pvalue
-2.24	-2.08	0.00

Table 2: EGARCH model for Crude Oil

AIC	SIC	Pvalue
-2.22	-2.03	0.00

Table 3: GARCH model for Gold

AIC	SIC	Pvalue
-2.10	-1.96	0.00

Table 4: EGARCH model for Gold

AIC	SIC	Pvalue
-2.25	-2.08	0.00

Tables 1 to 4 presented values of AIC and SIC for the two assets; gold and crude oil, to determine best models. The guidelines for model selection are, the lower the values of AIC and SIC better the model for the asset. Comparing Tables 1 and 2 it is shown that AIC and SIC for GARCH model is lower than that of EGARCH model. Therefore, GARCH model better forecast crude oil than EGARCH model. Also, comparing Table 3 and 4, it is seeing that AIC and SIC of EGARCH model have lower values than that of GARCH model. Then, it implies that EGARCH model better forecast gold than GARCH model.

CONCLUSION

As mentioned earlier that the study investigate forecasting method for assets prices. The research is mostly concerned with optimal model selection for forecasting of gold and crude oil. The data for analysis are monthly data that spans through years 2000 to 2017. Figures 1 and 2 showed the volatilities of the two assets. As shown in the figures that the pick price of gold in the year 2000 was #98 which was higher than that of crude oil at #23. Gold experienced highest price in 2008 at #250 while crude oil got highest price in 2007 at #120. However, both assets experienced least prices between 2016 and 2017, gold had less than #20 and crude oil had about #5. The study showed that gold has strong market value than crude oil. Moreover, the least prices for both assets in 2016 and 2017 may be as a result of the economic recession experienced at this period. It also showed that gold has ability to withstand stress during economic recession than crude oil.

As shown in the Tables, the forecasting models for the assets. GARCH model better forecast crude oil while EGARCH model better forecast gold. The study proved that each asset has its peculiar forecasting model. According to this research, it is recommended that investors should invest more on gold to serve as hedge or safe haven during economic recession.

REFERENCES

- Allaj, E. (2013). The Black-Litterman model: A consistent estimation of the parameter tau. *Financial Markets and Portfolio Management*. 27(2), 217-251
- AL-Najjar D. M. (2016). Modelling and Estimation of volatility using ARCH/GARCH models in Jordan stock market. *Asian Journal Finance Accounting*. 8(1), 152-167
- Beidas-Strom S. and Pescatori A. (2014). Oil price volatility and the role of speculation. IMF working paper
- Davis, M. H. and Lleo, S. (2016). A simple procedure for combining expert opinion with statistical estimates to achieve superior portfolio performance. *The Journal of Portfolio Management*. 42(4), 49-58.

forecasting model; GARCH and EGARCH

- Haggins, R. C., Koski, J. and Mitton, T. (2016). *Analysis for financial management* New York McGraw Hill Education
- Hood, M. and Malik, F. (2013). Is gold the best hedge and a safe haven under changing stock market volatility? *Review of Financial Economics*. 22(2), 47-52.
- Ince H. Trafalis T. B. (2017). A habrid forecasting model for stock market prediction. *Economic Computation and Economic Cybernetics Studies and Research* 21, 263-280.
- Krylov S. (2015). Applied analysis concept development: financial aspect. *European Journal of Accounting Auditing Research*. 3(5), 30-54.
- Manel Hamdi and Chaker Aloni (2015). Forecasting crude oil price using artificial neural network: A Literature Survey *Economics Belletin*, 35(2), 1339-1359
- Schulmerich, M., Leporcher, Y. M. and Eu, C. H. (2015). *Applied asset and risk management*. Springer.
- Timmermann, A. (2018). *Forecasting method in finance* UC San Diego, Rady School of Management.
- Van Binsbergen, J. H. and Koijen, R. (2010) Predictive regressions: a present-value approach: *Journal of Finance* 65, 4, 1439-1471
- Yanagihara H., Kenlchi K., Shinpei I. and Mariko Y. (2020). A study on the bias-correction effect of the AIC for selecting variable in normal multivariate linear regression models under models misspecification. *REVSTAT-Statistical*