Research on BYD's rate of return based on GARCH model

Mengyu Wang*

School of Economics & Management, Nanjing University of Science & Technology, Nanjing, China

*Corresponding author: 840613429@qq.com

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Abstract: Nowadays, the automobile industry of all countries in the world is in the trend of transformation from traditional vehicles to new energy vehicles. China's BYD automobile company has also attracted extensive attention from investors in the production of new energy vehicles. The most significant way for investors to analyze the A-share market is the frequent fluctuation of A-share, so they want to know the main characteristic of A-share market.

1. Introduction

This paper selects 1220 daily closing price data from 2015 to 2019 to construct the time series of BYD stock daily return. The results show that BYD stock is affected by the market and policies, and its stock return fluctuates greatly. Due to the continuous innovation of main business and many market uncertainties, the yield fluctuated the most in 2016; In 2017, due to the good feedback from the market on new businesses and the favorable impact of national subsidy policies, the fluctuation was small; In 2018, due to the slight downward impact of the macro auto market and the tightening of subsidy policies, the yield fluctuated greatly, but then stabilized.

2. Research background and significance

Nowadays, countries all over the world are facing the problems of high energy consumption and serious environmental pollution. The automobile industry is constantly transforming from traditional vehicles to new energy vehicles. At present, the "new energy vehicles" are in an opportunity period of immature technological development. The new energy vehicle companies represented by BYD should seize the opportunity and vigorously promote their own innovative development. At present, the hot issue in the financial market is the investment value of BYD, and the change of its rate of return is also deeply concerned by the majority of investors.

The stock price fluctuates frequently and violently, and its time series often shows the characteristics that the fluctuation in one period is obviously greater than that in another period. Since Engle first used arch model to show the change of conditional heteroscedasticity over time, autoregressive conditional heteroscedasticity model has been widely used and developed, especially in the fields of financial markets and financial derivatives. Bollerslev improves the arch model to increase the p-stage autocorrelation of heteroscedasticity function, which not only effectively fits the heteroscedasticity function with long-term memory, but also finally forms the conditional variance of the interference term of arch model into an ARMA process, which is GARCH model, which can accurately describe the conditional heteroscedasticity and volatility aggregation of time series. Foreign research results also show that this model can accurately predict the variance of return on financial assets.

This paper calculates the daily return based on 1220 daily closing price data of BYD's shares from 2015 to 2019, and then uses GARCH model to obtain the conditional variance varying with time, this can not only scientifically and reasonably reflect the characteristics of the current fluctuation of BYD's rate of return, but also analyze the company's operating conditions according to the current actual situation. In addition, it also enables the external stakeholders of the company to better

understand the development status of the company and make corresponding investment decisions according to the development status of the company.

3. Method introduction

Engle's autoregressive conditional heteroscedasticity (arch) model can obtain the usual volatility agglomeration of financial time series. However, the empirical results show that the higher-order arch model can better obtain conditional heteroscedasticity, which requires increasing the parameters to be estimated to reduce the efficiency of parameter estimation. To solve this problem, bollerslev added autoregressive term to arch model to expand the conditional variance function of arch model, which is called generalized arch model GARCH model. Compared with arch model, GARCH model has the following advantages: (1) GARCH model Type is relatively simple and can represent a high-order arch model; (2) GARCH model reduces many parameters to be estimated and simplifies the process of model identification and estimation; Therefore, GARCH model is used in this paper, and its mathematical model is as follows:

$$x_t = f\left(t, x_{t-1}, x_{t-2}\cdots\right) + \varepsilon_t \varepsilon_t = \sqrt{h_t}\, e_t \; h_t = \omega + \sum_{i=1}^{p} \eta_i h_{t-i} + \sum_{i=1}^{p} \lambda_j \varepsilon_{t-j}^2$$

4. Empirical analysis

4.1 Stationary test

The GARCH model selected in this paper needs to be based on the stable and non-white noise series of time series. The results of randomness test of time series show that the p value of LB test statistics is very small (all < 0.05) under each order delay, so it can be determined that the daily return of BYD stock belongs to nonwhite noise series. Then the autocorrelation (ADF) diagram test is used to determine its stationarity. The inspection results are shown in Figure 1:

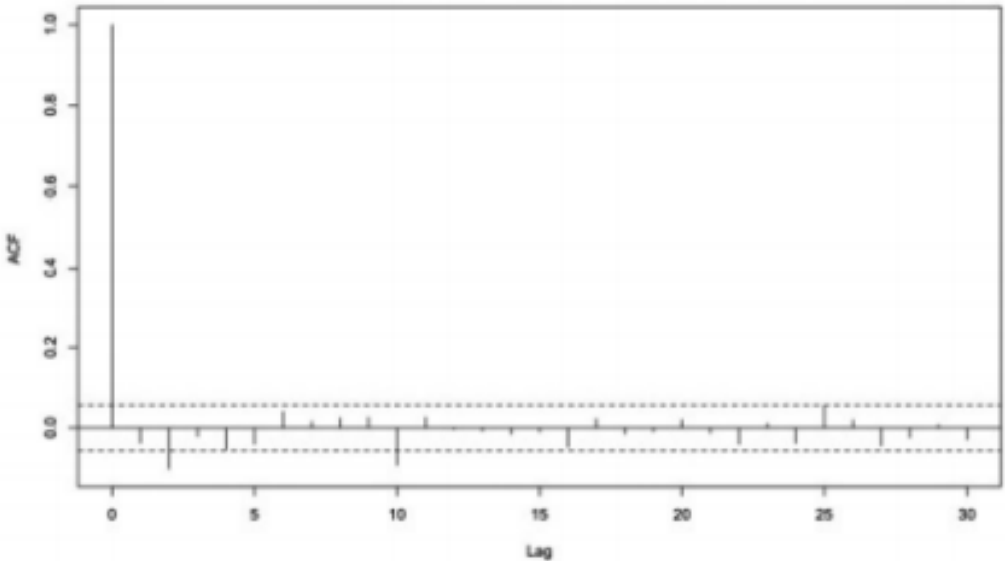

Figure 1. Autocorrelation diagram of BYD stock daily return series

The above figure shows the autocorrelation diagram of the sample. It shows that the autocorrelation coefficient increases after 10 orders of delay. It falls into the range of twice the standard deviation, and the autocorrelation coefficient decreases to zero faster. According to the properties of time series diagram and sample autocorrelation diagram, it can be considered that the time series is stable.

4.2 Extract level information and predict future levels

In order to determine the level information, partial autocorrelation (PACF) test is also required. PAD’s inspection results are shown in Figure 2:

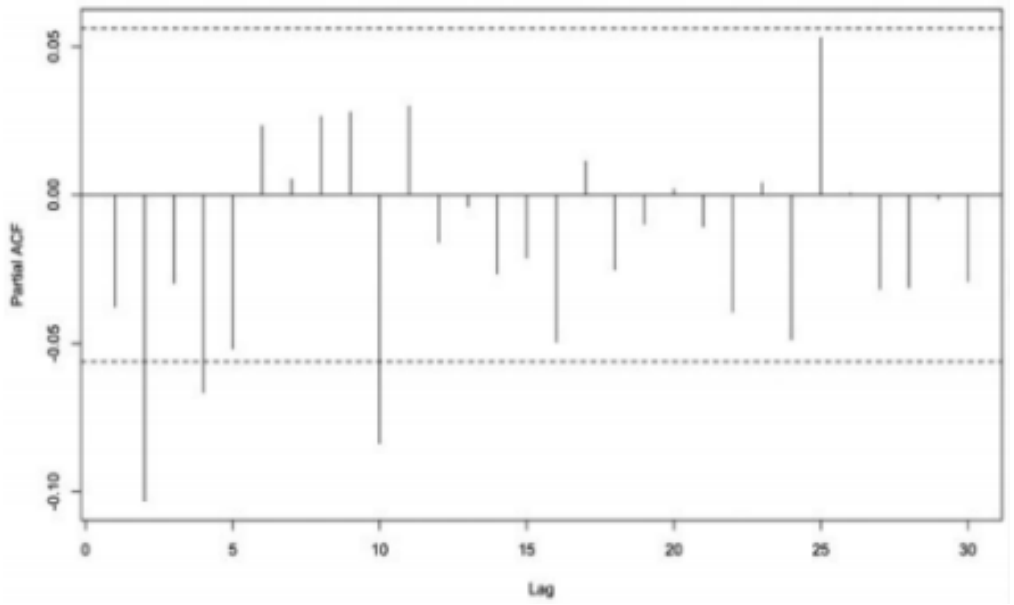

Figure 2. partial autocorrelation diagram of BYD stock return series

Combined with the partial autocorrelation diagram of BYD stock return series, the autocorrelation coefficient can be seen. And partial autocorrelation coefficients show the characteristics of non truncated. In this paper, auto. Provided in R is used Arima function to avoid the problem of inaccurate model recognition caused by lack of personal experience. auto. Arima function automatically identifies the order of the model based on the principle of minimum information, and can also give the parameter estimation of the model. In this paper, AIC criterion is also used as the amount of information. The automatic order determination result of the system is the fitting ARMA (1, 2) model, and the caliber of the model is: xt=600.6849+0.4338xt-1+εt-1- 0.0886εt-2, Var(εt) =116579.

At this time, through the residual white noise test, the results show that the model is effective. Then call the forecast function to complete the prediction of the five trading days after June 17, 2019. The prediction diagram is shown in Figure 3:

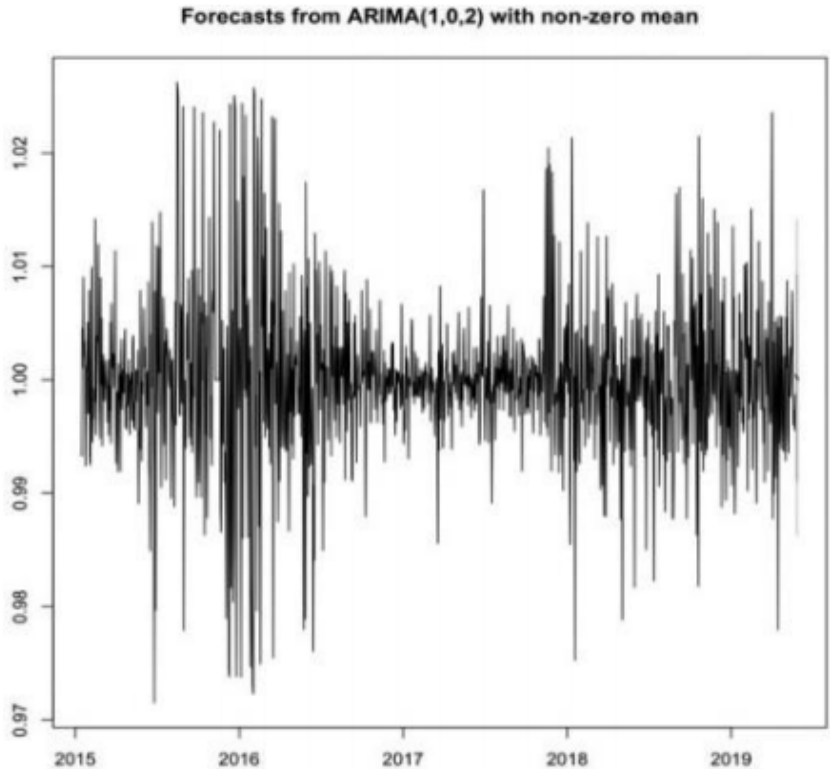

Figure 3. prediction chart of BYD stock daily return series for five periods

4.3 Conditional heteroscedasticity test (Portmanteau Q test)

Portmanteau Q is proposed by the statistical methods McLeod and Li, which is mainly used for Test the autocorrelation of the square sequence of residuals. The main idea is: if the variance of the residual sequence has heterogeneity and clustering effect, the square sequence of the residual will have autocorrelation. Therefore, the autocorrelation of the square sequence of residuals can be tested by variance heterogeneity test. The hypothesis condition of portmanteau Q test is: H0: the square sequence of residuals is purely random (homogeneity of variance) → H1: the autocorrelation of the square sequence of residuals (homogeneity of variance); If used ρK represents the square sequence of residuals{εk²} The delay k-order autocorrelation coefficient, then the assumption can also be expressed as: H0: ρ1=ρ2=…ρq=0←→H1: ρ1,ρ2,…,ρq not all zero; When the original hypothesis holds, Portmanteau Q statistic also seems to obey the formula with degree of freedom q-1's χ^2 Distribution Q (q)~χ^2(q-1);When the P value of (q) test statistic is less than the significance level α, The original assumption is not tenable. At this time, the sequence variance is non-homogeneous and has autocorrelation. The results of portmanteau Q test in R show that the residual sequence is significantly non-homogeneous in variance and has long-term correlation.

4.4 Fitting model

In practice, *p* and *q* in GARCH model are often assigned as 1, that is, GARCH (1,1). The garh (1,1) model is constructed, and the complete fitting model is obtained as follows: xt=600.6849+0.4338xt - 1+εt-0.4829εt-1-0.0886εt - 2+vt, vt ~N (0, 116579), vt=√ht et, ht=0.9015ht+ 0.09510 vt-1; From the above, it can be concluded that GARCH model can compare sub models in a short time BYD's stock return is predicted.

5. Conclusions and deficiencies

The above empirical analysis draws the following conclusions: (1) BYD's stock yield fluctuates under the influence of market and policy conditions Changes fluctuate greatly. This is mainly due to the increase of uncertain factors due to the innovation of main business. The short-term market responded to such events, which led to the most volatile yield in 2016; (2) In recent years, China has issued a large number of subsidy policies, and the market has feedback on new businesses Good, so the market expectation is getting better, and the fluctuation is relatively small in 2017; (3) Since 2018, the yield volatility has increased, mainly because the macro auto market has decreased slightly Due to the tightening of bank and state subsidy policies, the market expectation of the whole auto market is poor, but BYD's main business has strong profitability, and the volatility then tends to stabilize.

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