Based on HP-ARIMA Method Automotive Industry Stock Net Value Valuation Analysis ——Taking 10,908 samples from 9 enterprises as examples

Baoyu Zhang

Qufu Normal University, Rizhao, China

Keywords: Equity Valuation, Quantitative Investment, The Car Industry, The HP Filter Method, ARIMA Model

Abstract: As an important pillar of national economy, automobile industry plays an increasingly significant role in the development of national economy. By studying the fluctuation rules of the stocks of companies in the front, middle and back industrial chain of the automobile industry, we can provide reference for investors in the stock market of the automobile industry. In this paper, a total of 10,908 samples of 9 stocks are selected as the research objects. HP filtering method is used to analyze the problem according to ARIMA model. The results show that :(1) By eliminating the influence of short-term fluctuations by HP filtering, it can be seen that the automobile industry has basically experienced a complete cycle of "troughs - peaks - troughs"; (2) It is feasible to predict the stock price of automobile industry by HP-ARIMA method; (3) According to the stability test results, the conclusion of ARIMA model can still be obtained, and the model is robust.

1. Introduction

With the rapid development of China's economy, China's automobile industry has been developing in recent years. The automobile industry has become one of the leading industries in China. Research on stock valuation has always been a hot topic for many scholars at home and abroad, but most of them adopt traditional valuation methods or just based on theory. Research on the fluctuation rules of stock prices of companies in the front, middle and back end industries of the automobile industry can not only help investors make reasonable decisions, but also further understand the strategic significance of the automobile industry to the country.

This paper takes the daily opening price time series of 9 companies in the automobile industry, parts industry and service industry from May 8, 2017 to May 5, 2022 as the research object. HP filtering method is used to separate the long-term trend of stock fluctuations, and ARIMA model is used to test the causal relationship between stocks to predict stocks. Traditional valuation is more concerned with the Internet, medical and other industries. This paper analyzes the automobile industry with less attention but strong research value. Through interdisciplinary statistical analysis and causal inference through econometric model, it provides new analytical ideas for stock valuation.

2. Literature review

2.1. Stock valuation method

Stock valuation refers to the intrinsic value of a listed company. Stock valuation is calculated by estimating the assets and liabilities of a listed company at a certain price. It is expressed by price-earnings ratio.

Absolute valuation method and relative valuation method are the two most common methods of stock valuation. Absolute valuation method is the capitalization pricing method of future income, focusing on the estimation from the enterprise itself. Relative valuation method is to determine the value of enterprises by means of similar enterprises, focusing on comparison.

Among them, price-to-earnings ratio and price-to-book ratio are the two most commonly used methods. Price-earnings ratio valuation method is more intuitive, more easily reflect the relationship between the company's operating conditions and stock prices. Price-to-book valuation method is

relatively more stable, this valuation method is especially useful for some enterprises with huge profit changes.

2.2. Comprehensive review of literature

By sorting out domestic and foreign literature, foreign scholars began to study stock valuation earlier, so there is a relatively complete system of valuation methods and models. Wang et al. [1] analyzed the impact of consumers on the sales volume of new energy vehicles. Li et al. [2] used complex network to analyze the impact of the 2008 global financial crisis on major global stock indexes from 2005 to 2010. Li H[3] proposed an extensible and highly parallel association rule mining algorithm, SARL algorithm. Niu et al. [4] proposed a new mixed model for stock price index prediction. Domestic research on stock valuation is based on China's national conditions from different perspectives. Liu Yumin et al. [5] carried out feature extraction of indicators based on the sequence forward selection method of classification accuracy before model establishment.However, most of them are from a macro perspective and adopt relatively single models, such as residual income model [6,7]. The industries studied are mainly concentrated in the Internet industry and real estate industry. Therefore, this paper takes the automobile industry as the research object, and makes causal inference based on ARIMA model, to explore the applicability of the model. The final results also show that the model is suitable for the automobile industry.

3. Automotive industry and research data

3.1. Overview of automobile Industry

As an important pillar of the national economy, the automobile industry is characterized by long industrial chain, high correlation, wide employment area and large-scale production. In 2021, the number of cars in China will exceed 300 million, the added value of the automobile industry will account for 1.6% of GDP. The automotive industry is transforming from traditional machinery manufacturing to new-era artificial intelligence industry and new energy industry.This puts forward higher requirements for the whole automobile industry, auto parts industry and auto service industry. This paper selects Shanghai automotive industry corporation (600104), Great Wall Motor (601633), BYD (002594); Weichai Power (000338), Huayu Automobile (600741), Fuyao Glass (600600); China Grand Auto (600297), Zhenong Stock (002758) and China Auto Research (601965) in the automotive service industry were analyzed as the research objects for the valuation of net stock prices.

3.2. Research data and descriptive statistics

In this paper, nine stocks from three different sectors of the automobile industry are taken as research objects in the estimation and analysis of the equity value of the automobile industry based on HP-ARIMA method. The time series data used in this paper comes from 10,908 samples in the National Tai 'an Database. The study period is from May 8, 2017 to May 5, 2022.

Firstly, Stata software is used to conduct statistical analysis on a total of 10908 samples from 9 automobile companies in three industries, including mean value, standard deviation, maximum value and minimum value. Then the characteristics of the stock data studied can be understood.

Table.1. Descriptive statistics of each variable

Variable	Obs	Mean	Std. Dev.	Min	Max
P1(1)	1,214	110.453	85.284	37.680	330.500
P1(2)	1,214	24.970	5.278	14.880	37.160
P1(3)	1,207	19.682	16.375	5.530	68.300
P2(1)	1,214	12.829	4.072	6.610	26.050
P2(2)	1,214	59.683	24.722	28.790	117.590
P2(3)	1,214	23.900	3.413	16.850	35.210
P3(1)	1,203	10.707	2.058	6.500	24.860
P3(2)	1,214	4.634	1.977	2.040	9.830
P3(3)	1,214	10.853	3.997	5.450	20.820

4. An empirical analysis of forecasting the net value of stock units in automobile industry

4.1. Long-term trends in net unit value of auto industry stocks

Based on the periodicity and long-term trend of the data in Table 1, we further analyze the time series of the three representative stocks of the three industries by HP filtering method. HP filtering method believes that economic variables have a slow trend of fluctuation, presenting a long-term trend and short-term fluctuation [8]. The purpose of using this method is to remove the impurities of the short-term trend and select the long-term trend.

Let the original time series be Y, $Y=\{y_1,y_2,y_3... y_n\}$, can decompose into long-term trend series M, $M=\{m_1,m_2,m_3... ,m_n\}$, and the short-term fluctuation sequence C, $C=\{c_1, c_2,c_3..... , c_n\}$, then:

$$Y_i = M_i + C_i,\ i = 1, 2, 3,..., n$$

According to the decomposition principle of HP filter, namely the principle that HP filtering minimizes the loss function:

$$\min \sum_{i=1}^{n} \left\{ (Y-M)^2 + \lambda \sum_{i=1}^{n} \left[\left(m_{i+1} - m \right) - \left(m - m_{i-1} \right) \right]^2 \right\}$$

λ is a smoothing parameter, which is a penalty factor controlling the degree of smoothness.

After processing, the long-term trend sequence of enterprise stock price can be obtained, taking Enterprise 1 as an example.

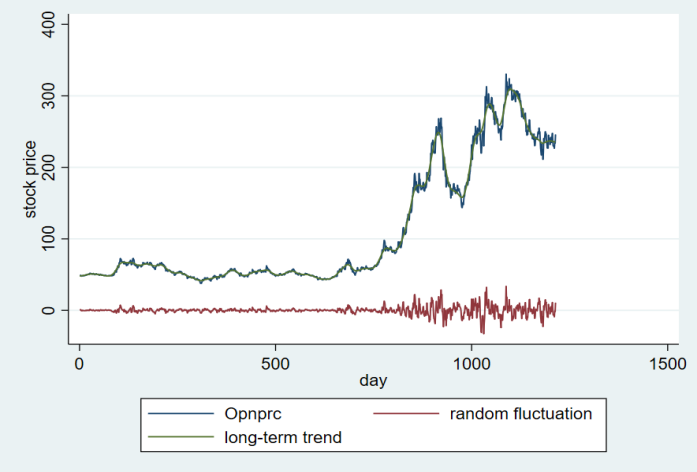

Figure 1. Long term trend of net value of P1(1) fund units

Figure 1 shows that in the vehicle industry, the stock price of Enterprise 1 fluctuated little in the first 700-800 days, and then showed an upward trend. In the range of 900-1100 days, it showed a U-shaped fluctuation, and the stock price reached a new low around 980 days. But since then share prices had soared and reached record highs. Then it showed a downward trend. Although the stock price fluctuated greatly around 1200 days, it remained stable at a higher level overall.

4.2. Forecasting and analysis of net unit value of automobile industry stock

Based on the 10,908 sample data of three auto industries from May 2017 to May 2022 from CSMAR database, ARIMA model is selected to predict and analyze the stock prices of these nine companies.

ARIMA model was proposed by Box, Jenkins, and Reinsel [9] in the 1970s. It is a combination of autoregression model (AR), moving average model (MA) and difference, which can be shortened as ARIMA(p, d, q).The general expression formula of ARIMA(p, d, q) model is:

$$X_t = \varphi_0 + \varphi_1 X_{t-1} + \varphi_2 X_{t-2} + \cdots + \varphi_g X_{t-p} + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} - \cdots - \theta_q \varepsilon_{t-q}$$

ARIMA model is proposed to model, estimate, test and predict stationary time series [10]. In this paper, the trading day is taken as the explanatory variable, and the long-term trend of the opening

price is taken as the explanatory variable to make causal inference.

Table.2. Forecast and analysis of net value of P fund units

Arima				
Core Variable	Core Factor	Standard Error	Z-value	P>|z|
P1(1)	0.198	4.41E-03	44.860	0.000
P1(2)	-0.013	2.46E-04	-52.950	0.000
P1(3)	0.034	1.04E-03	32.500	0.000
P2(1)	0.010	1.60E-04	59.500	0.000
P2(2)	0.063	1.08E-03	58.610	0.000
P2(3)	0.003	2.57E-04	11.180	0.000
P3(1)	0.000	1.31E-04	0.510	0.609
P3(2)	-0.005	7.05E-05	-73.070	0.000
P3(3)	0.009	2.03E-04	42.990	0.000

Based on the prediction analysis of 9 companies, according to the results in Table 2, taking company 1 in the whole vehicle industry as an example, the core parameter is 0.198, and the P value is 0.000, which is significant within 1% and three star significant, and the Z value is large, indicating that the difference between the fitting value and the real value is small, and the prediction is more accurate. A similar conclusion can be drawn in the parts industry. It shows that the practical meaning of the equation fits the real situation. The P value of company 1 in automobile service industry is 0.609, and the Z value is 0.510, which is small and not significant. However, the prediction analysis of Company 2 and company 3 is consistent with the change fluctuation of observed value, indicating that ARIMA model has achieved good prediction effect.

4.3. Robustness test of unit net value predictive analysis of automobile industry stock

Robustness test is to examine the explanatory ability of predictive analysis. After model construction, in order to verify the reliability and accuracy of conclusions, OLS+ robust standard error model and Tobit model were used to conduct robustness tests on the core model ARIMA model.

Through the OLS+ robust standard error model stability test and Tobit model stability test, it can be concluded that the coefficient sign of each variable has not changed. In the significance level, the significance level of all variables is similar. The conclusion of ARIMA model can still be obtained according to the stability test results, which indicates that ARIMA model is robust.

5. Conclusions

Aiming at the valuation of the stock net value of the auto industry, this paper selected a total of 10,908 sample data from 9 auto companies in three industries and selected the HP-ARIMA method to get the following conclusions:

(1) HP filtering method is adopted to remove impurities with short-term fluctuations and select the long-term trend of stocks. The cycle definition of "troughs - peaks - troughs" is adopted for the stock net value valuation, and all industries in the auto industry basically experience a complete cycle.

(2) ARIMA model is used to analyze and forecast the stock price of the automobile industry. The symbols of core parameters of vehicle industry company 2 and service industry company 2 are negative, and the coefficients of other companies are positive. Except the prediction data of one company is not significant, the other data can be well fitted with the real situation, indicating that it is feasible to predict the stock price of the automobile industry by HP-ARIMA method.

(3) The robustness of ARIMA model was tested by OLS+ robust standard error model and Tobit model. According to the stability test results, the conclusion of ARIMA model can still be obtained, indicating that ARIMA model is robust and has significant prediction effect. When applied to practice,

it can be close to the real price of the market, which can provide the basis for investors to make investment decisions.

References

[1] Wang L, Fu Z L, Guo W, et al. What influences sales market of new energy vehicles in China? Empirical study based on survey of consumers' purchase reasons[J]. Energy Policy,2020,142.

[2] Li B, Pi D. Analysis of global stock index data during crisis period via complex network approach[J]. Plos One,2018,13(7):e0200600.

[3] Li H. Scalable Association Rule Learning Algorithm for Very Large Dataset[D]. UC Irvine, 2020.

[4] Niu H, Xu K, Wang W. A hybrid stock price index forecasting model based on variational mode decomposition and LSTM network[J]. Applied Intelligence, 2020, 50: 4296–4309.

[5] Liu Yumin, Li Yang, Zhao Zheyun. Prediction of Component stock price Trend based on Feature selection in RF-LSTM Model [J]. Statistics and Decision, 2021,37(1):157-160.

[6] John R. M. The Use of Residual Income Valuation Methods by U.S. Sell-Side Equity Analysts[J]. Journal of Financial Reporting, 2017, 2(1) : 1-29.

[7] Zhao H.Application of improved Ohlson model in Value evaluation of Internet enterprises [J]. Finance and Accounting Communications, 2019(8):13-17.

[8] Yang Jianhui, ZHANG Ranxin. Prediction of stock price trend based on HP filter and GARCH Model [J]. Statistics and Decision, 2013(5):84-87.

[9] BOX G E P, JENKINS G M; REINSEL G C. Time series analysis: forecasting and control[J]. Journal of Time, 1976, 31(2):238-242.

[10] Chen. Research on financial Data based on Time Series Analysis method [D]. Dalian: Dalian University of Technology,2019.