Empirical Study on Traditional Chinese Medicine Industry-Based on Fama-French Three-Factor Model

Zixuan Luo[(✉)]

Shandong University, Jinan 264209, Shandong, China
`202000620443@mail.sdu.edu.cn`

Abstract. The traditional Chinese medicine industry has received more and more attention in the market. This paper is aimed to gain a deeper understanding of traditional Chinese culture, the traditional Chinese medicine. And provide direction for investors and policy development. This paper based on Fama-French three-factor model, market factor, factor of size, and B/M ratio factor are as three explanatory variables, while select 28 listed companies in the traditional Chinese medicine industry as the research objects. Divide 28 stocks into six portfolios according to the size and B/M ratio, with the monthly return rate of six portfolio from 2020 to 2022 as the explained variable, conducting empirical testing and regression analysis. And the tests make known that the changes in portfolio return can be explained by the three factors within the sample in different degree. This paper also compared the CAPM model with the Fama-French Three-factor model to find out that the Fama-French three-factor model fits this industry better.

Keywords: Linear Regression · Factor Analysis · Fama-French model

1 Introduction

In the following context, this paper uses FF model to represent Fama-French Three-factor model. Due to the late start of China's financial market, its characteristics are different from the foreign capital markets. So it is not enough to use the system risk of CAPM to analyze the stock yield of China's stock market. The FF model is required to test its effectiveness to explore if it applies to China's stock market. And there is a lack of research on China's stock market segmentation industry using FF model. This paper is dedicated to studying the changes in the traditional Chinese medicine industry. This study is committed to providing investors with better investment information and making recommendations for industrial policies.

And Yang pointed out that the relevant empirical research in China is mainly based on the use of CAPM. And Yang also tested that CAPM is suitable for the general A-share index component stocks, but preliminary speculation is that it might be effective using the FF model for some industries in the A-share market and not for some industries [1]. Wen and Ying Based on the FF model, conducting on the excess return rate of the portfolio of 80 listed companies in the pharmaceutical and biological industry from 2018

to 2021. The results showed that there was a strong correlation between the three factors and the excess return. The return rate of the pharmaceutical and biological industry stock portfolio was significantly affected by the three factors [2]. Xu pointed out that the three-factor model is applicable in STAR market, and its explanatory effect and goodness of fit are stronger than the CAPM model with only MKT explanatory factor [3]. Zhang pointed out that the three factors are clearly reflected in the empirical analysis. The coefficient of the factor of the market is the largest. The size effect and value effect should be statistically significant, but not as significant as factor of the market [4].

Zhang pointed out that the excess return rate of 50ETF can be explained better by FF model than the CAPM model. The FF model can better fit the current capital price of China's securities market [5]. Shi pointed out that the three factors of FF model have a great impact on the excess return rate, and the goodness of fit of each portfolio is significantly improved compared with the previous one without considering factor of size and book-to-value ratio factor, the fitting is better, illustrating that adding these two factors can better explain the impact factors of the excess return rate in China's sports industry stocks [6]. Li and Zhang pointed out that the FF model has strengthened its interpretation of the industry after the pandemic. The pandemic didn't impact significantly on the pharmaceutical industry in the United States, but still presented a "small scale" effect, the characteristics of growth stocks, and has a certain speculation attribute [7]. Hu and Lin appointed that the decision coefficient of mixed regression based on the three-factor model is high, and the regression coefficient is significant, proving performance of green funds can be explained by this model [8]. Zang pointed out that the return can be explained by market factor, factor of size, and B/M ratio factor in China's household electrical appliance industry, but there are other factors that require further empirical research [9]. Chen pointed out that based on three-factor model, the stability of factor coefficient of some industries such as medicine, biology, commercial trade, leisure service, and other industries is greatly affected [10].

2 Method

2.1 Data Resources

The data selects from 28 traditional Chinese medicine listed companies from 2020 to 2022. And the data all comes from CSMAR and eastmony.com. This paper selects the top 28 stocks in the total market value of the traditional Chinese medicine industry classified in the Shanghai, Shenzhen, and Beijing sectors of the eastmony.com. Table 1 shows the stocks selected.

And this paper chooses monthly market return rate as the monthly return from the A-share market. The monthly individual stock return rate, the monthly risk-free interest rate, and the B/M ratio data is all coming from CSMAR. In the following context, the A ratio represent to the B/M ratio. And the market value of individual shares at the end of each year represents the company size.

2.2 Data Processing Method

Stock grouping. According to the annual market value of 28 stocks, divided into big-cap stock group B and small-cap stock S in the proportion of (50%, 50%). And then on the

Table 1. Stock list

Stock code	Stock code	Stock code	Stock code
600436	000538	600085	000999
600332	002603	000423	600329
600566	603858	600535	600129
600771	002317	300026	600572
603567	600557	002737	600422
002287	600211	002424	600993
600750	600976	002390	000989

basis of the annual book-to-value ratio of the two groups, divide into the large value group with high A ratio (BH), large value group medium A ratio group (BM), large value low A ratio group (BL), small value high A ratio (SH), small value medium A ratio (SM) and small value low A ratio (SL) with the proportion of (30%, 40%, 30%).

Calculate the weighted average monthly return of each group. Calculate the weighted average rate of return with the year-end circulation market value as the weight.

Calculate the factor of market MKT_t, factor of size SMB_t and A ratio factor HML_t,

$$MKT_t = R_{mt} - R_{ft}, \; SMB_t = \frac{1}{3}(SH + SM + SL) - \frac{1}{3}(BH + BM + BL), \; HML_t = \frac{1}{2}(BH + SH) - \frac{1}{2}(BL = SL). \tag{1}$$

3 Results and Discussion

Table 2 shows initial processing of the data. The standard deviation for all six groups is around 0.1, and all of the six groups is profitable overall because of the positive mean. And the standard deviation of SL is the biggest, which may mean that the companies with small market value and small A ratio own higher stock risk. The standard deviation of BL and BH is less than SL and SH, which means in this industry companies with high market value are less risky than companies with low market value. SL and BL both own higher mean and higher standard deviation, meaning low A ratio companies may own higher return but own higher risk.

And then perform regression using the CAPM model for the six groups to identify if the excess return rate of stocks is only related to the MKT_t.

Table 3 indicates the regression result of the CAPM model. First, analyze the fitting degree. If the R Square is closer to 1, the fitting is better. The R Square of all groups is less than 0.5, the maximum value is the group BL only 0.400524, and the minimum value is the group SH only 0.068531.

So the CAPM model cannot fit the changes in the excess return rate of the Chinese medicine industry. And the excess return rate cannot be explained effectively by

Table 2. Descriptive statistics of six groups

	SL	SM	SH	BL	BM	BH
mean	0.029	0.009	0.015	0.034	0.012	0.015
std	0.142	0.071	0.114	0.092	0.087	0.100
Maximum	0.503	0.148	0.418	0.173	0.271	0.264
minimum	−0.227	−0.161	−0.212	−0.161	−0.160	−0.175

Table 3. Regression results of the CAPM model

	Intercept	Coefficient	R Square
SL	0.021	1.821	0.383
SM	0.006	0.724	0.243
SH	0.013	0.619	0.069
BL	0.029	1.211	0.401
BM	0.007	1.102	0.376
BH	0.011	0.812	0.153

the factor. Therefore, add the factor of size SMB and the A ratio factor HML to the model, and then the regression results should be analysed.

Table 4 indicates that all groups have passed F-test. And after considering the factor of size SMB and A factor HML, the R Square becomes larger, which means the regression fits better. Most of the R square exceeds 0.5.

Table 4. Regression results of three factors

	SMBt	HMLt	MKTt	F value	R^2	Adj R^2
SL	1.625 (p = 0)	−0.489 (p = 0.005)	1.408 (p = 0)	23.330 (p = 0)	0.686	0.657
SM	0.488 (p = 0.014)	0.225 (p = 0.031)	0.898 (p = 0)	11.073 (p = 0)	0.509	0.463
SH	0.955 (p = 0)	0.652 (p = 0)	1.128 (p = 0)	20.489 (p = 0)	0.658	0.626
BL	−0.288 (p = 0.235)	−0.290 (p = 0.029)	0.983 (p = 0)	12.401 (p = 0)	0.538	0.494
BM	−0.027 (p = 0.916)	0.109 (p = 0.430)	1.190 (p = 0)	6.786 (p = 0)	0.389	0.331
BH	0.382 (p = 0.154)	0.569 (p = 0)	1.262 (p = 0)	11.876 (p = 0)	0.528	0.483

And then analyze the coefficient. All of the coefficients of MKT are around 1, which means the market factors are positively correlated with the return. And most of the P value is 0, which shows that market factors have a significant impact on portfolio return at a significant level of 5%. And all six groups passed the t-test. It indicates that the better the market environment is, the higher the return on an investment portfolio is in this industry.

For the coefficient of SMB, in the large-cap stock, only BH is positive, and both BL and BM are negative. But the coefficient and p-value are small and all the 3 groups don't pass the t-test. In the low-cap stock, all of the 3 groups are positive, and all of the p-value is close to 0, which may mean in the small market value company, the bigger the size is, the higher the return is. There is a significant scale effect for the small-cap stocks but not significant for the big-cap stocks in the Chinese medicine industry.

For the HML, only BM doesn't pass the t-test. And except BM, the p-values of the other 5 groups all are less than 5%. For the BL and SL, the coefficient is negative. So it might mean that for the market with low A ratio stocks the higher the A ratio is, the lower the return is. But for the medium and high A stocks, the coefficient is positive, which shows that for these kinds of stocks, the higher the A ratio is, the higher return is. And a high A ratio indicates that the market's valuation of the stock is lower than the company's valuation, which is an indicator of an underperforming stock with a fragile financial position and additional financial risk, so the investors require higher risk compensation, the higher excess return.

And the coefficient of BM and BH is lower than SM and SH, which means with the increasement of market value, the correlation coefficient shows a downward trend. The effect of the A ratio factor on the excess return is decreasing. In conclusion, the A ratio factor can explain the changes in the return.

4   Conclusion

First, the market factor, factor of size, and A ratio factor all can explain the volatility of portfolio returns in the market. But there is a requirement for further empirical research. And the fitting effect of the three factors is better than only the market factor. It indicates that there is a correlation between the portfolio return rate and the three factors.

Second, the impact of factors varies in different portfolios. The overall economic environment owns the same moving trend as the Chinese medicine industry. And there is a normal systematic risk. But different portfolios own different sensitivity to risk.

And the stock portfolios with higher market value own higher returns. And high market value portfolios are less risky. For Small market value portfolios, the higher the stock size is, the higher the return is. And low A ratio stocks own higher returns and higher risks. In addition, for low A ratio stocks, the higher the ratio is, the lower the return is. But for high A ratio stocks, the opposite is true.

Third, it is recommended to focus on the external environmental risks and changes, and pay attention to the leading enterprises like Pientzhuang, Tongrentang, Yunnan Baiyao, and so on, which own more stable operations, higher dividends, more stable returns and lower risk. And pay attention to the high market value growth companies.

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