Risk Analysis for Baijiu Industry Based on CAPM Model during COVID-19

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Abstract. Chinese Baijiu industry has always been a popular investment choice. Since 2020, the scale of COVID-19 has been further expanded, followed by a gradual increase in the risk, therefore, calculation and analysis of the risk in Chinese Baijiu industry has become a priority. In this paper, the CAPM model is utilized for empirical research. Taking the 3-year interest rate of national debt as the risk-free interest rate, the opening and closing prices of Kweichow Maotai Co., Ltd, Shanxi Fenjiu Co., Ltd and Kouzijiao Co., Ltd, and Shanghai composite index and Shenwan Baijiu Industry Index from 2019 to 2022 are selected to calculate β, and the risk degree is determined according to the β range. According to the analysis, during the three-year pandemic, the expected rate of return of investment in the Chinese Baijiu industry is higher than the average market rate of return, and the risk level of Chinese Baijiu industry is higher than the risk of the entire market portfolio. In addition, the overall systematic risk of Chinese Baijiu industry is low. The research offers a guideline for investors in the A-share market to understand the real situation of companies in the Baijiu industry in all aspects and provide scientific value guidance for investors who prefer to make equity.

Keywords: CAPM model, Baijiu industry, β.

1. Introduction

In 1952, Markowitz first applied the mathematical concepts of mean and variance of asset portfolio payoffs, studied asset portfolios and selection by utilizing the expected rate of return (mean) of risky assets and risk represented by variance (or standard deviation). The paper also clearly defined investor preferences mathematically and proposed the modern theory of asset portfolios [1]. In 1964, the Markowitz asset portfolio theory served as the foundation for the Capital Asset Pricing Model (CAPM), which included the market factor as the only risk factor. The model examines how asset equilibrium values are formed and how systematic risk and excess returns on investment are related. Since systematic risk cannot be hedged, the accurate estimation of beta coefficient is particularly important. Rosenberg and McKibben found that the beta in the stock market varies in value depending on different industries [2], followed by Farrell who found that different economic sectors have different beta coefficients due to sector characteristics even within the same company [3].

In view of the restrictive preconditions for the application of CAPM are relatively harsh. In the process of practical application, the application effect is underperforming, as a result scholars proposed various extended CAPM models to break through the inherent limitations of the model. Brennan develops a CAPM model with tax implications, considering that in practice, dividends are received at different rates for different risky assets and that the tax rates for investors with different dividends are different [4]. Black creatively proposed the zero-β CAPM model which replaced the risk-free rate of return with the zero-β rate of return [5]. Merton proposed the continuous time series intertemporal ICAPM model, which states that in addition to being influenced by systematic risk in the market, special factors such as inflation and interest rates can also affect the return of assets. At the same time, it is also the first model to extend asset pricing models to dynamics [6].

Roll proposed the opposite view from the proponents of the previous CAPM model. Due to the mathematical characteristics of the market data itself, there are some logic problems, which make it ineffective in testing the accuracy of the CAPM model, resulting in the ineffectiveness of the CAPM model, which is the famous Roll's critique [7]. Breeden introduced an explanatory factor,

consumption growth rate, into the traditional CAPM model and proposed the Consumer Capital Asset Pricing Model, which was not tested empirically because the CCAPM considers more asset price influences [8].

Since then, many results from ongoing empirical testing have demonstrated that the CAPM model falls short in its ability to fully explain the market phenomena and is deficient in other features that would allow it to adequately characterize the market. In 1993, Eugene Fama and Kenneth French proposed expanding the CAPM model by two additional elements, SMB and HML, to create the Fama-French three factor model. This model captures the linear link between the three factors and the portfolio's excess return rate. The results indicate that adding two components improves the explanation of the portfolio's projected return [9]. Zhou explores the applicability of the LCAPM model in the Chinese stock market, while introducing non-systematic factors to investigate the connection between liquidity risk and stock returns from multiple perspectives [10]. Yang and Zheng empirically tests the applicability of the CAPM model in the A-share market by utilizing data from 2014-2019 [11]. For another study, CAPM and Fama-French three-factor model for Chinese SSE 50 index constituents are empirically investigated and conclude that both CAPM and Fama-French three-factor models can better explain the expected returns of individual stocks of SSE 50 index constituents [12]. Chen used the daily closing data of 20 listed companies in the Baijiu industry from 2016 to 2018 as a sample and applied the CAPM model to analyze them empirically, concluding that the CAPM model is clearly not applicable to the current forecasting analysis of the stocks of companies in the Baijiu industry in China [13]. Ban selected data from 2015 to 2019 to analyze the risk of Luzhou Laojiao Co., Ltd. using the CAPM model [14].

Since 2016, China's Baijiu industry has entered a new round of growth. Especially in 2017, the sector's excess returns were significant, far exceeding investors' forecasts, and the enthusiasm of investors was unprecedented. Although the COVID-19 caused slight turbulence in the market, it did not affect the confidence of the market in the recovery of Baijiu consumption. This paper precisely sees the investment enthusiasm of investors in the Baijiu industry and chooses the Baijiu industry as the research object to meet the needs of investors' decision-making. It is beneficial for individual investors in the A-share market to understand the real situation of companies in the Baijiu industry in all aspects and provide scientific value guidance for investors who prefer to make equity investments. The following part will first introduce the CAPM model and data selection, analyze the regression results, and give suggestions for the development of Baijiu industry.

2. Data & Method

2.1. Data

The data utilized in the paper are collected from two sources. The first is obtained through the official website of the People's Bank of China to obtain the 3-year interest rate of Chinese government bonds as the risk-free rate. The other one is obtained through Python crawling in the Tushare website to select the closing prices of Kweichow Maotai (600519.SH), Luzhou Laojiao (000568.SH), Shanghai composite index 300 index (000001.SH), and Shenwan Baijiu industry index (801125.SL) for the three years from July 1, 2019 to July 1, 2022.

2.2. Model

The CAPM model is calculated as follows:

$$R_{it} - R_f = \alpha_i + \beta_i\left(R_{mt} - R_f\right) + \varepsilon_{it} \tag{1}$$

Here, R_{it} is the rate of calculation of return on stock i at day t. R_f is the risk-free rate of return. β_i is the sensitivity factor of stock i to the market. R_{mt} is the market rate of return on day t, ε_{it} is a constant containing residuals and a random perturbation term. The expression of R_{it} is

$$R_{it} = \ln P_{it} - \ln P_{it-1} \tag{2}$$

Where P_{it} is the closing price of stock i on day t. Substitute Kweichow Maotai (600519.SH), Shanxi Fenjiu (600809.SH) and Kouzijiao (603589.SH) into the above formula respectively. As for calculation of R_{mt}, it can be denoted as:

$$R_{mt}=\ln I_{it} - \ln I_{it-1} \quad (3)$$

Where I_{it} is the closing price of index i on day t. Substitute Shanghai composite index (000001.SH) and Shenwan Baijiu industry index (801125.SL) into the above formula, respectively. Substituting R_{it} and R_{mt} into the CAPM model respectively will result in the combinations presented in Table. 1

Table 1. Combination of different selected R_{it} and R_{mt}

R_{it} / R_{mt}	Kweichow Maotai	Shanxi Fenjiu	Kouzijiao
Shanghai composite index	A	B	C
Shenwan Baijiu industry index	D	E	F

3. Results & Discussion

The resulting data will be inputted to OLS least squares linear regression through Eviews software, which will yield a total of six sets of regression results. Table. 2 summarized the regression results. For the T test, $H_0: R_{mt}-R_f=0$; $H_1: R_{it}-R_f\neq 0$. Let $\alpha=0.05$, after querying the t-distribution table to obtain the critical value, then $|t|>1.65$ is a small probability event under the original hypothesis. According to the above table, combinations A, B, C, D, E, F all satisfy $|t|>1.65$ and reject the original hypothesis that the variables are significant and pass the variable significance test.

Table 2. Regression results

Combination		β	R^2	α_i	t-statistic
β_{sz}	a	1.015271	0.311011	0.000815	18.12789
	b	1.224492	0.177800	0.001887	33.77679
	c	1.160503	0.204307	-0.000323	13.67207
β_{sw}	d	0.901523	0.889315	0.000056	76.48010
	e	1.125775	0.545020	0.000872	29.53082
	f	0.906524	0.452105	-0.001084	24.50963

If $\beta=0$, it indicates there is no connection between the change in the investment's rate of return and the change in the market portfolio's rate of return. If $\beta=1$, it indicates that investing in the asset will provide the market's average return and that the change in the rate of return of the investment will be consistent with that of the market portfolio. If $0<\beta<1$, it indicates that the level of risk of investing in this asset is lower than the risk of an all-market portfolio entire market portfolio. This asset is called defensive asset. If $\beta>1$, it indicates the level of risk of investing in this asset is higher than the risk of an all-market portfolio entire market portfolio. The asset is called offensive asset.

According to the regression results, the β values of combination A, combination B and combination C calculated using the Shanghai composite index as the market return are all greater than 1, indicating that the risk level of investing in the assets of these three companies is higher than that of the total market portfolio, with Kweichow Maotai having the lowest β value, close to 1. The beta values of combination D, combination E and combination F, calculated using the Shenwan Baijiu Industry Index as the market return, are distributed around 1, where β_d and β_f are slightly less than 1, indicating that the risk level of their assets is lower than that of the full market portfolio, and β_e is greater than 1, indicating that the risk level of the assets invested in these three companies is higher than that of the full market portfolio. Overall, investing in the assets of the three companies Kweichow Maotai, Shanxi Fenjiu and Kouzijiao has a higher level of risk than an all-market portfolio, regardless of whether the Shanghai composite index or Shenwan Baijiu industry index are used as market returns. With reference to past research findings, the return on the Baijiu sector should be higher than the risk

of an all-market portfolio. The COVID-19 directly led to a reduction in per capita disposable income and Baijiu, as a non-essential product with social attributes, was more significantly affected by the epidemic.

The percentage of systematic risk relative to total risk is shown by the goodness of fit R^2 acquired throughout the regression process. If the $R^2<0.5$, then the overall systematic risk of the company is relatively low. If $R^2\geq0.5$, then the overall systematic risk of the company is relatively high. According to the previous regression results, the R^2 of portfolio a, combination b and combination c calculated using the Shanghai composite index as the market return are all less than 0.5, indicating that the fit of the sample is weak and the overall systematic risk of each company is relatively small. The R^2 of combination d, combination e and combination f calculated using the Shenwan Baijiu industry index as the market return are oscillating around 0.5. R^2 for combination d and combination e are greater than 0.5, indicating a stronger fit and a higher systematic risk for both companies, while R^2 for combination f is less than 0.5, indicating a weaker fit and a lower systematic risk for the companies. In addition, it can be found that the fit of the Shenwan Baijiu Industry Index as a market return regression is higher than that of the SSE Index as a market return. This is related to the reason for the formation of these two indices, as the sample stocks are all listed stocks on the Shanghai Stock Exchange, while the sample stocks of the Shenwan Baijiu Industry Index are the 20 Baijiu stocks containing the three sample companies in this exercise. The latter will naturally have a higher degree of fit. The error term α reflects the relationship between actual and expected returns, with an α of less than zero indicating that actual returns are lower than expected returns, and an α of greater than zero indicating that actual returns are higher than expected returns. From the previous regression results, the α of Kweichow Maotai and Shanxi Fenjiu is greater than 0 for both the Shanghai composite index and the Shenwan Baijiu Industry Index as market returns, indicating that the actual returns meet expectations. On the contrary, Kouzijiao's α is less than 0, indicating that the actual return is less than expected, possibly due to the company's own problems rather than market factors.

4. Suggestions

Research and development of functional Baijiu to provide customized and personalized products to meet new demand in order to expand Baijiu consumption and promote the development of the Baijiu industry. Baijiu companies are working with universities and research institutes to develop functional baijiu (e.g., flavored wines for cooking and health wines for wellness regimen) on the basic attributes of baijiu. With the steady growth of market demand for festivals, conventions, collections, souvenirs and gifts, customized Baijiu products should be offered according to the needs of new consumer groups to develop small-volume Baijiu products to meet the needs of an increasingly diversified street-stall economy.

In order to meet the multi-level drinking needs of young consumers, companies should follow the consumption trends, pay more attention to the design and creation of consumption scenarios, and launch more new products suitable for young people's consumption. As far as Baijiu products are concerned, from international and domestic consumption laws of strong liquor, "low alcohol by volume" is the general trend, and the mainstream foreign liquors in the world, whisky, brandy, etc. are generally around 40% alcohol by volume. From a technical point of view, with the continuous development of winemaking technology, Baijiu with low alcohol by volume can also have a rich and layered flavor. Therefore, Baijiu companies should start to pay attention to the development of new products with low alcoholic strength, and constantly try to adapt to the needs of young consumers with personalized and fashionable products, such as low alcoholic Baijiu or Baijiu-based premixed Baijiu and cocktails. Lower alcohol by volume, higher quality will be the development trend of the Baijiu industry, and drinking low alcohol by volume is less likely to cause headaches, which is more in line with the concept of healthy consumption.

Digital technology is a product of technological progress and continuous innovation, and is the core driving force behind the upgrading of the Baijiu industry. Firstly, using digital technology to

innovate technological processes, promote intelligent operation of Baijiu production, improve the efficiency of Baijiu production, realize the traceability of the whole production process of Baijiu, and improve the quality of Baijiu across the board. Secondly, it is suggested to build new consumption scenarios with digital technology to provide consumers with more intelligent, convenient, and user-friendly services and to enhance the consumption experience. Furthermore, digital technology is used to control demand information, analyze the market in depth, help marketing channel innovation, expand marketing network system, and optimize marketing network layout. Lastly, the company can apply digital technology to the construction of an e-commerce platform for baijiu to reduce operating costs, build a more direct and convenient bridge between production and consumption, open a two-way communication channel between production and consumption, form a virtuous cycle between production and consumption, and promote the healthy and stable development of the baijiu industry.

Baijiu companies are advised to accelerate the integration of the Baijiu industry with the primary and tertiary industries, extend the industry chain vertically, optimize resource allocation, bring into play industrial synergies, and enhance the competitiveness of the Baijiu industry. Companies can trace the upstream origin of the Baijiu industry, connect with agriculture, and create brewing grain bases or industrial parks to create new consumption models, build new consumption scenarios and enhance consumers' spiritual satisfaction with wine culture, farming culture and leisure culture as the themes. Extending downstream in the Baijiu industry, companies develop "Baijiu + cultural tourism" projects around Baijiu-producing areas, tapping into the historical and cultural heritage of Baijiu, creating Baijiu culture centers, promoting industrial tourism and Baijiu culture tourism with a focus on Baijiu brewing, involving consumers in the production process of Baijiu, and meeting new consumer groups' needs for cultural and fashionable experiences. The project will allow consumers to participate in the production of Baijiu and meet the needs of new consumers for cultural and fashionable experiences.

5. Limitations & Prospects

The research mainly uses the CAPM model to analyze the Baijiu industry, but in the actual measurement, the CAPM model has limitations, and the current Chinese stock market has difficulty in meeting the assumptions of the CAPM model, which is one of the reasons why the existing Chinese stock market does not accommodate the CAPM model. In addition, the CAPM model is less operational in determining the risk factor β, and it is also difficult to reflect the operational and financial risk of individual companies to be valued relative to the market, which does not overcome the harshness of the assumptions made in the calculation of the risk factor β. Therefore, in future research, the beta measurement method for stocks can be further improved. In this case, the beta value of stocks can remain relatively stable within the range, thus it can truly and effectively reflect the systemic risk and make the model more realistic.

In addition to optimizing the calculation method for beta, it can also be improved by using the Fama-French three-factor model or the Fama-French five-factor model. The addition of the scale factor and the value factor weakens the role of parts of the market risk factors. Chinese financial market has a late start in development, and its characteristics and market environment differ from those of the stock markets in Europe and America. The reasons affecting the return on equity securities are complex and numerous. Therefore, it is insufficient to use systematic risk alone to explain stock returns. The method of testing returns needs to be further optimized by adding pessimistic minus optimistic factor, an improved size factor, obtained by excluding the smallest 30% of listed companies in terms of market capitalization from the traditional SMB.

Although the Shanghai composite index and the Shenwan Industry Baijiu Index can in a sense represent the market of the Chinese Baijiu industry, it is widely accepted the structure of the Chinese stock market is complex. Apart from Shanghai composite index and the Shenwan Industry Baijiu Index, there are various Baijiu ETFs. In the actual selection of investors, various types of Baijiu ETFs will have a better reference role, so just studying the Shanghai composite index and the Shenwan

Industry Baijiu Index will not provide a full understanding of the situation of the Baijiu industry, and the guidance significance for reality will be greatly reduced.

The selection of experimental data for the CAPM model should be carefully chosen for the research interval, and the sample stocks should be selected in a scientific and reasonable manner. It is believed that as Chinese stock market system continues to develop and improve, the capital trading market will gradually be sophisticated. Subsequently, one will choose a long enough time horizon and a more diversified sample of stocks to carry out empirical research on the CAPM model. As for the selection of alternative indices for the market portfolio, to guarantee the accuracy of the experimental data, market indices that encompass all assets should be selected as far as possible.

6. Conclusion

In conclusion, this paper investigates risks of Baijiu industry based on CAPM model. To be specific, Kweichow Maotai, Shanxi Fenjiu and Koujiao are selected to be the representatives of Chinese Baijiu industry to analyze its risks. According to the analysis, during the three-year pandemic, the expected rate of return of investment in the Chinese Baijiu industry is higher than the average market rate of return, and the risk level of Chinese Baijiu industry is higher than the risk of the entire market portfolio. In addition, the overall systematic risk of Chinese Baijiu industry is low. Nevertheless, the current Chinese stock market has difficulty in meeting the assumptions of the CAPM model and it is impossible to overcome the harshness of the assumptions made in the calculation of the risk factor β. In the future, Fama-French three-factor model or the five-factor model can be utilized in the research to weaken the role of parts of the market risk factors and more Baijiu ETFs will be selected to calculate the market return. Overall, these results offer a guideline for investors in the A-share market to understand the real situation of companies in the Baijiu industry in all aspects and provide scientific value guidance for investors who prefer to make equity.

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