Empirical Analysis of the Chinese Medical Industry Based on CAPM: before and after the COVID-19 Outbreak

Xintong Li
School of Accounting, Southwest University of Finance and Economy, Chengdu 610000, China.

Abstract: The sudden outbreak of COVID-19 has affected the global greatly, and the medical industry has played a very important role in fighting against the epidemic. This paper aims to test the applicability of the medical industry to the CAPM model and the overall risk tolerance of the industry, which is of vital significance for promoting the Chinese medical industry. To explore the reason for changes in medical companies under extreme stress, stocks of listed medical companies from January 2018 to December 2021, covering the period before and after the outbreak, are selected. By using the time series method to analyse, empirical results show a positive linear correlation between risks and benefits. With the development and reform of China's stock market, the CAPM model now has a better explanatory ability for the overall expected return of stocks of medical listed companies. However, due to the strong assumptions of the CAPM model, it fits poorly when occurring emergency.

Keywords: CAPM; Chinese Stock Market; COVID-19

1. Introduction

At the beginning of 2020, the sudden outbreak of COVID-19 took everyone by surprise and spread worldwide. In the past three years, the epidemic has had a significant negative impact on the global economy. Most enterprises had been hit seriously, but the medical industry was against the trend. Since there was a huge demand for medical protective equipment, the epidemic brought new opportunities to medical companies. Consequently, hope for the normalcy returning to the world falls on the medical industry. At the same time, financial markets showed direct reaction from investors. The global stock markets closed down a lot under the influence of COVID-19, but during this period, stocks of those medical companies seemed to have a strong ability to resist the fall. This gave a sign to investors, that if they want to reduce losses in economic depression caused by the pandemic, they must pay much attention to those stocks.

This article examines the beta of the medical industry before and after the COVID-19 outbreak and analyses the relationship between returns and risks of the medical industry under the influence of COVID-19. It aims to monitor changes in the medical industry when an emergency occurs. It also offers advise to investors who are considering investing in China's stock market in order to expedite its recovery from the financial crisis.

2. Literature review

The discovery of the CAPM model has led researchers around the world to carry out substantive empirical tests. Based on Markowitz's research on modern portfolio theory, Sharp (1964) and Lintner (1965) first distinguished risk into systematic risk and non-systematic risk.[1] Non-systematic risk can be effectively eliminated by using a diversified portfolio, while systematic risk is difficult to avoid. From this, they established the CAPM model. Fisher Black (1972) demonstrated the returns of the stock portfolios were linear related to their betas.[2] However, risk-free assets varied consistently and were unstable over a long period, and this may cause beta values deviate gradually.

Donghui Shi (1996) first used the CAPM model to test the Chinese stock market.[3] By studying 50 stocks listed on the SSE (SSE), he found that the systematic risk of the sample stocks was unusually high among all the risks. Therefore, he believed that the relationship between risk and return on the Shanghai A-share did not conform to the CAPM model. Yunhui Jin and Lin Liu (2001) found that the relationship between stock returns and beta was not as linear as expected in CAPM theory.[4] Otherwise, they claimed that stock returns were closely correlated to factors other than beta. This further proved that the CAPM model was not suitable for estimating the Chinese stock market. Qing Zhao and Dongfeng Wu (2015) randomly selected 100 stocks on the SSE to confirm the feasibility of the CAPM model in China.[5] They came to the conclusion that the stock returns ratio was significantly positive and linear related to its beta. It suggested that the CAPM model had certain applicability to the investment portfolio on the SSE, and the applicability was improving.

Taken together, western researchers have developed the basic theories of CAPM, and they believed that beta is effective. With the development of the Chinese securities markets, some scholars have gradually proved the applicability of the CAPM model. Based on the previous research, this paper takes 30 stocks of medical companies listed on the Shanghai A-share as the study subject and uses the OLS regression method to estimate beta. This could verify the previous theoretical results, so as to enrich the application of the CAPM.

3. Research methods

3.1 Model setting

The basics of the CAPM are expressed as the relationship between risk and return of individual stocks or investment portfolios. Following Qing Zhao and Dongfeng Wu (2015), we use the following formula to calculate the beta in stock markets,[6]

$$R_i = R_f + \beta(R_m - R_f)$$

where R_i is the rate of return for a specific asset i; R_f is the risk-free rate of return; R_m is the rate of return in the market; β is the sensitivity of the risk of a specific asset i to market risk.

Specifically, we could run the following regression,

$$R_i - R_f = a_i + \beta(R_m - R_f) + \varepsilon_i$$

where a_i is the part of earnings that is not affected by the market; ε_i is the error; a_i and β are both regression estimates.

3.2 Data selection

This paper randomly selects 30 stocks of medical companies from the market and calculates monthly yields by using their closing prices. The data is from Wind.

$$R_{k,t} = \ln P_{k,t} - \ln P_{k,t-1}$$

where $R_{k,t}$ is the yield of the stock k at the moment t; $P_{k,t}$ is the closing price of the stock k at the moment t.

By using market value to have a weighted average calculation, a rate of return for the entire industry is obtained.

$$R_{i,t} = \sum R_{k,t} \frac{V_{k,t}}{\sum_1^{30} V_{n,t}}$$

where $R_{i,t}$ is the weighted average of the returns of all sample stocks; $V_{k,t}$ is the market value of stock k at the moment t.

Select the national debt index of China as the risk-free rate. Since all A-share enterprises are listed on the SSE, it is reasonable to select the Shanghai A-share Index as the market rate of return, which reflects the changing trend of the stock market. The method of obtaining the monthly rate of return is the same as before.

4. Results

The data were divided into two groups. The first group is before the epidemic (January 2018-December 2019), and the second group is after the epidemic (January 2020-December 2021). As can be seen in Figure 1 and Figure 2, the relationship between industry yield and market yield is almost linear. The estimation equation of the overall industry yields and the market yields pre and post the

outbreak are shown in Table 1 and Table 2 respectively.

The values of R-squares are both less than 0.5, indicating that the market return has a weak ability to explain the monthly rate of return of each stock. At the same time, the P-values of both are less than 0.05, which means that they are significant. Accordingly, it is believable that the model can be used as an effective estimation of the systematic risk of the sample stocks. The pre-epidemic beta is less than 1, which means the stocks have lower risk and may be suitable for risk-averse investors; while the post-epidemic beta is greater than 1, suggesting that it is a typical high-risk stock that risk-loving investors will prefer.

5. Discussion

This paper uses the time series method to study the CAPM model and empirically tests the Shanghai stock market. According to the test results, the following conclusions can be drawn,

a) The beta values are greater than 0 in both periods, indicating the risk premium of the market portfolio is always in proportion to the risk premium of the stock portfolio;

b) The post-epidemic average rate of return of the market portfolio after the epidemic is higher than before.

5.1 Factors that influence the rate of return

In early 2020, both market yields and the medical industry yields could be seen on a downward trend, but medical-industry portfolio yields began to recover after early losses. At the same time, the market yields continued to decline. The reason for this is mainly affected by national policies and the irrational behaviour of investors. During this time, the government realized the significant role played by medical companies in epidemic prevention and control, and it began to take a series of measures to vigorously promote the operation of medical enterprises. As investors have been hit hard by the economic depression, fearing more serious losses due to the epidemic, they would rather take a higher risk to make up for the losses that have already occurred.

5.2 The applicability of the CAPM model in the Chinese stock market

One important assumption that CAPM holds should be reviewed: market participants are comparatively rational. By comparing the risk-free rate of two periods, it can be found that the risk-free rate in the second period is negative. This suggests that investors are not concerned about the time value of capital when the stock markets performed badly, but the pursuit of high returns brought by high risks in the industry. In the early 2020, the Chinese stock exchange was closed for about a week due to the Spring Festival holiday, causing Investor panic to intensify. This may have increased the negative impact of the COVID-19 outbreak on the Chinese stock market. As a result, investors behave irrationally. To sum up, the Chinese stock market is still in an emerging and immature stage, and the applicability of CAPM in it is not very strong.

5.3 Flaws in selecting stock

The debate on the CAPM model is continuing, and the CAPM test with China's capital market as the research object needs to be improved. Researchers usually considered a period of 4 or 5 years to be a suitable time interval to study a certain number of sample stocks. In contrast, two years seems to be a short time.Whereases, due to the relatively late establishment and immaturity of China's stock market, the market can be very volatile in a short time, which causes the temporal scales of these studies to be generally not long.

At present, global epidemic prevention and control are in the final stage, but the medical industry still needs different degrees of attention. The companies should optimize the industrial structure, reduce investment risks, and enhance the ability to resist risks. Investors are not supposed to invest too much in medical-company stocks due to being less impacted by the outbreak. They should also consider multiple factors, such as how risks increase significantly with profits after the pandemic.

References

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Tables and figures

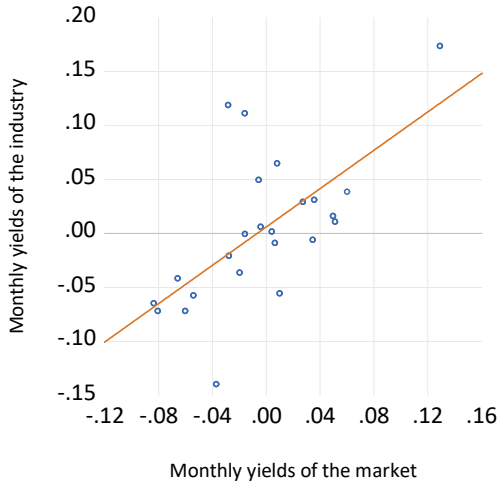

Figure 1 The sample period is from January 2018 to December 2019.

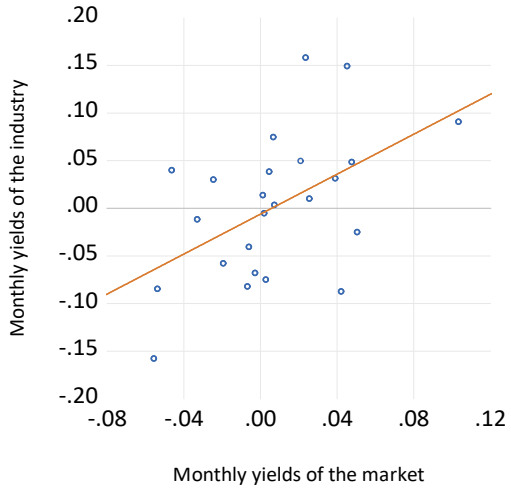

Figure 2 The sample period is from January 2020 to December 2021.

Table 1 The sample period is from January 2018 to December 2019.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.006070	0.011207	0.541676	0.5935
X1	0.887097	0.229857	3.859344	0.0008
R-squared	0.403706	F-statistic		14.89453
Adjusted R-squared	0.376601	Prob(F-statistic)		0.000849

Table 2 The sample period is from January 2020 to December 2021.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.006119	0.013955	-0.438469	0.6653
X2	1.048928	0.376594	2.785302	0.0108

R-squared	0.260701	F-statistic	7.757909
Adjusted R-squared	0.227096	Prob(F-statistic)	0.010789

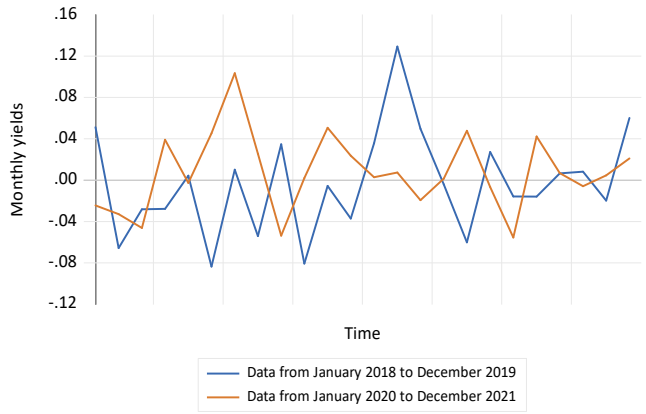

Figure 3 The sample period is from January 2018 to December 2019 and January 2020 to December 2021.