Empirical Research Based on CAPM Model in Online Education Industry

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Abstract—Online education has played a very important role in the epidemic [1]. Exploring the applicability of the online education industry to the study of the CAPM model and the overall industry's tolerance for risks is of positive significance in promoting the development of online education and the education industry. This article selects the latest data of 10 stocks listed in Shanghai and Shenzhen from 2018 to 2020, and uses the Capital Asset Pricing Model (CAPM) to conduct empirical research on the industry. The test results show that the β coefficient has a relatively small interpretation of the risks of China's education industry, and non-systematic risks still occupy a more significant position in education industry investment. Therefore, CAPM is not suitable for evaluating the performance of education-related stocks. At the same time, this article combines the background of China's stock market to make a further analysis of this model and explain the possible reasons for its poor applicability--the Chinese stock market is highly speculative. Finally, two suggestions are put forward for investment in the online education industry for investors. One is to seize investment opportunities in vocational education. Another is to use multiple indicators to jointly assess asset risks.

Keywords-CAPM; Online education; applicability

1. INTRODUCTION

In recent years, the scale of the online education market has grown steadily, and many enterprises in the education industry have begun to expand their business into online education. At the same time, due to the impact of the COVID-19, the teaching mode of schools in most areas has been generally changed to online courses [2].

Combining the development of the education industry in the past half year, a steady stream of companies entering the market, and the considerable development prospects of the education industry, this article chooses to conduct the research on Chinese education companies involved in online education to test the applicability of the capital asset pricing model (CAPM) to the education industry. At the same time, CAPM is further analyzed in the context of the Chinese

ICEMME 2022, November 18-20, Nanjing, People's Republic of China

DOI 10.4108/eai.18-11-2022.2326931

story to provide investors with certain guidance. There is a reference sense for the development of the online education industry and the impact of macroeconomics on online education under the epidemic.

2. EMPIRICAL TEST BASED ON CAPM

The main purpose of Capital Asset Pricing Model (CAPM) is to solve and prove the method of equilibrium asset prices in the securities market, the relationship between the expected rate of return and risky assets, etc. The development of capital and financial markets depends on the development of the CAPM model. The pricing method of prices is based on the CAPM model. The CAPM model is widely used in investment decision-making, theoretical analysis and other micro and macro fields.

2.1 Basic assumption

The capital asset pricing model has strict model assumptions, which mainly have the following points.

First, investors in the market are all rational, and the biggest characteristic of rational people is to achieve the maximum return rate in the market under the expected risk, or to minimize the market risk under the expected return rate.

Second, the market is completely efficient, and there are arbitrarily divided amounts of assets, but there are no taxes, transaction fees, etc., and investors can purchase arbitrary assets in the securities market as they wish.

Third, there is no institutional restriction on asset trading, such as allowing short selling in the market.

Four, the risk-free interest rate in the market is fixed, and borrowing or lending is allowed by using this interest rate.

Five, investors accept the price, and personal behavior does not affect the market and market prices.

Six, investors have the same expectations. They have the same expected value of expected return, standard deviation, and covariance between securities

2.2 CAPM model

The CAPM model is divided into the capital market line and the securities market line. The first is the capital market line:

$$E（R_p）= R_f + \frac{E(R_M) - R_f}{\sigma_M}\sigma_p$$

Rf represents the risk-free interest rate, E(Rp) represents the expected rate of return of the effective portfolio, σp represents the variance of the effective portfolio, E(RM) represents the

expected rate of return of the market portfolio, and σM represents the variance of the market portfolio.

The capital market line depicts the relationship between the return and risk of all effective asset portfolios in the capital market when they are in equilibrium. The investment portfolio is the only risky asset selected when all investors make decisions in accordance with Markowitz's theory.

However, the capital market line cannot describe the relationship between the return of a single asset or portfolio and its risk when the market is in equilibrium. The emergence of the securities market line makes this problem easy to solve:

$$E（R_i） = R_f + \frac{E(R_M) - R_f}{\sigma_M^2}\sigma_{iM}$$

E(Ri) represents the expected rate of return of a single security, E(RM) represents the expected rate of return of the market combination, represents the variance of the market combination, Rf represents the risk-free interest rate, and σiM represents the covariance of the market combination and a single security. The security market line shows the equilibrium relationship between the market portfolio, the covariance of a single security, and its expected rate of return. The formula can also be expressed as:

$$E(R_i) = R_f + [E(R_M) - R_f]\beta_{iM}$$

Among them,$\beta_{iM} = \frac{\sigma_{iM}}{\sigma_M^2} = \frac{cov(R_i,R_M)}{\sigma_M^2}$ represents the degree of contribution of the security i to market portfolio covariance, called β coefficient. β measures the sensitivity of asset i risk relative to market risk. The securities market line can restrain the setting of prices. When the market is in equilibrium, after estimating the β value of the asset or asset portfolio, the securities market line can determine the expected rate of return of a single asset or asset portfolio, as well as its price.

2.3 Sample selection

2.3.1 Individual stock selection and the measurement of individual stock yield (R_i)

This article selects online education concept stocks in Shanghai and Shenzhen A shares, and excludes ST and *ST stocks, totaling 10 stocks. The specific data is selected from the monthly closing price for a total of 36 months. From January 1, 2018 to December 31, 2020. The stock data comes from the Wind database. The reason for selecting the stocks of the sample companies is that the 10 stocks have been listed on the A-share market for a long time, at least three years, and the selected companies are representative, that is, in the online education industry, they generally obtain considerable profits. Their performances have grown steadily and the financial situations are relatively good, without large-scale losses. In addition, the data of these 10 stocks are comprehensive and true, with different sizes. And the samples have good

differences and representativeness, making the results have greater practical reference value. The formula for calculating the return on individual stocks is as follows:

Ri = (closing price of this month-closing price of last month) / closing price of last month *100%

2.3.2 Measurement of risk-free rate of return (Rf)

In view of the fact that Treasury bonds basically have no default risk, this article selects the 5-year Treasury bond interest rate as the representative of the risk-free yield. Combining the 5-year interest rate and the adjustment date, based on the weighted average calculation, the 5-year Treasury bond interest rate from January 2016 to December 2020 is 4.5%, converted into a monthly interest rate of 0.375%.

2.3.3 Measurement of market portfolio yield (R_M)

The sample stocks of the Shanghai Stock Exchange Composite Index include all listed stocks on the Shanghai Stock Exchange, which can fully reflect the fluctuations and trends of the stock prices listed on the Shanghai Stock Exchange. Therefore, the Shanghai Composite Index(SCI) from January 2018 to December 2020 is selected, and the relevant data is processed as an indicator of the market portfolio return rate. The data comes from the Wind database. The formula for calculating the market portfolio rate of return is as follows:

RM=(SCI at the close of this month-SCI at the close of the previous month) / SCI at the close of the previous month *100%

2.4 The empirical research process

2.4.1 Model setting

First, define Ri-Rf as Yit, which is the monthly excess return rate of stock i during t; then define RM-Rf as Xit, which is the monthly excess return rate of the market portfolio Shanghai Securities Composite Index m during t, thus Establish a univariate linear OLS regression model, the specific form is as follows:

Ri-Rf=αit+βit(Rm-Rf)+εit

Simplified form: Yit=αit+βitXit+εit

αit and βit are regression estimators; εit is the error term. Then, the second stage regression is performed on the basis of the first stage regression to the β coefficient. Take the β coefficient as the independent variable and regress with the monthly excess return Yit of stock i during the period t for further testing.

2.4.2 Regression analysis and testing

According to the regression results of the first stage, this article obtains the β coefficients and coefficients of determination R2 for each of the 10 stocks as shown in Table 1. (Stata is used as the regression tool).

TABLE I. R2 OF 10 STOCKS

	β	R2	p	t	Market Value (billion yuan)
1	0.8849204	0.1212	0.0374	2.17	32.92
2	0.772018	0.0406	0.2389	1.2	22.27
3	1.251815	0.2828	0.0008	3.66	46.3
4	1.108203	0.1966	0.0068	2.88	22.44
5	1.237677	0.1147	0.0434	2.1	29.61
6	1.02544	0.1568	0.0168	2.51	42.08
7	0.3748548	0.0253	0.3541	0.94	17.48
8	1.652195	0.2476	0.002	3.34	108
9	1.330102	0.3836	0.0001	4.6	26.11
10	1.590401	0.3311	0.0002	4.1	17.71

It can be seen from the regression of the first stage that the β of three companies are less than 1, and the β of the remaining seven companies are all greater than one. When the market rate of return fluctuates by 1 unit, companies with a β coefficient less than 1 have less volatility than market volatility, and investment risk is lower; companies with a β coefficient close to 1 are neutral stocks and their price fluctuations are similar to the market average stock price fluctuations; β The price volatility of stocks with a coefficient greater than 1 is significantly higher than the average stock price volatility in the market. Among them, the most volatile companies are close to 1.7 times the market, and they are semiconductor stocks with higher investment risks.

Calculating the average determination coefficient of the above-mentioned stocks shows that only 19% of the change in the excess return rate of individual stocks can be explained by the excess return rate of the market. The market portfolio has a mediocre explanation effect on the return of individual stocks.

Only two stocks' P value of β are greater than 0.05, and the test result is not significant. It can be concluded that the β coefficient of the first stage test is basically valid.

In the second stage of regression, the two stocks whose test results in the first stage are not significant are deleted. Taking the β coefficients of the remaining 8 stocks as independent variables, and regressing with their monthly excess average returns Yi, the result is Yi = 0.0045862β-0.012939, R2 = 0.0082. See Table 2 for specific regression results.

TABLE II. REGRESSION RESULTS

	Coef.	Std. Err.	t	p
β	0.0045862	0.0205459	0.22	0.831
_cons	-0.012939	0.0263816	-0.49	0.641

It can be seen from Table 2 that the coefficient of individual stock risk premium is only 0.0045862, and the coefficient of determination is very low, less than 1%, the P value of the independent variable is 0.831, and the relationship between stock returns and the β coefficient is not significant.

In summary, the applicability of the β coefficient to the education industry is not high, and systemic risks cannot explain the fluctuations of individual stock returns well. Changes in stock yields are less affected by the broader market index, and non-systematic risks still occupy a more significant position in investment in the education industry. Therefore, using CAPM to evaluate the performance of related stocks will produce some certain deviations.

3. FURTHER ANALYSIS OF CAPM BASED ON THE BACKGROUND OF CHINA'S STOCK MARKET

There have been many empirical studies on the applicability of CAPM in the world. Black, Jensen and Scholes (1972) used excess yields for empirical testing, which proved that the β seemed to be an important determinant of security returns [3]. Fama and MacBeth (1973) tested the relationship between the average return and risk of NYSE common stock, and conducted an empirical analysis of CAPM from the perspective of portfolio, which proved that CAPM was effective [4]. However, the applicability conclusions drawn for the Chinese market are not optimistic. Chen and Sun (2000) tested the effectiveness of CAPM in China's stock market, and the empirical results show that the β coefficient is weak in explaining the average earnings of China's stock market, and CAPM cannot be considered effective in The Chinese stock market [5]. Xue Hua and Zhou Hong (2001) also carried out CAPM empirical test on shanghai stock market, and the study was tested in four time periods, and the results still showed that CAPM suitability was not strong [6]. Combined with the background of the Chinese story, the reasons are as follows:

First, the Chinese stock market is highly speculative

Frequent speculative trading in the Chinese stock market has worsened the market environment and violated the assumption that "investors are risk averse" [7]. At the same time, the trading volume of China's stock market is huge, and transaction fees have a certain impact on market profits, which further interferes with the effectiveness of CAPM.

Second, violating the assumption of perfect competition

CAPM's assumption is that the market is completely competitive, and there is no possibility of price manipulation, all investors have the same source of information, and they analyze and process information in the same way. During the observation period, China's stock market is quite different from the above conditions [8].

The China Securities Regulatory Commission stated that the total number of administrative penalty decisions made in 2018 increased by 38.39% year-on-year, and the number of administrative penalty decisions, fines and confiscated amounts and the number of people banned from the market continued to record highs on the basis of the high base of the past three years. In 2019, the CSRC made a total of 304 administrative penalty decisions, with a fine of 4.183 billion yuan and banned 66 people from entering the market. In 2020, the CSRC made a

total of 339 administrative penalty decisions, with a fine of 5.296 billion yuan and banned 57 people from entering the market. The above data fully demonstrates that the Chinese stock market used insider to obtain high profits during the observation period, which violated the assumption of perfect competition [9].

Third, the form of investment income affects decision-making

CAPM's assumption is that the investment period tax burden is not considered, and all investors have the same single investment period. However, according to Chinese law, different forms of investment income face different tax burdens, which will affect investment decisions. For example, the law stipulates that investors are required to pay individual taxes at different rates according to the time from buying stocks to receiving cash dividends, and investors do not need to pay tax on the spread part of buying and selling stocks. The tax law leads the situation that the form of investment influences decision-making. These violate CAPM's assumptions.

4. RECOMMENDATIONS FOR INVESTMENT IN THE ONLINE EDUCATION INDUSTRY

First, seize investment opportunities in vocational education

As of May 29, 2021, there have been 48 investment and financing events in the online education industry, with the disclosed amount exceeding 9 billion yuan. From the perspective of the distribution of investment and financing events, in 2020, the education field has the most investment and financing events, with 29; the K12 field has the largest amount of online education financing, reaching 43.48 billion yuan. K12 is one of the hottest focuses in online education development in 2020. However, from January to May 2021, vocational education has become the field with the largest number of investment and financing events and the highest proportion of funds in online education, with a total of 10 cases and a total amount of 4.29 billion yuan. From the perspective of specific financing events, the investment and financing events in the field of vocational online education are distributed in various rounds, and the previous rounds accounted for 7 cases. Also, it can be seen that the field of vocational online education has attracted the attention of many large capitals [10].

While large amounts of capital are blessed, national policies are also inclined to support the development of vocational education. Due to the frequent occurrence of negative events in the K12 education field recently, the relevant regulatory policies for the compulsory education stage have become stricter. The rapid development momentum of the K12 online education field will be restricted, and vocational education is still strongly supported by national policies.

Second, using multiple indicators to jointly assess asset risks

Since the development of online education companies as a "burning money" project, except for a few companies that have entered the growth stage to obtain a few profits, most of them are still in a state of loss. The continuation of this state has not only resulted that a large amount of cash investment in the initial stage of the business has not yet produced any benefits, but the continuous losses have also made investment institutions gradually lose their confidence and patience. The online education industry has ushered in unprecedented changes. But after this round of large-scale use and experience, online education and education informatization may

enter a new stage of development. At the same time, there are more and more requirements for online enterprise valuation. When comparing the risk of different assets, multiple indicators should be used for evaluation, and attention should be paid to the effectiveness of different tools in different market contexts. For example, when evaluating CAPM, you should pay attention to its assumptions. At the same time, it is necessary to combine the standard deviation coefficient and the total risk value of the project under the analytic hierarchy process to jointly evaluate the risk.

5. CONCLUSION

Through the analysis, it can be seen that China's education industry stocks are not only affected by systemic risks, but also by other non-systemic risks. With the continuous improvement of our country's financial market and related supervision, investors will be more and more rational, and investment risk will be reduced accordingly. The emergence of this phenomenon may be due to the effectiveness of China's securities market is not sufficient. In China's current securities market, due to the lack of transparency of information, lack of adequate supervision, a large number of securities investors can not acquire the complete effective information.

At present, education-related industries still need enough attention. Although affected by different risks, such as systemic and non-systemic, its risks and benefits remain positively correlated. The education industry should optimize the industrial structure, make good use of the policy effect, carry out industrial upgrading, reduce investment risks and enhance the ability to resist risks.

Acknowledgement
First, I would like to extend my sincere gratitude to my teacher, Prof. Honigsberg, for her instructive advice. High tribute shall be paid to my supervisor of thesis, Ms. Han, whose profound knowledge and earnest attitude teaches me a lot. I am deeply grateful of her useful suggestions on my thesis.I am also deeply indebted to my tutor Frida and other teachers for their direct and indirect help to me.
Finally, special thanks should go to my friends who have put considerable time and effort into their comments on the draft.

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