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Empirical Analysis of Insurance Industry Based on CAPM Model

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Abstract **Review Article**

Since the reform and opening up, China's insurance industry has developed rapidly. In 2016, China's original insurance premium income exceeded that of Japan, becoming the second largest insurance country in the world. As an important part of national economy, insurance plays an important role in social stability and development. Based on the CAPM model, this paper makes an empirical analysis of the insurance industry and discusses whether the CAPM model is applicable to the insurance industry in China. The empirical results show that the overall volatility of the insurance industry stock is higher than the market volatility, and there is a significant risk premium compared with the market. The conclusion of this paper can be used as a reference for the portfolio strategy of the insurance industry, but the goodness of fit in the test results based on CAPM model is not high enough, which shows that the test process and the setting of the model are not perfect.

Keywords: Listed insurance company; CAPM model; β coefficient; white test.

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INTRODUCTION

Since the reform and opening up, China's economy has developed rapidly, people's lives have changed dramatically, and the insurance industry has been growing. As China's economy gradually turns from the high-speed growth stage in the early stage of reform and opening up to high-quality development, GDP keeps steady growth, residents' income steadily improves, and people's quality of life gradually improves. As the aging of the population becomes more and more obvious and people yearn for a healthy life, people's demand for insurance and risk management is increasing. As an important part of national economy, insurance plays an important role in social stability and development. In recent years, China's insurance industry has developed rapidly and made remarkable achievements. In the 2016-2017 white paper on insurance risk management issued by Ernst & young, in 2016, China's original insurance premium income exceeded 3 trillion yuan, surpassing Japan in the second place in the world, leading the world in growth rate and becoming the second largest insurance country in the world. With the continuous development of China's insurance industry, China has become an important market for the development of the world's insurance industry, which has a growing impact on the world's insurance industry. The insurance industry is becoming more and more prominent in the financial market. Insurance institutions have become important institutional investors in the bond market and capital market of China, which is conducive to promoting the transformation of the traditional financial system, improving the efficiency of financial resource allocation, and enhancing the stability and coordination of the financial system.

China has made remarkable achievements since the formal recovery of domestic insurance business in 1980. However, unlike most of the foreign joint-stock insurance companies are listed companies, the domestic insurance companies started late, and only in 2003 did the insurance companies listed in China. Domestic insurance companies are less listed, and there is a large gap compared with foreign insurance companies. Domestic scholars have less research on listed insurance companies in China. Therefore, this paper selects the insurance industry as the research object, and selects the daily closing price of six stocks in Shanghai and Shenzhen from January 1, 2017 to December 31, 2019 as the basic data to calculate the daily return rate of stocks. Taking the one-year fixed deposit interest rate published by the people's Bank of China as the risk-free interest rate, and the sample data was analyzed by the CAPM model. It is hoped that through the empirical study of CAPM model on the insurance industry, we can further understand and understand the current situation of the insurance industry, re-understand the securities market of the insurance industry, deepen our understanding of the

insurance industry stocks, analyze the investment value of the insurance industry, and explore the applicability of β coefficient to the insurance industry in China.

LITERATURE REVIEW

Research on CAPM model

The capital asset pricing model is referred to as the CAPM model for short. It was developed by William Sharpe, John Lintner, Jack Treynor, and Jan Mossin on the basis of asset portfolio theory and capital market theory in 1964. It is mainly used to study the relationship between the expected return of assets and risk assets in the securities market.

Since the CAPM model was put forward, there has been a lot of controversy about the validity of the CAPM model. Many foreign scholars have questioned the CAPM model. The most well-known is that Fama and French [1] confirmed that the market value scale and book market value compare with the return have a strong explanatory power to the yield, and β has little impact on the yield. There are also many scholars who support the CAPM model. Black, Jensen and Scholes [2], Fama and Macbeth [3] tested the stock portfolio empirically. The results are in line with CAPM model. There is a positive correlation between stock return and β. CAPM model has experienced a lot of empirical tests since its birth. The influence factors of β coefficient on the return of stock have always been a hot topic discussed and studied by scholars at home and abroad.

There are also many domestic scholars who have used the CAPM model for research. The empirical results are both applicable and not applicable to the model. Gou Dongning and Wang Weijia [4] conducted an empirical test on CAPM model based on the data of China's listed bank stocks from 2011 to 2014. The results show that CAPM model has significant ability to explain the earnings of four groups of bank stocks. However, for the four combinations, the goodness of fit of CAPM model is not high, and there are other important explanatory variables. He Huizhen [5] analyzed the monthly data of China's stock market from 2007 to 2010, and found that CAPM model is effective in China's stock market, and individual stock yield is positively correlated with market yield. However, Zhang Hu and Zou Yuanyuan [6] conducted time series test and cross-sectional test on the monthly return groups of 643 A shares in Shanghai stock market, and found that CAPM model is not fully applicable to Shanghai stock market. Jin Yunhui and Liu Lin [7] used ordinary least squares method, maximum likelihood method and generalized moment method to test the applicability of CAPM model in China's stock market, and found that the relationship between stock returns and beta coefficient is nonlinear. The CAPM model is not suitable for China's stock market.

Research on the stock prices of listed insurance companies

The stock price is the barometer of economy. The fluctuation of the stock price of the insurance company affects the value of the insurance company and the investors' profit and loss, as well as the economic stability. It is of great significance to analyze the stock price of the listed insurance company for the development of the insurance market. Many scholars have studied the stock price of the listed insurance company. Cong Jing and Wang Ling [8] studied the influencing factors of the stock price index of listed insurance companies, analyzed the influencing direction and degree. They found that the stock price index of listed insurance companies was inversely proportional to the price level, the external environmental index is the main influencing factor, and the internal operation index is relatively minor. Liu Yang [9] studied the volatility of the stock price of listed insurance companies in China by establishing GARCH, EGARCH and GARCH-M models, and found that the volatility of the return series of listed insurance companies has significant heteroscedasticity, and the volatility of stock price has persistence and asymmetry. Zhang Yu [10] studied the volatility of the stock price of listed insurance companies based on the asymmetric combination GARCH model, and made policy recommendations to investors, insurance companies and other stakeholders according to the empirical results. Li Jie [11] studied the correlation between stock price and operating performance of listed insurance companies, and found that the correlation between stock price and operating performance of listed insurance companies was weak.

To sum up, there are still doubts about whether CAPM model is applicable to China's stocks, especially in the field of insurance industry which is rarely studied. The number of Listed Companies in the insurance industry is small, and the development is not mature enough. It remains to be studied whether CAPM which uses the market to explain whether its stock excess return rate is reasonably applicable in the insurance industry.

Models and data

Model setting

$$\mathrm{E}(r_i) = r_f + \beta_i[E(r_m) - r_f]$$

According to the CAPM model, $\mathrm{E}(r_i)$ is the expected return of securities i, $E(r_m)$ is the expected return of the market portfolio, and r_f is the return of risk-free assets. The β coefficient is a risk measurement indicator, which measures the relationship between the excess return rate of risk assets and the excess return rate of the entire securities market, that is, measures the systematic risk of assets. When β>1, the expected rate of return obtained by investing in the security is higher than the expected rate of return of the market effective portfolio; when β=1, the expected rate of return

obtained by investing in the security is equal to the expected rate of return of the market effective portfolio; when β<1, the expected rate of return obtained by investing in the security is lower than the expected rate of return of the market effective portfolio.

Since the CAPM model is an ex-ante model, if we want to test the CAPM model with the existing data, we need to convert the CAPM model to an ex-post form so that we can use the data. So the model is set as:

$$r_{it} - r_f = \alpha_i + \beta_i(r_{mt} - r_f) + \varepsilon_i$$

Among them, r_{it} is the rate of return of the securitie i at t, r_f is the risk-free rate of return, the constant term α_i is the expected return that the market cannot explain, β_i is the systemic risk of the securitie i, and r_{mt} is the rate of return of the market portfolio at t , ε_i is a random error.

Selection of data

Selection of stocks

This paper mainly selects the insurance industry stocks in the industry classification of the CSRC. There are 7 stocks in total,of which Xishui(600291), Ping An(601318), PICC (601319), Xinhua Insurance(601336), China Taibao(601601) and China Life Insurance(601628) are listed on the Shanghai Stock Exchange, and Tianmao group(000627) is listed on the Shenzhen Stock Exchange. As the data of PICC (601319) is insufficient, the remaining six stocks are selected. And the daily closing price from January 1, 2017 to December 31, 2019 is selected as the basic data to calculate the daily yield.

Table-1: Selection of stocks

Stock code	Stock name	Stock code	Stock name
000627	Tianmao group	601336	Xinhua Insurance
600291	Xishui	601601	China Taibao
601318	Ping An	601628	China Life Insurance

Selection of risk-free rate of return

The risk-free rate of return usually refers to the interest rate that can be obtained by investing funds in an asset without any risk. In this paper, the interest rate of one-year fixed deposit published by the people's Bank of China in the sample period is 1.50%, which is converted into daily interest rate of 0.0041%.

Selection of market index

In this paper, six stocks are selected, five of which are listed in Shanghai Stock Exchange and one in Shenzhen Stock Exchange. Because the selected samples are listed on different exchanges and are distributed in Shanghai and Shenzhen, the CSI 300 index is selected for data analysis. CSI 300 index has gradually matured since 2005, and its compiling method is scientific and reasonable. As the value weighted index of the main stocks in Shanghai and Shenzhen stock markets, the CSI 300 index can better reflect the changes in stock price and the development trend of the stock market. The constituent stocks of the CSI 300 index cover about 60% of the market value of Shanghai and Shenzhen markets, which are well represented in the market. In a large number of empirical studies, the CSI index is used by many scholars to represent market returns.

Calculation of rate of return

$$r_{it} = \frac{P_t - p_{t-1}}{p_{t-1}}$$

$$r_{mt} = \frac{IND_t - IND_{t-1}}{IND_{t-1}}$$

Among them, r_{it} is the daily return of the stock, P_t is the daily closing price of the stock in t period, p_{t-1} is the daily closing price of the stock in t-1 period, and r_{mt} is the daily return of the CSI 300 Index. IND_t is the daily closing index of the CSI 300 Index in period t, and IND_{t-1} is the daily closing index of the CSI 300 Index in period t-1. The data are mainly come from the Guotai'an database.

Results and analysis of the empirical test

According to the basic data of the daily closing price from January 1, 2017 to December 31, 2019, we can calculate the daily rate of return. The daily yield is calculated based on the closing price from January 1, 2017 to December 31, 2019. Besides, the daily rate of return, risk-free rate of return and market portfolio rate of return are brought into the model, and the data is regressed by using Stata software. The results are shown in Table 2.

Table-2: Summary of regression results

Stock code	Stock name	β	t	p	R^2
000627	Tianmao group	1.18204	21.06	0.000	0.3819
600291	Xishui	1.531038	19.61	0.000	0.3457
601318	Ping An	1.229462	32.63	0.000	0.5939
601336	Xinhua Insurance	1.34735	24.74	0.000	0.4568
601601	China Taibao	1.217216	24.33	0.000	0.4484
601628	China Life Insurance	1.120632	23.64	0.000	0.4342

Analysis of beta coefficients

In the CAPM model, the total risk of an asset can be divided into two parts. One is the change of asset returns due to the change of market portfolio returns, that is system risk, and the other is non-systematic risk. The β coefficient is the risk measurement of market portfolio and measures the systematic risk of assets. The β coefficient reflects the sensitivity of securities to the expected rate of return of the effective market portfolio. If $\beta > 1$, it indicates that the expected rate of return of the asset is higher than the expected rate of return of the market, the price fluctuation is greater than the fluctuation of the market index, and the risk it bears is also higher than the risk faced by the market; conversely, if $\beta < 1$, it indicates that the expected rate of return of the asset is lower than the expected rate of return of the market, and the price fluctuation is smaller than the fluctuation of the market index, and the risk it bears is lower than the risk faced by the market; while $\beta = 1$, it indicates that the expected rate of return of the asset is the same as that of the market, the price fluctuation is the same as that of the market index, and the risk it bears is equal to the risk faced by the market. Generally speaking, we call the stocks with high volatility ($\beta > 1$) as offensive stocks, the stocks with low volatility ($\beta < 1$) as defensive stocks, and the stocks with the same volatility ($\beta = 1$) as the market as neutral stocks.

In the empirical results of this paper, the β's values of Tianmao group (000627), Xishui stock (600291), Ping An (601318), Xinhua Insurance (601336), China Taibao (601601601) and China Life Insurance (601628) are all greater than 1, and these five stocks belong to offensive stocks. For the insurance industry as a whole, the β's value is large, and the risk faced by the insurance industry stock exceeds that of the market average level. Although we believe that insurance itself is a relatively safe investment, the high return of the insurance industry stocks are accompanied by high risks. The fluctuation range of the insurance company's stock price is larger than that of the market, making it more suitable for the investors with risk preference to invest.

Analysis of correlation

The empirical results are compared with Prob (F-statistics) and the significance level α. If Prob (F-statistics) is less than the significance level, the original hypothesis is rejected, indicating that there is a significant linear relationship between the independent and dependent variables. In this paper's empirical results, the Prob (F-statistics) value of each stock is 0, less than $\alpha = 0.05$, rejecting the original hypothesis. It shows that there is a significant linear relationship between the market return of the insurance industry and the excess return of a single stock.

Analysis of significance

According to the data in Table 2, the p values of the β coefficient of a single stock are all 0, which are less than the significance level $\alpha = 0.05$. The original hypothesis is rejected, indicating that the probability of β coefficient equal to 0 is less than 0.05, and the β coefficient is significantly not 0. The independent variable has a significant impact on the dependent variable, that is, there is a significant relationship between the market portgolio yield of the insurance industry and the excess return of a single stock, which conforms to the model setting Fixed.

Analysis of determinable coefficient

In general, the determinable coefficient R^2 is used to test the goodness of fit of the model, and R^2 represents how much of the variation of the dependent variable can be explained by the independent variable. If the model is completely fits the sample observations, then $R^2 = 1$. Of course, it is rare that the model is completely fits the sample observations, and there are few cases where R^2 is equal to 1. A smaller R^2 means that the error variance is too large relative to the dependent variable. So it is difficult for us to accurately estimate the dependent variable's coefficient, but there is no doubt that the closer R^2 is to 1, the better the model fits.

In the empirical results of this paper, the determinable coefficients of six stocks are in the range of 0.34-0.6. Except for Ping An (601318), the determinable coefficients of Tianmao group (000627), Xishui (600291), Xinhua Insurance (601336), China Taibao (601601) and China Life Insurance (601628) are all less than 0.5. If R^2 is greater than 0.5, it means that the fluctuation of stock price is mainly influenced by the fluctuation of Shanghai and Shenzhen stock markets; if R^2 is less than 0.5, it means that the fluctuation of stock price is mainly influenced by the non-systemic risk such as the company's own factors. It can be seen from the empirical results that the β coefficient of a single stock is significantly not 0. But the overall fitting degree of the insurance industry is not high enough, which shows that the β coefficient does not well reflect the linear relationship between the stock's excess return rate and the market's excess return rate. As a whole, system risk is not the most important factor that affects the development of the entire industry. The impact of CSI 300 index on the insurance industry is not obvious. There are other factors that affect the stock yield of the insurance industry.

White test

Table-3: Results of white test

Stock code	Stock name	P
000627	Tianmao group	0.0751
600291	Xishui	0.4952
601318	Ping An	0.4085
601336	Xinhua Insurance	0.8730
601601	China Taibao	0.0175
601628	China Life Insurance	0.0042

This paper further conducted the White test. The results are shown in Table 3. From the results, we can see that the P values of Tianmao group(000627), Xishui(600291), Ping An(601318) and Xinhua Insurance(601336) are all greater than 0.05, indicating that the original hypothesis is satisfied and the regression model has homoskedasticity. Only the p value of China Taibao (601601) and China Life Insurance(601628) is less than 0.05, indicating that the original hypothesis is rejected and the regression has heteroscedasticity, which means that the parameter estimates are biased and the prediction result is invalid. On the whole, the prediction results of four stocks are valid, and the date of industry is of reference significance.

Analysis of empirical results

According to the results of empirical analysis, the systematic risk of China's insurance industry is greater than the market risk, and the range of return fluctuations is greater than the market fluctuations. There is a significant linear relationship between the market return rate of the insurance industry and the excess return rate of a single stock. However, based on CAPM model, the goodness of fit of insurance industry test is not high, which may be caused by multiple reasons. First of all, although the insurance industry in China has developed rapidly in recent years with remarkable achievements and promising prospects, its development is not mature enough, and there are few listed stocks in the insurance industry, which may lead to the lack of representativeness of empirical results. Secondly, simplifying the data in the test process may affect the empirical results. For example, this paper selects the CSI 300 index to replace the market portfolio, which to some extent affects the accuracy of the results. In addition, CAPM model has very strict assumptions, such as the requirement to meet the conditions of perfect market, but obviously the current stock market does not meet this assumption, so it may also affect the validity of the results.

CONCLUSION

Based on the above empirical analysis of the insurance industry, the fluctuation range of the insurance industry is larger than that of the market, and there is a significant risk premium compared with the market facing higher risks. However, the goodness of fit of the model is not high enough, which shows that CAPM model is far from enough to explain the insurance industry in China. At present, the return of the insurance industry stock cannot be well explained. The relationship between the excess return of the stock and the excess return of the whole market is not well explained by β coefficient, which also shows that other factors may affect the return of the stock. The CAPM model is an important asset pricing model, which provides a reference for investors' investment strategies, helps and guides investors to make scientific and reasonable investment decisions. However, it is difficult to meet the strict assumptions of CAPM model in the empirical process, which makes it difficult to apply CAPM model in practice. In addition, the selection of index in the actual operation will also affect the empirical results. Besides, China's insurance industry is still developing whose development is not mature enough, and the number of shares in the insurance industry is also small, which will affect the test of CAPM model.

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