# Analysis on Application of CAPM Model in Chinese Securities Market and Its Deficiencies

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**ABSTRACT**
The capital asset pricing model (CAPM), which accurately predicts the relationship between asset risk and expected return, is the cornerstone of modern financial economics. Starting from the most common unitary capital asset pricing model, this paper studies the application of the CAPM model in the Chinese securities market and discusses its current shortcomings. This paper selects the 2016-2020 Chinese Shanghai 50 index of 15 stocks with monthly returns as the research object. Using the single index model and the use of EXCEL and SPSS software to carry out the linear regression analysis, it was finally concluded that the stock with monthly returns and its market risks have a linear relationship.

***Keywords:*** *CAPM model, Chinese securities market, rate of return, risk*

## 1. INTRODUCTION

Starting from the most common unitary capital asset pricing model, this paper studies the application of the CAPM model in the Chinese securities market and discusses its current shortcomings. Most of the research in this field stays at the level of theoretical verification and data analysis [1]. On this basis, this paper simulates the stock market line (SML) according to the existing data and verifies the relationship between the return rate of securities assets and their market risk again[2].

This paper selects the monthly return rate of 15 constituent stocks in the Chinese Shanghai 50 index from 2016 to 2020 as the research object, adopts the single index model, and performs linear regression analysis with EXCEL and SPSS software to study the linear relationship between the monthly return rate and its market risk[3].

Although the application of the CAPM model in the Chinese securities market is not mature enough, it's still a model that investors can refer to and measure the relationship between the return rate of related assets and risk when investing in the securities market. On this basis, investors can combine the actual conditions of the market and assets and comprehensively consider various factors to make the most reasonable investment decision.

## 2. INTRODUCTION OF CAPM MODEL AND ITS PROBLEMS

The capital asset pricing model (CAPM) is a prediction model based on the expected return of risky assets that accurately predicts the relationship between asset risk and expected return. Modern portfolio selection theory was developed by Harry Markowitz in 1952 and further developed 12 years later by William Sharp, John Lintner, and Jan Mawson as the capital asset pricing model[4]. The assumptions of the capital asset pricing model are relatively harsh, which can be summarized as the following three points: 1. investors are rational mean-variance optimizers; 2. investors use the same input table, resulting in homogeneous expectations; 3. all assets are publicly traded, and investors can borrow money at a risk-free rate;Based on the assumptions above, we obtain the expected return-beta relationship, which is the most basic and universal expression of the capital asset pricing model:

$E(R_M) = R_f + \beta_M * [E(R_M) - R_f]$, where $E(R_M)$ is the expected return of the desired portfolio, $R_f$ is the risk-free rate in the current market. β is the risk coefficient of risky assets, which is used to measure the system risk that cannot be eliminated in the portfolio, and $E(R_M) - R_f$ represents the risk premium of the portfolio. That means there is a difference between the

actual rate of return on risky assets and the actual risk-free rate of return, indicating that excess returns are obtained due to taking certain risks. Since β is directly proportional to the contribution of securities to the risk of an optimal risk portfolio, it is taken as an appropriate index to measure the risk[5]. When β=1, the risk of the asset or portfolio is the same as the market's average risk, and its return rate is the same as the market's average expected return rate; When β<1, the risk of the asset or portfolio is lower than the market's average risk, and its return rate is naturally lower than the market average return; When β>1, the risk of the asset or portfolio is higher than the market's average risk, and its return rate is naturally higher than the market's average return. Given a value of β, the difference between the actual expected return of the stock and the normal expected return becomes the alpha of the stock and is denoted as α.

When α>0, investors will think that the price of the asset is undervalued and will appreciate in the future, i.e., they will increase their investment proportion in it; When α<0, investors will think that the price of the asset is overvalued and will depreciate in the future. In other words, they will sell the asset in large quantities and reduce their investment proportion. In this sense, a portfolio manager's job is to increase the proportion of assets that are greater than 0 and decrease the proportion of assets that are less than 0.

In this paper, the monthly returns of 15 stocks with the same time range in the sample of the SSE 50 index from 2016 to 2020 are used for verification[6]. Meanwhile, the SSE 50 index was selected as the measurement index reflecting the total returns and total risks of the Chinese securities market. The market risk-free interest rate adopts the RMB one-year deposit rate published by the People's Bank of China in 2018: 50%. The securities market yield $R_M$ and the average stock yield $R_i$ calculated in this paper are both continuous compound interest rates for several months, so the risk-free rate is also converted to a monthly continuous compound interest rate, i.e. 0.125%.

## 3. THE ESTABLISHMENT OF MODEL AND ANALYSIS OF EMPIRICAL RESULTS

### *3.1 β coefficient estimation*

#### *3.1.1 Calculation of rate of return*

First of all, we use the following formula to get the monthly return rate of SSE 50 index, namely the average monthly return rate of securities market $R_M$ : $R_{Mt} = \ln[1+(P_t - L_t)/L_t]$ , in which $P_t$ is the monthly closing index of SSE 50 index at time t, while $L_t$ is the monthly opening index of SSE 50 index at time t.

Similarly, we calculate the average monthly return of a single stock according to the following: $R_{it} = \ln[1+(X_{it} - M_{it})/M_{it}]$ (i=1, 2, 3…15), in which $X_{it}$ is the nominal closing price of stock i at time t, while $M_{it}$ is the nominal opening price of stock i at time t.

#### *3.1.2 β coefficient estimation*

In this paper, a single exponential estimation model is adopted, and its regression equation is: $R_{it} = \alpha_i + R_f + \beta_i * (R_{mt} - R_f) + e_{it}$ (i=1, 2, 3…15)(1), in which intercept term $\alpha_i$ is the expected excess return of the security when the excess return of the market index is 0; Slope $\beta_i$ is the sensitivity of the stock to the index; whenever the market index rises or falls by 1%, it is the rise or fall of the return of stock i, which itself is a random error term; $e_{it}$ is called residual value, which is the impact of the return rate at the company level at time t, and its mean value is 0.

Based on equation (1), we make the following deformation:

$R_{it} - R_f = \alpha_i + \beta_i * (R_{mt} - R_f) + e_{it}$ (i=1, 2, 3…15)(2), in which we defined $R_{it} - R_f$ as the dependent variable and $R_{mt} - R_f$ as the independent variable. Based on this, we used SPSS software to conduct regression operation on relevant data and obtained the following results:

| The coefficient of a. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | | B | standard error | trial version | | | tolerance | VIF |
| 1 | (constant) | 0.000 | 0.004 | | -0.145 | 0.885 | | |
| | market risk premium | 1.549 | 0.165 | 0.777 | 9.396 | 0.000 | 1.000 | 1.000 |
| a.The dependent variable:Equity risk premium | | | | | | | | |

China life

**Figure 1** Regression results of China Life

| The coefficient of a. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | | B | standard error | trial version | | | tolerance | VIF |
| 1 | (constant) | -0.002 | 0.004 | | -0.428 | 0.670 | | |
| | market risk premium | 1.465 | 0.181 | 0.728 | 8.088 | 0.000 | 1.000 | 1.000 |
| a.The dependent variable:Equity risk premium | | | | | | | | |

Xinhua insurance

**Figure 2** Regression results of Xinhua Insurance

| The coefficient of a. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | | B | standard error | trial version | | | tolerance | VIF |
| 1 | (constant) | 0.012 | 0.007 | | 1.836 | 0.072 | | |
| | market risk premium | 1.397 | 0.299 | 0.523 | 4.668 | 0.000 | 1.000 | 1.000 |
| a.The dependent variable:Equity risk premium | | | | | | | | |

China Duty Free Group

**Figure 3** Regression results of China Duty Free Group

| The coefficient of a. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | | B | standard error | trial version | | | tolerance | VIF |
| 1 | (constant) | -0.005 | 0.003 | | -1.826 | 0.073 | | |
| | market risk premium | 1.356 | 0.125 | 0.818 | 10.841 | 0.000 | 1.000 | 1.000 |
| a.The dependent variable:Equity risk premium | | | | | | | | |

Haitong Securities

**Figure 4** Regression results of Haitong Securities

| The coefficient of a. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | | B | standard error | trial version | | | tolerance | VIF |
| 1 | (constant) | 0.003 | 0.007 | | 0.413 | 0.681 | | |
| | market risk premium | 1.211 | 0.300 | 0.469 | 4.039 | 0.000 | 1.000 | 1.000 |
| a.The dependent variable:Equity risk premium | | | | | | | | |

Shanghai Fosun Pharmaceutical

**Figure 5** Regression results of Shanghai Fosun Pharmaceutical

| The coefficient of a. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | | B | standard error | trial version | | | tolerance | VIF |
| 1 | (constant) | 0.002 | 0.004 | | 0.530 | 0.598 | | |
| | market risk premium | 1.164 | 0.171 | 0.666 | 6.808 | 0.000 | 1.000 | 1.000 |
| a.The dependent variable:Equity risk premium | | | | | | | | |

Poly Development Holding Group

**Figure 6** Regression results of Poly Development Holding Group

| The coefficient of a. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | | B | standard error | trial version | | | tolerance | VIF |
| 1 | (constant) | 0.005 | 0.005 | | 1.089 | 0.281 | | |
| | market risk premium | 1.044 | 0.215 | 0.537 | 4.854 | 0.000 | 1.000 | 1.000 |
| a.The dependent variable:Equity risk premium | | | | | | | | |

Inner Mongolia Yili Shares

**Figure 7** Regression results of Inner Mongolia Yili Shares

| The coefficient of a. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | B | standard error | trial version | | | tolerance | VIF |
| 1 (constant) | 0.016 | 0.004 | | 3.945 | 0.000 | | |
| market risk premium | 0.972 | 0.175 | 0.590 | 5.563 | 0.000 | 1.000 | 1.000 |

a. The dependent variable:Equity risk premium

Kweichow Moutai

**Figure 8** Regression results of Kweichow Moutai

| The coefficient of a. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | B | standard error | trial version | | | tolerance | VIF |
| 1 (constant) | 0.002 | 0.004 | | 0.343 | 0.733 | | |
| market risk premium | 0.880 | 0.196 | 0.509 | 4.498 | 0.000 | 1.000 | 1.000 |

a. The dependent variable:Equity risk premium

SAIC Motor Corporation

**Figure 9** Regression results of SAIC Motor Corporation

| The coefficient of a. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | B | standard error | trial version | | | tolerance | VIF |
| 1 (constant) | 0.001 | 0.003 | | 0.352 | 0.726 | | |
| market risk premium | 0.838 | 0.119 | 0.679 | 7.037 | 0.000 | 1.000 | 1.000 |

a. The dependent variable:Equity risk premium

INDUSTRIAL AND COMMERCIAL BANK OF CHINA

**Figure 10** Regression results of Industrial and Commercial Bank of China

| The coefficient of a. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | B | standard error | trial version | | | tolerance | VIF |
| 1 (constant) | -0.003 | 0.003 | | -1.193 | 0.238 | | |
| market risk premium | 0.821 | 0.115 | 0.685 | 7.160 | 0.000 | 1.000 | 1.000 |

a. The dependent variable:Equity risk premium

Shanghai Pudong Development Bank

**Figure 11** Regression results of Shanghai Pudong Development Bank

| The coefficient of a. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | B | standard error | trial version | | | tolerance | VIF |
| 1 (constant) | 0.012 | 0.005 | | 2.408 | 0.019 | | |
| market risk premium | 0.808 | 0.230 | 0.419 | 3.516 | 0.001 | 1.000 | 1.000 |

a. The dependent variable:Equity risk premium

Foshan Haitian Flavouring and Food

**Figure 12** Regression results of Foshan Haitian Flavouring and Food

| The coefficient of a. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | B | standard error | trial version | | | tolerance | VIF |
| 1 (constant) | 0.000 | 0.002 | | 0.115 | 0.909 | | |
| market risk premium | 0.655 | 0.096 | 0.667 | 6.824 | 0.000 | 1.000 | 1.000 |

a. The dependent variable:Equity risk premium

AGRICULTURAL BANK OF CHINA

**Figure 13** Regression results of Agricultural Bank of China

| The coefficient of a. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | | B | standard error | trial version | | | tolerance | VIF |
| 1 | (constant) | -0.005 | 0.005 | | -1.032 | 0.306 | | |
| | market risk premium | 0.647 | 0.227 | 0.350 | 2.845 | 0.006 | 1.000 | 1.000 |
| a.The dependent variable:Equity risk premium | | | | | | | | |

China Unicom

**Figure 14** Regression results of China Unicom

| The coefficient of a. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | | Nonstandardized coefficient | | Standard coefficient | t | Sig. | Collinear capacity | |
| | | B | standard error | trial version | | | tolerance | VIF |
| 1 | (constant) | 0.004 | 0.003 | | 1.181 | 0.243 | | |
| | market risk premium | 0.487 | 0.133 | 0.434 | 3.671 | 0.001 | 1.000 | 1.000 |
| a.The dependent variable:Equity risk premium | | | | | | | | |

Yangtze Power

**Figure 15** Regression results of Yangtze Power

According to the results of unary regression analysis, we can also get the relationship between the monthly return rate of each stock and market risk, as shown in the following table:

**Table 1** The relationship between the monthly return rate of each stock and market risk

| Stock name | Comparison expression |
|---|---|
| China life | $R_{it}-R_f=1.549*(R_{mt}-R_f)$ |
| Xinhua insurance | $R_{it}-R_f=-0.002+1.465*(R_{mt}-R_f)$ |
| China Duty Free Group | $R_{it}-R_f=0.012+1.397*(R_{mt}-R_f)$ |
| Haitong Securities | $R_{it}-R_f=-0.005+1.356*(R_{mt}-R_f)$ |
| Shanghai Fosun Pharmaceutical | $R_{it}-R_f=0.003+1.211*(R_{mt}-R_f)$ |
| Poly Development Holding Group | $R_{it}-R_f=0.002+1.164*(R_{mt}-R_f)$ |
| Inner Mongolia Yili Shares | $R_{it}-R_f=0.005+1.044*(R_{mt}-R_f)$ |
| Kweichow Moutai | $R_{it}-R_f=0.016+0.972*(R_{mt}-R_f)$ |
| SAIC Motor Corporation | $R_{it}-R_f=0.002+0.880*(R_{mt}-R_f)$ |
| Industrial And Commercial Bank Of China | $R_{it}-R_f=0.001+0.838*(R_{mt}-R_f)$ |
| Shanghai Pudong Development Bank | $R_{it}-R_f=-0.003+0.821*(R_{mt}-R_f)$ |
| Foshan Haitian Flavouring and Food | $R_{it}-R_f=0.012+0.808*(R_{mt}-R_f)$ |
| Agricultural Bank Of China | $R_{it}-R_f=0.655*(R_{mt}-R_f)$ |
| China Unicom | $R_{it}-R_f=-0.005+0.647*(R_{mt}-R_f)$ |
| Yangtze Power | $R_{it}-R_f=0.004+0.487*(R_{mt}-R_f)$ |

## *3.2 Data analysis*

### *3.2.1 β coefficient estimation results analysis*

In this paper, 15 stocks with common time interval in SSE 50 index from 2016 to 2020 are selected for regression analysis, and the above regression results show: among the 15 selected stocks, there are 7 stocks with β>1, indicating that the risk degree of these 7 stocks is higher than the market average risk and they belong to "defensive assets". Moreover, the β coefficient of China Life Insurance is 1. 549, which is the maximum.

However, there are 8 stocks with β<1, indicating that the risk degree of these 8 stocks is lower than the market average risk and belongs to "offensive assets", and the β coefficient of Yangtze Power is 0. 487, which is the

minimum value. In addition, the risk coefficients β of the 15 selected stocks all passed the T test, indicating that there is a certain linear relationship between the defined dependent variable $R_{it}-R_f$ (i=1, 2, 3…15) and independent variable $R_{mt}-R_f$, i.e., there is a certain linear relationship between the monthly return rate of each stock and market risk.

### *3.2.2 α coefficient estimation results analysis*

Among the 15 stocks selected, there are 9 stocks whose coefficient α>0, indicating that the return rate of these 9 stocks is higher than the average return rate of the market, and the coefficient α of Kweichow Moutai is 0. 016, which is the maximum; While there are 4 stocks with coefficient α<0, indicating that the return rate of these 4 stocks is lower than the average return rate of the market, and the coefficient α of China Unicom and Haitong Securities is -0. 005 respectively, which is the minimum value; In addition, the coefficient α of China Life and Agricultural Bank of China is 0, indicating that their investment returns happen to be close to the market average returns. However, the T-test results of coefficient α regression show that the coefficient α of some stocks does not pass the T-test, indicating that the partial estimates are not reliable and there is still a deviation from the actual value.

### *3.2.3 Stock market line(SML)regression analysis*

Based on the β value of outstanding stocks estimated by the above regression and the mean of the excess return of each stock calculated, we carried out further linear regression and simulated the stock market line. The analysis results are as follows:

The model summary b

| Model | R | The square of R | Adjusted R squared | Error of standard estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 1 | 0.051 a | 0.003 | -0.064 | 0.0193705 | 2.002 |

a. Predictor variable: (constant), beta

b. The dependent variable: The average of the excess returns

**Figure 16** The result of further linear regression

coefficient a

| Model | | Nonstandardized coefficient | | standard coefficient | t | Sig. | Collinearity statistics | |
|---|---|---|---|---|---|---|---|---|
| | | B | Standard error | A trial version | | | tolerance | VIF |
| 1 | (constant) | -9.69E-05 | 0.017 | 0.051 | -0.006 | 0.995 | 1.000 | 1.000 |
| | beta | 0.003 | 0.015 | | 0.200 | 0.844 | | |

a. The dependent variable: The average of the excess returns

**Figure 17** The result of stock market line

According to the results, R squared is 0. 003, DW=2. 022, and according to the significance test results of the coefficient, we can conclude that the regression equation can not well explain the linear relationship between stock return and risk, let alone further explain the linear relationship between positive or negative correlation between them.

## 4. DISCUSSION

The current Chinese securities market is still an inefficient market that is not completely open and transparent. That is to say, it cannot simultaneously satisfy the conditions that all investors are rational to pursue the minimization of mean-variance and that market information is available to all investors at no cost, without security transaction costs, and with homogeneous expectations[7]. At the same time, another vital prerequisite is that the risk premium of a risky asset is proportional to its risk coefficient. In the current Chinese securities market, the risk premium of a risky asset is not only affected by its risk but also jointly affected and determined by various factors, such as the company's operating conditions. In this regard, it is impossible to consider the impact of risk on its risk premium without the influence of other factors. In addition, at present, the Chinese securities market is still in development on a small scale, which means it cannot give full play to the various functions of the stock market[8].

In addition, the basic content of the capital asset pricing model (CAPM) is to study the quantitative relationship between the expected return of assets and risky assets in the securities market; that is, in order to compensate for a certain degree of risk, how much return investors should get and how the equilibrium price is formed. Despite its shortcomings, the CAPM model has been widely recognized in the security theory circle[9]. It mainly analyzes the sensitivity of securities returns and market portfolio return changes, helps investors decide whether the additional return they get matches the risk, and can be used as a model for investors to refer to and measure the relationship between the return of relevant securities assets and risk when investing in the securities market. On this basis, combined with the actual market and asset conditions and comprehensively considering

various factors, investors can make the most reasonable investment decision[10].

## 5. CONCLUSION

According to the above analysis, the paper finds that the stock's monthly returns and its market risks have a linear relationship. Besides, the CAPM model has a limited ability to explain the relationship between the returns of the 15 stocks selected in this paper and their risks. The reasons can be summarized into two aspects: the Chinese market and the limitations of this paper, respectively. In terms of the Chinese market, an important prerequisite for the establishment of the CAPM model is to be in an efficient market.

As for the limitations, the sample in this paper can be expanded, and the factors analyzed in this paper can also be specified, such as national policies and managers' business strategies, which would be studied in future research.

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