The Applicability of Classic Capital Asset Pricing Model in Chinese Stock Market

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ABSTRACT
China has been one of the largest emerging markets and the second-largest economy in the world since the 'Reform and Opening-up' in 1978. However, because of the late development, Chinese financialization is still at a developing stage, and the Chinese stock market opened its first trade in 1989. By contrast, the New York Stock Exchange (NYESE) started in 1789. During these years of development, some models have been built to value the price of assets. The classic Capital Asset Pricing Model (CAPM) was a famous one raised by American scholar Sharpe in 1964, which is a model that indicates the relationship between the expected return of an asset or portfolio and the systematic risk of the market. The classic CAPM model's applicability has been tested practically in the US. However, China has a different system and a much younger age compared to the financial market in the US. Thus, this paper is going to investigate whether the CAPM model could be applied to Chinese market. The discussion will investigate the CAPM capabilities by referring to scholars' statistical studies. This paper will provide some statistical analysis and evaluate these methods by comparing Chinese and US markets, which leads to this paper's conclusion: the CAPM model does not fit into the current Chinese stock market.

Keywords: *Capital Asset Pricing Model, Chinese stock market, Modern Portfolio Theory, New York Stock Exchange*

1. INTRODUCTION

The classic Capital Asset Pricing Model (CAPM) was raised by American scholar Sharpe in 1964, which is a model that indicates the relationship between the expected return of an asset or portfolio and the systematic risk of the market, and it is demonstrated to price the risky assets fairly in the US stock market by other scholars including Black (1972), Shanken and Jogannathan (1993).

China is growing rapidly as one of the emerging markets. However, China is relatively short in the history of stock market since its establishment year is 1989 compared to 1789 of New York Stock Exchange, and it has been prolonged discussion that if the Chinese market is mature enough to fit the CAPM model in.

Therefore, this paper is going to discuss whether the CAPM model could be fitted in the Chinese Stock Market by focusing the study on four dimensions: 1) Basic idea and assumptions of CAPM model; 2) Methodology of CAPM testing; 3) CAPM test in Chinese stock market; 4) The uniqueness of Chinese stock market. The study could further contribute to the study of the efficiency level of Chinese stock market, and it would seize the future possibility for asset valuations by applying CAPM within the market.

2. THE CAPM MODEL

2.1. Markowitz's (1952) Modern Portfolio Theory (MPT)

The MPT raised by Markowitz is the fundamental theory of the CAPM model. In MPT, there are two kinds of risks within the market. First is systematic risk, which is also referred to as market risk as it affects the whole market, and it could not be eliminated by using diversification of assets, such as war, reformation of the market, and the change of interest rate. The second risk is the unsystematic risk which is the so-called company-specific risk. It is the kind of risk that suffers from a specific company, for example, financial burden, death of CEO, and the retirement of a key worker [1].

Conversely, unsystematic risk could be eliminated by diversifying the portfolio, that diversification means that holding a sufficient number of decentralized securities will eventually average out the unsystematic risks and leave the systematic risk out. According to diversification of the unsystematic risk, we could construct a portfolio that has the least amount of risk, but a considerable amount of return compared to holding single assets, and then the efficient frontier (EF) is formed. It is a crucial step before bringing the CAPM model into the MPT model.

2.2. Sharpe (1964) and Lintner (1966)

In MPT theory, Markowitz (1952) considered all the assets that construct a portfolio to be risky assets. Therefore, Sharpe and Lintner consider the possibility of consisting risk-free asset, in which the CAPM model is introduced [2].

The CAPM model describes the relationship between the systematic risk of the market and the average expected return, and it is restricted on some crucial assumptions about the competitive market, which could be stated as: 1) Investors could purchase and sell all securities at market prices; 2) Investors could borrow and lend at the risk-free interest rate with an unlimited amount; 3) Given the standard deviations of securities. Rational investors will seek wealth maximization by getting the highest return, which they will automatically hold efficient portfolios of traded securities; 4) Investors have homogeneous expectations regarding the standard deviations, covariance, and expected returns of securities. 5) There are no taxes or transactions costs incurred.

These assumptions exclude some failure of information and arbitrary opportunities to create an efficient market environment for the CAPM model to perform adequately.

Based on the assumptions above, Sharpe (1964) and Lintner (1966) developed the first CAPM model, stating the equations as follows:

For a given efficient portfolio i:

$$E(ri)=rf+\beta im(E(rm)-rf)$$

E(ri) is the expected return, and the right-hand side of the CAPM equation could be separated into two parts: 1) rf, which is the risk-free interest rate, and it could be referred to as the return of the risk-free asset; 2) βim(E(rm)-rf), which could be simplified as the return of a risky asset. That (E(rm)-rf) is the risk premium of the portfolio I where the E(rm) is the market rate of return. βim is the systematic risk of the portfolio.

From the equation, there is a positive linear relationship between the systematic risk of the market and the average expected return, which further implicates that an asset with a higher return that attracts investors always aligns with higher volatility and risk.

In 1972, Black produced the Zero-beta CAPM model based on the assumption that there's no risk for borrowing. In his version of the CAPM model, βim is a significant factor that could be expressed as:

$$\beta im = Cov(Ri, Rm)/Var(Rm)$$

For any risk-free asset, its covariance with the market should be zero, and the βim will become zero, which means the βim of an asset without excess return should be zero. Therefore, by allowing short sales of the risky assets, and Black replaced the risk-free rate of return (rf) by zero-beta return, r0m, which formed Black's version of the CAPM model:

$$E(ri)=r0m+\beta im(E(rm)-r0m)$$

CAPM model helps with introducing the capital market line (CML) in the MPT model. Given CAPM assumptions, the most optimal line will be a tangent line lies at some point on the market portfolio line (EF), which is also known as a combination of risk-free assets and the market portfolio that gives the most favorable return with the lowest level of riskiness (shown in Figure 1).

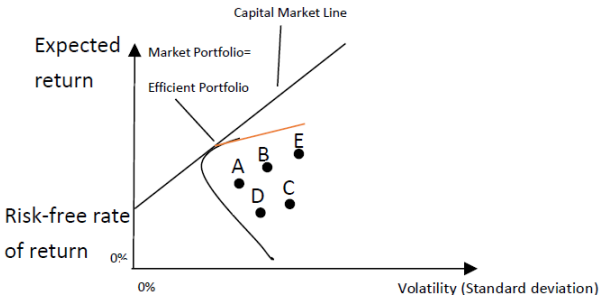

Figure 1: CAPM model

Deriving from the CML, as the unsystematic risk is washed out, there's only systematic risk, and a security market line (SML) will be formed — a positively linear line cross through the risk-free rate of return that clearly shows the relationship between the expected return and Bim. Simultaneously, according to the CAPM model, if the expected return and beta for individual securities are plotted, they should all fall along the SML (Shown in figure 2)

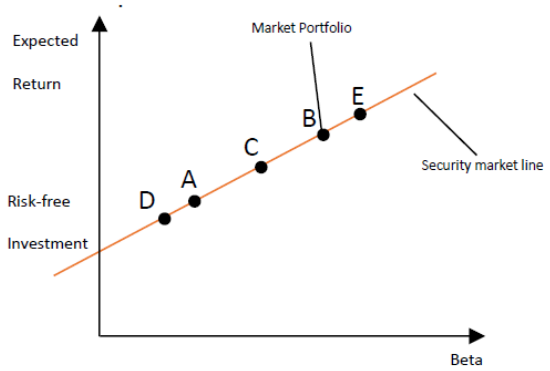

Figure 2: Market portfolio and security market line

3.METHODOLOGY

3.1. General View

This paper is going to discuss the validity of Sharpe-Lintner classic CAPM model in Chinese stock market. To examine the CAPM model, it is not to challenge the assumptions made by the CAPM model but to test if its statement is solid in the realm. Many scholars examine its capabilities in determining the relationship in the US market with different methods, and it has been a constant debate in the financial world since published.

3.1.1. Black, Jenson, and Scholes (1972) Method

In 1972, Black, Jenson, and Scholes (BJS) produced a strategy to test the CAPM model in the US market, which is the most well-known strategy. They selected the monthly rate of return among all stocks traded on the NYSE from 1931 to 1965 from 10 portfolios. The main equation they set to test in regression is:

$$rjt = \alpha j + \beta jm*rmt + \varepsilon jt$$

rjt is the estimated expected excess return of the portfolio at time t, and they calculate the average by summing up all the returns across time and divide by the time. αj is the risk-free rate of return. βjm is the beta estimated. rmt is the risk premium of the market portfolio. εjt is the random variable created in the equation for running regression, and if the relationship is established, this random variable should be remarkably close to 0.

They run cross-sectional regressions by considering the standard error created by αj and rmt. The result they got is not as close as the estimation they forecast, and the t statistics are significantly different from their original value that resulted from the approximation error. However, if we put the regression result on a graph, CAPM is still applied. The regression line is 1.08, which is positive, and the intersection is a positive number. This proves the Black version of the CAPM model, that is, the expected return of assets and the systemic risk of the market are in a positive linear relationship, and α j, the intersection point, is not necessarily zero to indicate a risk-free rate of return.[5].

Black's method contains betas among different periods and the beta will be discrete within the portfolio, which is closer to the CAPM assumptions. Significantly, this method test both Sharpe-Lintner's (1965) and Black's (1972) version of the CAPM model [5].

3.1.2. Fama and MacBeth (1973).

In 1973, based on the regression method raised by Black, Jenson, and Scholes, Fama and MacBeth (FM) established an improved non-linear regression model to test the applicability of the CAPM model, the main idea as follows:

$$ri = gama0+gama1*\beta+gama2*\beta^2+gama3+\varepsilon$$

Where ri is the expected return of the portfolio I, gama0 is the same as the Jenson alpha = risk-free rate of return.Gama1 is the risk premium of the market portfolio. Gama2 is the parameter created to test if the squared of beta would affect the return. Gama3 is the parameter created to test if the unsystematic risk(s) would affect the return. ε is a random variable created for regression.

Fama's method is based on the assumptions that the CAPM model will be effectively affected by the other elements like the beta square and the unsystematic risk. For the CAPM model to establish, gama2 and gama3 should be 0 to prove that the CAPM model is not non-linear. The result of Fama's test concluded as it further supports the applicability of the CAPM model, especially in the long term. Fama's method focuses on stocks traded on the NYSE from 1926 to 1968, which has one more period compared to the BJS method, and this method works on multiple cross-sectional regressions to calculate the mean of the beta, which leads to the lower error of approximation [6].

However, Banz (1981) argued that other factors could affect the expected return. Fama and French (1992) had proved themselves as well as Banz's deficiencies. Soon, Jagannathan and Wang (1993) rebutted Fama and French [7].

3.1.3. Other arguments

Banz (1981) arises the size effect that BJS and FM do not mention, which significantly affects the expected return. He tested the model by using a similar method as FM (1972) [7]. He chose the time between 1936 to 1975, and he switched the beta square to firm size as another independent variable. The result for Banz's approach was against the traditional view on the CAPM model. The gama1 is negative, and the firm size has a positive impact on the expected rate of return with large

t-statistics in absolute value, which indicates that the expected return is neither linear nor positive to the beta, and the consideration of firm size is necessary.

On the other side, Fama and French (1992) used identical research as Banz (1981) to test the data from July 1963 to December 1990, which further proves Banz's idea, and they brought book-to-equity ratio into the model, and their result shows that it is an even better factor [8].

However, Black suggested that Banz's result is inconsistent to disprove the CAPM model due to period-specific data. Moreover, Kothari, Shanken, and Sloan (1995) challenge Fama and French's statistics by criticizing their high standard errors and the trend that higher book-to ratio companies are likely to fail in the future. Jogannathan and Wang (1993) proved the practical usefulness of CAPM again, and they pointed out that the failure of CAPM may be caused by the inappropriateness of its assumptions, which further led to a more developed model in the future [9].

3.2. CAPM in China

3.2.1. Uniformity of CAPM model test in China

In contrast with the US market, the result of different empirical tests of the CAPM model in the Chinese stock market is consistently the opposite of the equation.

3.2.2. Xiaoyue Chen and Aijun Sun (2000)

Xiaoyue Chen and Aijun Sun (2000) chose 269 stocks in the A-share market from September 1994 to September 1998. They used the sorting technique and FM cross-sectional regression to test the validity of the CAPM model in the early stage of the Chinese stock market. Furthermore, they used the method that Litzenberger and Ramaswamy raised and revised by Shaken, which avoids error in the variables and helps to improve the beta accuracy [10]. Their conclusion is that CAPM model does not fit into the Chinese stock market. However, their findings are drastically different from several years before.

In 1995, the beta has a negative relationship with the expected return. In 1996, the result matched the CAPM model statistically significantly (t-stat = 1.76), whereas beta has no explanatory power to the expected return (t-stat = 0.35) [10]. Chen and Sun evaluate that caused by the few selected periods and the regulation in the Chinese stock market which has been through a significant change. That said, other scholars in China, for example, Lin Liu, Zhaojun Yang, Jue Zhang, their investigations further approve Xiaoyue Chen and Aijun Sun's result.

3.2.3. Juan Mou, Hao Zhang, Yanfu Li (2016)

Not only stocks in the SSE, but there is also a recent study by Juan Mou which indicates the applicability of the CAPM model in the CSI 300. The stocks they chose in CSI 300 involve 125 representative securities in both SSE and SZSE stock market, these stocks are stable in trend, which eliminates some outliers that could affect the data. The time horizon is January 2011 to January 2014, and they separate the securities into three groups [13].

Based on the methods from Fama and French (1996), they construct eight models to examine the CAPM model, and the final equation shows contradict result to the CAPM model. It suggested that there was no clear positive relationship between the expected return and the beta, and no positive relationship between risk and return.

3.2.4. Yifan Chen, Jiayi Sun, Wen Xu, Hui Jin (2019)

Yifan Chen selected 50 stocks on SSE 180 from different industries from January 2016 to January 2018. The team used the BJS method along with the FM method to run time series regression and cross-sectional regression [12].

Surprisingly, their investigation shows that there is a consistent implication with the CAPM model, and there is a positive relationship between the risk and the expected rate of return from 2016 to 2018. However, within the pricing model, the systematic risk is not the only determinant factor, which states that it will not exclude the adaptation of unsystematic risk when considering the pricing of an asset.

3.2.5. Evaluation of test in China

However, a shared limitation existed among these studies, which is focused on the short term, and there might be insufficient data resources to prove the CAPM model in the long run. Moreover, there are significant systematic impacts that happen during the research period that have been excluded from discussion, and it is not the most up-to-date data. Therefore, the result might be biased if considering all the factors, but it will not be elaborated in this paper.

Among many studies within China, even there are some cases where the risk and return in a positive relationship, all the studies disprove the linear relationship between the systematic risk and the expected rate of return, or in other words, the systematic risk is not the only factor which will determine the expected return. The mainstream view of the causation given by all the scholars is the uniqueness and immatureness of the Chinese market.

4. THE UNIQUENESS OF THE CHINESE STOCK MARKET

From the study of Chuankai, Li. (2009) few majority reasons are inter-correlated with each other which causes non-empirical usage of the CAPM model in China. Firstly, Chinese stock market has been established in 1990, and it has only been for 31 years. It is a brief history compared to other developed countries' markets. For instance, one of the largest stock exchanges — NYSE, has been through a 229-years history. When the fast-growing economy meets the young financial market. Secondly, the legislation could not alter with the rapid growth of the market, which means there are many areas still not well-regulated. Thirdly, there is unbalanced information between institutional investors and individual investors that do not meet the assumptions of the CAPM model, which will further incur Arbitrage opportunities. Therefore, people will expect differentiated returns for the same security. Fourthly, most individual investors lack financial knowledge, and most of them are speculative. Even for some institutional investors, they are making excess returns by information failure. Unlike the US, most of the investors have at least some financial knowledge, and the US stock market is mature due to development. Combining all factors, China's stock market is still inefficient compared with other developed countries[11].

5. CONCLUSION

To conclude, the CAPM model cannot be empirically applied to the Chinese market. Because the results that scholars test in the Chinese market exhibit consistent results, in which the beta has no clear positive relationship with the expected return, and even the statistics are not valid consistently or statistically significant. Chinese stock market is an inefficient stock market. It is a consequence of immature investors, unbalanced information, arbitrage, and non-perfect regulation. These causations significantly miss the assumptions of the CAPM model. Hence, the classic CAPM model could not be applied to the current Chinese market up to 2018. However, this study based on statistics that exceeds over 10 years due to time concern, which might be time-biased, and it could be improved by collecting primarily from the current market. Moreover, choices on some research including specific periods like recession, which consists of higher standard error could be replaced by research that investigating in normal cycles.

In addition, there is a prospect that according to the Fourteenth Five-Year Plan (2021), there will be reformation for the Chinese financial market, and the regulation will be stricter to hit arbitrary behavior by utilizing information failure [14]. Moreover, the fast-growing internet in China provides low-barrier channels for people to learn financial knowledge, which means the acceleration of financialization, and more rational investors generated will be a near future. As a result, the Chinese stock market will gradually become more mature for the next few decades, which might be more desirable to test the classic CAPM model at that time.

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