

# Applicability Analysis of CAPM Model in the Context of Epidemic

Yiwen Zhao\*

Economics and Business, University of Newcastle, Callaghan, 2308, Australia

\*Corresponding author: C3377701@uon.edu.au

**Abstract.** Under the impact of the epidemic, the economy of all countries has been affected to varying degrees, and the most obvious common one is that the global inflation rate has risen, thus resulting in the phenomenon of purchasing power deviation. The focus of this paper is that the traditional Capital Asset Pricing Model (CAPM) lacks the prediction of this part of the risk, so it can not realize the original intention of THE CAPM Model, completely to wash away this part of the risk. As well as the domestic and foreign research review in recent years, the literature analysis, the conclusion is drawn, in view of the traditional CAPM in the international portfolio investment deficiency, as well as the applicability in the real financial market, this paper suggests that under the purchasing power parity offset, the use of high-order CAPM through the international portfolio investment is a more stable choice.

**Keywords:** High-moment; CAPM, Inflation; Deviation of PPP.

## 1. Introduction

### 1.1 Research Background

With the change and relaxation of regulation in various countries, the rapid development of international investment has undoubtedly been accelerated. In addition, the rapid development of information technology has closely connected the financial markets of various countries, and finally the economy of various countries is gradually approaching the global integration. Taking China and the United States as examples, China, as a developing country, is experiencing rapid economic development, especially investing more capital in its foreign exchange reserves. Therefore, it is worth discussing how to maintain and increase the value of international investment in the face of such huge foreign exchange reserves.

In addition, since the outbreak of pneumonia in last two thousand and nineteen was reported, World which brought a big shock, and the menacing lung disease virus outbreak in 2020 influenced the world economy, all countries will face a steep reduction in national economic growth, population rising unemployment, international trade, and cross-border financing ability, as well as the negative reflection of commodity price changes, etc. In response to the threat of COVID-19, various parties have adopted appropriate policies and monetary policies to ease the crisis and promote development. However, given the lack of momentum in global economic development and the narrow scope for the implementation of traditional monetary policies, unconventional monetary policies are likely to cause huge asset price shocks in major economies, thus bringing about huge negative spillover effects and leaving greater variables for the long-term development of the world.

In response to the epidemic, governments around the world have adopted various forms of temporary fiscal and monetary policy measures in light of differences in national conditions. In terms of monetary policy, central banks in the world cut interest rates 205 times in the 11 months to 2020, while central banks in major developed economies continued to maintain non-low interest rate policies, that is, the federal fund's yield rate remained in the range of zero to 0.25%. In addition to rate cuts and rock-bottom interest rates, conventional monetary policy measures include targeting inflation. End of August 2020, in Kansas City at the world's central banks in the United States, the federal reserve released long-term goals and monetary policy strategies to make major changes, the expression of will focus on inflation reached near the symmetry of the two percent target "statement of the modified to seek to achieve the long-term goal of" two percent average inflation ". The

introduction of the new inflation targeting system suggests that the Fed will be able to offset the past "gap" with the "surplus" of future inflationary pressures, and create excess funds within the limited room for rate cuts to raise the tolerance rate for inflationary pressures to meet the rising risk of deflation.

## 1.2 Research Purpose

For the research purpose of this paper, the application of Capital Asset Pricing Model (CAPM) model in international investment is also subject to no small resistance, because two sufficient conditions of efficient market are given in the hypothesis of CAPM model. That is, assume that in the stock exchange market, transaction costs and stock information are symmetric. However, there is no such thing as a stock market without transaction costs. In the capital market, there are frictions between capital and information flow that hinder securities investment, such as no taxes, no transaction costs, no risky borrowing, no loan spreads, etc. The epidemic has also had a significant impact on the inflation rate. In fact, many other countries around the world are currently facing serious inflation due to the epidemic. You can even say that they have reached alarming levels of inflation. In the developed world, inflation in the United States was 4.2 percent in April. That's the highest U.S. inflation rate in decades. Generally speaking, inflation rate exceeds 3%, it is relatively vicious inflation or relatively serious inflation. India's latest inflation figure, at 4.29 percent, is on a par with the United States. To be precise, the epidemic has brought about significant inflation.

The reason why it hasn't happened in China today is largely because China has been relatively successful in controlling the epidemic. Almost every country hit hard by the pandemic has experienced high inflation and a shift in purchasing power. This is also not conducive to the application of CAPM a model, because inflation is not taken into account in the application of CAPM model, so risk hedging cannot be realized in the application of portfolio investment, which will lead to inaccurate calculation results of market portfolio investment optimization.

## 1.3 Research Significance

The significance of discussing and studying international asset pricing in this paper lies in that, from the practical point of view, China's foreign exchange reserves are still growing, which provides a relatively reasonable international investment plan for foreign exchange portfolio. On the other hand, with the gradual opening of China's capital market, the study of international portfolio pricing can provide a theoretical basis for the construction of fund portfolio and the valuation of international assets. At the same time, international investment, the external environment changes, foreign exchange risk, extreme value risk and many other uncertain factors. Therefore, from the perspective of practice, it is of great practical need and practical significance to study high-order international asset portfolio.

In terms of theoretical significance, the applicability of CAPM model in the real market should be improved, such as how to price international assets, whether international asset pricing includes exchange rate risk, the impact of inflation rate on the application of CAPM model, and the impact of market structure on pricing. This series of problems with the global economic integration, and increasingly become a hot topic of theoretical research. The early international asset pricing models were developed in the mean-variance framework. More and more evidences show that asset pricing theory is very rigorous in theoretical derivation, but due to its harsh assumptions, when applied to practice, it will produce great evaluation deviation, and there are certain defects, so it also loses persuasion. The distribution of financial market returns shows the phenomenon of peak after tail, and the high moment risk cannot be ignored.

## 1.4 Paper Organization

This paper is divided into three parts, the first is the traditional CAPM model in the real market application of the defects are analysed. Secondly, based on the in-depth research of many scholars on the significance of high-order moments to asset pricing, this chapter will review and comment on the

domestic and foreign research status of traditional asset pricing models and four-order moments asset pricing models. Finally, it summarizes the conclusions and suggestions of this paper, and puts forward the deficiencies of this study and the areas needing improvement.

## 2. Basic analysis of capital asset pricing model

The capital asset pricing model (CAPM), which is mentioned in this work, is the first model ever created that systematically and correctly captures the positive connection between return and risk. In the 1960s, Sharp, Lintner, and Treynor put out the idea. The choice model of capital allocation, which serves as a strong foundation for future financial market analysis and international securities investment, is the basis for the pricing model of capital. This theory is based on Harry Markowitz's systematic analysis of various risk portfolios and how investors should carry out portfolio investment to diversify and hedge risks, so as to minimize the investment risks of investors and reduce the standard deviation of investment portfolios. Based on the above research, he further proposed the mean-variance model to make the returns and risks more specific. In the capital asset pricing model, when investors consider how to invest, they mostly choose based on the mean-variance model. In the mean-variance model, the point where the line crosses the curve is called the efficient portfolio, which indicates that through these efficient portfolios, the internal operating risks of the company are reduced and only market risks are avoided. In addition, Markowitz suggested that the efficient frontier of the mean-variance model has a point that is ray-tangent to the risk-free interest rate. He referred to this line as the asset market line and this point as the most effective or the portfolio in the market. This means that the efficient market portfolio corresponding to the tangent point will be the best efficient portfolio of all. The market portfolio is the cornerstone of all capital asset price models. According to Markowitz, if one replicates the same market portfolio according to the ratio of the market portfolio, the main difference between investors is the ratio of risk-free debt and the ratio of the market portfolio to one's net worth. It laid a solid theoretical foundation for economists' in-depth study and analysis of market structure and innovation of capital asset price model.

However, Sharp, Lintner, and Treynor made five fundamental assumptions in order to determine the genuine market mix:

First, investors are rational and want higher expected returns on the basis of risk aversion. Second, investors can get a reasonable investment portfolio. Third, investors get access to loans at no risk. Therefore, investors can set their own financing leverage according to their own ability. Fourth, in efficient securities markets there is no difference in knowledge between participants. They have the same information, the same expectations of risk, and the same decisions and judgments. Fifth, the market has the ability to operate independently. The securities market is free of taxes and transaction fees.

## 3. Analysis of the shortcomings of CAPM model

CAPM has always been a financial model attracting much attention. According to the data of CNKI, CAPM model has been discussed more and more in recent years, which is mainly used in the research of stock market. The analysis and research of the model have been discussed more and more, which can prompt us to improve the model. This section will explore the CAPM and its strengths and weaknesses. The CAPM model has the following advantages: it objectively explains the relationship between risk and return, i.e., that a high level of risk entails a high level of return. However, the CAPM model also has flaws: the model's hypothesis is too far removed from reality, and the beta parameter is challenging to evaluate.

The above assumptions are obviously impossible to achieve in real life. CAPM model has low adaptability to financial market in The United States. The empirical study proves that this model is not feasible in American capital market. For example, a study conducted by Black, Jensen and Roll in 1972 showed that SML estimated returns could not be proven to be accurate estimates of recorded

returns. This means that beta is not properly priced by the market [1]. The same is true in the Chinese market, The capital asset pricing model in the foreign market development for nearly 60 years, the introduction of China, Chinese scholars have done a lot of research, but the results were mostly CAPM model the low explanatory power to the Chinese market, due to the time of Chinese stock market is a foreign in terms of time, development is not mature, speculative, small dish stock market vulnerable to control, difficult to meet the capital asset pricing The assumptions of the model. Zhang Jiaxuan (2017) selected samples from March 2012 to March 2017 and randomly selected 100 stocks in China's stock market for empirical test. The Shanghai Composite Index was taken as the market index, and the results showed that CAPM could not fully adapt to China's stock market [2].

#### 4. Improved applicability of the CAPM model

Emmanuel Jurczenko, Bertrand Maillet established an accurate four-moment capital asset pricing relationship by using the dual-fund currency separation theorem[3]. Among the fourth-moment risks, the cokurtosis of The Chinese market portfolio, the cokurtosis of the American market portfolio and the cokurtosis of the American inflation rate are significant. That is to say, the return of Chinese portfolio not only bears third-order moment risks, extreme value risks, such as the co-skewness risk of the Chinese market portfolio, the co-skewness risk of American inflation, but also the co-skewness risk of the American market portfolio and the co-kurtosis risk of American inflation. It can also be concluded that the contribution of higher moments to asset premium is significant through variance decomposition.

Then it means that the four-order CAPM can make a better explanation of the market. A large number of empirical studies have shown that Arditti (1967, 1969), Jean (1973)Rubinstein(1973), Levy (1978) Scott and Hotvath (1980), when the return rate sequence does not meet the normal distribution, the co-high-order moment risk of asset portfolio and market portfolio needs to be priced[4-8]. Therefore, many scholars are committed to expanding the mean variance framework, incorporating high-order moment risks into the analysis, and expanding the capital asset pricing model. Kraus and Litzenberger (1976) were among the first scholars to include the term of third-order moment coskewness in the asset pricing model. They extended the always linear relationship between return and risk to nonlinearity and derived the third-order moment capital asset pricing model [9]. Through cross-sectional test of American stocks from 1926 to 1975, it is found that the coskewness risk of the asset-market portfolio is as significant as the covariance in explaining the return rate. The model supports that when the portfolio return distribution is negatively skewed, investors will demand higher return compensation. Sareewiwat Thana Malone (1985) used Kraus and Litzenberger's (1976) three-moment asset pricing model to examine the relationship between stock returns and risks in Thailand, an emerging market, in the 1970s, and reached the same conclusion [10].

Based on the above studies, Dittmar (2002) derived the fourth-order moment asset pricing model based on the nonlinear asset pricing kernel function determined by investor psychology, namely marginal risk aversion and diminishing marginal caution [11]. Hwang and Satchell (1999) showed that the fourth-moment CAPM had better explanatory power than the standard CAPM in explaining the cross-section benefits [12]. On the basis of Dittmar (2002), Marie Lambert (2007) incorporated systematic covariance, coskewness and cokurtosis into the analysis framework under the assumption of absolute risk aversion and absolute diminishing caution, and derived the fourth-order moment CAPM [13]. At the same time, combined with Fama-French (1993) and Carhart (1997) empirical factors: size, book-to-market ratio and momentum, the stock data of the United States from 1996 to 2006 were classified and empirically verified. The systematic coskewness and cokurtosis of the portfolio constructed according to the book-to-market ratio are significant [14]. Daniel Chi-Hsiou Hung (2007) studied 20 countries from an international perspective, 44290 stock data from August 1988 to November 2003 were classified and combined based on the size and momentum effect, and the pricing effects of the third and fourth moments were investigated from the aspects of cross section

and time series. It is found that the extended third and fourth moment's model can better explain the power [15].

## 5. Conclusion

This paper systematically analyzes the CAPM model from two perspectives, one is the current financial environment background, the other is the inflation and purchasing power deviation caused by the epidemic environment, and points out the shortcomings of the traditional CAPM combined with facts. In addition, relevant literatures and periodicals in recent years are sorted out and the conclusion is drawn that the advantages and reasons of using high-order CAPM in the case of inflation and PPP deviation are given. However, based on the significance of high-order moments in international asset pricing, this paper argues that high-order moments should be taken into consideration in the construction of actual investment portfolios. Only in this way can the relationship between risk and return be more comprehensively reflected. This paper does not discuss the construction of international optimal portfolio in depth. The follow-up study of this paper, I think, should be to apply the theoretical model to the actual portfolio construction. Any model needs to serve the real world. How to apply the four-moment international asset pricing model to the construction of international asset portfolio will be the focus of the subsequent research in this paper. And I will continue to work on this issue.

## References

- [1] S. Andrei, "Weaknesses of the capital asset pricing model." International Finance and Banking Conference. 2016.
- [2] J. Zhang, Empirical analysis of CAPM model in Shanghai A-share Market. China Market, 2017(20):75-77.
- [3] J. Emmanuel, and B. Maillet, "The four-moment capital asset pricing model: between asset pricing and asset allocation." Multi-moment Asset Allocation and Pricing Models (2012): 113-163. DOI: 10.1002/9781119201830.ch6
- [4] A., Fred D. "Risk and the required return on equity." The Journal of Finance 22.1 (1967): 19-36. DOI: 10.2307/2977297
- [5] J., H. William, "More on multidimensional portfolio analysis." Journal of Financial and Quantitative Analysis 8.3 (1973): 475-490. DOI: 10.2307/2329646
- [6] L., Haim. "Equilibrium in an Imperfect Market: A Constraint on the Number of Securities in the Portfolio." The American Economic Review 68.4 (1978): 643-658.
- [7] R., E. Mark, "The fundamental theorem of parameter-preference security valuation." Journal of Financial and Quantitative Analysis 8.1 (1973):61-69.DOI:10.2307/2329748
- [8] S., C. Robert, and P., A., Horvath. "On the direction of preference for moments of higher order than the variance." The Journal of finance 35.4 (1980): 915-919. DOI: 10.2307/2327209
- [9] K., Alan, and R., H., Litzenberger. "Skewness preference and the valuation of risk assets." The Journal of finance 31.4 (1976): 1085-1100. DOI: 10.2307/2326275
- [10] L., Kian-Guan. "A new test of the three-moment capital asset pricing model." Journal of Financial and Quantitative Analysis 24.2 (1989): 205-216. DOI: 10.2307/2330772
- [11] D., F. Robert, "Nonlinear pricing kernels, kurtosis preference, and evidence from the cross section of equity returns." The Journal of Finance 57.1 (2002): 369-403. DOI: 10.1111/1540-6261.00425
- [12] H. Wang, S. sung, and Stephen E. Satchell. "Modelling emerging market risk premia using higher moments." International Journal of Finance & Economics 4.4 (1999): 271-296. DOI: 10.1002/(SICI)1099-1158(199910)4:43.0.CO;2-M
- [13] L., Marie, and G., Hübner. "Comoment risk and stock returns." Journal of Empirical Finance 23 (2013): 191-205. DOI: 10.1016/j.jempfin.2013.07.001

- [14] F., Hsing, and Y. L., Tsong. "Co-kurtosis and capital asset pricing." *Financial Review* 32.2 (1997): 293-307. DOI:10.1111/j.1540-6288.1997.tb00426.x
- [15] H., Chi-Hsiou Daniel. "The four-moment CAPM and non-linear market models in momentum and size strategies." (2007). DOI: 10.2139/ssrn.495362