

The Asset Allocation Analysis for Banking and Technology and Retail Industries

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Abstract. With the outbreak of COVID-19 in 2020, the economies of almost all countries in the world have faced inevitable and significant losses. The GDP growth rate of major economies in the world has not improved or even declined. During the pandemic, many people lost their jobs, which meant they lost a regular source of income to support them; At this time, the money made by the way of making money online -- buying stocks, or various financial products -- is very important, and portfolio analysis is the first step to successful investment. In this paper, four of the most successful companies in the United States are selected for analysis. They are AAPL, AMZN, AXP, and JPM, which respectively involve the financial industry, banking, technology, and retail industry in the United States. This article uses three methods for portfolio optimization, which are called mean-variance analysis, CAPM Model and Fama French Three Factor Model, this paper calculates the weight proportion of four companies under Three different models. The results show that in mean-variance model has the highest projected revenue among the three models, while CAPM has the lowest projected revenue. Meanwhile, among the mean-variance models, AAPL has the highest proportion of investment, but among the CAPM and FF3F models, JPM, which has the worst performance in the mean-variance models, has the highest proportion. This research will benefit the related investors in financial markets.

Keywords: Mean-Variance Analysis, CAPM Model, Fama French Three Factor Model, Sharpe Ratio, Financial Markets

1. Introduction

Since 1952, when Markowitz, an American economist, first proposed to analyze the investment portfolio by using mean-variance model, mathematical models have been widely studied by economists, and many new models have been developed in the future [1]. An effective investment management is crucial, and for investors, they not only hope to have excellent investment returns, but also help reduce investment analysis, so it is particularly important to choose a reasonable mathematical model to help them match assets [2]. Sharpe ratio is a very important data to measure the asset allocation plan, which measures the expected excess return per unit risk. Therefore, a high Sharpe ratio often means an excellent portfolio plan [3].

Nowadays, there have been a lot of studies on portfolio optimization, but most of the studies are about the overall market economy, and the specific research on the financial industry and banking and other fields is very little. For example, Huseyin Ocal and Anton Abdulbasah Kamil studied the daily data of BIST 100 index of Istanbul Exchange and KOMPAS 100 index of Indonesia Stock Exchange in the past five years [4]. Paramitha and Faturohman studied the optimal method to determine the allocation of financial assets in the case of the downturn of the entire security market during the pandemic [5]. Li and He studied how to allocate the proportion of household risk assets in low-income families in China and optimize their investment decisions [6].

The above information can show that specific studies on specific industries are relatively rare, which is where the value of this study lies. The companies selected in this article are some of the top companies in the industry, and the methods to analyze and study them are described below. First, this paper collects data on historical monthly closing prices from October 2017 to May 2022 and calculates their average returns and correlations between several assets. Second, by using the collected average and covariance, this paper obtains the first portfolio with the largest Sharpe ratio calculated by mean-variance analysis, and also makes a portfolio with the smallest risk rate to

compare with the previous table. Thirdly, this paper has collected the relevant data of the world's overall financial market in nearly one hundred years, and established Capital Asset Pricing Model and Fama French Three Factor Model respectively. Compared with the models calculated by mean-variance analysis, CAPM model and FF3F model take into account more parameters, so the forecasts provided by CAPM model and FF3F model will be more accurate, which can help investors to formulate their investment plans based on the whole world economy.

The following is a summary of the remaining parts. Part 2 shows the data, Part 3 depicts the methods, Parts 4 and 5 show the results and conclusion, respectively.

2. Data

The data used in this paper comes from YahooFinance(finance.yahoo.com). This paper selected the following 4 companies which are AMZN, AXP, AAPL, and JPM for their closing prices in five years from October 2017 to August 2022. All data used are adjusted close data. The monthly return rate of each stock is obtained by calculating the price difference of two adjacent months. Meanwhile, the companies selected in this paper are from different industries, including one technology company, two financial companies and one retail company, which effectively avoids correlation in the stock market.

Table 1. Descriptive Statistics of the Selected Assets

	AMZN	AXP	AAPL	JPM
Mean return	0.02159	0.01393	0.02957	0.00831
Geomean	0.01711	0.01064	0.02570	0.00552
Variance	0.00929	0.00667	0.00800	0.00560
Standard Deviation	0.09641	0.08164	0.08942	0.07479

As can be seen from Table 1, AAPL's yield is the highest among the four stocks, reaching 2.96%. JPM's yield is the lowest, just 0.83%. From the point of view of risk, AMZN has the highest risk, while JPM has the lower risk.

3. Methods

3.1 Mean-Variance Analysis

Mean-variance Analysis is the most convenient modeling tool that investors use most frequently in the stock market. By calculating the average return and risk rate of the stock in the past (variance and standard deviation can show the risk rate), investors can build an effective portfolio and find an optimal balance between return and risk. According to Waggle, “with mean-variance analysis investors can determine portfolio weights that maximize returns for given risk levels or that minimize risk for given return levels.” [7]. The following are the relevant formulas for mean-variance analysis:

$$E(r_{blend}) = E(wr_p + (1 - w)r_f) \quad (1)$$

$$\sigma^2(r_{blend}) = w^2\sigma^2(r_p) \quad (2)$$

Where $E(r)$ stands for expected return, σ^2 stands for the variance, r_p stands for risk premium, r_f stands for risk-free rate, and w is the weight for different assets in the portfolio. Notice the sum of weights of assets should be equal to 1. Based on the calculated data of expected return and variance, we can get Sharpe Ratio of this portfolio easily, which is

$$\text{Sharpe Ratio} = \frac{E(r_{blend}) - r_f}{\sigma} \quad (3)$$

The Sharpe ratio is created to calculate how much return is generated for each unit of risk in the portfolio. It is obvious that an investor should maximize the Sharpe ratio when selecting the assets in his portfolio.

3.2 Capital Asset Pricing Model

The Capital Asset Pricing Model (CAPM) provides powerful and intuitively pleasing predictions of the risk-return relationship expected when investing in stocks. According to Sreenu, “By incorporating the short run momentum effect, the robustness of the CAPM is improved for the purposes of this study, represents the ideal performance of an effective asset pricing model.” [8-10]. Based on mean-variance analysis, CAPM model takes the whole market economy into consideration, and the results obtained are more beneficial to investors' judgment. The Expected return formula of the model is as follows:

$$E(r_i) = r_f + \beta_i E(r_m - r_f) \quad (4)$$

$E(r_i)$ means the anticipated return, β_i means investment's beta value, the market portfolio's return is represented by R_m , the expected return of the market is $E(r_m)$, and R_f stands for risk-free interest rate.

Beta value shows the growth of the company's stock compared with the overall stock market. When the beta value is positive, it indicates that the company's stock price has a consistent trend with the overall stock market price (when the overall market develops well, the company can also develop well). On the contrary, when the beta value is negative, the company develops inversely to the overall market. As can be expected, the development of most companies is consistent with the overall market, and their beta value is positive.

3.3 Fama-French Three-Factor Model

The Fama-French Three Factor Model is a statistical model developed by Eugene Fama and Kenneth French in 1992 and used to estimate the future return of stocks. As the name indicates, on the basis of CAPM model, FF3F model has two additional parameters, namely Market Value Factor (which is SMB beta) and book-to-market ratio Factor (which is HML beta). Therefore, FF3F model can always provide investors with a more accurate market rate of return. The model of the expected return can be shown as:

$$E(r_i - r_f) = \beta_i [E(r_m - r_f)] + s_i [E(SMB)] + h_i [E(HML)]. \quad (5)$$

Where r_i is the total return of the portfolio, r_f is the risk-free rate of the market, $E(r_m - r_f)$ shows the abnormal return on the market portfolio. SMB and HML refers to two different types of company's condition, i.e., market capital and size, respectively. β_i , s_i and h_i are the factor coefficients.

4. Results

After using the appropriate covariance equation, this paper calculates the relationship between the returns of four stocks in the last five years. As can be seen from Table 2, the covariance of the four stocks are all positive, which means that when the stock value of one company increases, the stock prices of the other companies will also tend to increase. And when one company's share price falls, the share prices of other companies are likely to fall too. In addition, none of the covariance between

the companies selected in this article is 0, which means that the companies selected in this article are all related to each other.

Table 2. Covariance of Selected Assets

	AMZN return	AXP return	AAPL return	JPM return
AMZN return	0.00914	0.00273	0.00527	0.00251
AXP return	0.00273	0.00655	0.00262	0.00423
AAPL return	0.00527	0.00262	0.00786	0.00231
JPM return	0.00251	0.00423	0.00231	0.00550

As can be seen from Table III, in the mean-variance model, if the maximum Sharpe ratio (MVE Portfolio) is calculated, the proportion of AAPL in the Portfolio is the largest, and the proportion of JPM is 0%. This is probably because JPM, a financial bank, has generated relatively low returns during the pandemic compared with the other three (half of Amazon's, two-thirds of American Express's, and one-third of Apple's). However, if you are looking for a portfolio (MVP portfolio) that minimizes the risk rate, JPM will hold 43.5% of the portfolio, while Amazon has the lowest proportion in this portfolio.

Table 3. Weights of Assets in MVE and MVP Portfolios

	AMZN	AXP	AAPL	JPM
MVE portfolio weight	4.6%	15.9%	79.5%	0%
MVP portfolio weight	13.3%	19.2%	24.0%	43.5%
MVE Portfolio			MVP Portfolio	
Portfolio return	0.026		Portfolio return	0.017
Portfolio variance	0.006		Portfolio variance	0.004
Standard deviation	0.078		Standard deviation	0.063
Sharpe Ratio	0.341		Sharpe Ratio	0.0275

According to the Data in Kenneth R. French's Data Library (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html), the average value of risk-free rate is 0.08% and the average value of risk-premium is 0.67% in nearly 100 years from July 1926 to now. Table 4 lists the CAPM beta of these four assets and calculates the expected returns according to the formula provided above, and then obtains the proportion of each asset in the CAPM model. From the data, we can see that the largest proportion appears in JPM (43.0%), while the smallest proportion appears in AXP (14.2%). The two companies are both American financial service banks, but their development in the recent five years is quite different.

Table 4. Maximum Sharpe Ratio Portfolio under CAPM Model

	AMZN	AXP	AAPL	JPM
CAPM beta	1.196	1.500	1.148	1.081
CAMP	0.00893	0.00794	0.00861	0.00815
expected return				
CAPM	20.3%	14.2%	22.5%	43.0%
portfolio weights				
Portfolio return	Portfolio variance	Standard Deviation	Sharpe Ratio	
0.008	0.004	0.064	0.132	

Table 5. Parameters of Each Asset in the FF3F Model.

	AMZN	AXP	AAPL	JPM
FF3F MKT	1.267	1.059	1.204	1.060
beta				
FF3F SMB	-0.402	-0.028	-0.314	0.134
beta				
FF3F HML	-0.761	0.559	-0.479	0.709
beta				

According to the parameters calculated in Table 5, the return rate of FF3F model and the proportion of each asset in portfolio can be further obtained. As can be seen in Table 6, AMZN and AAPL have the lowest market share in portfolio (0% and 11%, respectively). Looking back at Table 5, we can see that the SMB beta and HML beta of these two companies are both negative, resulting in their yields being very low in the FF3F model (0.60% and 0.67%, respectively), which is about half of the JPM yield.

Table 6. Portfolio details under FF3F

	AMZN	AXP	AAPL	JPM
FF3F expected return	0.60%	1.00%	0.67%	1.08%
FF3f portfolio weight	0%	19.5%	11,0%	69.5%
Portfolio return	Portfolio variance	Standard deviation	Sharpe Ratio	
0.010	0.005	0.067	0.152	

5. Conclusion

The purpose of this article is to help investors make investment strategies in the current hot investment areas. This paper selects several of the largest companies in the United States as examples, uses three different investment models, and calculates different asset allocation schemes. In the mean-variance model, technology companies are allocated a high proportion of assets, but in the CAPM and FF3F models, the performance of technology companies becomes mediocre, and JPM companies occupy a much higher proportion than other assets (It is worth noting that in the mean-variance model, JPM accounted for 0%). There is no denying that these investment models still have shortcomings, and because there are many factors that affect asset

value, such as the occurrence of world disasters or management changes, there are many such factors that are not taken into account in the models.

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