The use of three-factor model to make financial portfolio and help clients' decisions

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Abstract. minimizing the risks involved in investing and also increasing the chance of making profits are the most essential two factors in investment. In order to make profits and reduce risks, more and more people tend to find professional managers to make financial portfolios since they are the ones who understand clients' financial needs and suggest the best and unique investment strategies. During the calculation, we choose the three-factor model over CAPM. The traditional asset pricing model, known formally as the CAPM uses only one variable to describe the returns of a portfolio or stock with the returns of the market as a whole. In addition, generally speaking, the Fama-French Three-Factor Model provides a much better explanation for cross-sectional variations in stock returns in a number of countries. Our paper discusses the advantages and disadvantages of three-factor models compared to CAPM, and the use of three-factor model.

Keywords: CAPM model, mutual funds options, excess returns.

1. Introduction

With the development of people's life quality, people have more and more disposable income, so more and more people use the extra money to invest in the financial market. When people invest, people tend to find professional financial managers to reduce the risks and increase profits. This is because there are a number of different kinds of financial options-- stocks, bonds, mutual funds, etc. In our investment, we choose mostly mutual funds.

This is because in the past twenty years, mutual funds get more and more attention from small investors. At the end of the twenty-first century, the number of mutual funds in the United States exceeded the number of securities listed on the New York Stock Exchange. Compared to direct investments in individual stocks and bonds, mutual funds offer the advantages of liquidity and diversification at a relatively low cost [1].

Due to their different characteristics, people need to tread off between risks and returns. There are some models to help us make the final decisions and help us to measure excess returns, such as CAPM and the three-factor model. Although CAPM has revolutionized the field of finance, a number of researches have been argued against it, revealing several weaknesses, because of this, the three-factor model was developed as a response to the inadequate performance of the CAPM [2].

Instead of using the traditional CAPM model, we use the three-factor model since CAPM uses only one variable to describe the returns of a portfolio or stock with the returns of the market as a whole. And there are multiple reasons why it is better to use three-factor model over CAPM. .

We made the pension part equal to 0 and ended up with approximately 10% of BPTUX, 50% of AVALX, 20% of JMIGX, and 20% of OBMCX. It comes out with a Sharpe ratio of 0.173.

2. Data

In order to make the diversification as much as possible, we try to choose five representative mutual funds from different sectors and fields.

BPTUX: Baron Partners Fund R6 Shares is a focused Fund that invests mainly in U.S. companies of any size with significant growth potential. A substantial percentage of the Fund's assets are in its top 10 holdings. It also uses leverage. Non-diversified[1]. The majority of funds were invested in the field of the customer cycle.

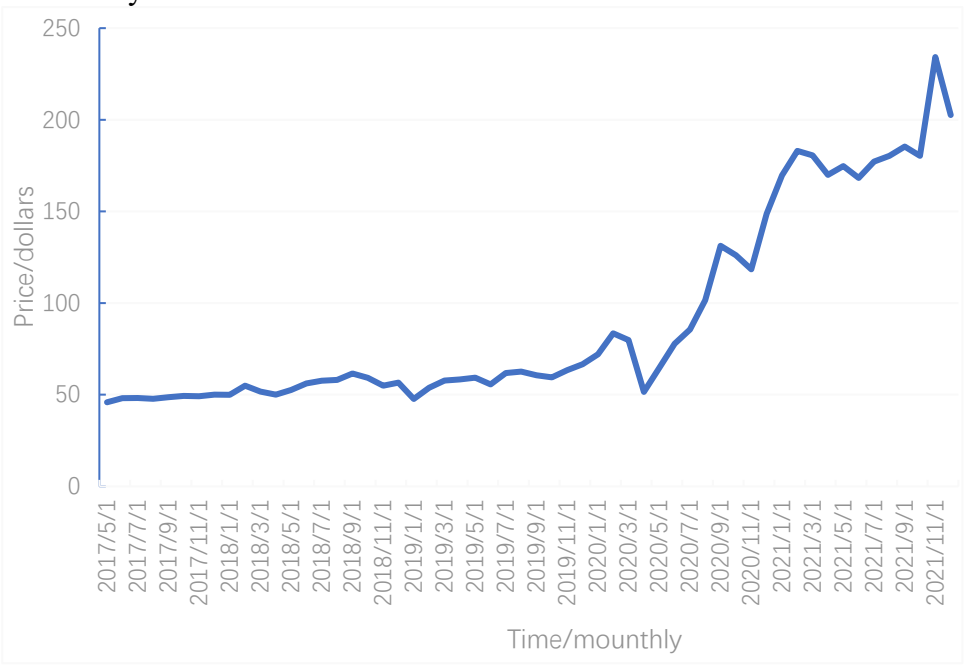


Fig.1. Five years price of BPTUX (from yahoo finance)

From the graph, we could easily notice that the price of BPTUX over the last five years has been growing steadily, especially from 2020. Being influenced by the Covid, the BPTUX decreased, but, afterward, it increased significantly, showing it is still a high potential mutual fund in the future.

Netflix, Inc. is an American subscription streaming service and production company. It offers a film and television series library through distribution deals as well as its own productions, known as Netflix Originals. Netflix" was one of the most searched terms on Google in 2021, and it had six of the top 10 most searched programs on the search engine, showing that the company maintains its brand strength. Netflix also plans to spend about $17 billion on content this year, close to what it spent in 2021. This may indicate that the company is able to cut costs because it understands what types of content work best and how to produce shows more efficiently.

From the graph, Netflix is a mutual fund that is suitable for long-term investment, especially, influenced by the Covid, most people had to stay at home because of lockdown. Therefore, people's demand of videos increased significantly, so it increased in value in that period. We can also see that Netflix decreased in value to some extent recently.

Even if the Netflix price fall rapidly compared to a half year ago, Netflix is still one of the most successful movie companies in the world. Also, we think it does not reach the intrinsic value or true value in the market. In the future, regardless of small or large increase or decrease in the market, we would not sell the stocks until it reach the true value in the market. For stocks that are underestimated, they have more room to grow in the future.

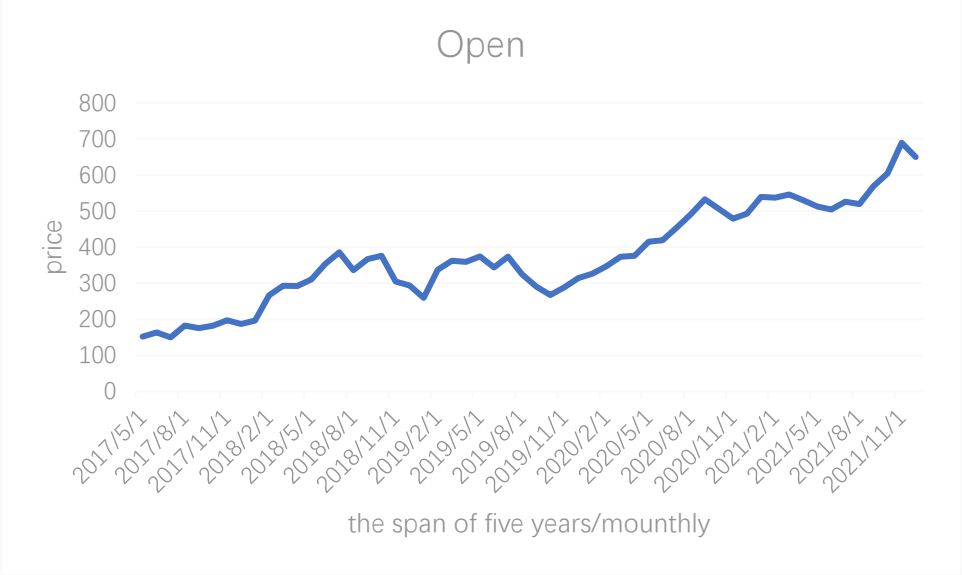


Fig.2. The recent five years stock price of Netflix

AVALX consists shares of a number of small cap companies. Small-value funds invest in stocks of small companies that are less expensive or growing more slowly than the other small-cap stocks. Therefore, we could diversify our portfolio, reducing risks in the market. In terms of holdings, most of the funds were invested in the field of basic material and energy.

As we can see from the graph below, the mutual funds has increased significantly during these years, except for the period of lockdown.

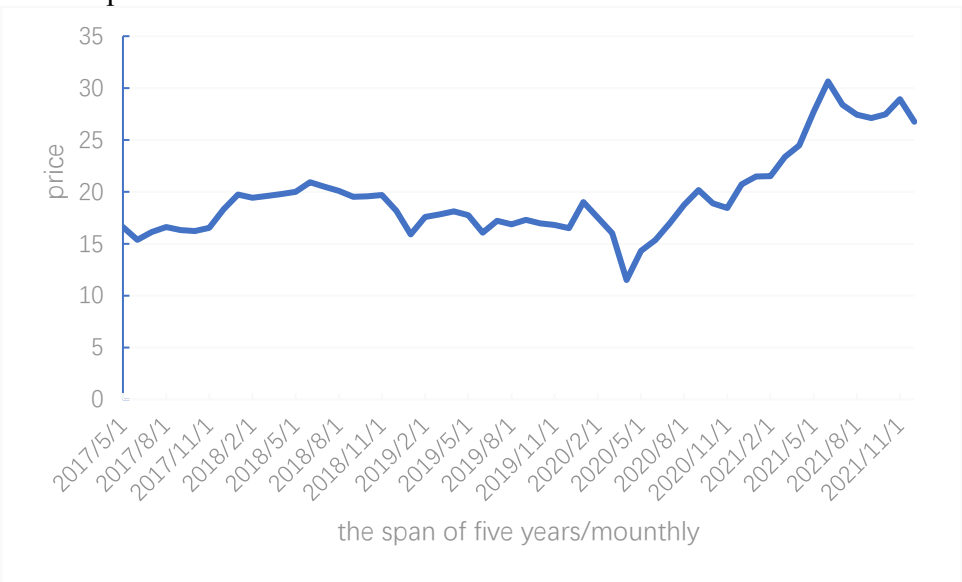


Fig.3. Recent five years price of AVALX (from yahoo finance)

GMLGX (GuideMark R Large Cap Core Fund) consist mainly large cap core companies, including APPLE, AMAZON, ALPHBET, etc. Compared to small-cap core companies, large cap core companies are more safer.Large-cap stocks are generally considered to be safer investments than their mid- and small-cap stock counterparts because they are larger, more established companies with a proven track record.

This is shown by the graph, except for the period of lockdown, in which most mutual funds also decreased in value, GMLGX increased steadily. Because of it, it is suitable for customers who do not want to take too much risks and who are conservative.

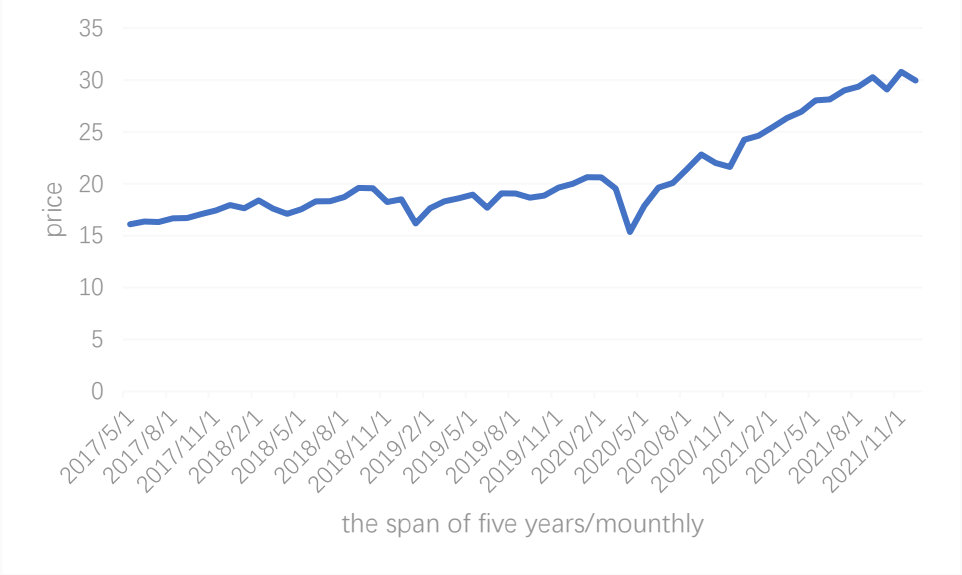


Fig.4. Recent five years price of GMGLX (from yahoo finance)

OBMCX (JPMorgan SMID Cap Equity Fund Class C) seeks income and capital appreciation by investing primarily in a diversified group of mutual funds， including technology, basic materials, health care, etc, within the same group of investment companies that invest primarily in fixed income and equity securities.



Fig.5. Recent five years change in price of OBMCX (from yahoo finance)

Making a financial portfolio is like making food, since you can not add everything you like. This is because you need to take the would flavor into account. In investment, we definitely cannot invest all of our money in a booming field as we need to consider the long term effects and risks.

Making portfolio to become diversified is vital. For example, if a customer who is conservative, he may invest too much money in safe and large cap assets. However, it has two major risks. Firstly, if the market changes rapidly such as being influenced by the war, since he just invested in large cap mutual funds, he will lose a large quantity of money, instead of gaining as much profits as he predicted. Also, if the invest just in large cap core, he is going to lose the opportunities to gain lots of profits. This is because, in the market, small companies are generally the ones who have more rooms to grow rapidly in the long run. In contrast, the majority of customers pay close attention to large and steady companies and fields, because of this, they are the ones who are mostly likely to be overestimated in market.

In order to make sure that the funds and stocks we choose are not closely correlated and related to each other, we use the beta value to calculate the covariance in Excel. In probability theory and statistics, covariance is a measure of the joint variability of two random variables.

For this project, random variables are the beta value. In finance, the beta (also known as β or market beta or beta coefficient) is a measure of how an individual asset moves (on average) when the overall stock market increases or decreases. Therefore, beta can show the effect of an individual asset to the risk of whole market portfolio, especially it is used in small quantity.

$$\text{covergence} = \frac{\sum(\text{return}_{ABC} - \text{Average}_{ABC}) \times (\text{Return}_{XYZ} - \text{Average}_{XYZ})}{(\text{sample size}) - 1} \quad (1)$$

After using covariance formula, we get the result. As you can see from the diagram below, we can see low covariance between these mutual funds, which is a perfect sign. So we confirm these are the mutual funds we want and use three factor model for the next step.

Table 1. Covariance of these stocks

	BPTUX	GOLD	NFLX	AVALX	JMLGX	OBMCX
BPTUX	1					
GOLD	0.08110389	1				
NFLX	0.46766433	-0.0304444	1			
AVALX	0.54521111	0.34481601	0.21780422	1		
JMIGX	0.67428581	-0.001974	0.37471315	0.6130183	1	
OBMCX	0.55917869	-0.0676904	0.40656592	0.6413081	0.70470384	1

After calculating covariance using regression in excel, we output the relationship between those mutual funds(covariance). Afterward, we found something odd: 1. FlCLX and Bptux are closely correlated (covariance is as high as 0.87, after using data analysis) 2. LYM and Bptux are closely related (covariance is as high as 0.65). We want to ensure all the mutual funds are diversified and are not closely related to each other. When two mutual funds are close to each other, our customers are going to take more risks, and therefore, we decided to omit the first two mutual funds we chose.

3. Research Technique(3-Factor Model)

There are a number of models, including arbitrary pricing model, three factor model, CAPM model, five factor model, etc, and all have their own advantages and weaknesses.

3-factor model is a model that uses a small number of factors to explain complex phenomena. [3] Traditional models, formally known as CAPM, use only one variable to describe the earning of the stocks. However, the model uses three variables. For the first time,they found that two classes of stocks were larger than the market as a whole :(1) small-cap stocks with a high book-to-market ratio, and (2) stocks (B/P stocks, called value stocks, and growth stocks)

Factor model is a statistical model to explain complex phenomena using a small amount of root causes or factors. [3] the traditional asset pricing model, formally known as the CAPM only one variable to describe the returns of a portfolio or return on equity market as a whole. In contrast, the fama - French model using three variables. Fama and France for the first time, found that two types of stocks than the market as a whole: (I) small-cap stocks with high book-to-market ratio (ii) the stock (B/P, is often referred to as value stocks, and growth stocks).

The model selection of three factors is the useful research on the basis of the summary, for the United States and other countries are showed good ability to explain the data, these three factors are: market risk, size, and the carrying value. FF used the data from 1963 to 1991 in the United States to establish a linear model based on the factors, which can give reasons for the risk-return differences of different stocks. In 1992,they found the scale factor was represented by the current market value.

In the FF model formally proposed in 1993, the scale and book-to-market ratio were carefully designed indexes, but the essence remained unchanged. Compared with the CAPM model,it is more precious and accurate. Because it could add into more factors . Obviouly ,it will become useful. And I will give some explanations to know about the model.

$$r = R_f + \beta(R_m - R_f) + b_s \cdot SMB + b_v \cdot HML + \alpha \quad (2)$$

SMB stands for "small (market cap) minus large", HML stands for "high (book-to-market ratio) minus low"

Compared with CAPM, researchers believed three factor model can explain the cross-sectional changes of return of stocks. [4] Fama and French did the research of three main USA stock exchange institutions from 1963 to 1990, they found that, β Changes in cross-sectional expected returns cannot be fully explained. [5] In order to solve this problem, they extend the CAPM model to companies size and book. What they found was that the new model is able to explain much better, compared to to the one in the past, and there are vital scale premium and value premium in the US stock market. In 2015, Fama and French proposed a new model called five-factor model, introducing new factors-- profitability and investment --into the three factor model, but the new model does not take the small stocks into account [4-5]. In addition, the function of the value factor in explaining the average rate of return is weakened by these two new factors [6-8].

Our test results show that: (1) Fama French three factor model is suitable for Shanghai A-share market because it can well illustrate and demonstrate the cross-sectional change of stock return; (2) SSE A-share market has scale premium, that is, small company stocks' return rate is often higher than large company's counterpart, although premium level is different in different industries; (3) There is a value premium in the A-share market of Shanghai Stock Exchange, that is, the return rate of high be / me stocks is often higher than that of low be / me stocks, although there are significant differences between the four sectors [9-10].

4. The results of the research

First : We need to calculate the excess return to get the coefficients and expected return. The formula of excess return: (monthly return) – (risk free risk) = (excess return).

Risk-free risk: The non-risk rate of return refers to the ratio of return you can get if one invests money in a non-risk investment assets, such as gold. Risk-free rate of return is usually used as the primary return, and the lots of potential and underlying risks that may generated from it is considered. The result of a risk-free rate of return plays a critical role in fund performance evaluation. In Fact, all kinds of performance evaluation methods, including Treynor, Sharpe, and Jensen ratios. All use a risk-free rate of return in the past.

Table.2 Excess return of these stocks

Average excess return	BPTUX	GOLD	NFLX	AVALX	JMIGX	OBMCX
	0.031635	0.008486	0.023737	0.0162	0.024005	0.018843

From this table 2,we could know the average excess return. In the table, the BPTUX had the highest excess return(0.0316),while the GOLD had the lowest excess return(0.008486).

Second: Next step, we need to calculate the expected return about the stocks.

Excess returns are defined to be the value that is greater than the rate of return in the market. Rates of return are usually presented through some financial asset models, such as the Capital Asset Pricing Model.

The CAPM model formula : Expected Return (Ra) = RF + β(MR-RF) (3)

Where: Ra is Expected return on a asset , RF represents non-risk rate, β represents Beta value of the security and MR represents expected return of the market .

The formula can be changed to incorporate excess returns, demonstrated by the following formula.

Expected Return = RF + β(MR-RF)-TR (4)

Where:Ra is Expected return on a security,RF represents non-risk rate,MR is expected return of the market and TR shows actual or Total Return from the security.

$$\text{Expected Return} = \text{Risk Free Rate} + [\text{Beta} * \text{Market Return Premium}] \quad (5)$$

$$\text{Excess Returns} = \text{Total Return} - \text{Expected Return} \quad (6)$$

Table 3. Some important data of these stocks

Mkt-RF	SMB	HML	RF			
0.0065	0.0021	0.0039	0.0025			
BPTUX			GOLD		NFLX	
Beta			Beta		Beta	
1.7361478			0.2424318		0.98523171	
	coefficients			coefficients		coefficients
intercept	0.007706		intercept	0.0006901	intercept	0.0076015
Mkt-RF	1.7159403		Mkt-RF	0.4262464	Mkt-RF	0.9482411
SMB	0.23467		SMB	-0.8583583	SMB	0.5572499
HML	-0.3673357		HML	-0.1439862	HML	-1.0212941
E(r)			E(r)		E(r)	
0.0127138			0.0029065		0.0058507	
AVALX			JMIGX		OBMCX	
Beta			Beta		Beta	
1.2752755			1.371724		1.4020413	
	coefficients			coefficients		coefficients
intercept	0.0036042		intercept	0.0113316	intercept	0.0051986
Mkt-RF	1.1506083		Mkt-RF	1.0611453	Mkt-RF	1.1764523
SMB	0.3545241		SMB	1.5271977	SMB	0.9972424
HML	0.7192996		HML	0.0333056	HML	0.3301574
E(r)			E(r)		E(r)	
0.0135287			0.0127345		0.0135288	

Third: The portfolio

We made the pension part equal to 0 and ended up with approximately 10% of BPTUX, 50% of AVALX, 20% of JMIGX, and 20% of OBMCX. It comes out with a Sharpe ratio of 0.173.

Table 4. Some important data of these stock

	BPTUX	GOLD	NFLX	AVALX	JMIGX	OBMCX
ER	0.01521381	0.0054065	0.00835074	0.01602872	0.01523445	0.01602876
ER-rf	0.01271381	0.0029065	0.00585074	0.01352872	0.01273445	0.0135276
Weight						
	BPTUX_rf	GOLD_rf	NFLX_rf	AVALX_rf	JMIGX_rf	OBMCX_rf
	0.08795075	0	0	0.50481988	0.20796471	0.19926466
ER	0.01579188					
Sharpe Ratio	0.173					

We calculate the portfolio weights by using the solver in excel. What we did first was to estimate the ones without a pension. It comes out with a Sharpe ratio of 0.173. Then, we calculate the one with a pension which makes the pension part equal to 0.71. This set includes approximately 71% of the

pension, 11% of GOLD, 4% of NFLX, 9% of JMIGX, and 5% of OBMCX. In this case, the Sharpe ratio is 2.0968, which is exceptionally high.

5. Conclusion

When we were selecting the stocks, we chose to select widely in order to avoid the high covariance, which decreases the risk as much as possible. After comparing the CAPM and the Three-factor model, we finally choose the Three-factor model because it's more related to reality.

After all, more cases are included in this model. We calculated two assets, one with pension and one without it. In most cases, the portfolio with a pension is better than the one without it because the pension can help a stable expected return and with shallow risk. Even though the pension return decreases somehow, its Sharpe ratio is still high than the one without a pension

In our life, when we want to do the best portfolios to maximize profits, we always have some methods to do that. Now, we would like to introduce the 3-factor model to help clients' decisions. In the research, we need to use the EXCEL to calculate some important data. After the stage, we could get the best portfolio to help our investment.

We made the pension part equal to 0 and ended up with approximately 10% of BPTUX, 50% of AVALX, 20% of JMIGX, and 20% of OBMCX.

Although we try to complete the research, there are still some drawbacks to the paper. First, we have limited knowledge about finance, so we could not give the perfect results for the research. Besides, we only use the latest information about stocks, but we do not take other risks into account. When we decide to buy one stock, we could not only concentrate on the financial position. We also need to think about the prospect of the corporation and the international situation. For example, the conflict between Russia and Ukraine and Covid-19 have been the important factors to influence our investment decisions.

In the future, we will try to improve our ability with the computer, because we could calculate the data by ourselves instead of doing that according to the course. And we also want to read some books about finance and investment, so that we will have our own ideas about investments. We all know the best portfolio not only needs precise data, but also needs the ideal principle from the investors. Besides, What we're going to do is, instead of just looking at past data, we're going to use some quantitative knowledge to predict future data and adjust the portfolio. Because past data are far less relevant than future data. However, our current knowledge reserves do not support us to do further data analysis. Therefore, I hope we can work harder to learn computer and financial knowledge so that we can bring you some more accurate data in the future

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