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Empirical Research on Multi-Factor Alpha Strategy in the A-Share Market

Liu Kaiqi[1,a,*]

[1]*Insititute of chemisty and chemical industry, Shanghai Jiao Tong University, Shanghai China*
a. alexzender@sjtu.edu.cn
**corresponding author*

Abstract: Among many quantitative investment means, Alpha strategy, as a typical strategy, has ushered in unprecedented development opportunities. Therefore, how to obtain excess Alpha returns stably and how to select the portfolio with higher future returns from the massive stock pool has attracted more and more attention from investors. This paper uses the ranking score method to determine the effective factors in the candidate factors and constructs a multi-factor Alpha strategy stock selection model in the A-share market. This paper first uses historical data to conduct sample analysis of stocks, studies the correlation between various indicators of listed companies and Alpha returns of individual stocks, and selects candidate factors that can effectively screen stocks with high Alpha returns. After that, the strategy model was established for back testing to test the application and feasibility of Alpha strategy in China's A-share market. Four effective factors are selected according to previous studies. And use the market data from January 2022 to December 2022 to back test the alpha strategy. The back test results show that the multi-factor Alpha strategy in this paper meets the expected performance in the A-stock market and can outperform the market to obtain excess returns. This paper studies the multi-factor Alpha strategy in the A-stock market, aiming to improve the feasibility of this strategy in the Chinese stock market, hoping to provide objective and effective investment ideas for asset managers and obtain investment methods that can obtain excess returns.

Keywords: Alpha strategy, Multi-factor model, Quantitative investment

1. Introduction

In 1952, Markowitz proposed the mean-variance model (MVM) [1], which laid a solid theoretical foundation for current research on investment and asset portfolio. Markowitz's view in the model is that there is a relationship between return and investment risk in the process of asset portfolio construction: Investors instinctively avoid investment risks to obtain high returns. This is the first time that the quantitative perspective appeared in the field of investment research, which brought new thinking for the subsequent research in the field of investment, that is, to study the relationship between expected return and investment risk. The Capital Asset Pricing Model (CAPM) was put forward by Sharpe in 1964 [2]. This theory is mainly put forward to solve how to link the expected returns of investors with the pricing of assets in an equilibrium securities market. When studying this model, Sharpe found that there are two kinds of risks in the securities market, namely systemic risk and non-systemic risk. According to the division of these two kinds of risks, the income sources of

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assets are also divided into two different kinds. The returns from investment activities that carry unsystematic risk are called excess returns, or Alpha returns. When studying how to evaluate the performance of securities investment, Sharpe, JackTreynor and MichealJensen respectively designed an index named after them to measure the performance of asset portfolios established by asset managers during their investment activities. The Sharpe Index, Treynor Index and Jensen Index are now widely used. The momentum strategy in Alpha strategy category builds a portfolio based on the principle that, based on the analysis of historical data, it is believed that assets with a higher overall return in a certain period in the past will still outperform assets with poor performance in the future, and this effect is called the momentum effect. Titman and Jegadeesh were the first to discover the momentum effect in stock investment when they studied American stocks in 1993. They sorted the monthly return information of American stocks from 1965 to 1989 according to the rate of return, evaluated the performance of the portfolio by quarter in each year, and selected the assets ranked in the top tenth as the winning portfolio and the assets ranked in the bottom tenth as the losing portfolio [3]. Around the same time, Wermers, Titman and Grinblatt conducted a quarterly study of the investment activities of about 150 fund products from 1975 to 1984 and found that up to four-fifths of the investment activities were based on the momentum effect. Moreover, the research results show that in general, the return rate of fund companies has increased every quarter [4]. This momentum effect is one of the very common phenomena in the capital market, which is widely found in various asset types such as stocks, bonds, foreign exchange, and commodity futures [5], and it is also widely found in the capital markets in different regions of the world [6]. Performance is also very stable in different periods [7]. Although the explanation of the cause of the momentum effect is still a lot of debate, there are still a lot of financial practitioners in Wall Street based on the momentum effect of asset allocation. Among all the MSCI style factors, the products with the highest annualized returns and sharpe ratios include the momentum factor. When Fama and French studied the factors affecting the investment returns of the US stock market in 1992, they found that beta value could not be used to explain the different returns of different assets but was used to assess the systemic risks of securities. At the same time, we also found the factors that can clearly explain the difference in the rate of return of different assets, namely, the three factors of company market value, book-to-market ratio, and price-to-earnings ratio, while the return of non-systemic risk that cannot be explained by beta is excess return. Fama and French summarized their research findings and thus gave birth to the FamA-French three-factor model. Barroso and Santa-Clara proposed a momentum strategy in which the volatility of financial assets is fixed in a certain period of time. The method for calculating weights in the research is the reciprocal of the variance of each period, to ensure that the volatility of the momentum strategy is the same in each period. Through empirical testing, it is proved that this momentum strategy performs better than the previous momentum strategy without controlling volatility [8]. Some scholars combined the traditional momentum strategies that were implemented from different perspectives and used cross-sectional data and time series models to optimize the traditional momentum strategies and construct a dual-momentum strategy [9]. Based on Markowitz's asset allocation theory, Daniel and Moskowitz extracted the available information contained in the volatility of the market that can predict the returns of momentum strategies. Such dynamic momentum strategies use dynamic weights and have significantly higher returns than traditional momentum strategies [10]. Some people analyzed a new Alpha momentum strategy based on their three-factor Alpha investment stock using daily return estimation [11]. Empirical analysis showed that Alpha momentum showed less exposure to dynamic factors than price momentum, and Alpha momentum was more related to insufficient response to company-specific news. And price momentum is mainly driven by price overshoot caused by momentum trading. Akhter and Yong investigated the time-varying behavior of momentum and reverse profit and showed that the existence of medium-term momentum profit and the long-term reversal effect change with time [12]. Under the adaptive market

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hypothesis (AMH), changes in market conditions are the main reason for the time-varying behavior of market efficiency, which in turn affects the momentum profit of the stock market. In addition, momentum profits are not statistically significant during stock market crashes and bubbles, but normal market conditions have a positive effect on momentum profits. Some professors combined quantitative and qualitative analysis to build a quantitative investment model and added the consideration of the shareholder confidence index into the model to obtain a portfolio with higher returns than the Shanghai Composite Index [13].

2. Theory

2.1. Development of multi-factor model

2.1.1. Capital asset pricing model

Markowitz's risk investment theory, also known as mean-variance model, breaks through the previous theoretical thinking of optimal asset portfolio. It evaluates risks and returns from a quantitative perspective and measures the different investment behaviors of investors with risk appetite. Sharpe et al. also carried out a simplified design, which greatly simplified the calculation process, and this capital asset pricing model (CAPM) came into being. In the capital asset pricing model, the relationship between portfolio return rate and market return rate is measured by coefficient, and it is found that portfolio return rate is related to market portfolio [2]. The CAPM model is proposed based on the following assumptions:

1. Investors know that the probability distribution of investment return is normally distributed.
2. Investors' expectations of risk and returns are consistent.
3. Investors' investment decisions are determined by expected returns and expected risks.
4. Investors are rational, they will take risks at the same time, choose to invest in securities with higher returns; At the same rate of return, they will choose the securities investment with relatively low risk.
5. The market is completely efficient and there is no resistance to investment.

See equation (1) for the CAPM model formula:

$$E(R_i) = R_f + \beta_i(E(R_m - R_f)) \quad (1)$$

E(Ri) $E(R_i)$----Expected rate of return on financial assets
R_f--- Risk-free yield
β_i---- The beta coefficient of financial asset i
$E(R_m)$---- The expected return of the market

2.1.2. Fama-French three-factor model

Fama and French found that different factors explain the return on investment of American capital market assets to different degrees. Among them, the market value, book value and P/E ratio of listed companies are more suitable for analyzing the different returns of different stocks, and the excess part of return is the compensation for the part that the beta coefficient cannot explain in the capital asset pricing model. In 1993, Fama and French conducted empirical research on the American market based on capital asset pricing model and arbitrage pricing theory and concluded that the market capitalization factor (SMB), book-to-market ratio factor (HML) and market portfolio (Rm-Rf) of listed companies could explain the return rate of different stocks [14].

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2.1.3. Ranking method multi-factor model

The principle is to rank stocks according to their factor scores, and then select the top or bottom stocks according to demand. The key premise of constructing the model based on the ranking method is that the selection of factors will affect the return rate of stocks, that is, if there is a significant correlation between the factors and the return rate of stocks, we can select investment stocks according to the ranking of the factor scores of stocks.

The advantage of the ranking method is that it selects stocks according to the ranking mechanism and tests the effectiveness of each factor. Another advantage is that it simplifies the process of building the model and directly takes whether it can win excess returns as the criterion for evaluating the effectiveness of factors, which perfectly fits the purpose of building a multi-factor model. Its disadvantage is that there is multicollinearity in the correlation test between factors.

The rank-based model focuses on how to select factors and construct a portfolio to achieve market-beating returns. The process of constructing a multi-factor model based on the ranking method is as follows: the first step is to select candidate factors. Firstly, factors are divided into categories, and the logical rationality of various factors on whether stocks can be screened according to the rate of return is analyzed, to test the logical validity of factors. Then, the empirical analysis of the factors is carried out to test their effectiveness, and the stocks are ranked from high to low or from low to high according to the factor scores, and then the stocks are evenly divided into several groups according to the ranking.

Then, according to the calculation results, the relationship between the excess return of each group and the ranking of the group is observed, and the characteristics of the average return of each group are summarized. If the rate of return varies significantly with the group ranking, it can be preliminarily determined that the factor is effective. The second step is to check the correlation between the factors, test whether there are redundant factors, if there are and according to the elimination or consolidation method to deal with. The third step is to select stocks through the effective factors obtained, and then assign weights to stocks in proportion to construct a portfolio. Then, the constructed portfolio is back tested to see whether it can win excess returns, to judge whether the model is effective.

2.2. Alpha strategy

2.2.1. Principle of alpha strategy

The Alpha strategy selects high-quality stocks with the potential to earn excess returns based on rigorous logic and a series of processes and uses short stock index futures and other means to remove Beta and reduce the correlation with the market to obtain excess returns. William Sharp pointed out that investors not only face risks brought by the overall trend of the market, but also face non-systemic risks determined by the asset portfolio when conducting investment trading activities. Systemic risk is reflected in the rise and fall of market benchmarks, which investors can strip away by shorting stock index futures. Investors can build a portfolio that excludes systemic risk by going long on stock portfolios and short on stock index futures, and then the portfolio can stably obtain the excess return after eliminating Beta.

The Jensen Index is an indicator used to evaluate performance, which was proposed by American economist Michael Jensen in 1968 when he studied fund performance evaluation. Jensen Index is proposed based on the traditional capital asset pricing model. By differentiating the return rate of a portfolio in a certain period with the expected return rate of the portfolio in the same period, the result obtained by the difference is called Jensen return, which can also be called Alpha return. The expression formula is shown in (2).

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$$\alpha = R_p - [R_f + \beta(R_m - R_f)] \quad (2)$$

α ----The portion of the portfolio where the actual return exceeds the CAPM return
R_p---The real rate of return on the portfolio
R_f---The risk-free rate of return
β ----Systemic risk in the portfolio
R_m----The yield of the market benchmark

2.2.2. Advantage of alpha strategy

The advantage of Alpha strategy in quantitative investment lies in the value analysis and evaluation of investment indicators. It does not rely on the analysis of market trends, nor does it rely on the trend analysis of different stock portfolio strategies, and the investment value analysis of stocks is more scientific and objective.

The core of Alpha strategy execution is simply to realize profits smoothly by taking long positions in high-quality stocks while taking short positions in market indexes. Alpha strategy has three main competitiveness: First, investors will bear less real risk when using Alpha strategy for investment, because the asset portfolio obtained by Alpha strategy is less affected by market fluctuations, and the system risk is removed as much as possible. The return rate is the part of the asset portfolio that exceeds the market return. It is a neutral strategy that can make steady profits; The second is to use the financial lever to the maximum extent, the amount of capital required is less, and the actual risk is smaller; The third is to avoid the problem of timing. The main source of Alpha returns is the excess return rate of high-quality stocks. Investors only need to focus on finding high-quality stocks that outperform the market, which can avoid investors' energy being too scattered, instead of paying too much attention to national economic data and overall market trend.

3. Empirical Analysis in A-share Market Multi-factor Alpha Strategy

3.1. Selection of stock sample

In this paper, A multi-factor Alpha strategy stock selection model is constructed in the A-stock market and empirically tested. To verify the effectiveness of the model, the CSI 300 index is adopted as the market benchmark in this study.

The main reasons for using CSI 300 index as a market benchmark to measure the return rate of investment portfolio are as follows: On the one hand, CSI 300 index includes finance, information technology, medicine and health and other major fields, which is basically consistent with the industry distribution ratio of the whole market, and the industry structure is more balanced, and the representative force is strong. On the other hand, the profitability of the enterprises covered by the CSI 300 index is among the best in the market, the income and net profit of the enterprises are high, and the total market value accounts for a large proportion in the market, which can already represent the general trend of the market.

There are two main principles for selecting stocks for empirical analysis in this study:

(1) Excluding listed new shares: The development of newly listed companies is not stable, and the previous public data is also relatively scarce, which may affect the accuracy of the research and analysis results. Therefore, this study chooses companies listed before 2000 as the stock samples for empirical research.

(2) Remove ST, *ST and delisted stocks: ST stock companies have abnormal conditions and cannot be traded normally, while *ST stocks have delisted risks, so we remove stocks with major

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problems in financial operating conditions and abnormal stock price fluctuations when we select stocks.

3.2. Calculation of alpha and beta values

According to the alpha formula, see equation (2). Using Excel to regression the past data to calculate the beta value, the beta value of each month is calculated by the trading data of all the trading days of the stock in the month and the return information of the market benchmark.

3.3. Factor selection and weight ratio

3.3.1. Factor selection

According to previous research results, this paper selects seven factors to enter the candidate pool. The seven factors that pass the test are the growth rate of return on equity, price-to-book ratio, enterprise value multiple, shareholders' equity turnover, return on equity, cash suitability ratio and the sum of the shareholding ratio of the top three circulating shares of the company.

The empirical test for the validity of the factors in the candidate pool is as follows:

1.Evaluate the correlation degree between several factors and alpha yield respectively. The average return rate was calculated on a quarterly basis and histograms were made according to each group of factors to calculate the correlation degree between the factors and the alpha return rate during the training period. The influence factors were selected for further testing.

2.Further test the ability of candidate factors to screen stocks. The three hundred sample stocks were divided into 10 groups on average according to the order of the score compliance of the 7 factors from high to low. The data of the first group ranked first and the tenth group ranked last were taken out for comparative analysis, and the correlation analysis was conducted between the factor data of the test period and the return rate of the stocks.

Finally, the four factors confirmed in this paper are the growth rate of return on equity, price to book ratio, shareholders' equity turnover and return on equity.

3.3.2. Weight ratio

Using these four factors to build a stock selection model, the primary task is to solve the problem of proportional distribution of factor weights. The weight of factors depends on the contribution degree and effectiveness of this factor to the model and assigns higher weights to the factors with better stock α return performance and lower weights to the factors with slightly worse stock α return performance. Can construct a multi-factor stock picking model that is more likely to win market-beating returns. The main purpose of the multi-factor stock selection model constructed in this paper is to obtain α returns that exceed the market. Therefore, the α returns of the first group will be used as the weight reference of the factor during the empirical test. The weight ratio construction is shown in Table 1:

Table 1: Weight Ratio

Factors	α	Weight ratio
growth rate of return on equity	17.04%	33.89%
price to book ratio	7.97%	15.85%
shareholders' equity turnover	13.15%	26.15%
return on equity	12.12%	24.10%

Therefore, the steps of stock selection are: first, all stock samples are sorted according to the scores of each effective factor, and the corresponding scores of each factor are recorded, and then the

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effective factors are assigned the above weights, respectively. Finally, the comprehensive scores of all stock samples are calculated, and the stocks with high comprehensive scores are selected to build a portfolio according to a certain weight ratio. The stock selection model is shown in formula (3).

$$F_i = 0.3389X_1 + 0.1585X_2 + 0.2615X_3 + 0.241X_4 \quad (3)$$

F_i represents the comprehensive score of stock i, X1 represents the factor score of the growth rate of return on equity of stock i, X2 represents the factor score of price-book ratio, X3 represents the factor score of shareholders' equity turnover, and X4 represents the factor score of return on equity.

3.3.3. Back test results

In general, each company releases financial reports at the end of April, the end of August, and the end of October, so we regroup our investment stocks on the first trading day of May, September, and November. However, although this method of adjusting the position mix makes the analysis process simpler, the alpha gain from such a position adjustment cycle will be lower than the maximum alpha gain. Because some companies have released their financial reports before this point in time, it means that our reaction to market information will be delayed. If the news is about the stock price rising, then the stock price has risen when we adjust our portfolio to go long on the stock, and if the news is about the stock price falling, the stock price has fallen by a certain amount when we short the stock. In either case, the alpha return on our investment will be lower than the maximum possible alpha return. Since the main purpose of this study is to verify the feasibility of Alpha strategy in A-share market, the empirical results will not be materially affected by the difference in alpha yield. In actual investment activities, we can also determine A limited number of stock pools through other stock selection methods. In this way, it is possible to realize the adjustment of the position portfolio when the listed company updates the financial report, to obtain the highest alpha yield as possible.

The test will use the data of 210 stocks in the stock sample in 2022 to select the top ten stocks with comprehensive scores of four factors in the 2 periods of May 2022 to August 2022, and September 2022 to October 2022 respectively. The test decides the weighting ratio of the portfolio according to the total market value of each stock, weighted by the corresponding total market value of each stock. The Alpha and Beta calculation periods in the following table are months. The investment returns for each period are shown in Table 2 to 3:

Table 2: 2022.05-2022.08

Stock code	Proportion	Beta	Alpha(%)	Average yield(%)
600132.SH			-2.8577	-9.5230
600809.SH	0.041901351	1.9211	1.7619	8.3309
000792.SZ	0.229037868	1.8776	-0.8400	-3.9060
002709.SZ	0.10847162	0.0119	7.3757	27.7478
600732.SH	0.049759845	4.8230	31.4424	171.4504
600887.SH	0.018410142	2.1638	-1.4902	-4.6886
002756.SZ	0.169921718	0.7162	6.4200	29.8470
688303.SH	0.029162151	2.1883	-0.2156	0.3279
601888.SH	0.073985361	1.5141	1.7739	8.1982
605499.SH	0.245228518	2.5079	5.0330	23.2120
CSI 300 Index	0.034121425	1.7961		1.711
portfolio				8.52

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Table 3: 2022.09-2022.10

Stock code	Proportion	Beta	Alpha(%)	Average yield(%)
605117.SH			242.8101	-11.0830
600132.SH	0.043047602	34.0366	142.1822	-21.7368
002311.SZ	0.02647008	21.1024	17.7952	-5.3279
600732.SH	0.049616274	2.8252	73.0670	-0.6749
002756.SZ	0.019828349	10.1042	-17.1291	-13.4631
688005.SH	0.027328927	-1.4009	-93.1542	-24.4039
300750.SZ	0.022881769	-11.0754	-79.0653	-22.6822
603185.SH	0.577169472	-9.2595	58.0734	-9.1866
002466.SZ	0.02554266	8.6431	-57.9325	-16.3603
600188.SH	0.091805348	-6.8217	152.9404	-15.4167
CSI 300 Index	0.116309517	22.0978		-13.23
portfolio				-18.87

4. Conclusion

According to the calculation results, the average return of the Alpha strategy from May to August 2022 is 6.8%, while the loss from September to October is 5.6%. From May to August alone, the Alpha strategy did not perform as well as just investing in stocks, but considering the data from September to October, the Alpha strategy reduced its losses by 13.23%. This conclusion indicates that the Alpha strategy worked as a whole, avoiding the huge losses caused by the bear market, but it is far less than we would like. As analyzed in Table 2-3, there is a problem with stock code 300750.SZ. The total market value of this stock is very high, so the weight ratio after the stock selection is very large, which makes the loss of this stock, the final portfolio loss is very large. In addition, through the analysis of its factors, it is found that although its ROE growth rate is extremely high, ROE is at a low level, while the final average ROE of 600132.SH in the same table is at a very low level, which indicates that the factor model we adopted is not well applicable to all stocks, and this aspect still needs to be improved.

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