Investment strategy analysis based on three-factor stock selection model

—Take the CSI 500 Index constituent stocks as an example

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Abstract. With the continuous development of quantitative investment concepts, multi-factor stock selection models, as an important part of it, have stable performance in different market environments. This article optimizes the three-factor stock selection model, taking the CSI 500 Index constituent stocks as an example. Based on the research on the three-factor model, the debt leverage factor is introduced to optimize the stock selection model. The empirical test results show that the new stock selection model is significant among the CSI 500 index constituent stocks. Based on this, this article believes that the new stock selection strategy has certain investment reference value.

Keywords: three-factor stock selection model; quantitative investment; debt leverage.

1   Introduction

With the development of the domestic economy and the continuous development of people's investment concepts, quantitative investment, as an investment strategy that uses quantitative methods from mathematics, statistics and other disciplines to guide investment decisions, has been favored by investors. As an important component of quantitative investment, the stock selection model is also a current mainstream financial investment field. Whether it is an asset pricing model, a three-factor stock selection model or a stock selection model with more factors, these are all popular in academia. Research objects in this area are more focused in foreign countries, and domestic research in this area is also constantly developing. It is worth noting that scholars are discussing the application of the three-factor stock selection model in different types of markets. Foreign investors have also begun to use the three-factor stock selection model to optimize their investment strategies and increase their wealth. Based on previous research findings, my country is still in a weakly efficient market, which lays a theoretical foundation for the application of the three-factor stock selection model in my country's capital market. Facing the complex investment products in the capital market, the three-factor stock selection model can be effectively and widely used in investment

portfolios. This investment method can bring higher income to investors and reduce the risk of investors at the same time. risks assumed.

2   Literature review

2.1   Development of quantitative investment theories and models

Quantitative investment, as one of the more popular investment methods in the current financial investment community, has been developing since its birth in the 20th century. Markowitz (1959) first constructed the optimal mean-variance investment portfolio, and pioneered the use of quantitative methods to study the ratio of security returns and risks, breaking the lack of quantitative calculations in securities investment analysis, which set the stage for future generations. The research on quantitative investment lays a solid foundation.[1] Subsequently, Sharp (1964) and others constructed the asset pricing model (CAPM) based on this quantitative method, which considered market risk as the source of risk for investment returns, laying a theoretical foundation for quantifying the relationship between returns and risks of securities.[2]

Farmer (1965) pioneered the market efficiency hypothesis, which held that the capital market is highly efficient, and the market's profit opportunities are reflected in asset prices, but investors cannot continue to obtain sustained excess returns. The efficient market hypothesis has important guiding significance for the operation of capital markets and investment decisions.

Stephen (1976) proposed the APT arbitrage pricing theory to explain the relationship between asset expected return and systematic risk, giving investors a more comprehensive perspective to understand the source of asset returns and better construct investment portfolios. Subsequently, Fama and French (1993) further found that the β value of the stock market cannot fully explain the difference in stock return rates, but the market value and price-earnings ratio of listed companies can explain the difference in return rates. Therefore, on the basis of market risk factors, scale factors and valuation factors were added to construct a three-factor model to explain the anomalies of efficient markets and provide a method for the study of quantitative stock selection strategies.[3] Fama and French (2015) innovatively added profit factors and investment factors to the three-factor stock selection model, and proved through experiments with historical data that they constructed a five-factor stock selection model, which added new features to quantitative investment and new options.[5]

Piotrowski (2000) first scored and ranked 9 selected factors among a large number of financial indicators, constructed a new investment portfolio, and obtained considerable returns.[4] Based on the scoring method proposed by Piotrowski (2000) , Pasha (2005) selected 9 factors based on profitability factors and verified their effectiveness to construct an investment portfolio and achieved good income performance. [6] I-Cheng Yeh (2022) found that the combination of "synergy" and stock selection models can strengthen the ability of stock selection models to increase investment return. Optimization models are used to generate optimal investment portfolios that provide optimal expected returns for a set of portfolios with different risk levels.

2.2   Domestic practice of quantitative investment models

Based on the academic research on the three-factor model, the development of its investment strategy in my country's capital is continuing. Fan Longzhen (2002) constructed a new stock selection model through research on the three-factor model and explained the index differences in China's stock market.[7] Chen Shoudong (2003) also confirmed its role in China's capital market by constructing a new three-factor stock selection model and taking China's Shanghai Stock Exchange 180 constituent stocks and Shenzhen Stock Exchange 100 constituent stocks as examples. [8] Wang Xiaolong (2005) constructed a stock selection model through the analysis of the three-factor stock selection model. Through empirical testing, he found that the size factor has a greater impact on the rate of return than the value factor, explaining the differences between the indexes in China's stock market. [9] Wu Di (2012) used the construction of a scoring stock selection model to effectively screen factors, construct a new investment portfolio, and test the impact of candidate factors on investment returns in the capital market under different circumstances. [11] Zhu Shiqing (2015) constructed a multi-factor stock selection model through the scoring method and the analytic hierarchy process, and obtained considerable returns in the capital market. [12] Zhao Shengmin (2016) compared the five-factor stock selection model with the three-factor model and found that the three-factor model is more suitable for the Chinese market. [10] Xu Jingzhao (2017) constructed a new three-factor model by weighting the effective candidate factors and performed well in the market. Liang Yi (2022) believed through research that the combination of investor sentiment index and multi-factor stock selection model can bring excess returns to investors, which provides new ideas for investors to expand their investment portfolios.

3   Literature summary

Based on the research findings of domestic and foreign scholars on multi-factor stock selection models, based on the asset pricing model, factors that affect the rate of return are continuously and innovatively added, and a multi-factor stock selection model is constructed to try to predict asset prices, thereby finding suitable investments. investor's portfolio strategy. With the continuous improvement of my country's capital market and the continuous development of science and technology, with the support of artificial intelligence and big data technology, domestic scholars in my country have begun to use different index constituent stocks as samples to study the effectiveness factors that have an impact on the return on assets. , thereby constructing their own investment portfolio strategies for domestic investors. This article is mainly based on the research on the three-factor model stock selection strategy. It replaces the valuation factor with the debt ratio factor (DER), improves and optimizes the three-factor stock selection model, constructs a new investment portfolio, and explores the application of new investment strategies in China. 500 index component stocks.

4   Experimental design

4.1   Theoretical basis of the three-factor model

The three- factor stock selection model was mainly proposed by Fama and French in 1992. It is an expansion of the asset pricing model (CAPM) and aims to explain stock investment returns more comprehensively. The three factors mainly include:

Market factor (MKT): The market factor is similar to the market risk factor in CAPM, indicating the risk of stock investment relative to the entire market.

Market Capitalization Factor (SMB): The Market Capitalization Factor measures the excess returns of small-capitalization stocks relative to large-capitalization stocks.

Book-to-market factor (HML): The market-to-market factor measures the excess returns of small-capitalization stocks relative to large-capitalization stocks.

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$$R_p - R_f = \alpha_i + \beta_i\left(R_m - R_f\right) + s_i SMB_i + h_i HML_i + \varepsilon_i$$

Based on the research of the above model, the market capitalization factor and the book-to-market ratio factor will have an impact on the stock's return rate. However, with the economic environment in different periods and the national economic conditions in different regions. Fama 's three-factor stock selection model may not fully explain the stock's return. Research based on Fama 's related article points out that debt leverage also affects stock returns.

4.2   Research methods

4.2.1. Literature research method

This paper collects, arranges and comprehensively analyses the existing Chinese and foreign literature, so as to have a more profound understanding of quantitative investment and three-factor stock selection model, which fills the knowledge gap for me, confirms the research direction, and more importantly, provides the corresponding theoretical foundation for the research of this paper.

4.2.2. Combining qualitative and quantitative

This paper adopts a mixed research method combining qualitative and quantitative research. On the one hand, qualitative research can help this paper to explain the patterns or trends in the data and verify the results of quantitative data. It can analyse the research problem from multiple perspectives and identify potential influencing factors; on the other hand, the quantitative research can provide extensive and objective data support for this paper and improve the credibility of the research results. The combination of the two methods can provide a more comprehensive and in-depth understanding of the research problem

4.3   Model settings

In the study of the above theoretical basis and research methods, this article uses the wind database, taking the annual data of CSI 500 Index constituent stocks from 2017 to 2022 as a sample, with a total of 2995 observations. Quantitative operations were performed using Stata data analysis software. Four indicators, namely market excess return, CSI 500 index return, total assets, and debt ratio, are selected to represent and optimize the three-factor stock selection model.

$$R_p - R_f = \alpha_i + \beta_i(R_m - R_f) + s_i SMB_i + h_i DER_i + \varepsilon_i$$

α_i is the regression constant term, R_m is the market rate of return at time t, R_f is the risk-free rate of return at time t, ε_i is a random interference term consistent with the normal distribution, SMB_i is the simulated portfolio rate of return of the market capitalization factor at time t, DER_i is the liability factor at time t simulated portfolio return rate.

5   Analysis of empirical results

5.1   Descriptive results analysis

The details of the descriptive results are shown in the table 1. There are a total of 2995 valid observations. From the perspective of explanatory variables, the maximum value of the debt ratio reciprocal factor is 3 2.63, the minimum value is - 0.467, the average value is 1.98, and the variance is 2. 64; The maximum value of ln's total assets is 2 7.93, the minimum value is 1 7.49, the average value is 2 3.50, and the variance is 1.369. It can be found that the CSI 500 constituent stocks mainly include relatively large companies, but there are also some medium-sized companies. Such medium-sized companies have relatively high debt leverage and face greater financial pressure, which may bring corresponding investment concerns to investors. But overall, the market conditions of CSI 500 constituent stocks are relatively stable and suitable for investors to invest.

Table 1. Descriptive outcome analysis

	Obs	Mean	Std.dev.	Min	Max
market excess return	2,995	-0.0107	0.221	-0.363	0.238
CSI 500 Index Return Rate	2,995	0.0150	0.219	-0.333	0.264
debt ratio reciprocal factor	2,995	1.980	2.646	-0.467	32.63
ln total assets	2,995	23.50	1.379	17.49	27.93

5.2   Regression analysis

In order to further analyze the explanation of the debt ratio factor and total assets on the CSI 500 constituent stocks, this article uses Stata 18.0 data analysis software to conduct an empirical analysis of the multiple regression analysis model on the data. During the process, the data of total assets are de-logarithmed to reduce the impact of extreme values on the results and make the data more suitable for analysis. After regression analysis, the debt ratio factor itself is not significant in the market. However, this article tried to take the inverse of the debt ratio factor and found that the inverse is very significant in the market. This may be related to market emotions or psychological factors; this Related to related theories in behavioral finance, at the same time, the inverse may better capture the risks and opportunities related to market fluctuations; the inverse of the debt ratio may better represent market sentiment than the debt ratio. Due to my lack of academic level and theoretical foundation, I did not conduct more in-depth research.

Table 2. Regression analysis result

	(1) market excess return
L n total assets	0.000784 ***(0.0000595)
debt ratio reciprocal factor	0.000197 ***(0.0000346)
CSI 500 Index Return Rate	1.005 ***(0.000299)
_cons	-0.0446 ***(0.00142)
N	2995
R^2	1.000
adj. R^2	1.000

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

From the regression results of table 2, we can find that the correlation coefficient between the logarithm of total assets and the market excess return is 0.000784 , and is significant at the 1 % significance level, showing a positive correlation; the reciprocal factor of the debt ratio has a positive correlation with the market excess return The correlation coefficient is 0.000197 and is significant at the 1 % significance level, showing a positive correlation. This shows that total assets and liability leverage have certain explanatory power on stock returns.

6   Limitations of this article

Based on my academic level and lack of relevant theoretical knowledge, first of all, the data queried is only the data of the CSI 500 Index constituent stocks in the past five years. The accuracy and inclusiveness of the data cannot be guaranteed, and there is a lack of consideration of important financial matters. and verification. Secondly, the correlation between factors and the theoretical basis for factor selection cannot be explained rigorously.

7   Conclusion

With the continuous growth of the domestic economy, people's wealth continues to accumulate, and the investment concept is deeply rooted in the hearts of the people. The concept of quantitative investment has begun to enter everyone's field of vision. Stock selection model is one of the important investment methods. This article uses the three-factor stock selection model as the theoretical basis and takes the CSI 500 Index constituent stocks as an example to try to improve and optimize a new stock selection model. From the above research steps, we can find that the optimization model composed of market factors, size factors, and debt leverage factors is applicable to the CSI 500 Index constituent stocks. Among them, the CSI 500 index return rate represents the market factor, the logarithm of total assets represents the size factor, and the inverse debt ratio factor represents the debt leverage factor. These three factors have certain significance for the market excess rate of return.

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