Research on the Influencing Factors of Capital Asset Income ---- Is Based on the Fama-French Three-Factor Model

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Abstract: Capital asset pricing is very important to the development of listed companies. It is not only related to the performance of micro enterprises, but also related to the stability and development of macro financial markets. Therefore, the in-depth study of the law and influencing factors of listed companies' return on capital assets is a theoretical problem worthy of in-depth exploration, but also has significant practical significance. In this paper, 160 stocks from 2012 to 2021 are selected for empirical analysis, and it is concluded that stocks of small-scale companies can realize good risk hedging as a hedge tool, and the trend of large-scale high-yield stocks conforms to the traditional capital asset pricing theory.

1.Introduction

In order to predict the performance of different capital asset portfolios and help investors better predict the potential returns of the capital asset portfolios they buy in the stock market, the capital asset pricing model has undergone a series of evolvement and improvement. H. M. Markowitz[1] proposed the Mean-Variance Model and applied mathematical statistics to the study of portfolio selection for the first time. Sharpe[2], an American scholar, proposed the concept of Sharpe ratio, which assumed that there was a linear relationship between asset returns and market portfolios. Theoretically, the representative research results of Capital Asset Pricing are mainly concentrated in CAPM (Capital Asset Pricing Model) and APT (Arbitrage Pricing Theory). Since the CAPM model was put forward, the financial academia has been studying the impact factors of capital asset pricing for nearly 60 years. CAPM and APT[3] theoretical models provide the theoretical basis for the study of impact factors. CAPM model is a single factor model, which simply states that in the equilibrium state of the market, the expected rate of return on capital assets in the securities market only has a linear relationship with the systemic risk of the whole market. However, the Fama-French three-factor model (FF3FM), which was put forward in 1993, pioneered the empirical capital asset pricing. It proposed a systematic method to test the capital asset pricing theory. It also constructs a simple empirical capital asset pricing theoretical model, which greatly promotes the development of modern finance[4]. Fama-French three-factor model was initially applied to the stock market. Fama-French (1993) analyzed 25 stock portfolios in the United States from July 1963 to December 1991, and concluded that the stocks that outperformed the market were small-scale and high-yield stocks. Subsequently, the three-factor model developed rapidly. Stock returns can be explained by three factors: market return, book price and size factor[5]. CAPM, APT and Fama-French theoretical models have made effective studies on capital asset pricing. For example, Xu Zhengrong et al.[6] selected the monthly trading data of stocks in the Internet finance industry from December 31, 2015 to December 31, 2020, and confirmed that the CAPM model is applicable to the Internet finance industry. Zhao Qing et al.[7] selected 100 stocks from Shanghai Stock Exchange to prove the applicability of CAPM model. Guo Shumei[8] selected 33 financial stocks to prove that the financial sector of Shanghai Stock Exchange basically conforms to APT model. Zhang Lishuang[9] selected the individual stock data of the constituent stocks of China's SSE 50 Index in the case of the novel coronavirus epidemic for analysis, and found that CAPM and Fama-French models could also explain the expected return under the extreme stress test. Wang Luyao[10] selected comprehensive monthly A-share market data from January 2004 to June 2020 to analyze the impact of investor sentiment on capital asset pricing. However, there are also some shortcomings. The research is not detailed enough, and basically doing a whole study. The research methods need to be further developed: CAPM model takes only market factors into account, while some models do not take core factors into account. Based on the Fama-French three-factor model, this paper selects data of 160 stocks and classifies them according to their size and profitability. Then, market factors, size factors and profitability factors are used to explain stock returns.

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2.Data source and model construction

In this study, 160 stocks from 2012 to 2021 are selected as samples, and the data of annual return rate, total income, market return rate and Treasury bond yield to maturity come from the Wind database.

Table1.Descriptive statistics of variables

Variable	Obs	Mean	Std.Dev	Min	Max
stock return rate	1600	25.2517	56.72319	-60.02808	589.1607
risk-free return	1600	3.404748	.3930293	2.856417	4.159588
stock excess return rate	1600	21.84696	56.70377	-63.65462	586.2144
market profitability	1600	10.04156	22.62906	-25.3098	51.6595
market return rate	1600	6.636812	22.53633	-28.93634	47.49991
scale factor	1600	2.178887	12.25404	-31.02596	15.97073
profitability factor	1600	8.299861	25.58806	-15.51298	168.8271

The Fama-French three-factor model adopted in this project is as follows:

$$R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + s_i SMB_t + r_i RMW_t + \varepsilon_{it} \quad (1)$$

In the model, R_{it} represents stock return rate, R_{ft} is risk-free return, R_{mt} is market profitability, $R_{it} - R_{ft}$ is stock excess return rate, $R_{mt} - R_{ft}$ is market return rate, α_i is intercept term, β_i is market risk measurement, SMB_t is scale factor, which reflects the difference between large and small stock portfolio return rate, RMW_t is profitability factor, which reflects the difference between higher return and lower return portfolio return rate, and r_i is the correlation coefficient of profitability factor.

Explained variable: $R_{it} - R_{ft}$ is the difference between the stock yield minus the risk-free interest rate. Among them, stock yield rate selects the annual yield rate of 160 stocks from 2012 to 2021, while risk-free interest rate selects the yield rate of Treasury bonds to maturity from 2012 to 2021.

Explanatory variable: $R_{mt} - R_{ft}$ is the difference between the stock return rate minus the risk-free interest rate, that is, the market return rate, is the market factor. SMB_t is the size factor. RMW_t is the profitability factor. The stock return rate of this subject is the annual return rate of 160 stocks from 2012 to 2021, which is derived from the Wind database. The scale factor is measured by the total revenue scale. The profitability factor is measured by the average stock return.

According to the Fama-French three-factor model and existing literature, stock size and profitability are grouped to form a 2×2 portfolio. Firstly, the annual total income of 160 stocks and its return rate were averaged respectively. Secondly, the total income of each stock in each year was compared with the average income, and the return rate of each stock in each year was compared with the average return rate, and the small-scale low return group (S/L), small-scale high return group (S/H), large-scale low return group (B/L) and large-scale high return group (B/H) were obtained. Thirdly, SMB and RMW are calculated based on the average returns of each group of small low-yield, small high-yield, large low-yield and large high-yield in each year, as follows: SMB= (S/L+S/H-B/L-B/H) /2, RMW= (S/H+B/H-S/L-B/L) /2. Finally, the annual returns of SMB and RMW portfolios are calculated respectively of each year.

3.Empirical results

Table2. Empirical results

Group			S/L	S/H	B/L	B/H
intercept term	α		14.829*** (4.57)	36.277*** (6.54)	6.289* (1.85)	-9.622 (-0.77)
	RMX	β	-4.503*** (-3.08)	-10.972*** (-4.32)	2.087 (1.29)	16.447*** (3.54)
coefficient	SMB	s	-3.508*** (-3.03)	-11.315*** (-5.64)	2.060 (1.61)	12.661*** (3.38)
	RMW	h	-0.026 (-0.27)	0.211 (1.08)	0.000 (.)	0.336 (1.64)
F test	F		21.59*** (0.000)	24.63*** (0.000)	36.13*** (0.000)	6.06*** (0.000)
Goodness of fit	Adj-R2		0.176	0.228	0.472	0.723

Note: * p<0.1, ** p<0.05, *** p<0.01, values in brackets are standard deviation.

In the regression of market return to the four groups of stock excess return, it can be seen that the β value of the S/L and S/H groups, that is, the small-scale group, is less than 0, so the excess return of small-scale stocks changes inversely with the return of the stock market. B/L, B/H group, that is, the large group β value is greater than 0, so the excess return of large stocks changes in the same direction as the stock market. In the T-test, the p value of S/L, S/H and B/H is less than 0.01, so it can be considered that there is a significant linear relationship between market factors and stock excess return, while there is no significant linear correlation between market factors of B/L and stock excess return, which is speculated to be due to the small number of samples.

In the regression of the size factor SMB to the excess return of stocks, it can be seen that the s value of S/L and S/H groups, namely small-scale groups, is less than 0, so the size factor of small-scale stocks is negatively correlated with the excess return of stocks. Group B/L and B/H, that is, the s value of the large group is greater than 0, so the size factor of the large group is positively correlated with the excess stock return rate. In the T-test, the p value of S/L, S/H and B/L is less than 0.01, so it can be considered that the size factor has a significant linear correlation with the excess stock return. There is no significant linear correlation between the size factor of B/L and the excess stock return, which is speculated to be due to the small number of samples.

In the regression of profitability factor RMW to excess return rate, it can be seen that the h value of the S/L group, that is, the small-scale low-return group, is less than 0, so the profitability of the small-scale low-return group is negatively correlated with the excess stock return rate. Group B/L and B/H, that is, the h value of the high-yield group is greater than 0, so the profitability of the high-yield group is positively correlated with the excess stock return rate. In the T-test, the p values of the four groups were all greater than 0.1, and there was no strong linear correlation. Therefore, RMW has no significant impact on the excess return of stocks.

According to the results of F test, the p values of S/L, S/H, B/L and B/H were all less than 0.01, indicating that the regression of the 4 groups was highly significant. It can be seen that the impact of market factor RMX and size factor SMB on the excess return has a significant linear correlation, while the impact of profitability factor RMW on the excess return of stocks has no significant linear correlation.

Goodness of fit describes the proportion of interpretive sum of squares in the total sum of squares in the regression results, and the adjusted goodness of fit refers to the proportion of interpretive sum of squares in the total sum of squares when the degree of freedom is removed. Since the number of samples in this paper is 160 stocks, it indicates that the number of samples meets the requirements of large samples in statistics. Therefore, goodness of fit indicates that the reviewed sum of explanatory squares has a greater explanatory effect on the total sum of squares.

4.Analysis of economic significance

According to the four stock regression results, in the sample stocks with small and low returns and small and high returns, the impact of market return and size factor on stock excess returns is significant, while the impact of profitability factor on stock excess returns is not significant. Specifically, for small-scale low-return sample stocks, the regression coefficient of market return on stock excess return is -4.503, which is significant at the 1% significance level. For small-scale high-return sample stocks, the regression coefficient of market return on stock excess return is -10.972, which is significant at the 1% significance level. This indicates that for small-scale low-yield and small-scale high-yield stocks, the stock returns and market returns may present a negative relationship, indicating that the stock price fluctuation rule of such stocks presents a reverse trend with that of large-cap stocks. Therefore, investors who buy small-scale low-yield stocks cannot analyze and make decisions only according to the general trend of the stock market. They must pay attention to the actual law of this kind of stock before making corresponding investment decisions. In addition, the regression coefficient of small-scale low-return scale factor for stock excess return is -3.508, which is significant at the significance level of 1%; the regression coefficient of small-scale high-return scale factor for stock excess return is -11.315, which is significant at the significance level of 1%. This indicates that the size factor of small-sized low-yield and small-sized high-yield stocks also presents an inverse relationship with stock returns. So the investors who buy small-sized companies' stocks should not only analyze the size of such stocks when purchasing stocks, but should note that there is no positive relationship between the size effect and stock returns. In addition, according to the regression results, there is no significant internal relationship between the profitability factor and the excess return rate of stocks. Therefore, stocks cannot be purchased only by analyzing the profitability of enterprises. To sum up, for stock investment in small-scale companies, investors should not simply analyze traditional risk-return analysis or traditional capital asset pricing definition, but should pay attention to the abnormal behavior and law of stock price deviation from the market. For small - scale high - yield stocks, traditional investment methods may lead to greater losses for an investor. Large - scale low - yield group stock is not significant, it means not representative, do not recommend to buy. The influence of market rate of return and size factor on stock excess return is significant, but the influence of profitability factor on stock excess return is not significant. Specifically, for large-scale high-yield sample stocks, the regression coefficient of market return on stock excess return is 16.447, which is significant at the significance level of 1%, indicating that for large-scale high-yield stocks, stock return and market return may be in the same direction. This shows that the fluctuation regularity of this kind of stock is in the same direction as that of

large-cap stocks. Therefore, investors who buy large-sized high-yield stocks can analyze and make decisions according to the general trend of the stock market.

5.Conclusions

In short, the small-scale group reflects that the group of stocks can realize a good risk hedge with the stock market, and its average annual return is higher than the risk-free return rate, so it can be used as a good hedge tool. The trend of large-scale high-yield stocks conforms to the traditional capital asset pricing theorem, and has a positive relationship with the size factor, but has no significant relationship with the profitability factor.

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