

Вей Жуйся,

Сяо Цзян

Ланьчжоуский университет финансов и экономики
(г. Ланьчжоу, Китайская Народная Республика)

ANALYSIS OF INFLUENCING FACTORS OF YIELD BASED ON QUANTILE ASSET PRICING MODEL

In order to study the impact of the five factors on the excess return of stocks in the five-factor asset pricing model, and to explore the contribution of the five factors to the excess return of stocks at different quantiles, this paper first introduces quantiles on the basis of the five-factor asset pricing model, and constructs a new quantile asset pricing model. Then, at different quantile points, the influence of each factor on the stock's excess return and the degree of change are measured. The empirical results show that under different levels of excess return, the five factors have different influence factors and the degree of influence on the excess return. Market factors and scale factors have less impact on low stocks» excess returns, but have a greater impact on high stocks» excess returns. The book-to-market value ratio factor has more influence on the medium excess return than the low and high excess return. Profit factors and investment factors have a small effect on high excess returns. This study measures the influencing factors of China's stock return rate, which can provide a new perspective for the government's financial risk management and investors» investment decision-making.

Keywords: *quantile regression, asset pricing model, stock market, excess return.*

С целью изучить влияние пяти факторов на избыточную доходность акций в пятифакторной модели ценообразования активов и вклад пяти факторов в избыточную доходность акций в разных количествах, в статье вводятся квантили на основе пятифакторной модели ценообразования активов и строится новая модель ценообразования активов с квантилями. В разных точках квантиля измеряется влияние каждого фактора на избыточную доходность акций и степень изменения. Эмпирические результаты показывают, что при разных уровнях избыточной доходности пять факторов оказывают разное влияние на избыточную доходность. Рыночные факторы и факторы масштаба оказывают меньшее влияние на избыточную доходность акций с низкой доходностью, но большее влияние на избыточную доходность акций с высокой доходностью. Коэффициент соотношения балансовой и рыночной стоимости оказывает боль-

шее влияние на среднюю избыточную доходность, чем на низкую и высокую избыточную доходность. Факторы прибыли и инвестиционные факторы оказывают незначительное влияние на высокую избыточную доходность. В исследовании измеряются факторы, влияющие на доходность акций Китая, что может обеспечить новую перспективу для управления финансовыми рисками правительства и принятия инвестиционных решений инвесторами.

Ключевые слова: *квантильная регрессия, модель ценообразования активов, фондовый рынок, избыточная доходность.*

1. Introduction

As a significant pillar of modern financial market price theory, asset pricing models have always been a hot spot for scholars. It attempts to explain the difference in stock returns by identifying the factors that influence investors' investment decisions. Since Fama and French proposed the three-factor model in 1992 and the improved five-factor model in 2015, the capital asset pricing model has become a powerful tool for the modern stock market to measure asset prices, as well as a measure of risk and return in current finance.

Most of the existing literature uses least squares regression to analyze the influencing factors of China's stock market return. However, most stock returns have low peak and thick tail characteristics, and it is not appropriate to replace the above characteristics with normal characteristics. As a result, the estimation result got by the fewest squares is not linear and unbiased. Therefore, this paper intends to introduce quantile into the existing five-factor asset pricing model. Based on the quantile factor asset pricing model, we measured the factors affecting stock return rate and the difference of the influence degree under different levels of return rate.

2. Model setting and data analysis

2.1 Model setting

This paper introduces panel quantiles based on the five-factor asset model to study the five-factor asset pricing model of the market factor MKT, scale factor SMB, book-to-market ratio factor HML, profit factor RMW, and investment factor CMA. The degree of influence of excess returns is established by the following five-factor panel quantile model:

Among them, is the excess return rate of a stock. The market factor MKT reflects the market risk premium, which is the difference between the monthly market rate of return considering the reinvestment of cash dividends and the monthly risk-free interest rate. The scale factor SMB is the difference between the return rate of a small market value and a vast market value stock portfolio.

The book-to-market value ratio factor HML is the difference between the return rate of the high book-to-market value ratio and the low book-to-market value ratio stock portfolio. The profit factor RMW is the difference between the return rate of the high-profit and low-profit stock portfolio, and the investment factor CMA is the difference between the return rate of the conservative investment and aggressive investment stock portfolio.

2.2 Data sources

This paper selects 90 stocks in the A-share real estate industry from January 2000 to December 2020 as a sample for empirical research. The monthly individual stock return rate of stocks selects the monthly return rate of individual stocks considering cash dividend reinvestment, and the risk-free interest rate adopts the monthly risk-free interest rate (the central bank announces the March fixed deposit benchmark interest rate).

2.3 Test of panel quantile model form

The test of the panel quantile model form is mainly to test whether it belongs to the position shift model or the position scale shift model through the residual distribution of different quantile levels, that is, to analyze the relationship between the models under different model quantiles. The results of Khmaladze Test using R software are shown in Table 1.

Table 1 — Test of panel quantile model form

Variable	Position drift model	Position scale drift model
MKT	3.441	0.462
SMB	1.669	0.781
HML	0.734	0.560
RMW	0.653	0.259
CMA	0.369	0.339
overall	6.558	2.084

Table 1 shows the overall model test statistics of the position drift model and the position scale drift model and the test statistics of their respective variables. From the overall statistics of the model, the T statistic value of 6.558 of the position drift model is greater than the T statistic value of 2.084 of the position scale drift model. It can be concluded that the probability of rejecting the „position drift model» is relatively higher, so the position scale drift model is more reasonable. It shows that the fitting curves of the model at different quantiles are not parallel. This also shows that under different levels of excess return, the five factors have different degrees of influence on the excess return.

3. Empirical analysis

3.1 Data check

Panel data contains the characteristics of cross-sectional data and time series data. In order to avoid the appearance of «false regression» and ensure the validity of the estimation results, the stationarity analysis of the panel data is first carried out, that is, the unit root test is used to test whether the process is stable. The test results are: Y, MKT, SMB, HML, RMW, and CMA reject the null hypothesis that there is a unit root at a significance level of 1 %, that is, the series of six variables are all stationary.

3.2 Ordinary least squares regression results

First, use the least square method to perform regression analysis on the five factors, and the results are shown in Table 2.

Table 2 — Ordinary least squares regression results

Variable	Influence coefficient	T statistic	P values
MKT	1.050	56.724	0.000
SMB	0.391	7.482	0.000
HML	0.018	0.253	0.800
RMW	-0.533	-4.701	0.000
CMA	0.218	2.056	0.040
C	0.002	1.728	0.084

It can be seen from Table 2 that in the ordinary least squares regression model, the market factor MKT, the scale factor SMB, the book-to-market ratio factor HML, the investment factor CMA and the excess return rate of individual stocks are positively correlated, and the profit factor RMW and the excess return rate of individual stocks are negatively correlated. The regression coefficients of the market factor MKT, scale factor SMB, and profit factor RMW are significant at the 1 % level, the regression coefficient of the investment factor CMA is considerable at the 5 % level, and the regression coefficient of the book-to-market value ratio factor is not significant.

3.3 Panel data quantile regression results

Panel quantile regression was used to divide the excess return rate into three quantile: 10 %, 50 % and 90 %, and explore the heterogeneity of the influence of five factors at different loci on the excess return rate of stocks. The regression results are shown in Table 3.

Table 3 — Quantile regression results

variable	QR_10	QR_50	QR_90
MKT	0.865*** (42.890)	0.992*** (54.929)	1.187*** (36.226)
SMB	0.342*** (6.174)	0.375*** (9.726)	0.567*** (6.564)
HML	0.072 (1.106)	0.144*** (3.477)	0.005 (0.051)
RMW	-0.566*** (-6.723)	-0.573*** (-8.412)	-0.364** (-2.185)
CMA	0.211** (2.487)	0.198*** (2.794)	0.243 (1.501)
C	-0.106*** (-46.772)	-0.010*** (-7.238)	0.113*** (37.339)

Note: «*», «**» and «***» mean significant at the test significance level of 0.1, 0.01 and 0.001 respectively. The values in brackets are *t* values, the same as below.

As can be seen from Table 3, at 10%, 50% and 90%, market factor MKT, scale factor SMB, book-to-market ratio factor HML, profit factor RMW and investment factor CMA all have different influences on the excess return of stocks.

Furthermore, the trend graphs of the estimated values of coefficients at different quantiles are given, as shown in Figure 1.

As can be seen from Figure 1, Figure 1 describes the coefficient estimates and confidence intervals of market factor MKT, scale factor SMB, book to market ratio factor HML, profit factor RMW and investment factor CMA at different quantile levels when the quantile changes is equidistant from 0.1 to 0.9.

With the increase of the quantile point, the coefficient got by the quantile regression of the market factor MKT shows a rising trend, indicating that with the increase of the quantile point, the market factor MKT has an increasing influence on the excess return rate. The reason may be different levels of influence by market fluctuations. When the market experiences systemic fluctuations, stocks with higher excess returns will experience greater volatility, while stocks with lower excess returns will experience less volatility. Therefore, under the low level of excess return, market factors have little effect on the excess return rate of stocks, and under the level of high excess return, market factors have a tremendous impact on the level of excess stock return.

With the increase of quantile points, the quantile regression coefficient of the scale factor SMB also shows a rising trend, indicating that SMB has little influence on stocks with low excess return rate, but has a great influence on stocks with high excess return rate. The reason may be that risk-neutral

investors tend to invest in stocks with low or medium excess returns, and risk-conscious investors tend to invest in stocks with high excess returns. Because small companies have higher risk compensation returns, risk appetites are more willing to hold stocks in small-scale companies to obtain higher returns. At this time, the small market value effect of the scale factor will be more obvious.

With the increase of quantile points, the coefficient of book-to-market value ratio factor HML through quantile regression shows a trend of first increasing and then decreasing. From the overall trend, when the excess return rate is at a relatively high level, the book-to-market value ratio factor HML has a bigger impact on it. The reason for this result is that information asymmetry makes investors more willing to invest in undervalued stocks, so that at relatively high levels of excess return, the book market value ratio factor has a more significant impact on the excess return.

With the increase of quantile points, the estimated value of the coefficient of the profit factor RMW does not change much before the 0.5 quantiles and shows an upward trend after the 0.5 quantiles. When the stock excess return rate

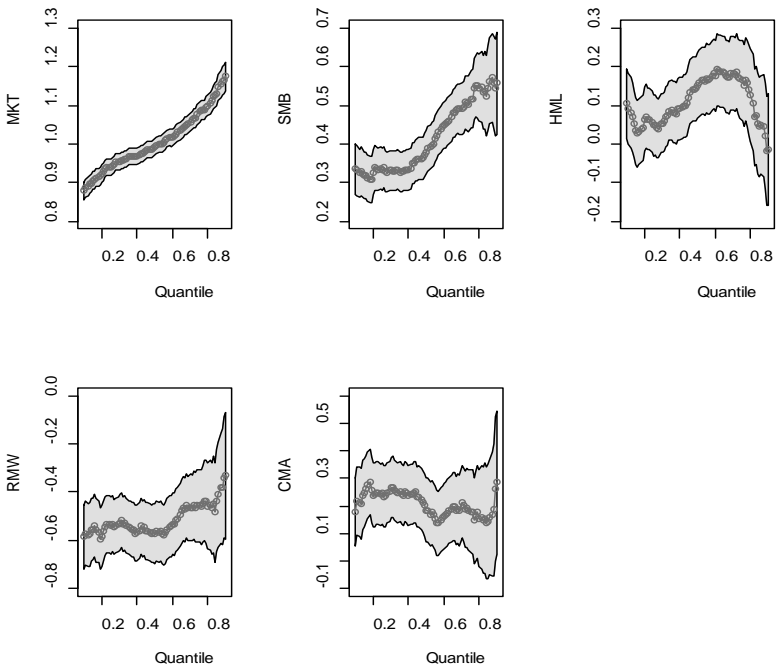


Figure 1 — Trend chart of coefficient estimates at different quantiles

is at a low or medium level, the profit factor RMW has little effect on it, and both have a substantial impact on the stock excess return rate. When the stock's excess return rate is at a relatively high level, the profit factor RMW has little effect on it. The reason may be that risk-neutral people tend to stocks with low and medium excess returns, while risk-preferred stocks are more inclined to stocks with high excess returns. The aforementioned makes risk-neutral investors at low and medium excess returns. Preferentially choose stocks with lower yields so that the profit factor will negatively affect the excess yields and have a greater degree of influence. Under the level of high excess yields, risk preference investors prefer stocks with higher yields. Thus, the impact of profit factors on excess returns will be reduced.

With the increase of quantile points, the estimated value of the investment factor CMA's coefficient is relatively stable before the 0.4 quantile, and the volatility increases after the 0.4 quantile, and the estimated value of the coefficient decreases relatively. It shows that under the low level of excess return, the investment factor CMA has a greater impact on the excess return, and under the

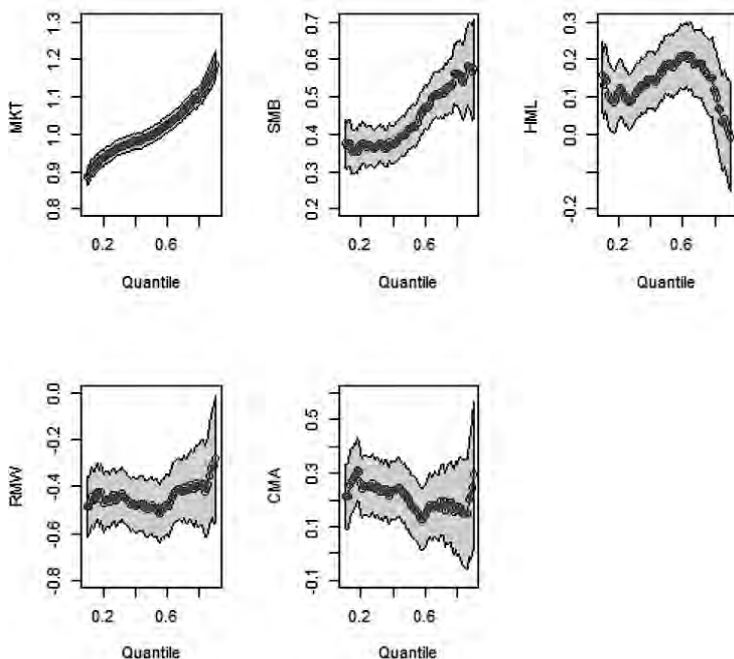


Figure 2 — Trend chart of coefficient estimates at different quantiles

high level of excess return, the investment factor CMA has less influence on the excess return. The reason may be that investors choose specific investment strategies under different levels of excess return. Under low excess yield levels, investors are more willing to adopt conservative strategies, and the proportion of conservative investment strategies increases. Investment factors have a greater impact on excess yield. At high excess yield levels, investors are more inclined to adopt aggressive strategies. The proportion of aggressive investment strategies has increased, and the coefficient of influence of investment factors on the excess return rate is relatively small.

3.4 Robustness test

The paper provides the corresponding robustness test as follows: Adjust the sample period from January 2000 to December 2020 to January 2000 to August 2021, and then continue the quantile regression, as shown in Figure 2.

As can be seen from Figure 2, similarly, for the market factor MKT and the scale factor SMB, with the increase of the quantile point, the quantile regression coefficients have shown a rising trend, that is, the impact on the stocks under the low excess return level. If it is minor, it will have a greater impact on stocks at a high level of excess return. For HML, when the stock excess return is at a medium level, the HML will have a greater impact on it when the stock exceeds. When the rate of return is at a low and high level, the book-to-market value ratio factor HML has less impact on it. For the profit factor RMW, it is negatively correlated with the excess return rate of stocks, and it has a smaller relationship with the high excess return rate. Impact: For the investment factor CMA, different quantile points have different degrees of influence on the level of excess return. In summary, all robustness analyses confirm that the above analysis conclusions are robust.

4. Research conclusions and enlightenment

This paper studies the heterogeneity of the factors of different stocks' excess return levels. The empirical results believe that:

First, from the results of least squares regression and panel data quantile regression, the coefficients obtained by the two regressions are basically similar in signs, but when the excess returns of individual stocks change at different levels, the coefficients will show a certain trend of change.

Second, from the results of quantile regression, at different quantile points, market factors, scale factors, book-to-market value ratio factors, profit factors and investment factors have different effects on stock excess returns.

Based on the above research and conclusions, the enlightenment of this paper is:

First, using the population mean to analyze the problem will ignore the heterogeneity of individuals within the population. Therefore, when we analyze financial data, we can use the method of quantile regression to make the research conclusions more comprehensive and robust.

Second, the influence of factors on different levels of excess returns is varied. Listed companies can better analyze themselves according to the degree of influence of particular factors on the excess returns and refer when the company makes business decision-making management. For investors, it is a better understanding of the intrinsic value of the company's assets, and helps investors understand the factors that affect the excess return rate of stocks and how much influence they have to make a suitable investment strategy.

References

1. Tomohiro Ando and Jushan Bai. Quantile Co-Movement in Financial Markets: A Panel Quantile Model With Unobserved Heterogeneity[J]. *Journal of the American Statistical Association*, 2020, 115(529) : 266–279.
2. Chen Liang and Dolado Juan J. and Gonzalo Jesús. Quantile Factor Models[J]. *Econometrica*, 2021, 89(2) : 875–910.
3. Eugene F. Fama, Kenneth R. French. A five-factor asset pricing model[J], *Journal of Financial Economics*, Volume 116, Issue 1, 2015.
4. Qi Lin. Noisy prices and the Fama–French five-factor asset pricing model in China[J], *Emerging Markets Review*, Volume 31, 2017.
5. Selebogo Mosoeu and Odongo Kodongo. The Fama-French Five-Factor Asset Pricing Model and Emerging Markets Equity Returns[J], *The Quarterly Review of Economics and Finance*, 2020.
6. Zhuo Chen and Jiarui Lu. The Effectiveness Analysis of Fama-French Five-Factor Model in China A-share Market[J]. *Scientific Journal of Economics and Management Research*, 2021, 3(8).