Research On Performance Continuity of Mixed Funds Based on FF Five Factor Model

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Abstract. In the Chinese market, many retail investors believe in the law of "the strong will always be strong and the weak will always be weak" when making fund investment for speculative purposes, and select stocks mainly based on the fund's previous performance data. Therefore, through the comparison of monthly returns, quarterly returns and annual returns of the fund, it is found that the performance continuity is more obvious at the monthly level. At the quarterly level, the fund as a whole appears reversal effect, momentum effect disappeared. In the semi-annual level, it is found that there are several reversals, the fund performance changes irregularly, only in a few groups there is a certain continuity, from the overall view of the fund performance there is no continuity. From the perspective of factors, the fund is greatly affected by CMA, while the explanatory ability of other factors gradually weakens with the extension of investment time, and the five factors only show significant explanatory ability in the short term.

Keywords: Fund, Performance sustainability, five factor model.

1. Introduction

1.1 Research background

After the state issued the Operation and Management Measures for Publicly Offered Securities Investment Funds in 2015, hybrid funds began to replace stock funds in the investment market and become the mainstream products in the fund market, providing investors with a wider range of investment channels. With the continuous improvement of national income, the requirements for the preservation and appreciation of assets are also gradually increasing. Investors, no longer satisfied with the meagre returns on bank deposits that they see as no match for the depreciating value of their assets due to inflation, are increasingly pouring money into the stock market. Compared with the stock investment with high risk, the fund's characteristics of collective financial management, professional management and risk diversification are more attractive to investors.

At present, the fund family in China's capital market is very large. It can be seen from the data center that public offering funds occupy a large share in the fund market in China, and there is also relatively big competition. In order to attract investors to invest, each fund company will beautify the data and distort the data to provide investors with wrong reference direction and damage the interests of investors. In order to solve such problems, in the process of the rapid development of funds, relevant regulations on fund supervision are constantly updated. The regulatory authorities hope to protect the interests of investors and maintain a fair, just and open investment environment through strict supervision.

Since most of the investors in the Chinese capital market are retail investors, more than 90% of investors refer to the past performance when making fund investment, believing that the past data of the fund can reflect the future trend and the performance has a certain continuity. Since most investors firmly believe in this law, it is particularly important to study the sustainability of fund performance. Therefore, it is hoped that this study can confirm whether the law of "the strong will always be strong and the weak will always be strong" exists.

1.2 Research purpose and significance

This paper mainly provides relatively effective suggestions for investors' investment decisions through research. As we all know, in the fund market, there are two kinds of investment strategies: one is strength strategy, which is based on momentum effect; The other is the inversion strategy, which is based on the inversion effect. When a certain degree of consistency in fund performance is demonstrated in real capital markets, investors can firmly choose a strong strategy - buying funds that have performed well in the past and selling funds that have performed poorly in the past to gain. On the contrary, when it is proved that the performance of the fund is not sustainable, the strong strategy will be ineffective. At this time, investors can choose the reversal strategy -- selling the funds with good performance in the past and buying the funds with poor performance in the past to obtain certain returns.

At present, when investors invest in the capital market, most of them are determined that the performance of the fund is sustainable and adopt a strong strategy. However, due to the large number of retail investors in our capital market, the speculative sentiment and "herding effect" are relatively obvious, so whether this strategy is really effective and thus pursued by investors or widely adopted because of "herding effect" needs further consideration. Therefore, this paper needs to conduct in-depth research on the sustainability of fund performance, so as to confirm the first possibility. To provide investors with effective investment advice. As the research object of this paper is quite in line with the investment needs of the vast majority of contemporary investors, it has strong economic and practical significance.

1.3 Innovation points and deficiencies

1.3.1 Innovation points

(1) In the sample selection, the partial stock mix and balanced mix of open hybrid funds are mainly studied, and the sample number is 740. The selected sample interval is from 2015 to 2020, and the research time is relatively long. In this paper, the research focuses on the monthly level, quarterly level and semi-annual level, and the results are more comprehensive and persuasive.

(2) This paper studies the sustainability of fund performance based on FF five-factor model. FF five factors were proposed in 2015, adding profitability factor and investment style factor on the basis of FF three factors (1993) and Carhart four factors. Five factors are widely recognized in the world, but there are few studies on five factors in China. There are even fewer studies on fund performance evaluation using five factors, mostly on the investment style and performance attribution of funds, and few studies on the sustainability of fund performance.

(3) The sample interval selected in this paper includes not only the 2015 stock market crash but also the 2019-2020 COVID-19 epidemic. Through the analysis of the abnormal economic environment, the economic and practical significance of the demonstration is enhanced.

1.3.2 Deficiencies

(1) The sample period of this paper is only six years, and the data volume of the half-year is insufficient, lacking a large number of data support at the significance level.

(2) Due to the small sample data, this paper lacks empirical research on the annual level and is incomplete in the study of cycles.

2. Literature review at home and abroad

2.1 Sustainability of fund performance

Fund performance research started in foreign countries, and there are different views on fund performance sustainability research. The emergence of Sharpe Index, which was constructed by Sharpe et al in 1966, started the study on fund performance. Sharpe studied the Sharpe Index as a standard to measure fund performance. In the process of research, he found that the performance of

the fund was not sustainable, and there was no correlation between the present and the future performance. Subsequently, Jensen proposed Jensen Index to investigate the risk-adjusted excess rate of return. Treynor Index was proposed in combination with Treynor. The three indexes had different effects in measuring risk-adjusted fund performance.

However, after the 1990s, many scholars found the law of continuity in fund performance. In the study of fund performance, Carhart found that there was a certain persistence in fund performance in the short term, but not in the long term, which was a great progress in the study of fund performance. Later, Miguel A. Ferreira in his research on biased stock funds, clearly pointed out that there was continuity in fund performance, but this continuity was mainly manifested at the level of losers [1]. There also seem to be certain sustained signals in different markets. When studied the Korean market through four and five factors, found that there was also sustained performance of partial stock funds in the Korean market.

Compared with foreign countries, the development of Chinese fund industry is slow, so the research on fund performance is also lagging behind other countries, but in spite of this, there are still many scholars in the active study.Li Xuefeng adopted the multi-phase interface regression method in his research on the performance sustainability of Chinese open-end funds, and found that the fund has the performance sustainability within half a year, and the value investment style and fund asset scale are important factors affecting the sustainability. The multi-stage interface regression method is used to study the performance sustainability of open-end funds in China. It is found that the fund has the performance sustainability in half a year, and the value investment style and fund asset size are important factors affecting the sustainability[2].Lin Sen, Wang Shixiong and Chang Jiang also found the persistence of fund performance in their research on the open-end hybrid funds from 2005 to 2009, and indicated that the sample funds consistently used high-beta, small-medium cap and value investment strategies in terms of investment strategies, and the momentum effect was not obvious at this time[3]. Li Can in the process of measuring the sustainability of the performance of Chinese open-end funds, took the rate of return as the performance index, conducted a sorting and sorting group discussion, and found that the fund performance had good sustainability in the short term, but the sustainability gradually disappeared with the lengthening of the cycle [4]. This is similar to the study of Carhart.

What has been said above proves that the fund has certain sustainability, but it only stays at the short-term level. Other scholars believe that such sustainability still exists not only in the short term but also in the long term. Ma Rong and Li Honggang judge the sustainability of fund performance rankings by the liquidity of fund performance rankings [5]. The results show that the sustainability of fund performance varies in different time periods, but on the whole, most fund rankings show sustainability.Yu Jin, Liu Xiang et al. conducted a long-term investigation on the samples based on the three factors and found that the performance of the samples was persistent, mainly because investors believed that "the strong will always be strong and the weak will always be weak"[6].

In my country, there has also been disagreement about the sustainability of fund performance. There are also quite a few investors who believe that fund performance is not sustainable. Xia Xin found that sustainability only exists in the market with unilateral uptrend and the cycle is short [7]. When the sample is expanded to examine the cycle, the apparent sustainability no longer exists. In the same year, Zhao Liyuan combined Sharp Index and Treynor Index to study big data funds, and the empirical results showed that such persistence still did not exist, and even in the market, the reversal strategy was more effective [8]. Zhao Shuo adopted different research methods in short-term and long-term studies, which also proved that there is no persistence of performance [9].

2.2 Five-factor model

Before the five-factor was proposed, Fama and French first proposed the three-factor model in 1993, which comprehensively considered CAPM model and APT arbitrage model [10]. Later, the momentum factor was introduced and the four-factor model was summarized by Carhart. In 2015, FF supplemented the three-factor and four-factor and then added the profitability factor and investment

style factor to get the current five-factor model [11]. Therefore, in the analysis of the five-factor model, we need to know about the three-factor and four-factor model.

Three-factor model is proposed on the basis of CAPM model and APT arbitrage model. In addition to the compensation for systemic risk (MKT), the model also takes into account SMB size factor and HML book-to-market factor. Through these three factors to explain and analyze the return rate of securities portfolio, the more variables added, the more accurate the measurement can be improved.

The four-factor model was proposed on the basis of the three-factor model. Carhart believed that although the three-factor model was greatly improved compared with CAPM and APT models, it ignored the momentum factor (MOM). Therefore, momentum factor is added on the basis of the three factors to form a four-factor model. This model is proposed to control the impact of systemic risk on stocks, adjust the original return, and obtain the extraordinary return after controlling the risk factors. It comprehensively considers the impact of systemic risk, book-to-value ratio, market-to-size ratio and momentum factors on fund performance, so as to evaluate fund performance more comprehensively and measure fund's ability to obtain excess returns through active investment management more effectively.

The five-factor model was put forward in 2015. Due to the late time, the current research of Chinese scholars on this model stays in the GEM and A-share market, and A few scholars conduct research on specific industries. In terms of using its research funds, it mainly focuses on the overall evaluation of fund performance, that is, which factor has a greater impact on fund performance. Or through the comparative analysis of three factors and five factors, indicating that the five factors are more suitable for the study of our capital market than three factors. In short, there are few studies on fund performance continuity, which is why this article is written.

2.3 Literature review

In the research on fund performance sustainability in foreign countries, most scholars study fund performance in the United States, while a small number of scholars study fund performance in South Korea, and the conclusion is basically that fund performance is not sustainable. But since the 1990s, many scholars have found continuity. Due to the different research methods used, the conclusions produced are also different. Some studies are carried out in the way of cross-sectional regression, while others conduct in-depth analysis and discussion on Jensen index, both of which prove the existence of persistence to varying degrees.

The research on the sustainability of fund performance started late in our country, and the conclusion is contradictory. Some scholars found that the performance of the 22 funds established in the early stage was not sustainable from the perspective of the whole line. In addition, the cross-section regression method also confirms the existence of this kind of unsustainability. In terms of model selection, domestic scholars generally use Fama-French three-factor model, Carhart four-factor model, Sharp index, Treynor index, TM model and CL model for research. FF five-factor model is proposed late, so it is also the least studied model at present.

3. Research design and variable selection

3.1 Research design

In this paper, fund performance is divided into two parts. One part is the compensation provided by the risk factor implied by the investment style of the fund, and the other part is the excess return unrelated to the risk. Among them, the excess return is related to the stock selection ability of the fund manager, which is the part of the return that exceeds the risk compensation obtained by the manager through his own judgment. In this paper, the research on the sustainability of fund performance mainly focuses on the excess return. To judge whether the fund performance is sustainable by whether the income is sustainable.

In the process of sample processing in this paper, grouping method is mainly adopted, which is also the design idea of Carhart (1997). The growth rate of the net value of the fund is regarded as the

rate of return of the fund, and it is equally divided into ten groups, each group contains 74 sample funds. The groups were arranged in ascending order, with the top 10% growth rate as the tenth group and the bottom 10% growth rate as the first group. In this way, ten observation groups were formed, and each period was ranked independently without interference. According to the grouping of funds in the t period, the performance of each fund in the t+1 period is substituted to form ten groups of t+1 fund performance ranked according to the performance of funds in the t period. Within each fund group, the average rate of return of equal weights is calculated. After that, multiple regression is carried out between the yield of these weights and FF five factors, and the sustainability of fund performance is examined by the size of intercept term after regression. If the excess return, that is, the intercept term, shows an increasing phenomenon, it means that the fund performance has obvious continuity. On the contrary, there may be a certain reversal phenomenon.

3.2 Model Design

The model adopted in this paper is Fama-French (2015) five-factor model, and the specific formula is expressed as follows:

$$R_{it} - R_{ft} = \alpha_i + \beta_i \times (R_{mt} - R_{ft}) + s_i \times SMB_t + h_i \times HML_t + r_i \times RMW_i + c_i \times CMA_t + \varepsilon_i$$

The left side of the equation represents the portfolio risk premium, namely the excess return obtained by the fund, R_{it} refers to the rate of return obtained by the i fund during the period t. R_{ft} refers to the risk-free rate of return in period t; R_{mt} is the rate of return of the market portfolio at time t; SMB_t refers to the scale factor of period t, which represents the difference between the yield of low-market portfolio and high-market portfolio. HML_t refers to the book-to-market factor in period t, which represents the difference of return rate between value portfolio with high book-to-market ratio and growth portfolio with low book-to-market ratio. RMW_i is the profitability factor in period t, which represents the difference between the return rate of the portfolio with high operating profit and that of the portfolio with low operating profit; CMA_t refers to the investment style factor in period t. This value represents the difference of return rate between low investment level (conservative type) and high investment level (aggressive type). The regression coefficient in the formula,also has its own meaning. Where α_i represents the excess return brought by the fund manager, which is the focus of this paper, and the rest represents the influence of various factors on the excess return of the fund.

3.3 Data Selection

3.3.1 Sample selection

Considering that FF five factors were put forward in 2015, and the years from 2015 to now are the years of rapid development of Chinese fund, this paper selects the period from January 1, 2015 to December 31, 2020. This stage includes the stock market crash of 15 years and the "black swan event" of 2020 -- the COVID-19 pandemic. The main purpose of this paper is to explore whether the five factors still have considerable forecasting ability when the sample is included in recession and prosperity.

In terms of fund selection, 7,789 cemetery funds were selected, and a total of 740 funds were selected as the sample of this paper. ETF/LOF/QDII and passive funds are mainly excluded. The specific reasons are as follows: Considering that ETF and LOF are listed funds, the changes in market supply and demand will affect the prices of funds, so we are excluded. In addition, QDII funds, which invest in overseas targets, and passive funds, which operate through machinery, have been eliminated in favor of active funds, which better reflect a manager's ability to pick stocks and time.

After considering the applicability of FF five factor model, we decide to study the stock fund. Eliminate partial bonds and monetary funds in the fund. Through the above screening, a total of 740 funds has been selected, and the above sample data are from the CSMAR.

3.3.2 Variable data selection

(1) Fund yield rate R_{it}

In this paper, the growth rate of the net value of the fund is used to represent the return rate of the fund. The higher the growth rate, the better the performance of the fund. In essence. The rate of return of the fund represents the growth of the fund's net assets, which in turn is represented by the net value per unit share. Therefore, this paper chooses the rate of return of the fund as the growth rate of the net value per unit share of the fund. The specific calculation formula is as follows:

$$R_{it} = \frac{Nav_{it}}{Nav_{it-1}} - 1$$

Where, Nav_{it} represents the net value of the revested unit of fund i at the end of period t, and Nav_{it-1} represents the net value of the revested unit of fund i at the end of period t-1. All data are from the CSMAR database.

(2) market portfolio return rate R_{mt}

In the calculation of market portfolio rate of return, the comprehensive monthly market rate of return of Chinese A-share market stocks after taking cash dividends into account is calculated through weighted average.

(3) risk-free interest rate R_{ft}

In the risk-free return measurement index, there are various controversies. This paper chooses the monthly one-year fixed deposit interest rate as the risk-free interest rate indicator, mainly because this indicator is relatively market-oriented and accepted by most people.

(4) Factor index

FF five-factor model, as the name suggests, has five variable factors, namely market factor, size factor, book value factor, profitability factor and investment style factor. In this paper, factor data in Gutai 'a database is selected directly, because the data is obtained strictly in accordance with the factor grouping, more reliable.

In the construction of factors, there are three construction methods, respectively 2*2, 2*3, 2*2*2*2. In the descriptive statistics of factors below, it is found that the results of the third method of factor construction are not much different. At present, the 2*3 combination is generally adopted. Therefore, in the selection process, all factors in this paper are constructed according to the 2*3 construction method.

4. An empirical study on continuous performance of Chinese open-end mixed funds

4.1 Statistical description of sample funds

There are 740 sample funds in this paper. Through descriptive statistics on sample funds, it is found that the average monthly return of the fund is 1.45%, exceeding the benchmark level, which indicates that the fund can bring positive returns to investors in the market and indeed has investment value. According to the monthly data of each month, the lowest rate of return of the fund was -38.56% in July 2016, and the highest rate of return was 45.54% in May 2015. Fund returns In February 2017, the difference between the maximum and minimum returns was the smallest, 8.299%, indicating that the fund performance in that month was relatively stable without much fluctuation. In December 2020, the difference between the minimum value and the maximum value was the largest, reaching 56.46%, which may be due to the extreme instability of fund performance caused by the epidemic. Considering the trend of fund in the previous months, there was a high probability of dramatic fluctuations in performance. From the standard deviation level of the sample, the average standard deviation of 740 funds is 1.78%, which is not much different from the average return. Overall, the fund performance is relatively good. The maximum value of standard deviation appeared in May 2015 (10.03%), and the minimum value appeared in February 2017. The specific values are described in the table below:

Table 1 Descriptive statistics of sample funds

VARIABLES	N	mean	sd	min	max
Jan-15	740	4.313	4.917	-10.66	26.72
Feb-15	740	6.235	3.665	-0.588	25.35
Mar-15	740	15.38	6.214	-1.338	31.17
Apr-15	740	12.29	5.885	0	40.53
May-15	740	18.12	10.03	-6.623	45.54
Jun-15	740	-12.27	7.774	-30.18	8.942
Jul-15	740	-12.12	6.845	-29.95	12.09
Aug-15	740	-11.01	5.84	-25.91	1.619
Sep-15	740	-0.183	3.106	-12.02	14.67
Oct-15	740	13.25	6.516	-3.92	30.05
Nov-15	740	5.927	4.672	-3.482	23.76
Dec-15	740	3.569	2.959	-7.412	14.33
Jan-16	740	-21.27	8.834	-38.59	0.406
Feb-16	740	-1.821	2.758	-14.34	11.98
Mar-16	740	11.6	5.685	-1.824	26.73
Apr-16	740	-1.153	1.999	-8.381	6.723
May-16	740	0.178	2.011	-7.351	7.901
Jun-16	740	4.232	2.768	-2.496	17.82
Jul-16	740	-0.46	3.338	-11.1	10.28
Aug-16	740	1.993	1.775	-3.204	12.33
Sep-16	740	-0.897	1.907	-12.35	5.202
Oct-16	740	1.396	1.4	-3.122	6.318
Nov-16	740	0.832	1.854	-5.339	11.43
Dec-16	740	-3.885	2.329	-19.38	1.79
Jan-17	740	-0.603	1.993	-8.506	7.151
Feb-17	740	2.435	1.374	-1.168	7.131
Mar-17	740	1.105	2.301	-5.332	8.695
Apr-17	740	-0.631	2.201	-8.241	6.335
May-17	740	-2.521	2.836	-16.2	4.451
Jun-17	740	5.151	2.4	-0.955	11.93
Jul-17	740	0.959	2.932	-7.973	15.55
Aug-17	740	2.323	1.961	-2.453	10.01
Sep-17	740	2.171	2.024	-6.359	10.35
Oct-17	740	3.298	3.18	-7.628	12.44
Nov-17	740	-2.565	2.799	-13.44	11.32
Dec-17	740	1.594	2.499	-8.796	9.893
Jan-18	740	1.798	3.745	-10.04	42.55
Feb-18	740	-2.872	3.24	-11.8	11.21
Mar-18	740	-0.201	3.823	-12.11	16.31
Apr-18	740	-2.841	2.351	-12.15	8.004
May-18	740	1.679	3.745	-9.405	14.41
Jun-18	740	-5.061	2.532	-13.97	4.005
Jul-18	740	-1.031	2.238	-8.475	11.94
Aug-18	740	-5.364	2.609	-13.24	2.023
Sep-18	740	0.054	2.132	-8.961	6.174
Oct-18	740	-8.29	3.51	-20.72	0.693
Nov-18	740	1.6	1.961	-5.583	9.74

Dec-18	740	-3.342	2.039	-11.65	2.463
Jan-19	740	3.134	2.468	-7.569	12.81
Feb-19	740	12.61	5.006	-1.673	30.76
Mar-19	740	7.354	3.654	-0.743	22.7
Apr-19	740	-0.909	2.962	-13.21	11.82
May-19	740	-4.599	2.092	-11.16	2.457
Jun-19	740	4.076	2.692	-10.25	12.59
Jul-19	740	2.508	2.385	-4.107	13.04
Aug-19	740	3.283	3.358	-5.507	17.25
Sep-19	740	1.136	2.429	-9.117	11.48
Oct-19	740	2.279	2.083	-3.817	15.01
Nov-19	740	-0.226	1.987	-7.143	9.107
Dec-19	740	6.808	2.746	-0.416	15.33
Jan-20	740	2.764	5.455	-20.57	25.88
Feb-20	740	3.517	3.649	-6.86	17.5
Mar-20	740	-6.68	4.887	-31.14	5.61
Apr-20	740	7.247	3.255	-10.62	18.89
May-20	740	2.753	3.349	-7.23	13.26
Jun-20	740	10.88	5.488	-29.88	24.82
Jul-20	740	12.99	4.988	-20.31	31.09
Aug-20	740	2.189	3.967	-34.06	14.55
Sep-20	740	-4.383	2.689	-16.64	6.11
Oct-20	740	2.191	2.887	-15.92	13.73
Nov-20	740	1.98	4.292	-23.69	20.3
Dec-20	740	8.094	7.278	-29.24	27.22
Total	53280	1.445652778	1.777278795	-38.59	45.54

4.2 Statistical description of factors

In the CSMAR, $R_m - R_f$ will be recorded as MKT. The results show that the mean value of MKT in the 2*3 group is 0.00516, which indicates that in the Chinese stock market, investors can get an average monthly income exceeding the market benchmark by 0.516%. The mean value of SMB is 0.00520, which is a positive number, indicating that in our stock market, rational investors should invest in companies with small market value, so that they can get 0.520% more returns than companies with larger market value. The mean value of HML is -0.00480, which is a negative value, indicating that a growth fund invested in a low book-to-market ratio can get 0.480% more returns than a value stock invested in a high book-to-market ratio. The mean RMW is 0.00396, indicating that investors should invest in companies with higher operating profit margin to obtain 0.396% additional return. The mean value of CMA is -0.00322, indicating that companies investing in low investment can get an average monthly excess return of 0.322% compared with companies investing in high investment. By observing its standard deviation, it is found that the standard deviation of MKT, SMB, HML and RMW is larger than 2.5%, and the standard deviation of MKT and SMB is larger than 5%, which indicates that these two factors fluctuate greatly. The standard deviation of CMA factor is 0.0225, which is the smallest among the five factors, indicating that the factor is relatively stable and has little fluctuation. The details are shown in the following table:

Table 2 Descriptive statistics of five factors

VARIABLES	N	mean	sd	min	max
MKT	72	0.00516	0.0660	-0.243	0.175
SMB	72	0.00520	0.0489	-0.0781	0.229
HML	72	-0.00480	0.0392	-0.144	0.0922
RMW	72	0.00396	0.0279	-0.0821	0.0573
CMA	72	-0.00322	0.0225	-0.0463	0.0545

4.3 Applicability analysis of Fama-French five-factor model

As the five-factor was proposed only in recent years, although it has been widely used in international banks, its applicability in the Chinese market needs to be further verified. In China, many scholars mainly study the market of A-share and GEM based on the five factors, while A few studies specific industries, and there is little research on the fund market. Therefore, before using the five factors to study funds, it is necessary to discuss the applicability of the five factors in China's capital market.

4.3.1 Correlation test

The first step in the applicability test of the five factors is to look at their correlation. In the study of factor correlation, we mainly studied the monthly level and the daily level, and found that there was basically no difference except the difference of CMA factor symbols. In pearson test, it is generally believed that the absolute value of correlation coefficient between 0.8 and 1.0 indicates a strong correlation between factors. Strong correlation between 0.6 and 0.8; There was a moderate correlation between 0.4 and 0.6. There is a weak correlation between 0.2 and 0.4. A very weak correlation or no correlation between 0 and 0.2. According to the above interval, a strong correlation exists between RMW and SMB, and the absolute value of the correlation coefficient is 0.829. There was a strong correlation between HML and SMB, and between HML and RMW. The absolute values of correlation coefficients were 0.751 and 0.604, respectively. There was a moderate correlation between CMA and RMW, and the correlation coefficient was -0.513. There was a weak correlation between MKT and SMB, HML, RMW, and CMA, and the absolute value of correlation coefficients were all between 0.2 and 0.4. Finally, HML and CMA showed a very weak correlation, and the correlation coefficient was only 0.0194. From the perspective of symbol, RMW is negatively correlated with MKT, SMB and CMA, which may be because when a company has strong profitability, its investment scale will expand correspondingly. Generally, small companies have a higher book-to-market ratio, but compared with large companies, small companies have lower scale and investment amount, which also explains why SMB has a negative relationship with HML and a positive relationship with CMA. In short, there is a complex relationship between the factors.

Table 3 pearson test of five-factor data

	MKT	SMB	HML	RMW	CMA
MKT	1				
SMB	0.253	1			
HML	-0.356	-0.751	1		
RMW	-0.285	-0.829	0.604	1	
CMA	0.0211	0.319	0.0194	-0.513	1

4.3.2 Redundancy factor test

The so-called redundant factor refers to the excess explanatory variables in the model, that is, the variables that can be explained by other factors. The explanatory power of redundant factors is very low, and basically has no effect on the explained variables. In the above correlation test, it is found that the correlation among the five factors is relatively complicated. In order to eliminate the existence of redundant factors, the redundancy test will be carried out below to eliminate the redundant factors

and replace them. The method of redundancy test is based on the Fama-French method of solving redundancy factors: one of the five factors is taken as explained variable, and the other four factors are taken as explanatory variable for regression to see whether they can be explained by the other four factors. The test results are shown in the table:

Table 4 five-factor redundancy test

VARIABLES	MKT	SMB	HML	RMW	CMA
MKT		-0.119**	-0.104**	-0.086***	-0.004
		(-2.37)	(-2.62)	(-2.97)	(-0.11)
SMB	-0.647**		-0.467***	-0.306***	0.055
	(-2.37)		(-5.91)	(-5.02)	(0.73)
HML	-0.891**	-0.733***		0.131	0.487***
	(-2.62)	(-5.91)		(1.49)	(6.52)
RMW	-1.360***	-0.893***	0.244		-0.603***
	(-2.97)	(-5.02)	(1.49)		(-5.62)
CMA	-0.049	0.142	0.797***	-0.531***	
	(-0.11)	(0.73)	(6.52)	(-5.62)	
_cons	0.009	0.006**	-0.000	0.005***	0.001
	(1.38)	(2.17)	(-0.10)	(2.99)	(0.67)
N	72	72	72	72	72
adj. R-sq	0.354	0.783	0.785	0.772	0.603

Note: ***, ** and * are significant at the significance level of 1%, 5% and 10% respectively

The criteria for determining redundancy factors are as follows: the adjusted R^2 is large and the constant term is not significantly different from 0. When the five factors were respectively tested for redundancy, it was found that when SMB, HML and RMW were successively returned as explained variables, the adjusted R^2 values were all above 75%, which met the condition of large R^2, indicating that these three factors could be explained by other factors. The requirements for redundancy factors are initially met. On this basis, the intercept item con is analyzed, and it is found that the intercept items SMB and RMW are significantly different from 0. The intercept item of SMB is 0.006, which is significant at the 5% level. RMW has an intercept term of 0.005, which is significant at the 1% level. Therefore, it can be judged that these two factors do not meet the redundancy factor test and the possibility of redundancy factor is excluded. The intercept term of factor HML is 0 and not significant, so the redundancy factor is judged to be HML.

In the processing of redundancy factors, HML was orthogonal into HMLO factors by referring to Fama-French processing method, and HMLO was defined as the sum of intercept term and residual after regression of HML to Rm-Rf, SMB, HML and RMW factors. The normalized HMLO factor should have no linear correlation with other factors.

4.4 Empirical analysis of fund performance sustainability

4.4.1 Monthly Data

Since most Chinese stock markets are retail investors, the research shows that quite a large number of investors are short-term investment, so this paper first carries out a regression analysis on the monthly data in the study of fund performance sustainability.

It is generally believed that the larger the adjusted R^2 is and the closer it is to 1, the better the model fitting degree will be. From the regression results of fund performance at the monthly level, it can be seen that the minimum adjusted R^2 value is 0.797, and the adjusted R^2 of the six groups from the third group to the eighth group reaches more than 90%, indicating that the model has a good fitting degree at the monthly level, and the five factors have a strong explanatory ability for fund performance. The alpha value in the table represents the return of the fund brought by the operation of the fund manager, which corresponds to the intercept item con in the model. The larger the intercept item is, the greater the return of the fund. As can be seen from the table, the excess returns of the fund

generally show an increasing trend of 1 to 10 groups. Since the groups are arranged in ascending order, in the same direction as the changes of excess returns, it can be preliminarily judged that the fund performance has continuity at the monthly level, and the results are very significant. In the five groups from the second to the sixth, the change of alpha value is not large, indicating that the performance of funds in the intermediate period is more stable than that of the previous period.

From the perspective of five factors, the most significant factor was CMA, which was significant at 1% level in all groups. As the CMA factor coefficient is negative, it fully shows that fund performance has a great negative correlation with the investment style of the fund. In other words, low investment (conservative) stocks can bring more returns, as a rational investor should focus on conservative investment funds rather than aggressive investment funds. This phenomenon seems to contradict investors' perception of investment strategies. Generally speaking, conservative funds mean lower risk, which also means less return, so they offer less return than investing in aggressive funds. However, in the regression results, it appears that investment in conservative funds is more likely to obtain excess returns, which may be related to the "lottery preference theory". That is to say, investors will have a fluke psychology: in the market, investors will invest in more aggressive funds for high returns. Due to the large number of investors and the fund is a benefit-sharing investment product, the per capita excess returns are actually relatively small. Out of this mentality, conservative funds will bring more returns. MKT factor shows strong significance in the six groups of data in the middle segment, which indicates that fund performance has a significant positive correlation with the market excess return rate to a certain extent. This is obvious, because fund performance needs to go according to the market, when the whole capital market is in a bull market, fund performance will naturally become better. SMB factors show strong significance in groups 3-10, indicating that fund investment in small-cap stocks can bring more returns. HMLO is a replacement of the redundant factor HML. After redundancy processing, the explanatory ability of HML is greatly improved. Except the first group, which is significant at the 5% level, the other nine groups are significant at the 1% level. The performance of RMW and HMLO factor is the same, indicating that the fund can get more returns by investing in companies with high operating profit rate.

In short, at the monthly level, the five factors all have a good ability to explain the fund performance, and at the monthly level, the fund has a continuous performance.

Table 5 Monthly regression results

group	MKT	SMB	HMLO	RMW	CMA	alpha%	_adjR2
1	0.385**	-1.258**	3.526**	-3.494**	-2.388***	1.703**	0.797
	(2.49)	(-2.36)	(2.49)	(-2.50)	(-3.75)	(2.16)	
2	0.356***	-1.025**	3.604***	-3.340***	-2.127***	2.307***	0.851
	(2.80)	(-2.33)	(3.08)	(-2.89)	(-4.05)	(3.55)	
3	0.431***	-1.071***	4.001***	-3.598***	-2.154***	2.458***	0.939
	(4.89)	(-3.52)	(4.94)	(-4.50)	(-5.92)	(5.46)	
4	0.416***	-1.248***	4.412***	-4.044***	-2.360***	2.645***	0.955
	(5.35)	(-4.64)	(6.17)	(-5.73)	(-7.35)	(6.65)	
5	0.419***	-1.347***	-1.347***	-4.357***	-2.477***	2.921***	0.947
	(4.72)	(-4.39)	(-4.39)	(-5.41)	(-6.75)	(6.43)	
6	0.412***	-1.228***	4.543***	-4.094***	-2.393***	2.760***	0.915
	(3.70)	(-3.19)	(4.44)	(-4.06)	(-5.21)	(4.85)	
7	0.396***	-1.272***	-1.272***	-4.281***	-2.463***	2.808***	0.913
	(3.47)	(-3.22)	(-3.22)	(-4.13)	(-5.22)	(4.81)	
8	0.305**	-1.543***	5.713***	-5.170***	-2.752***	3.426***	0.904
	(2.46)	(-3.61)	(5.01)	(-4.60)	(-5.38)	(5.41)	
9	0.237*	-1.647***	6.192***	-5.615***	-2.976***	3.804***	0.880
	(1.67)	(-3.36)	(4.75)	(-4.37)	(-5.09)	(5.25)	
10	0.186	-1.813***	6.620***	-6.064***	-3.153***	4.288***	0.817
	(1.02)	(-2.89)	(3.97)	(-3.69)	(-4.21)	(4.62)	

Note: ***, ** and * are significant at the significance level of 1%, 5% and 10% respectively

4.4.2 Quarterly Data

After the study on the monthly level, it is found that the five factors have strong explanatory ability for fund performance and fund performance has significant continuity. Then, this paper studies on the quarterly level and finds that the adjusted R2 has improved to a certain extent except for the tenth group, which indicates that compared with the monthly level, the fitting degree of the quarterly model has improved to a certain extent and the fitting degree is better. Intuitively, the alpha value of regression results shows a decreasing trend, and the top 10% fund group has the lowest quarterly excess return, which is 4.402. The fund group ranked in the bottom 10% got the highest excess return at the quarterly level, which was 14.451% and significant at the 1% level. Contrary to the increasing trend at the monthly level, it means that the persistence of fund performance no longer exists, and the momentum effect does not exist, and the reversal effect occurs. At the same time, it is observed that the lowest excess return obtained by the tenth group corresponds to the lowest adjusted R2 value. One possible explanation is that the model in the tenth group is poorly fitted, leading to the inaccurate regression results. As for the reversal of fund performance, this paper speculated that it may be related to the investment style of the fund. When the fund manager is more inclined to invest in low-investment funds, the fund will be more likely to obtain higher performance and thus be classified into the tenth group. At this time, if the fund manager's investment style has changed to some extent, he will invest in high-investment funds and be classified into the first group, and the corresponding excess returns will be affected. Frequent changes in fund managers and investment styles make reversals much more likely.

From the perspective of five factors, CMA factor is still the most significant factor, indicating that fund performance has a strong correlation with its investment style at the quarterly level. The significance of MKT is not obvious at the quarterly level, except for the significance of Group 4 -- 7 at the 5% level and group 8 at the 10% level, other groups are not significant, which indicates that the funds in the middle segment are affected by market excess returns, but not significantly. Funds that have done well or badly in the past are not affected by the market's excess returns. Except for the last four groups, all SMB factors show a significance of 1%-10%, which indicates that investment funds can obtain certain scale compensation in the market. Except for group 9 and group 10, HMLO has a relatively high level of significance, indicating that the fund can obtain more returns from investing in companies with relatively high book market value. RMW is generally relatively significant, which means that fund in our country still pays more attention to the yield rate of the investee company when investing.

The explanatory ability of the above factors is improved to a certain extent compared with the monthly level, but the result is a reversal effect on the monthly level of fund performance. There is no continuity.

Table 6 quarterly regression results

group	MKT	SMB	HMLO	RMW	CMA	alpha%	_adjR2
1	-0.250	-2.532**	8.361**	-8.286**	-4.800***	14.451***	0.884
	(-0.78)	(-2.34)	(2.80)	(-2.81)	(-3.66)	(3.18)	
2	0.140	-1.794**	6.306***	-5.969***	-3.622***	11.120***	0.963
	(0.76)	(-2.85)	(3.63)	(-3.48)	(-4.75)	(4.20)	
3	0.230	-1.894**	6.353***	-5.9831***	-3.453***	11.090***	0.962
	(1.19)	(-2.88)	(3.50)	(-3.34)	(-4.33)	(4.01)	
4	0.34171**	-1.633***	5.735***	-5.192***	-3.123***	9.796***	0.976
	(2.18)	(-3.06)	(3.91)	(-3.58)	(-4.85)	(4.38)	
5	0.477**	-1.270*	4.633**	-4.108**	-2.523***	8.306***	0.967
	(2.60)	(-2.04)	(2.70)	(-2.42)	(-3.35)	(3.18)	
6	0.4713**	-1.326**	4.448**	-4.065**	-2.470***	8.039***	0.966
	(2.62)	(-2.16)	(2.64)	(-2.44)	(-3.33)	(3.13)	
7	0.508**	-1.243	4.487**	-3.859*	-2.358**	7.818**	0.952
	(2.34)	(-1.68)	(2.21)	(-1.92)	(-2.64)	(2.53)	
8	0.497*	-1.438	4.798*	-4.200*	-2.506**	8.493**	0.941
	(2.04)	(-1.74)	(2.10)	(-1.86)	(-2.50)	(2.44)	
9	0.484	-1.462	4.564	-4.022	-2.375*	8.225*	0.896
	(1.57)	(-1.39)	(1.58)	(-1.41)	(-1.87)	(1.86)	
10	0.64569	-0.84961	2.615	-1.798	-1.266	4.402	0.633
	(1.13)	(-0.44)	(0.49)	(-0.34)	(-0.54)	(0.54)	

Note: ***, ** and * are significant at the significance level of 1%, 5% and 10% respectively

4.4.3 Semi-annual data

In the semi-annual regression results, due to the limited number of samples, the significance of the regression results is not obvious. However, it can be seen from the adjusted R2 that, except for the tenth group, the R2 of the other nine groups are all above 80%, indicating that the degree of model fitting is generally good, and the degree of model fitting will be higher with the extension of the investigation period, which is greatly improved compared with monthly and quarterly.

Through the observation of alpha value, it is found that the excess return of the fund has reversed for many times. In the half year interval, the fund only maintains the sustainability of fund performance in the third group, the fourth group and the fifth group, and the significance is good. By observing the corresponding adjusted R2, it can be seen that the model with a fitting degree of more than 95% can be predicted, and the fund performance can maintain a certain continuity.

From the perspective of the five factors, the CMA factor performance is still due to the strong excess return of the fund. At this time, MKT is not significant in any group, which indicates that the fund performance has a low correlation with the market excess return in a long observation period, but there is still a certain positive correlation. The SMB factor is significantly weakened, indicating that in the half-year period, the fund performance is less affected by the size, and the compensation from the size is also reduced. Similarly, HMLO only has a significance level of 1% in the third group, indicating that the impact of book-to-market ratio on fund returns will be reduced over time. The RMW factor in the second group to the fifth group is significant at 5% level, the sixth group is significant at 1% level, and the rest are not significant. Therefore, it can be concluded that in the long run, Chinese funds will not pay much attention to the operating profit rate of the investee companies.

The above is from the perspective of semi-annual observation, the purpose is to provide certain investment reference opinions for value investors. The results show that from the semi-annual level, the sustainability of fund performance only exists when the model fitting degree exceeds 95%, and there will be several reversals. The sustainability does not exist and the explanatory ability of factors for fund performance is weaker than that of monthly and semi-annual.

Table 7 Semi-annual regression results

group	MKT	SMB	HMLO	RMW	CMA	alpha%	_adjR2
1	0.261	-2.086	6.689	-6.262	-3.424*	19.481	0.899
	(0.65)	(-1.66)	(1.96)	(-1.93)	(-2.42)	(1.95)	
2	0.18362	-2.505**	7.655**	-6.962**	-3.755**	23.237**	0.948
	(0.63)	(-2.75)	(3.09)	(-2.96)	(-3.66)	(3.20)	
3	0.388	-2.207**	6.952***	-6.099**	-3.395***	21.023***	0.978
	(1.91)	(-3.51)	(4.07)	(-3.76)	(-4.79)	(4.20)	
4	0.274	-2.580**	8.037**	-7.112**	-3.866***	24.436***	0.970
	(1.14)	(-3.45)	(3.95)	(-3.68)	(-4.58)	(4.10)	
5	0.22762	-2.603**	8.032**	-7.044**	-3.883***	24.545**	0.960
	(0.83)	(-3.06)	(3.47)	(-3.20)	(-4.04)	(3.62)	
6	0.435	-2.071*	6.850*	-5.708*	-3.218**	21.683**	0.946
	(1.37)	(-2.10)	(2.55)	(-2.24)	(-2.89)	(2.76)	
7	0.419	-1.770	5.935*	-5.053	-3.026**	19.619*	0.943
	(1.34)	(-1.82)	(2.25)	(-2.01)	(-2.76)	(2.53)	
8	0.626	-0.956	3.556	-2.891	-2.226	13.703	0.905
	(1.53)	(-0.75)	(1.03)	(-0.88)	(-1.55)	(1.35)	
9	0.36081	-1.750	5.665	-4.882	-2.941	20.098	0.809
	(0.64)	(-1.00)	(1.20)	(-1.08)	(-1.50)	(1.45)	
10	0.267	-1.817	5.950	-4.749	-2.958	17.640	0.626
	(0.34)	(-0.74)	(0.89)	(-0.75)	(-1.07)	(0.90)	

Note: ***, ** and * are significant at the significance level of 1%, 5% and 10% respectively

5. Conclusions and Suggestions

5.1 Conclusion

Based on the 740 open-end hybrid funds screened from January 1, 2015 to December 31, 2020, this paper uses multiple regression method to study the relationship between fund performance sustainability and FF five factors. This paper follows the research idea of Carhart (1997) and divides the sample funds into 10 groups to study their performance sustainability. Analysis is carried out by drawing conclusions at the monthly, quarterly and semi-annual levels. According to the regression results, it is found that on the monthly level, the performance sustainability of the fund is relatively obvious, which fully reflects the characteristics of "the strong is always strong, the weak is always weak". At the quarterly level, the momentum effect disappeared, that is, the top 10% of funds gained the lowest excess returns. Instead, the bottom 10 percent of funds enjoyed the highest returns. In the semi-annual level, it is found that there are several reversals, the fund performance changes irregularly, only in a few groups there is a certain continuity, from the overall view of the fund performance there is no continuity.

From the perspective of factor, CMA factor has always been more significant than other factors. It shows that the performance of the fund is greatly affected by its investment style. The MKT factor has strong significance at the monthly level, but gradually weakens in the quarter and half year. Especially in the half year, MKT is not significant at all. Therefore, it can be judged that the influence of market excess return on fund performance will gradually weaken over time. In the long run, funds will gradually not be compensated for the systemic risks they take. SMB factor is relatively significant in the short term, but its significance is weakened in the long term, indicating that the impact of scale compensation on the performance of our fund is mainly reflected in the short term, and the long-term impact function will be reduced. HMLO factor and RMW factor both have certain significance in the short and long term, indicating that the fund performance is affected by the book-to-market ratio and

the return rate of the investored units. However, in the long term, the significance level of the two decreases, indicating that the impact will be reduced in the long term. In the long run, all the factors showed a trend of significant decrease, indicating that the five factors have strong explanatory ability in the short run, but the explanatory ability will be weakened in the long run.

5.2 Suggestions

Based on the above conclusions, this paper will put forward suggestions from the perspective of fund managers, investors and regulatory authorities:

5.2.1 Fund Managers

For fund manager, need to improve their own investment ability. When making investment selection, factors such as the size, book-value ratio, profitability and investment style of securities companies should be fully taken into account, and the fund performance evaluation attribution should be used to find out its own weak points and correct them. At the same time, according to the regression results, the investment style of fund managers will have an important impact on the sustainability of fund performance. Fund managers should attach importance to their own investment style and maintain the sustainability of investment strategies.

5.2.2 Investors

Most investors of our country are not value type investors; they pursue too much current income. From the regression results, the fund performance in the short term has a certain continuity, in the long term this continuity will be reversed. Therefore, in the short term, investors can adopt a strong strategy, buy the current good performance of the fund, sell the current poor performance of the fund, in this way to obtain excess returns. However, in the long run, such as quarterly or semi-annual, the strategy needs to be changed. At this time, the fund performance reverses, and the investment needs to pay attention to various factors.

In short, for investors, the need to maintain rational investment, can not only "yield" have said.

5.2.3 Supervision

The regulation of the capital market has never been relaxed. However, there are still false publicity and excessive publicity about fund performance, which will mislead investors to invest. The regression results of this paper find that fund performance persists in the short term, but will reverse in the medium and long term. Therefore, the regulatory authorities should judge the authenticity of the information released by fund companies and prevent fund companies from misleading investors by exaggerating the performance of fund managers in the past. At the same time, we should resolutely resist the way of performance publicity for investors to invest, not to mention the selection of a specific period of time for performance publicity.

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