# An empirical analysis of the applicability of the Fama-French five-factor model and the three-factor model to China's stock market – Based on validated evidence from listed Chinese Internet companies

Ruobing Wang[1,*]

Jinan Thomas school, 666 Boxue Road , China

**Abstract:** Previous research on the Fama-French three-factor (FFTF) model in domestic academia has been dominated; while the literature and applications of applying the Fama-French five-factor (FFFF) to study the Chinese stock market are scarce, and the only few articles are contradictory in their respective conclusions. This study examines the applicability of the FFTF model and FFFF model in the Chinese stock market, starting from the empirical analysis of these two models respectively. The results of this paper conclude that the FFTF model has an overall concentration of fit of over 80 %, while the FFFF model has a concentration of fit of over 89 %, thus confirming that the FFFF model is more suitable for explaining and predicting the returns of Internet-listed companies in the Chinese stock market. However, the shortcomings of in the estimation of the value factor parameters in FFTF and FFFF models still exist, and there is still a need to improve on the original model.

## 1. Introduction

Fama and French proposed the FFTF model in 1993[1] and the FFFF model in 2015[2] to explain the expected return on a cross-section of stock portfolios, and both models are now widely accepted and used by academic research and financial firms. model is able to detect whether an investment strategy can achieve the expected returns through book-to-market, market risk and company size[3] . However, many academics and industry practitioners believe that the FFTF model does not explain the correlation between stock profitability and investment style (portfolio). For this reason, Fama and French added the investment style and profitability model to the parameters of the model again in 2015 and proposed a FFFF model based on the dividend discount model in order to better fit the investment return on stock investment style (portfolio). the applicability of the FFFF model and the FFTF model to the Chinese stock market has been widely studied in China, and currently Some scholars in domestic academia believe that the model for domestic equity asset returns should be based on the FFTF model, and there is very little literature and application of the FFFF to study the Chinese equity market, and the only few articles are contradictory in their conclusions.The applicability of the FFTF model and the FFFF model in the Chinese equity market is The questions of how well the FFTF model and the FFFF model can be applied to the Chinese stock market and which model can better fit the expected return of the Chinese stock market have not been clearly answered in the current academic literature. This study examines the applicability of the FFTF model and the FFFF model to the Chinese stock market, based on data on Chinese Internet listed companies in recent years.

## 2. Variable selection and descriptive statistics

### 2.1. Sources of data

In order to verify the applicability of the FFTF model and FFFF model to the Chinese stock market, this paper selects 752 Internet listed companies in China's Shenzhen-traded A-shares from February 2011 to October 2021 as the research object, excludes data gaps and the data of companies delisted during this period, simulates the construction of 25 portfolios, and uses the monthly return of each The monthly return of each portfolio was used as a sample for the study, making a total of 129 samples as the data source for this study. The data for each sample includes closing price, outstanding share capital and monthly return. All data in this article is taken from the official website of Wanders.

* Corresponding author: 2076583793@qq.com

## 2.2. Selection of variables

The data for this study was selected from the trading data of Internet listed companies in China's Shenzhen trading A-shares. The stock market capitalisation and book-to-market ratios of these Internet companies were grouped and ranked, and the 25 portfolios constructed were ranked according to the excess returns of 5 x 5 portfolios as the explanatory variables, and the excess returns of the 5 x 5 portfolios constructed are shown in Table 1.

**Table 1.** List of 5 x 5 portfolio excess returns

| Size - B/M | Low | 2 | 3 | 4 | High |
|---|---|---|---|---|---|
| Small | 0.0324 | 0.0286 | 0.0370 | 0.0320 | 0.0277 |
| 2 | 0.0328 | 0.0251 | 0.0274 | 0.0310 | 0.0217 |
| 3 | 0.0143 | 0.0244 | 0.0305 | 0.0198 | 0.0195 |
| 4 | 0.0170 | 0.0256 | 0.0175 | 0.0186 | 0.0152 |
| Big | 0.0147 | 0.0096 | 0.0119 | 0.0164 | 0.0137 |

As shown in Table 1, the excess return formula for this study is the portfolio weighted monthly return minus the one-year treasury yield, which is the monthly weighted average excess return consisting of the equity market capitalisation minus the book-to-market ratio[4] . Due to space limitations in this paper and the need for regression analysis, only the average return weighted to the time series is used for each portfolio.

## 2.3. Construction of the factors

### *2.3.1 The way in which factors are constructed*

The main way of constructing factors for the FFTF model and FFFF model is to first rank the indicators from largest to smallest and then use the return differential of these ranked indicators as the constructing factor, for this purpose, Fama and French proposed three methods of constructing the model factors in 2015, the constructing methods are shown in Table 2[2] . These three factor construction methods are also explored in this paper to verify the applicability of the constructive factor approach in the Chinese equity market.

**Table 2.** Three ways of constructing the Fama factor

| Methods | Demarcation point | Formula |
|---|---|---|
| The 2 x 3 scale takes intersections with each of the other three | Size: two groups<br>Book-to-market ratio: three groups<br>Profit: three groups<br>Investments: three groups | SMB-B/M=(SH+SN+SL)/3-(BH+BN+BL)/3SMB-OP-(SR+SN+SW)/3-(BR+BN+BW)/3<br>SMB-Inv=(SC+SN+SA)/3-(BC+BN+BA)/3<br>SMB=(SMB-B/M+SMB-OP+SMB-Inv)/3<br>HML=(SH+BH)/2-(SL+BL)/2RMW=(SR+BR)/2-(SW+BW)/2<br>CMA = (SC+BC)/2 - (SA+BA)/2 |
| The 2 x 2 scale takes the intersection with the other two respectively | Size: two groups<br>Book-to-market ratio: two groups<br>Profit: two groups<br>Investments: two groups | SMB=(SH+SL+SR+SW+SC+SA)/6-(BH+BL+BR+BW+BC+BA)/6<br>HML=(SH+BH)/2-(SL+BL)/2<br>RMW=(SR+BR)/2-(SW+BW)/2<br>CMA = (SC+BC)/2 - (SA+BA)/2 |
| 2 x 2 x 2 x 2 Each of the four variables is taken as an intersection | Size: two groups<br>Book-to-market ratio: two groups<br>Profit: two groups<br>Investments: two groups | SMB=(SHRC+SHRA+SHWC+SHWA+SLRC+SLRA+SLWC+SLWA)/8 -(BHRC+BHRA+BHWC+BHWA+BLRC+BLRA+BLWC+BLWA)/8<br>HML=(SHRC+SHRA+SHWC+SHWA+BHRC+BHRA+BHWC+BHWA)/8-(SLRC+SLRA+SLWC+SLWA+BLRC+BLRA+BLWC+BLWA)/8<br>RMW=(SHRC+SHRA+SLRC+SLRA+BHRC+BHRA+BLRC+BLRA)/8-(SHWC+SHWA+SLWC+SLWA+BHWC+BHWA+BLWC+BLWA)/8<br>CMA=(SHRC+SHWC+SLRC+SLWC+BHRC+BHWC+BLRC+BLWC)/8-(SHRA+SHWA+SLRA+SLWA+BHRA+BHWA+BLRA+BLWA)/8 |

As shown in Table 2, the first method of grouping factors is to group the newly added investment factor and earnings also according to the market capitalisation ratio method[3] . The specific grouping method sorts the three factors - investment factor, earnings and book-to-market ratio - into three groups in descending order of size and takes the intersection of the market value variable factor and the other three variables according to the grouping to obtain 2 x 3 = 6 combination factors[4] . This includes the Size Factor (SMB), the Value Factor (HML) and the Investment Factor (HML), and, with two more factor sizes, SMB-Inv and SMB-OP.

However, it can be observed that this approach uses the fama FFTF approach to grouping the newly added variable factors and the reason for grouping other indicators than market capitalisation in group 1 in Table

2 cannot be justified. Furthermore, looking at the formula for group 1 in Table 2, it can be seen that the constructs for these groups take the low and high groups of indicators and discard the middle group. [5]Therefore, in order to be consistent with the construction factors, a 2 x 2 factor construction method can also be used, with the construction method and formula shown in Table 2 for Group 2. This factor construction method is not very different from Group 1, except that the three factors - investment factor, earnings and book-to-market ratio - are ranked in descending order, as in Group 1. There is no difference from the 2 x 3 method other than that the book-to-market ratio, earnings and investment are sorted from smallest to largest and grouped into two rather than three groups by size.

To control for other variables in the constructed factors, four more variable factors were constructed according to group 3 in Table 2[6] , grouping the four variable factors of investment, earnings, market capitalisation ratio and firm size in descending order, resulting in 2 x 2 x 2 x 2 = 16 combinations of the value factor (HML), size factor (SMB), investment factor (CMA) and earnings factor ( RMW).

### *2.3.2 Descriptive statistics of the factors*

The descriptive statistics for the factor constructs are shown in Table 3, with the descriptive statistics being the mean, standard deviation and t-test for the factor constructs.

**Table 3.** Descriptive statistics for the factors under the three construction methods

| Method 1 2 x 3 | | | | | |
|---|---|---|---|---|---|
| | Mkt-RF | SMB | HML | RMW | CMA |
| Average value | -0.0072 | 0.0124 | -0.0008 | 0.0002 | 0.0009 |
| Standard deviation | 0.0974 | 0. 0379 | 0.0311 | 0. 0305 | 0.0266 |
| t | -4.9126 | -12.2809 | -6.7672 | -6. 5009 | -7. 6521 |
| Method 2 2 x 2 | | | | | |
| | Mkt-RF | SMB | HML | RMW | CMA |
| Average value | -0.0072 | 0. 0124 | -0.0004 | -0. 0010 | 0.0002 |
| Standard deviation | 0. 0974 | 0.0389 | 0.0233 | 0.0238 | 0. 0206 |
| t | -4.9126 | - 7.1811 | -6.7407 | -6. 4673 | -6.8430 |
| Method 3 2 x 2 x 2 x 2 | | | | | |
| | Mkt-RF | SMB | HML | RMW | CMA |
| Average value | -0.0072 | 0.0122 | 0.0000 | 0. 0003 | 0. 0001 |
| Standard deviation | 0. 0974 | 0. 0352 | 0. 0219 | 0. 0208 | 0.0165 |
| t | -4. 9126 | -7. 4971 | -7. 0053 | -6. 5303 | -7.8101 |

As shown in Table 3, the 2 x 3 group focused more on the values at both ends of this market capitalisation ratio, earnings and investment variables, with a value factor (HML) of -0.0008 for the 2 x 3 group, -0.0004 for the 2 x 2 group and 0. 0000 for the 2 x 2 x 2 x 2 group, indicating that the differences in value factors were narrowing and eventually not differing, while the t-values were able to remain largely unchanged.

### *2.3.3 Correlation of factors*

The correlation coefficients between the different construction methods for the scale factors are shown in Table 4.

**Table 4.** Correlations of the factors under different construction methods

| Group 1 | | L: SMB | |
|---|---|---|---|
| | 2 x 3 | 2 x 2 | 2 x 2 x 2 x 2 |
| 2 x 3 | 1 | | |
| 2 x 2 | 0.9988329 | 1 | |
| 2 x 2 x 2 x 2 | 0.9868433 | 0.982704 | 1 |
| Group 2 | | L: HML | |
| | 2 x 3 | 2 x 2 | 2 x 2 x 2 x 2 |
| 2 x 3 | 1 | | |
| 2 x 2 | 0.9836726 | 1 | |
| 2 x 2 x 2 x 2 | 0.9275127 | 0.9538076 | 1 |
| Group 3 | | L: RMW | |
| | 2 x 3 | 2 x 2 | 2 x 2 x 2 x 2 |
| 2 x 3 | 1 | | |
| 2 x 2 | 0.9769461 | 1 | |
| 2 x 2 x 2 x 2 | 0.9401484 | 0.9616993 | 1 |
| Group 4 | | L: CMA | |
| | 2 x 3 | 2 x 2 | 2 x 2 x 2 x 2 |
| 2 x 3 | 1 | | |
| 2 x 2 | 0.9495079 | 1 | |
| 2 x 2 x 2 x 2 | 0.9067626 | 0.9121791 | 1 |

As shown in Table 3, the correlation coefficient between the 2 x 3 method and the 2 x 2 x 2 x 2 method reached 0.98, while the correlation coefficient between the 2 x 3 method and the 2 x 2 method reached 0.99. This high correlation coefficient also reflects the accuracy of the data selected in this exercise and illustrates the high consistency of the raw data used in several construction methods. In order for the variable factors to reflect the excess premium of the stock, it is also necessary to control for the full range of variables, so the 2×2×2×2 method is used in this paper for the factor construction of the model.

## 2.4. Descriptive statistics

Based on the factor construction method of 2 x 2 x 2 x 2, this empirical test examines the extent to which the FFTF model and the FFFF model explain the stock returns of Internet listed companies in the Chinese stock market by examining the extent to which the four variable factors of market capitalisation, book-to-market ratio, earnings and investment explain the trend in average stock returns[7] , and the results obtained are shown in Table 5.

**Table 5.** 5 x 5 Portfolio Excess Return Table

| Panel 1 Size - B/M | Low | 2 | 3 | 4 | High |
|---|---|---|---|---|---|
| Small | 0.0324 | 0.0286 | 0.0370 | 0.0320 | 0.0277 |
| 2 | 0.0328 | 0.0251 | 0.0274 | 0.0310 | 0.0217 |
| 3 | 0.0143 | 0.0244 | 0.0305 | 0.0198 | 0.0195 |
| 4 | 0.0170 | 0.0256 | 0.0175 | 0.0186 | 0.0152 |
| Big | 0.0147 | 0.0096 | 0.0119 | 0.0164 | 0.0137 |

| Panel 2 Size - OP | | | | | |
|---|---|---|---|---|---|
| Small | 0.0349 | 0.0281 | 0.0284 | 0.0284 | 0.0284 |
| 2 | 0.0258 | 0.0213 | 0.0208 | 0.0290 | 0.0336 |
| 3 | 0.0310 | 0.0226 | 0.0161 | 0.0188 | 0.0222 |
| 4 | 0.0224 | 0.0236 | 0.0177 | 0.0154 | 0.0197 |
| Big | 0.0115 | 0.0137 | 0.0126 | 0.0089 | 0.0159 |
| Panel 3 Size - Inv | | | | | |
| Small | 0.0304 | 0.0305 | 0.0294 | 0.0264 | 0.0299 |
| 2 | 0.0218 | 0.0187 | 0.0232 | 0.0257 | 0.0273 |
| 3 | 0.0245 | 0.0166 | 0.0213 | 0.0208 | 0.0250 |
| 4 | 0.0190 | 0.0161 | 0.0181 | 0.0202 | 0.0192 |
| Big | 0.0082 | 0.0131 | 0.0136 | 0.0086 | 0.0134 |

In Table 4, Group 1 shows the monthly weighted average excess returns of 25 portfolios, which are 5 x 5 portfolios consisting of 5 market capitalisation portfolios and 5 book-to-market portfolios. It can be observed that the stock market presents a more significant average return with the maximum difference between Group 1 and Group 5 being 1.8%, 1.9%, 2.5%, 1.6%, 1.4% respectively, with the middle group reaching the highest value of the difference. The value effects of book-to-market and average returns are smaller in Group 2 than in Group 1, and the average returns in Group 3 are higher than in Group 3 and smaller than in Group 1, with the difference in the ratio of value effects being 1.5% in Group 3 and only 0.5 % in Group 5.

## 3. Empirical analysis and results

### 3.1. Results the FFTF model

The parameter estimates and t-values for the FFTF model obtained through time series regression analysis are shown in Table 6.

**Table 6.** List of parameter estimates, t-values for the FFTF model

| | Low | 2 | 3 | 4 | High | Low | 2 | 3 | 4 | High |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | a | | | | | t(a) | | |
| Sma | 0.021 | 0.004 | 0:001 | - | - | 5.686 | 0.578 | 0.257 | - | - |
| 2 | - | - | - | - | - | - | - | ~0.17 | - | - |
| 3 | - | - | - | - | - | - | - | ~0.13 | - | - |
| 4 | - | - | - | - | ~0.00 | - | - | ~0.44 | - | - |
| Big | 0.002 | - | 0.003 | 0.004 | 0.002 | 0.778 | - | 1.187 | 1.374 | 0.778 |
| | | | b | | | | | t(b) | | |
| Sma | 0,938 | 0.937 | 1.000 | 0.985 | 1.029 | 24.58 | 13.32 | 20.18 | 21.22 | 21.68 |
| 2 | 1.042 | 0.996 | 1.034 | 1.033 | 1.001 | 20.72 | 22.41 | 21.44 | 21.91 | 19.11 |
| 3 | 0.926 | 1.031 | 1.026 | 1.041 | 1.047 | 17.63 | 23.14 | 22.66 | 21.29 | 23.30 |
| 4 | 0.991 | 1.057 | 1.039 | 1.069 | 1.030 | 22.00 | 22.04 | 22.82 | 26.09 | 27.51 |
| Big | 0.965 | 1.033 | 1.046 | 1.054 | 0.965 | 37.29 | 26.04 | 32.26 | 30.52 | 37.29 |
| | | | s | | | | | t(s) | | |
| Sma | 1.633 | 2.006 | 2.000 | 2.160 | 2.428 | 13.72 | 9.142 | 12.94 | 14.91 | 16.40 |
| 2 | 1.879 | 1.741 | 1.838 | 1.751 | 1.699 | 11.99 | 12.56 | 12.22 | 11.91 | 10.40 |
| 3 | 1.355 | 1.484 | 1.426 | 1.499 | L3480 | 8.275 | 10.68 | 10.10 | 9.834 | 9.622 |
| 4 | 1.146 | 1.214 | 1.134 | 1.199 | 0.935 | 8.168 | 8.117 | 7.990 | 9.387 | 8.009 |
| Big | 0.049 | 0.471 | 0.304 | 0.181 | 0.049 | 0.610 | 3.810 | 3.010 | 1.689 | 0.610 |
| | | | h | | | | | t(h) | | |
| Sma | - | 0.088 | - | 0.253 | 1.127 | - | 0.245 | - | 1.068 | 4.652 |
| 2 | - | - | 0.147 | 0.343 | 0.826 | - | - | 0.597 | 1.426 | 3.090 |
| 3 | - | - | 0.085 | 0.409 | 0.680 | - | - | 0.368 | 1.641 | 2.968 |
| 4 | - | - | 0.155 | 0.397 | 0.608 | - | - | 0.667 | 1.901 | 3.184 |
| Big | 0.666 | - | 0.119 | 0.462 | 0.666 | 5.042 | - | 0.718 | 2.621 | 5.042 |

As shown in Table 5, the FFTF model constructed for each of the 25 combinations had a parameter estimate of 0.98 for the explanatory variable market factor and a t-value of 24.93; a parameter estimate of 1.3 for the explanatory variable size factor and a t-value of 10.58; and a parameter estimate of 0.18 for the explanatory variable value factor, giving the model a goodness-of-fit of 0.85. As shown in Table 5, the higher F-values and the failure to value factor that passed the test, therefore, the FFTF model has some flaws.

### 3.2. Results the FFFF model

The parameter estimates and t-values for the FFFF model obtained through time series regression analysis are shown in Table 7.

**Table 7.** List of FFFF model covariate estimates, t-values

| | Low | 2 | 3 | 4 | High | Low | 2 | 3 | 4 | High |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | a | | | | | t(a) | | |
| Small | 0.0132 | 0.0102 | 0.0059 | 0.0011 | -0.0026 | 2.8744 | 1.4622 | 1.2223 | 0.2554 | -0.5374 |
| 2 | -0.0008 | 0.0022 | 0.0043 | 0.0025 | -0.0002 | -0.1815 | 0.5069 | 0.9586 | 0.5759 | -0.0560 |
| 3 | -0.0018 | 0.0017 | 0.0045 | 0.0022 | 0.0003 | -0.3747 | 0.4088 | 1.0785 | 0.5189 | 0.0662 |
| 4 | -0.0036 | 0.0019 | 0.0026 | 0.0016 | 0.0013 | -0.8211 | 0.4185 | 0.6177 | 0.4362 | 0.3877 |
| Big | -0.0018 | 0.0016 | 0.0067 | 0.0077 | 0.0029 | -0.4538 | 0.4061 | 2.1367 | 2.4639 | 1.3310 |
| | | | s | | | | | s(a) | | |
| Small | 1.1705 | 1.4472 | 1.5642 | 1.6663 | 2.0747 | 7.4172 | 6.0309 | 9.4635 | 11.0932 | 12.4150 |
| 2 | 1.4938 | 1.3731 | 1.3635 | 1.2638 | 1.1340 | 10.1035 | 9.1123 | 8.8037 | 8.4123 | 7.4095 |
| 3 | 0.9703 | 1.0152 | 0.9587 | 1.0020 | 0.8844 | 6.0259 | 7.2605 | 6.6503 | 6.8754 | 6.4235 |
| 4 | 0.7544 | 0.7421 | 0.7167 | 0.7670 | 0.6639 | 5.0207 | 4.7042 | 4.9354 | 5.9080 | 5.8213 |
| Big | 0.1775 | 0.1942 | 0.0605 | -0.0512 | 0.0035 | 1.2909 | 1.4382 | 0.5631 | -0.4781 | 0.0460 |
| | | | h | | | | | t(h) | | |
| Small | -0.7334 | 0.0217 | -0.0425 | 0.1861 | 0.8126 | -4.4543 | 0.0867 | -0.2462 | 1.1878 | 4.6609 |
| 2 | -0.4128 | -0.1678 | 0.1269 | 0.2692 | 0.6556 | -2.6759 | -1.0673 | 0.7851 | 1.7175 | 4.1061 |
| 3 | -0.2483 | -0.0653 | 0.0196 | 0.3309 | 0.4981 | -1.4782 | -0.4478 | 0.1301 | 2.1765 | 3.4679 |
| 4 | -0.4195 | -0.1722 | 0.1066 | 0.1851 | 0.4536 | -2.6760 | -1.0461 | 0.7034 | 1.3670 | 3.8123 |

| Big | -0.6176 | -0.1668 | 0.0751 | 0.3490 | 0.4991 | -4.3058 | -1.1838 | 0.6699 | 3.1246 | 6.3463 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | r | | | | | t | | |
| Small | -2.0331 | -0.9900 | -0.7986 | -0.9637 | -0.2909 | -0.8485 | -2.7172 | -3.1820 | -4.2252 | -1.1465 |
| 2 | -0.4730 | -0.5290 | -0.9141 | -0.9457 | -1.1642 | -2.1071 | -2.3122 | -3.8871 | -4.1459 | -5.0101 |
| 3 | -0.8096 | -0.9588 | -0.9315 | -1.0855 | -0.9133 | -3.3112 | ~4.5162 | -4.2561 | -4.9051 | ~4.3686 |
| 4 | -0.9049 | -1.0187 | -0.8913 | -0.8067 | -0.5468 | -3.9663 | -4.2530 | -4.0422 | -4.0923 | -3.1579 |
| Big | -0.7471 | -0.7684 | -0.6003 | -0.5436 | 0.0015 | -3.5790 | -3.7471 | -3.6784 | -3.3445 | 0.0133 |

As shown in Table 6, the FFFF model constructed for each of the 25 portfolios has an explanatory variable market factor parameter estimate of 0.02 and a t-value of 6.83, indicating that stock returns are positively related to the market factor with strong parameter significance; the intercept of the FFFF model is significantly lower than that of the FFTF model, indicating that the FFFF model for stock returns explanation is not as strong. The explanatory variable size factor parameter was estimated at 0.92 with a t-value of 25.04, indicating that the size factor is also linearly related to stock returns and the parameter significance is also strong; the explanatory variable value factor parameter was estimated at 0.14 and the goodness of fit of the model reached -6.5, indicating that the value factor is also linearly related to stock returns, but the parameter significance is not strong. The explanatory variable investment factor parameter estimate was -0.0592 with a t-value of -0.28, indicating that the investment factor showed an inverse relationship with stock returns and the parameter significance was weak. As shown in Table 6, the goodness of fit of Fama-French's FFFF model reaches 89 %, which is significantly higher than Fama-French's FFTF model, thus Fama-French's FFFF model has a higher degree of explanation for the stock returns of Internet listed companies. The higher F-value and the investment factor and value factor that do not pass the test also prove that Fama-French's French's FFFF model also has some shortcomings in the degree of explanation in the Chinese stock market.

## 4. Analysis of the extent to which the model explains

### 4.1. FFTF model

As shown in Table 5, the intercept for Group 1 is largely negative, with only one set of 25 portfolios with significant parameters and a parameter factor estimate of 0.0220, resulting in a t-value of 5.6873, which is not a significant intercept. All of the parameter estimates for the market factor in Group 2 are positive and all of the t-values tested are significant, indicating that the market factor is closely related to stock returns. The parameter estimates for the size factor in Group 3 were positive; the t-test values were largely significant, with three groups of insignificant t-values, 0.61, 1.69 and 0.61 respectively. 9 of the 25 parameter estimates for the value factor in Group 4 were negative, and the remaining 16 groups were also insignificant, and the more positive the parameter estimates, the less significant the t-values.

The FFTF model has an overall concentration of fit of over 80 %, with a maximum value of 93 % and a minimum value of 64 %, which indicates that the FFTF model is suitable for the Chinese stock market to a certain extent. However, 16 of the 25 sets of parameter estimates of the value factors in Group 4 of the FFTF model show insignificant status, which indicates that the FFTF model is not ideal in explaining the stock market returns of Chinese Internet listed companies. To adopt the FFTF model for the application and prediction of Chinese Internet listed companies, it is The FFTF model needs to be improved effectively in order to apply and forecast Chinese Internet listed companies using the FFTF model.

### 4.2. FFTF model

As shown in Table 6, the Group 1 intercept, although negative, has been optimised relative to the FFTF model, e.g. only six of the 25 combinations of significant parameters are negative, and only two groups are significant, 0.0132 and 0.0067 respectively, but the T-values obtained are basically consistent with the FFTF, and the intercept significance is also low, which can also indicate that the FFFF model has a higher degree of explanation for the Internet companies' stock The degree of explanation of the returns of the FFFF model is high; all parameter estimates of the FFFF are positive, and the t-values tested are all significant. Only one of the parameters of the market factor in Group 2 is negative, while all the others are positive and all t-values are significant, indicating that the market factor is closely related to stock returns. The size factor in Group 3 has positive parameter estimates; the t-test values are largely significant, with five insignificant t-values of 1.2909, 1.4382, 0.5631, -0.4781 and 0.0460, respectively. Of the 25 groups of value factors in Group 4, 10 have negative parameter estimates and the remaining 14 groups are also insignificant, and the more positive the parameter estimates, the less significant the t-values.

The FFFF model was constructed with an overall high concentration of fit of 89 % or more, which is more suitable for explaining the data of Internet listed companies in the Chinese stock market as it has a higher degree of explanation of stock returns compared to the FFTF model. However, the deficiency of insignificant status in the parameter estimation of the value factor of the FFFF model still exists, and the two parameter factors added, the earnings factor and the investment factor, are not significant enough; the FFFF model, although basically passing the F-test, is optimized compared to the FFTF model, but it has no significant effect on the Chinese Although the FFFF model basically passed the F-test, it was optimised compared to the FFTF model, but the explanation of the earnings of

Internet-listed stocks in the Chinese stock market still had certain shortcomings.

## 5. Conclusion

This paper uses the FFTF model and the FFFF model to explore the degree of explanation of the earnings rate of Internet-listed companies in the Chinese stock market. The FFTF model and the FFFF model are used to rank and construct the size factor, the value factor, the earnings factor and the investment factor as indicators. The empirical results concluded that although the overall fit of the FFTF model was high, with an overall score of over 80 %, the value factor was not significant enough and had certain application flaws; in order to better explain the returns of the Chinese stock market, the FFFF model was constructed by adding the investment factor and value factor to the FFTF model. After using the regression test, the fit concentration of the FFFF model was generally higher, at over 89 %, which improved the explanation of stock returns compared to the FFTF model, and was therefore more suitable for explaining the data of Internet listed companies in the Chinese stock market, but the significance of the value factor of the FFFF model was still not significant enough.

In order to better fit and explain the Chinese stock market, the FFTF model and FFFF model need to be optimised, and the new FFTF model and FFFF model need to be reconstructed according to the characteristics of the Chinese stock market, so that the new model can be better than the original FFTF model and FFFF model in terms of parameter estimation and fit. The new FFTF model and FFFF model will be reconstructed according to the characteristics of the Chinese stock market so that the new model will be better than the original FFTF model and FFFF model in terms of parameter estimation and goodness of fit.

## References

1. Fama E F, French K R. Common risk factors in the returns on stocks and bonds [J]. Journal of financial economics, 1993, 33(1): 3-56.
2. Fama E F, French K R. A Fama-French five-factor asset pricing model[J]. Journal of financial economics, 2015, 116(1): 1-22.
3. Fama E F, French K R. Profitability, investment and average returns[J]. Journal of financial economics, 2006, 82(3): 491-518.
4. Fama E F, French K R. Incremental variables and the investment opportunity set [J]. Journal of Financial Economics, 2015, 117(3): 470-488.
5. Fama E F, French K R. Choosing factors[J]. Journal of financial economics, 2018, 128(2): 234-252.
6. Wu Minhua. An empirical study of Fama-French five-factor model in Chinese A-share market [D]. Jilin University, 2016.
7. Zhou Luo, Zhang Deli. An empirical study on the effectiveness of the Chinese stock market - based on the Fama-French five-factor model[J]. Business Manager, 2019(05):22-22.