

Piotroski's FSCORE: Evidence from Chinese Stock Market

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Abstract

This paper studies the applicability of the fundamental strength measure FSCORE proposed by Piotroski (2000) in Chinese A-share stock market. The results find that FSCORE can predict the short-term and medium-term profitability. The FSCORE is positively correlated with the stock return and the FSCORE strategy has the excess return that cannot be fully explained by factor models. After controlling characteristics of size, profitability and momentum, FSCORE can still predict the stock return. Therefore FSCORE is a unique fundamental strength measure applicable to Chinese stock market.

Keywords

FSCORE; Fundamental Strength; Excess Return.

1. Introduction

The FSCORE (Fundamental score) is considered to be a classic composite measure of a company's fundamentals strength in many stock markets. Proposed by Piotroski (2000), it is constructed by nine rules using eight indicators from financial statements, comprehensively measuring the fundamental strength of a company from three dimensions: profitability, solvency and operational efficiency [1]. FSCORE has a value range of 0 to 9, and the higher the score, the stronger the company's fundamentals. Piotroski (2000) finds that among companies with high book-to-market ratios in the United States, FSCORE is positively correlated with the future stock return [1]. Since then, many literatures (e.g., Turtle and Wang, 2017 [2]) begin to study FSCORE as an independent anomaly, testing whether the strategy of buying high FSCORE companies and selling low FSCORE companies can achieve excess return. AMOR-TAPIA and TASCÓN (2016) compares the returns of 4 fundamental anomalies in the European stock market and finds that the return of FSCORE strategy is the most significant and stable [3]. Walkshäus (2020) validated FSCORE's ability to predict the stock return in 20 developed country markets and 15 developing country markets and confirms that FSCORE is positively correlated with the future profit [4]. In addition, FSCORE is used as a proxy variable of fundamental strength in other empirical studies, as results show that FSCORE is positively correlated with future profitability of companies (Fama and French, 2006 [5]) and the needs of institutional investors (Choi and Sias, 2012 [6]), indicating that FSCORE can differentiate the quality of corporate fundamentals.

However, although many studies find that FSCORE has the ability to predict returns in various countries' stock markets and can be used as a proxy variable of fundamental strength, there are relatively few empirical studies related to the Chinese stock market. Jiang et al. (2020) verifies the existence of FSCORE strategy's premium in the Chinese stock market, stating an average monthly excess return of 1.09%, but its sample is only up to December 2015 and thus lacks research based on the latest data [7]. Therefore, this article uses the latest and most comprehensive sample data to test the applicability of FSCORE in Chinese A-share stock market. This paper first constructs the FSCORE measure and tests the ability of FSCORE to predict the company's future profitability, then tests the existence of excess return generated by the FSCORE strategy.

2. Research Design

2.1. Data and Variable

The stock trading data, financial data and investor sentiment index used in this paper are from China Stock Market and Accounting Research (CSMAR). The sample of this paper is Chinese A-share companies excluding the financial industry. In order to avoid the influence of outliers on research results, this paper also excludes the data of companies listed less than one year and those in ST(special treatment) period. Although A-share companies publish quarterly financial statements since 2002, the final time range of sample is from May 2004 to December 2021 due to missing values caused by difference processing and to ensure that the number of companies exceeds 1000 per month.

The core variable of this paper is the fundamental strength measure FSCORE. Specifically, the profitability dimension includes return on assets (ROA), net cash flow from operating activities (CFO), ROA difference (diffROA) and accrued profit (ACCURAL, which is defined as net profit less CFO). The solvency dimension includes long-term debt ratio difference (diffLEVER, which is the ratio of long-term debt to total asset), current ratio difference (diffLIQUID, which is the ratio of current assets to current liability) and whether the company issued common equity in the past 12 months (Issuance). The operation dimension includes the difference of gross profit margin (diffMARGIN) and the difference of asset turnover (diffTURN). Based on these indicators, FSCORE is computed as formula (1), where $I(\bullet)$ is an indicative function. If the condition in parenthesis is met, this binary signal equals 1, otherwise equals 0. Since the financial statements of each company are published at different times, the indicators are calculated as trailing twelve months data according to latest financial statements and updated at the beginning of every month.

$$\begin{aligned}
 FSCORE = & I(ROA > 0) + I(CFO > 0) + I(diffROA > 0) + I(ACCURAL < 0) \\
 & + I(diffLEVER < 0) + I(diffLIQUID > 0) + I(Issuance \leq 0) \\
 & + I(diffMARGIN > 0) + I(diffTURN > 0)
 \end{aligned} \tag{1}$$

2.2. Hypothesis and Model Construction

FSCORE can be used as a proxy variable of fundamental strength not only because its elements come from financial statements, but also because many studies find that it can positively predict the company's future profitability. Therefore, this paper puts forward the first hypothesis.

Hypothesis 1: the FSCORE can predict the company's future profitability.

In order to test hypothesis 1, this paper proposes model (2) to test the prediction ability of FSCORE to the future profitability, where ROA is chosen to represent the profitability. The explained variables of the model select the one-quarter ahead, one-year ahead, two-year ahead and three-year ahead ROA respectively (m equals to 3, 12, 24 and 36 months respectively), and the control variables are natural logarithm of stock market value (SIZE) and historical ROA.

$$ROA_{i,t+m} = \alpha + \beta FSCORE_{i,t} + \gamma_1 \log(SIZE_{i,t}) + \gamma_2 ROA_{i,t} + \varepsilon_{i,t} \tag{2}$$

Although many literatures verify that the FSCORE strategy can bring the excess return in the U.S. and European stock markets, the strategy is rarely tested in the Chinese stock market. Therefore, this paper puts forward the second hypothesis:

Hypothesis 2: the FSCORE strategy can obtain a significant excess return.

In order to test hypothesis 2, the FSCORE strategy is constructed to calculate the monthly equal-weighted and value-weighted return. The t-test and classical asset pricing factor model (CAPM

model, Fama-French three factor model and Fama-French five factor model) are used to test whether FSCORE strategy has the excess return.

The construction method of FSCORE strategy is as follows. At the beginning of each month, FSCORE is calculated according to the latest published financial statements and then all stocks are grouped based on FSCORE. The stocks are divided into five groups to make each group's size close. Companies with scores of 0-3 are divided into group F1, companies with score of 4, 5 and 6 are divided into group F2, F3 and F4 respectively, and companies with scores of 7-9 are divided into group F5. FSCORE strategy is defined as buying stocks in F5 and selling stocks in F1 at the same time, and rebalances at the beginning of each month.

Furthermore, in order to test that FSCORE provides new information other than profit, this paper uses Fama-Machbeth regression to control more characteristic variables. The testing model is as formula (3), where profitability is represented by gross profit margin (MARGIN), ROA and return on net assets (ROE) respectively.

$$R_{i,t+1} = \beta FSCORE_{i,t} + \gamma_1 P_{i,t} + \gamma_2 \log(SIZE_{i,t}) + \gamma_3 \log(BM_{i,t}) + \gamma_4 MOMR_{i,t} + \varepsilon_{i,t} \tag{3}$$

In formula (3), the explained variable is $R_{i,t+1}$, which represents the monthly return of stock i in the month $t+1$. The explanatory variable $FSCORE_{i,t}$ is the FSCORE of stock i at the end of month t . The control variables include the company's profitability $P_{i,t}$ (which is replaced by MARGIN, ROA and ROE respectively), the natural logarithm of the company's market value, the natural logarithm of the book-to-market ratio, and the cumulative rate of return for the past $t-12$ to $t-1$ months.

3. Empirical Results and Analysis

3.1. Descriptive Statistics

The total number of data is 465858, including 4225 listed companies and 212 months. The average value of FSCORE is 5.57, indicating that the fundamentals of the overall sample are relatively strong.

Table 1 describes the basic characteristics after the quintile grouping. The low group is group F1 and the high group is group F5. The average FSCORE of these two groups are 2.67 and 7.54 respectively, indicating that the samples with extreme values of 0 and 9 are in the minority. The monthly average number of companies in each group increases with the increase of average FSCORE, indicating that there are more strong fundamentals than weak fundamentals.

Table 1. Average FSCORE and number of companies in each group

	low	2	3	4	high
average FSCORE	2.67	4.00	5.00	6.00	7.54
average number of companies	241	330	469	483	674

3.2. FSCORE and Future Firm Profitability

Table 2 lists four regression results to study the prediction ability of FSCORE on the future profitability. The regression coefficients of the first three columns suggest that, after controlling the common cross-sectional characteristics that affect the future profitability, FSCORE still has a significant positive prediction ability for the short-term and medium-term profitability (the one-quarter to two-year ahead ROA). But FSCORE is unable to predict the long-term profitability (three-year ahead ROA). Among the control variables, the prediction ability of ROA is similar to that of FSCORE, but its coefficients are generally larger. The coefficients of size are positive, indicating that large companies are generally more profitable than small companies.

The last row of the Table 2 calculates the future profitability gap between the high group and the low group. In the short-term and medium-term, under the same characteristics of historical ROA and size, the average ROA of stocks in the high group will be 0.68 ~ 1.36% higher than that in the low group.

Overall, the regression results show that the fundamental information contained in FSCORE is significant in the economic and statistical sense, and is different from the company’s historical profit information and size. Therefore, hypothesis 1 cannot be rejected.

Table 2. FSCORE's ability to predict future profit

	one-quarter ahead ROA	one-year ahead ROA	two-year ahead ROA	three-year ahead ROA
intercept	-19.93 (-1.15)	-54.15 (-1.49)	-25.98* (-1.80)	-45.36 (-1.05)
FSCORE	0.14*** (3.69)	0.28*** (3.04)	0.23** (2.34)	-0.65 (-0.79)
ROA	0.96*** (13.13)	0.53*** (3.87)	0.42*** (10.34)	-0.34 (-0.49)
log(SIZE)	0.89 (1.08)	2.49 (1.44)	1.22* (1.77)	2.56 (1.07)
sample number	106712	106712	106712	106712
R ²	0.48	0.59	0.54	0.01
difference	0.68	1.36	1.12	-3.17

The New–West adjusted t-statistic is given in parentheses. *, ** and *** denote statistical significance at the 10%, 5%, and 1% levels respectively. difference = (average FSCORE of high - average FSCORE of low) × coefficient of FSCORE.

3.3. FSCORE Strategy and Excess Return

Table 3. Raw and excess return of quintile portfolios and FSCORE strategy

	equal-weighted				value-weighted			
	raw return	CAPM α	FF3 α	FF5 α	raw return	CAPM α	FF3 α	FF5 α
low	1.11 (1.39)	0.29 (0.35)	-0.31** (-2.47)	-0.22* (-1.79)	1.81** (2.24)	0.95*** (3.77)	0.67*** (3.53)	0.70*** (3.65)
2	1.32* (1.70)	0.52 (0.33)	-0.06 (0.44)	0 (0.03)	1.97*** (2.65)	1.18*** (4.75)	0.87*** (4.46)	0.90*** (4.46)
3	1.42* (1.88)	0.63** (3.12)	0.09 (0.84)	0.11 (0.97)	1.94*** (2.72)	1.18*** (5.64)	0.98*** (5.78)	0.95*** (5.62)
4	1.61** (2.20)	0.83*** (3.04)	0.31*** (3.41)	0.33*** (3.41)	1.95*** (2.77)	1.19*** (7.15)	1.00*** (6.51)	0.98*** (5.95)
high	1.94*** (2.65)	1.17*** (2.91)	0.67*** (6.17)	0.68*** (5.93)	2.52*** (3.58)	1.76*** (8.63)	1.62*** (9.29)	1.58*** (9.35)
high - low	0.83*** (5.76)	1.82*** (3.10)	1.85*** (6.15)	1.86*** (6.22)	0.70*** (3.23)	1.31*** (3.92)	1.35*** (4.08)	1.36*** (4.08)

The New–West adjusted t-statistic is given in parentheses. *, ** and *** denote statistical significance at the 10%, 5%, and 1% levels respectively.

Table 3 shows the monthly raw return and excess returns adjusted by factor model. The excess return is the intercept of the raw return regression result in factor models. For the returns of

quintile portfolios, the original and excess returns increase monotonically with FSCORE. The equal-weighted raw return increases from 1.11% to 1.94%, and the value-weighted raw return increases from 1.81% to 2.52%. Horizontally, the excess return adjusted by multi-factor models are significantly lower than that of the CAPM model, indicating that the explanatory ability of the multi-factor model is better than that of the CAPM model. However, the explanatory power of the five factor model is not much higher than that of the three factor model.

The raw returns of FSCORE strategy are 0.83% and 0.70% respectively, which are both significant at the 1% level. The excess return of the strategy is higher than the raw return, which may be due to the negative coefficients on the relevant factors. Because the excess returns adjusted by three types of factor models are all greater than 0 and are significant at the 1% level, hypothesis 2 cannot be rejected.

In order to further control the impact of other cross-sectional characteristics and test the unique prediction ability of FSCORE on future returns, this paper uses Fama-Machbeth regression to control profitability, size and momentum.

Table 3 shows the results of Fama-Machbeth regressions controlling for profitability. The results show that no matter which profit proxy variable is used or whether the control variables are added, FSCORE still has a positive prediction ability for the future return of stock. In column (1), the coefficient of FSCORE is positive and significant at the 5% level, indicating that the higher the FSCORE, the higher the future return. After controlling the common characteristics of size, book-to-market ratio and momentum, the coefficient of FSCORE in columns of (2) and (3) are still significant. Columns of (4) - (6) are results of adding different profit indicators as control variables. The coefficients of FSCORE are 0.17, 0.21 and 0.21 respectively, which are all significant at the 1% level. The results suggest that the information contained in FSCORE is different from the profit proxy variables. The last row of Table 3 calculates the premium predicted by FSCORE. Under the same other conditions, the average monthly return of the stock in high FSCORE group is 0.83 ~ 1.66% higher than that in low FSCORE group.

Table 4. Fama-Machbeth regression controlling for profitability

	(1)	(2)	(3)	(4)	(5)	(6)
FSCORE	0.31** (2.36)	0.18*** (6.01)	0.18*** (6.64)	0.17*** (6.88)	0.21*** (12.86)	0.21*** (13.54)
MARGIN				0.25 (0.74)		
ROA					-3.63* (-1.68)	
ROE						-1.72** (-2.10)
log(SIZE)		0.02 (0.57)	0.04 (0.84)	0.03 (0.72)	0.03 (0.76)	0.03 (0.68)
log(BM)		0.84* (1.75)	0.53 (1.55)	0.55* (1.68)	0.51 (1.38)	0.68* (1.77)
MOMR			0.08 (0.22)	0.06 (0.18)	0.02 (0.08)	0.07 (0.22)
Obs.	475866	475866	475866	475866	475866	475866
R ²	0.036	0.044	0.050	0.056	0.068	0.083
premium	1.51	0.88	0.88	0.83	1.02	1.02

The New-West adjusted t-statistic is given in parentheses. *, ** and *** denote statistical significance at the 10%, 5%, and 1% levels respectively. premium = (average FSCORE of high - average FSCORE of low) × coefficient of FSCORE.

According to the above results of t-test, factor models and Fama-Machbeth regressions, FSCORE is an independent indicator to the stock's future return, and the FSCORE strategy can obtain a significant excess return in the Chinese stock market.

4. Conclusion

This paper studies the applicability of the fundamental strength measure FSCORE in Chinese A-share stock market. The sample ranges from May 2004 to December 2021 and involves 4225 listed companies.

The conclusions are as follows. First, the FSCORE can comprehensively reflect the fundamental strength. After controlling the historical profit and size of the company, FSCORE still has a significant ability to predict the short-term and medium-term profitability in the future. Second, the FSCORE is positively correlated with the stock's future return and the FSCORE strategy has a significant excess return that cannot be fully explained by the common asset pricing factor models. In summary, FSCORE contains unique information different from the profitability, which means it can represent fundamental strength and can predict the expected rate of return of stocks.

Academically, this paper provides updated and comprehensive empirical evidence for the prediction ability of FSCORE in China. It also provides an empirical basis for other studies to use FSCORE as a fundamental strength proxy variable. In the practical sense, this paper provides investors with a quantitative fundamental investment strategy suitable for Chinese A-share market. The excess return of this strategy also reminds investors to pay more attention to the information in financial statements.

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