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Modified Piotroski Score for Higher Returns

Divij Sharma*; Sabhya Kapur**; Saiyam Bhatnagar***; Tejasvi Singh****

*Birla Institute of Technology and Science,

Pilani Campus, Pilani.

f20180751@pilani.bits-pilani.ac.in

**Birla Institute of Technology and Science,

Pilani Campus, Pilani.

f20180804@pilani.bits-pilani.ac.in

***Birla Institute of Technology and Science,

Pilani Campus, Pilani.

f20180883@pilani.bits-pilani.ac.in

****Birla Institute of Technology and Science,

Pilani Campus, Pilani.

f20180953@pilani.bits-pilani.ac.in

Abstract

The Piotroski score is a discrete number between 0-9 that determines the strength of a firm's financial position. It is a popular metric used to judge value stocks, with nine being the best and zero being the worst. Some of these criteria include Net Income, ROA, Long-Term Debt, Gross Margin, etc. In April 2000, Piotroski published the paper "Value Investing: The Use of Historical Financial Statement Information to Separate Winners from Losers," which demonstrated that the Piotroski score method would have seen a 23% annual return between 1976-1996 if the expected winners were bought, and expected losers shorted.

In this paper, we attempt to scrutinize the constituting parameters and apply our fundamental knowledge of economics to identify this method's shortcomings. Subsequently, we made suitable adjustments to the score to overcome these flaws and improve the overall portfolio returns. The constituting parameters are chosen in a way to achieve a better Sharpe ratio at a lower Beta.

Keywords: Piotroski Score, Sharpe Ratio, Value Investing.

Introduction

The F-Score developed by Piotroski in 2000 (Piotroski, 2000) is a composite score based upon nine parameters to gauge a company's fundamental strength. The F-Score has since been used to identify weak and strong value stock companies. Piotroski's analysis, made on the US markets, showed a positive relationship between stock returns and the F-Score.

The F-Score is defined as the sum of nine binary signals, which are described below:

Profitability Criteria

1. Return on Assets (ROA) being positive
2. Operating Cash Flow being positive
3. Change in ROA over the previous year being positive
4. Operating Cash Flow/Total Assets being higher than ROA

Leverage, Liquidity, and Source of Funds Criteria

5. Long Term Debt Ratio should be lower than the previous year
6. Current Ratio should be higher than the previous year
7. No new shares issued year

Operating Efficiency Criteria

8. Gross Margin should be higher than the previous year
9. Asset Turnover Ratio should be higher than the previous year

For each criterion satisfied, one point is awarded, i.e., each point is equal in its weight relative to the others. A company that scores an seven or higher is considered fundamentally strong, whereas a score of two or lower is extremely poor. Investors can thus use it to screen out winning stocks from losing stocks.

Literature Review

Ever since the first publication about the F-Score (Piotroski, 2000), multiple studies have been done to extend its scope and test its efficacy in different markets. A study by Ng and Shen (Ng & Shen, 2016) analyzed the use of F-Score for screening substantial value and growth stocks for the Asian markets. Hyde (Hyde, 2018) gave evidence about the F-Score's applicability for screening stocks to generate returns for the Australian market.

While Piotroski, when first describing the F-Score, only focused his study on value stocks, studies have also been done which analyze the applicability of the F-Score across the entire spectrum of the market. Since at its base, the F-Score is gauging the fundamental strength of a firm, it can be used to analyze all types of firms, both value, and growth.

Tikkanen and Äijö in 2018 showed that strategies that employ ratios such as dividend yield and P/E could be improved if the F-Score of the stocks is also taken into account. (Tikkanen & Äijö, 2018). Walkshäusl, in 2019, published an analysis on the European market over 27 years (1990-2017). He found a strong relationship between the F-Score and the past price performance of a firm. This shows that the F-Score can also analyze the momentum in the stock's performance (Walkshäusl, 2019).

Further analysis done by Walkshäusl in 2020 showed that the F-Score is a significant predictor for a broad cross-section of international stock returns. Work done by him showed that the F-Score is a reliable metric for both developed non-US markets and the emerging markets, cutting across the sizes of the firms. It further remains robust even after controlling for momentum, operating profit, and investments. His findings were consistent with Piotroski's original paper on the F-Score (Piotroski, 2000) that information on the firm's fundamentals is only slowly incorporated into the price of the stock by the investors (Walkshäusl, 2020).

Methodology

We aim to test two long-only portfolios:

- Buy and hold portfolio based on Piotroski score and market-based buy signals.
- Buy and hold portfolio based on our modified Piotroski score and market-based buy signals.

We created both the portfolios using the stock that had the highest scores (7 and above for both) and tested them for two years. The composition of the portfolio is changed every two years to reflect the changes in the stocks' scores. Our tradeable universe consisted of stocks that are a part of NIFTY50 (as of 1st December 2020). We used Blueshift by QuantInsti. Table2 lists the results of the backtest.

We made two jupyter notebooks to give the stocks in our universe a score and screen them based on that score. One was for the original Piotroski score and the other for our modified Piotroski score. The source code for the notebooks and the data set can be found here.

Table1: Piotroski Score, Modified Piotroski Score and Changes Made

Piotroski Parameters	Modified Score	Key Changes
Net Income Operating Cash Flows Return on Assets Quality of Earnings Leverage Current Ratio No issuance of equity Asset Turnover Ratio Gross Margin	Net Income Quality of Earnings Leverage Current Ratio No issuance of share Asset Turnover Ratio Gross Margin Price-Earnings ratio Price-Book Value ratio Enterprise Value-EBITDA ratio Change in Cash flow	Removed parameters (a) Return on Assets (b) Operating Cashflow Added parameters (a) Price-Earnings ratio (b) Price-Book Value ratio (c) Enterprise Value-EBITDA ratio (d)Change in FCFF

Parameter Definitions

1. Net Income – Positive Net Income reported in the Financial year.
2. Operating Cash Flows – Positive Cash flows reported in the Financial year.
3. Return on Assets – Ratio of Net Income to the Total Assets.
4. Quality of Earnings – Major Income share from the company's core activity rather than alternative sources.
5. Leverage – Decrease in the Long-Term Debt of the Company from the previous year.
6. Current Ratio – Ratio of the Current Assets to the Current Liabilities.
7. No Issuance of equity – No new Equity issued in a financial year.
8. Asset Turnover Ratio – Ratio of Total Sales to the Average assets over the year.
9. Gross Margin – Ratio of Gross Profit (Total Revenue – Cost of Goods Sold) to Total Revenue.
10. Enterprise Value – Net Market Capitalization of the Company added to Net Assets and subtracted by net Debt.
11. EBITDA – Earnings before Interest, Taxes, Depreciation, and Amortization.
12. Change in FCFF – Difference in FCFF in the current year and last year.

If net income is positive, then return on assets (net income/total assets) will be positive as total assets cannot be negative. Further, if net income is positive, cash flow from operations will also be positive. Subtracting expenses from operating cash flow gives net income. Negative operating cash

flow implies revenue from other sources is greater than revenue from operations. There is another parameter (operating cash flow greater than net income) that enforces the same condition.

Therefore, the original Piotroski F-Score parameters positive return on assets and positive operating cash flow is redundant and removed from our modified score because of the reasons mentioned above.

We added a parameter that change in Free Cash Flow to Firm (FCFF) should be positive. FCFF is possibly one of the most critical indicators of a company's financial health and stock value. A positive change in FCFF is an indicator of growth.

Enterprise Value to EBITDA (EV/EBITDA) is another ratio that we used to score companies. It compares the value of a company (Debt included) to its cash earnings, less non-cash expenses. A benefit of this ratio is that it is normalized for differences between companies and becomes an excellent parameter for comparison.

The original Piotroski score parameters are based on company financials and are not market-driven. It often leads to the problem that stocks with a good score are often overvalued and are not suitable for a buy and hold strategy. For this, in addition to the EV/EBITDA ratio, we added two more commonly used market-driven ratios; Price to Earnings ratio (PE) and Price to Book Value (PBV). The three ratios together help in identifying undervalued companies.

We also changed no new shares issued to net equity issuances to account for buybacks.

Technical Indicators Used

1. Moving Average Crossover: 200-day moving average is used as the long-term moving average, and the 50-day moving average is used as the short-term moving average. When the 50SMA crosses over the 200SMA, it is an indication of the start of an uptrend. We use this to get an optimal buying point.

2. Average directional movement index (ADX): ADX is used to gauge the strength of a trend. ADX values between 0 and 25 indicate the absence or weak trend. Values between 25-50 indicate a strong trend. 50-75 is a very strong trend, and 75-100 is an extremely strong trend.

We used both these indicators to generate a buy signal for the stocks selected by the Piotroski score and our modified score. The moving average crossover can give false signals; therefore, we used ADX to confirm the crossover's buy signal.

Results

Table2: Results of Backtesting

Piotroski					Modified Piotroski			
Years	**Returns (%)**	**Alpha**	**Beta**	**Sharpe**	**Returns (%)**	**Alpha**	**Beta**	**Sharpe**
12-14	32.10	0.05	0.77	0.95	41.18	0.09	0.70	1.34
14-16	89.87	0.22	1.43	1.38	72.70	0.21	0.87	1.69
16-18	71.27	0.07	1.58	1.33	93.71	0.2	0.96	2.30
18-20	5.96	-0.08	1.44	0.25	36.06	0.09	0.82	1.10

Returns

From the table it can be seen that on average our model is performing better than the original model. The average annual returns for the original model is 25% and for our modified model is 30.5%.

Beta

$$\text{Beta coefficient}(\beta) = \frac{\text{Covariance}(R_e, R_m)}{\text{Variance}(R_m)}$$

where:

R_e = the return on an individual stock

R_m = the return on the overall market

Covariance = how changes in a stock's returns are related to changes in the market's returns

Variance = how far the market's data points spread out from their average value

The backtesting shows that the Beta(the measure of the portfolio's volatility) is considerably better in the Modified-Piotroski's portfolio. The average Beta of the Piotrosiki stands at 1.305, while the Beta of our modified Piotroski portfolio is 0.837. The risk associated with our portfolio is considerably less than the historic Piotrosiki's portfolio since Beta is a measure of the portfolio's volatility with respect to the market, a lesser Beta signal towards a more stable portfolio.

Sharpe Ratio

$$Sharpe\ Ratio = \frac{R_p - R_f}{\sigma_p}$$

where:

R_p = return of portfolio

R_f = risk-free rate

σ_p = standard deviation of the portfolio's excess return

The Sharpe Ratio gives the number of standard deviations the Return of Portfolio is away from the market's risk-free return. Our Sharpe ratio (1.6075) exceeds the Sharpe ratio of the Piotroski portfolio (0.9775). Results empirically show that our portfolio gives a far better Sharpe Ratio at a lower Beta.

Conclusion

Through this exercise, we attempted to explore possibilities beyond the original F-Score. We designed our modified version of the F-Score to try to overcome some limitations or redundancies in the original score. As the backtesting results suggest, we have been able to improve upon the original score and generated higher returns. Some limitations, however, are that, our tradeable universe consists of only 50 stocks and the data is not available for all the stocks for all the years.

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