Does Piotroski F-Score work in Emerging Markets? The Brazilian market analysis

Erich Leonardo Ratzat

WorldQuant University
eratzat@hotmail.com

Abstract

The objective of this paper is to test Piotroski (2000) model in the Brazilian Market for the period 2005-2018. In addition, apply the momentum strategy after the Piotroski portfolio selection to identify if there is any improvement in returns and risk.

Keywords: *Piotroski, F-Score, Emerging Markets, BOVESPA, book-to-market, momentum factor.*

1. Introduction

The success of fundamentalist investment strategies is well documented. The Piotroski index (F_Score) created by the accounting professor at Stanford University, at the time a professor at Chicago University's Business School, Joseph Piotroski, aims to identify companies that present financial strength by analyzing financial statements. Piotroski (2000) created an index with 9 financial/accounting indicators that focus basically on 3 areas: profitability, financial leverage and operating efficiency. His study was based on US stocks and it showed that there was a significant improvement in observed returns (at least 7.5%) when stocks were selected from financially strong and high Book-to-Market firms.

Although this investment strategy has significant diffusion in developed markets, in Brazil there are few studies on the subject. Lopes and Galdi (2007) adapted the F_Score model to the Brazilian reality and obtained similar results to Piotroski (2000).

The purpose of this research paper is two-fold. First, test whether the F_Score strategy continues to produce abnormal returns in more recent periods (2005-2017). This period comprises different economic scenarios including major financial crises as well as periods of economic recovery. The importance of this analysis is to test the robustness of the strategy in different economic cycles with impacts in an emerging market such as Brazil.

The second objective is to verify the performance of Piotroski's investment strategy if we add another well-known strategy: the momentum factor. An important study by Vanstraceele and Du Toit (2012) involving European countries showed that by combining single factors that generate abnormal returns with a second factor it is possible to find combinations that increases market outperformance even more. Thus, this study will analyze the effect of adding the momentum factor to the F_Score index for even greater abnormal returns in the Brazilian market.

2. Literature Review

The term value investing, in short, can be explained by the existence of stocks with low prices when compared to their fundamentals, that is, stocks that are often traded at prices that do not reflect their real value when taking into account their financial statements. The value anomaly comes from the idea that these stocks perform better on average than growth stocks (stocks with high prices relative to their fundamentals).

One of the most studied and widespread value investing measures in academia is the book-to-market measure. There is extensive research in this sense covering both the international financial market (Rosenberg, Reid and Lanstein, 1985; Fama and French, 1995; Capaul, Rowley and Sharpe, 1993; Lakonishok, Shleifer and Vishny, 1994; among others), and the Brazilian market (Ramos, Picanço and Costa Jr, 2000; Rostagno, Soares and Soares, 2005; Santos and Montezano, 2011).

In Brazil, Galdi and Lopez (2007) analyzed the relevance of accounting information for effective decision making in financial investments and implemented an adapted F_Score. Pullen (2013) analyzed the effectiveness of the Piotroski model in the South African market, while Hyde (2013) analyzed Piotroski F_Score in emerging markets.

While it is easy to find studies regarding financial statements as a way to identify winning stocks in developed markets, in emerging markets a few studies can be pointed out: Tantipanichkul (2011) in Thailand, Galdi and Lopes (2007) in Brazil, Kang and Ding (2005) in Asia and Japan, Pullen (2013) in South Africa, Valdés and Ramírez (2014) in Mexico and Tripathy and Pani (2016) in India. This initiative may indicate greater attention to emerging markets in recent years.

Although Brazil is one of the 10 largest economies in the world, there is a missing gap on the literature when it comes to investment strategies in the equity market. One of the reasons can be explained by the fact that in Brazil a greater attention has always been given to fixed income due to the high interest rates that the country historically had.

Piotroski (2000) in his study shows the existence of abnormal returns in the US stock market when analyzing stocks with high Book-to-Market (BM) and that these stocks had some type of financial difficulty. Thus, Piotroski (2000) elaborated his F_Score index to separate the winners from the losers by analyzing metrics obtained from the financial statements. Focusing on 3 large groups (profitability, leverage and operational efficiency) it was possible to identify good companies that would be showing a financial recovery and this fact would be an indicator of future improvement in their stock prices.

In Brazil, the existing studies confirm the existence of a value anomaly in the Brazilian market. Ramos, Picanço and Costa Jr (2000) studied the BM factor, indicating that stocks with high BM presented better results for the same level of risk when compared to stocks with low BM. Santos and Montezano (2011), also reached similar results analyzing BM and Price to Earning (P/E) in the period 1989-2009.

Lopes and Galdi (2007), analyzed the quality and relevance of the financial statements in Brazil as a way to predict abnormal results and adapted the methodology proposed by Piotroski (2000) adapted to the Brazilian reality creating the BrF_Score index. The authors obtained results similar to Piotroski (2000) in the period 1994-2004.

The results obtained by Lopes and Galdi (2007) indicate that the abnormal returns come from small companies with low liquidity and with high level of indebtedness indicating certain differences with Piotroski (2000).

3. Research Hypothesis

This paper aims to test the hypothesis that the Piotroski (2000) methodology also works in emerging markets, especially in the Brazilian market. In addition, another factor will be tested in conjunction with F_Score: the momentum factor. The idea is to verify if, when adding the momentum factor after the portfolio selection based on the Piotrsoki (2000) model, there is any improvement in the portfolio's global return.

4. Data and Methodology

4.1 Data Source and Indicators modelling

The idea of using financial statements to forecast a stock performance is not new. Piotroski (2000) based his work on previous one like Ou and Penman (1989) – about how financial ratios created from financial statements could predict future changes in earnings; Frankel and Lee (1998) – about price lagging and fundamental values; Lev and Thiagarajan (1993) – about the 12 financial signals useful to financial analysts; among others.

The beauty of the Piotroski research is centered on easy indicator elaboration and most of them are intuitively easy to interpret.

The strategy first select high book to market (HBM) firms. It is used to compare the book value of a firm to its market value. The indicator can be calculated as follow:

$$Book\ to\ Market\ Ratio = \frac{Common\ Shareholders\ Equity}{Market\ Cap}$$

There is a vast research around this topic which shows that the HBM firms – also knows as value stocks – delivery abnormal returns. In short, high book-to-market ratios indicates fundamentally cheap stocks. But among HBM firms there are a few that has strong performance (less than 44% of all HBM firms) while the majority present poor performance. Piotroski created the F Score to separate the winners HBM firms from the losers HBM firms.

Basically, Piotroski group his nine indicators in three main areas: profitability, leverage and operating efficiency. Below is a summary of each ratio used to build the F Score starting with profitability indicators:

1. RETURN ON ASSETS – ROA

$$ROA = \frac{Net\ Income\ before\ extraordinary\ items}{Total\ Assets\ at\ the\ beginning\ of\ the\ year}$$

The indicator measures the profitability of a company regarding ts assets. In other words it gives a general idea on how efficiently a company uses its assets to generate earnings. The higher the ROA value the better because it indicates the company is generating more earning with less assets.

Regarding the strategy, if ROA is positive, then the indicator is equal to 1, otherwise 0.

2. CASH FLOW FROM OPERATIONS – CFO

$$CFO = \frac{Cash\ Flow\ from\ Operations}{Total\ Assets\ at\ the\ beginning\ of\ the\ year}$$

Cash Flow from operations differ from ROA because here the goal is to identify the amount of money that a company can generate through its operations. It is also known as the amount of money generated by the company core business.

Regarding the strategy, if CFO is positive, then the indicator is equal to 1, otherwise 0.

3. ΔROA

$$\Delta ROA = ROA\ from\ current\ year - ROA\ from\ previous\ year$$

The idea is to measure the profitability change. It shows if a company is improving when compared with the previous year. While ROA check if the return on assets is positive, ΔROA check if it is improving.

Regarding the strategy, if ΔROA is positive, then the indicator is equal to 1, otherwise 0.

4. ACCRUAL

$$ACCRUAL = \frac{Net\ Income\ before\ extraordinary\ items - CFO}{Total\ Assets\ at\ the\ beginning\ of\ the\ year}$$

Accrual is part of the revenue which was not received in cash. It is very important to distinguish between cash earnings from accrual earnings. In other words, earnings from cash is more sustainable than earnings from accruals. The calculation is done by subtracting CFO from ROA. If ROA is greater than CFO, than we have a positive accrual. If CFO is greater than ROA we have a negative accrual. In this case a high accrual it is not a good metric. A good company in this case should aim for a negative accrual. For Piotroski, as we are dealing with value companies (penalized by the market), when it shows more money coming in it is a good sign.

Regarding the strategy, if ACCRUAL is negative, then the indicator is equal to 1, otherwise 0.

The next three indicators deal with Leverage, Liquidity and Source of Funds:

5. ΔLEVERAGE

$$Leverage = \frac{Total\ Long\ Term\ Debt}{Average\ Total\ Assets}$$

$$\Delta\text{LEVERAGE} = \text{LEVERAGE}\ from\ current\ year - \text{LEVERAGE}\ from\ previous\ year$$

The capital structure is an important metric to check a firm's ability to pay its debts, how the liabilities are financed. The indicator shows if it is with short or long term debt. Leverage is measuring the long term debt compared with the firm's average assets. As Piotroski is looking for value firms, distressed firms, when the leverage from one year increases compared to previous year it is a bad sign.

Regarding the strategy, if ΔLEVERAGE is negative, then the indicator is equal to 1, otherwise 0.

6. ΔLIQUIDITY

$$Current\ Ratio = \frac{Current\ Assets}{Current\ Liabilities}$$

$$\Delta\text{LIQUIDITY} = \text{LIQUIDITY}\ from\ current\ year - \text{LIQUIDITY}\ from\ previous\ year$$

As the short term debt is dangerous metric for distressed firms, Piotroski idea is to check the firm's ability to cover current liabilities with its current assets. The goal is to measure the change in current ratio comparing the current year with the previous one.

Regarding the strategy, if ΔLIQUIDITY is positive, then the indicator is equal to 1, otherwise 0.

7. ISSUED SHARES

The idea here is to check if the company is increasing its equity offer. This metric is important as dealing with distressed firms the investor want to see financial improvement. In this case, raise money it is not a good sign.

Regarding the strategy, if ISSUED SHARES is positive when compared with previous year, then the indicator is equal to 0, otherwise 1.

The next two indicators focus on operating efficiency:

8. ΔMARGIN

$$Gross\ Margin\ Ratio\ (GMO) = \frac{Gross\ Margin}{Total\ Sales}$$

$$\Delta\text{MARGIN} = \text{MARGIN}\ from\ current\ year - \text{MARGIN}\ from\ previous\ year$$

Gross margin is calculated by net sales revenue minus its cost of goods sold. By dividing this by total sales we have the gross margin ratio. Investor are looking for a high profit margin. The firm's goal is to improve the margin from one year when compared with the previous one.

Regarding the strategy, if ΔMARGIN is positive when compared with previous year, then the indicator is equal to 1, otherwise 0.

9. ΔASSET TURNOVER

$$Asset\ Turnover\ Ratio = \frac{Total\ Sales}{Total\ Assets\ at\ the\ beginning\ of\ the\ year}$$

This metric measures the firm's ability to generate revenues from its assets. The higher the better.

Regarding the strategy, if ΔTURNOVER is positive when compared with previous year, then the indicator is equal to 1, otherwise 0.

The final goal is to build the F Score which is nothing more than the sum of all nine indicators previously presented

F Score = ROA + CFO + ΔROA + ACCRUAL + ΔLIQUIDITY + ΔLEVERAGE + ISSUE STOCKS + ΔMARGIN + ΔTURNOVER

The F Score ranges from 0 to 9. Piotroski stated that the companies considered winners would be those with grades 8 and 9. While the losers would be in the range of 0 and 1.

The number of companies listed in Brazil is slightly more than 10% of US listed companies, which has a direct impact on the number of firms with extreme F Score values. In this study, we chose to elaborate a long portfolio only with the objective of making the strategy easier to be applied by the common investor. In this way, companies with low F Score will not be considered on the portfolio, only those with high F Score will be analyzed.

As stated before Piotroski considers winners the companies with grades 8 and 9. Applying the same methodology in Brazil we face some problems. When selecting only companies with grades 8 and 9, the sample becomes too small, which ultimately impairs the analysis of results. An alternative was to extend the winner's scores to 7, 8 and 9. The same methodology was performed by Lopes and Galdi (2007) and Baldo (2016). With this modification it was possible to obtain a more reasonable number of companies for the sample.

The first step was to establish the criteria for selecting the companies considered as HBM. Thus, for each year the companies were divided into quintiles and those in the highest quintile were considered as HBM. To eliminate distortions in the sample, companies with negative HBM were disregarded.

Once all companies were identified in a given year as HBM or not, the score for each indicator was calculated. According to the specific criteria of each indicator, a score of 1 or 0 was assigned. After this step, the total sum of the nine indicators was calculated for each company and that corresponds to the F Score. Winners were considered companies with a grade above 7 (inclusive). And losers with a grade below 2 (inclusive).

For each year from 2005 to 2018 this methodology was performed and obtained the Piotroski ranking. In Annex 1 it can be seen the selected companies that formed the portfolio by year and below the following table shows the number of companies per year.

The annual portfolio of companies considered winners was calculated taking into account all companies with a score higher than 7 (inclusive). An equally weighted portfolio was created each year. As an example, if in one year 10 companies presented a F Score greater than or equal to 7, then each company was assigned a 10% weight in the portfolio. The same logic was adopted for all the years of the sample.

To avoid any bias in calculating the portfolio's return, it was considered the first business day after the last day of April as the starting point of portfolio return calculation. The reason to start evaluating portfolio performance only in May is due to the fact that listed companies have until the end of April to disclose their financial statements for the immediately preceding year.

After portfolio's formation, the holding period for performance consideration was one year. This means that the investor buys stocks early in May and stays with them for a period of one year until May of the following year.

For illustration purpose, for the portfolio of 2006 we considered the financial statements for 2005 and the calculation of the portfolio's return was considered from May 2006 until May 2007. Then is carried out a new analysis of the ranking of Piotroski and formed the

portfolio of 2007 based in the 2006 financial statements and beginning of the portfolio return calculation in May 2007 through May 2008. This process was carried out for all years of the sample.

After the elaboration of the annual portfolios considering F Score, the momentum factor was added in the same portfolios. The objective was to compare some performance change in the portfolio result over the sample period.

Several studies such as "Quantitative Value Investing in Europe" by Tim du Toit and Phillip Vanstraceele, point to indicatives of abnormal returns when incorporating the momentum factor in the strategy.

The momentum factor was used as a filter to select from the Piotroski portfolio, only stock which the last 6 months returns was above zero. If the stock in Piotroski portfolio had in the last 6 months a return below zero, it was dropped from the portfolio.

The results can be seen in the following section.

5. Results

5.1 Piotroski F Score Performance

Portfolio performance analysis between 2005 and 20181 showed results superior to a simple buy and hold strategy of the Bovespa Index.

The table below shows the annual returns for the sample period.

Table 1 – Piotroski and BenchMarking Returns

Year	No of Stocks – Piotroski Portfolio	Piotroski Portfolio Return	Benchmarking Return (Ibovespa)
2005	2	-25.67%	44.92%
2006	2	96.65%	43.08%
2007	1	88.52%	38.89%
2008	8	-17.65%	-26.72%
2009	3	92.41%	18.51%
2010	9	13.01%	2.49%
2011	7	-5.99%	-15.68%
2012	2	0.14%	-1.81%
2013	2	-5.69%	-4.24%
2014	7	-7.20%	2.97%
2015	4	-5.32%	-8.13%
2016	3	27.90%	29.38%
2017	3	67.06%	22.39%
2018	6	24.29%	24.53%

[1] The results for the year 2018 was done from May 2018 until January 2019 due to the working period of this paper.

The portfolio based on Piotroski's F Score resulted in a return of 342.46% over the analyzed period while the buy and hold strategy resulted in 170.60% over the same period.2

While the buy and hold strategy resulted in an average annual return of 12.19%, Piotroski's strategy resulted in an average annual return of 24.46%.

5.2 Piotroski F Score Performance with Momentum Factor

In addition to analyzing the superiority of Piotroski's strategy, it was tested whether adding the momentum factor as a filter in Piotroski's strategy would present some improvement.

In summary, the momentum strategy considers the return of the last 6 months of the selected stocks from the Piotroski portfolio. As an illustration, if a given stock had returns above zero in the last 6 months then it remains in the portfolio, otherwise it is eliminated from the portfolio.

The table below shows the results of adding the momentum factor between 2005 and 2018.

Table 2 – Piotroski, Momentum and Benchmarking returns

Year	No of Stocks – Piotroski with Momentum	Piotroski with Momentum Return	No of Stocks – Piotroski Portfolio	Piotroski Portfolio Return	Benchmarking Return (Ibovespa)
2005	2	-25.67%	2	-25.67%	44.92%
2006	2	96.65%	2	96.65%	43.08%
2007	1	88.52%	1	88.52%	38.89%
2008	2	13.60%	8	-17.65%	-26.72%
2009	3	92.41%	3	92.41%	18.51%
2010	7	-0.52%	9	13.01%	2.49%
2011	3	21.37%	7	-5.99%	-15.68%
2012	1	42.59%	2	0.14%	-1.81%
2013	2	-5.69%	2	-5.69%	-4.24%
2014	1	7.71%	7	-7.20%	2.97%
2015	1	11.11%	4	-5.32%	-8.13%
2016	2	50.64%	3	27.90%	29.38%
2017	3	67.06%	3	67.06%	22.39%
2018	5	26.20%	6	24.29%	24.53%

[2] The buy and hold strategy was based on Bovespa return from May to May of each year. Except for the year 2018 which the return was calculated between May 2018 and January 2019.

From the above analysis it can be inferred that by adding the momentum factor to the Piotroski portfolio the portfolio presented even greater gains when compared to a buy and hold strategy.

For the same period analyzed, the F Score strategy plus the momentum factor presented an average annual return of 34.71%. This represents 10.24% above Piotroski's performance and 22.52% above benchmarking performance.

6. Conclusion

Although one of the explanations of the effectiveness of Piotroski's strategy is the non-follow-up of HBM stocks by financial analysts, adding the 6-month momentum factor shows a more than 10% increase in annual returns when compared to the F Score strategy and more than 22% above benchmark returns (buy and hold Ibovespa).

The momentum factor, widely diffused in both developed and emerging markets, also has a strong impact on value stocks as is the case with HBM firms. This combination of two factors corroborates a recent study conducted in Europe on performance improvement with more than one factor. In this study all combinations improved with the addition of the momentum factor of 6 months and 12 months.

By allowing the common investor apply easy to implement strategies as Piotroski and momentum, it becomes possible to demystify the idea that today only complex strategies produce some kind of alpha. Exploring value strategies in emerging markets has been a constant of successful hedge funds around the world. The Brazilian market has turned out to be another emerging market where the analysis of the financial statements still shows abnormal returns over time. Brazil joins other emerging countries like India and South Africa with excellent results adopting Piotroski's methodology.

This study opens possibilities for studying the combination of other factors usually employed in value strategies such as Earnings Yield, Free Cash Flow, Greenblatt Magic Formula, Price to Sales ratio among others.

As said before the combination of factor analysis focusing on value investing is not new in developed markets but in emerging markets there is still a gap to be filled. It is hoped that this study will enable further research in this regard.

7. Annex 1

```
Portfolio Return for year 2005 was: -0.2567
The number of stocks on the Portfolio was: 2
The Price to Book quintile for year 2005 was 0.63
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
3	MGEL4	7.0	-0.328263	0.555727	5000.0	-1641.313051
27	HOOT4	7.0	-0.185185	0.102902	5000.0	-925.925926

```
Portfolio Return for year 2006 was: 0.9665
The number of stocks on the Portfolio was: 2
The Price to Book quintile for year 2006 was 0.6
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
2	SBSP3	8.0	0.402203	0.527117	5000.0	2011.015869
19	VGOR4	7.0	1.530760	0.323259	5000.0	7653.800255

```
Portfolio Return for year 2007 was: 0.8852
The number of stocks on the Portfolio was: 1
The Price to Book quintile for year 2007 was 0.81
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
4	IGUA6	7.0	0.885187	0.704952	10000.0	8851.874232

```
Portfolio Return for year 2008 was: -0.1765
The number of stocks on the Portfolio was: 8
The Price to Book quintile for year 2008 was 1.4
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
0	CESP6	8.0	-0.411538	1.377566	1250.0	-514.421972
10	SBSP3	7.0	-0.220682	0.957777	1250.0	-275.852053
14	CTKA4	7.0	-0.372737	1.336091	1250.0	-465.921193
21	ENBR3	7.0	0.022950	1.181643	1250.0	28.687118
23	ELET3	7.0	0.170808	0.338017	1250.0	213.509901
27	CEDO4	7.0	0.249014	0.728277	1250.0	311.267291
28	BRKM5	7.0	-0.569134	1.082655	1250.0	-711.417598
29	LUXM4	7.0	-0.280625	1.257824	1250.0	-350.781628

```
Portfolio Return for year 2009 was: 0.9241
The number of stocks on the Portfolio was: 3
The Price to Book quintile for year 2009 was 0.62
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
0	IENG3	8.0	0.800000	0.209881	3333.333333	2666.666667
2	CTSA3	8.0	-0.008739	0.443928	3333.333333	-29.128768
17	HBOR3	7.0	1.981062	0.399454	3333.333333	6603.541254

```
Portfolio Return for year 2010 was: 0.1301
The number of stocks on the Portfolio was: 9
The Price to Book quintile for year 2010 was 1.03
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
1	TPIS3	8.0	0.804067	0.961302	1111.111111	893.407660
2	PNOR5	8.0	-0.526027	0.785998	1111.111111	-584.474886
4	ENMT3	8.0	-0.387026	0.664280	1111.111111	-430.028863
15	SULT3	7.0	0.005472	0.272113	1111.111111	6.079753
19	LIXC3	7.0	0.403125	0.841784	1111.111111	447.916667
20	CRPG5	7.0	-0.043444	0.803161	1111.111111	-48.270670
29	DXTG4	7.0	0.579517	0.909170	1111.111111	643.908095
33	HBTS5	7.0	0.337500	0.515435	1111.111111	375.000000
34	IGUA6	7.0	-0.002194	0.949873	1111.111111	-2.437367

```
Portfolio Return for year 2011 was: -0.0599
The number of stocks on the Portfolio was: 7
The Price to Book quintile for year 2011 was 0.91
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
0	SPRI3	8.0	-0.393834	0.653602	1428.571429	-562.619572
9	MGEL4	7.0	-0.529872	0.825944	1428.571429	-756.959400
18	TNCP3	7.0	0.499158	0.657185	1428.571429	713.082660
21	BRIV4	7.0	-0.164978	0.579830	1428.571429	-235.683242
22	BAZA3	7.0	-0.143954	0.827923	1428.571429	-205.648963
28	CRPG5	7.0	0.535836	0.796539	1428.571429	765.480254
30	ELEK3	7.0	-0.221606	0.864978	1428.571429	-316.580648

```
Portfolio Return for year 2012 was: 0.0014
The number of stocks on the Portfolio was: 2
The Price to Book quintile for year 2012 was 0.72
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
5	PRVI3	7.0	0.425897	0.718615	5000.0	2129.483084
10	LIXC3	7.0	-0.423077	0.581646	5000.0	-2115.384615

```
Portfolio Return for year 2013 was: -0.0569
The number of stocks on the Portfolio was: 2
The Price to Book quintile for year 2013 was 0.74
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
13	TRIS3	7.0	-0.074561	0.486043	5000.0	-372.804346
19	CEBR5	7.0	-0.039330	0.357804	5000.0	-196.649183

```
Portfolio Return for year 2014 was: -0.072
The number of stocks on the Portfolio was: 7
The Price to Book quintile for year 2014 was 0.73
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
3	PTNT4	8.0	0.122203	0.566335	1428.571429	174.576350
5	ROMI3	8.0	-0.518827	0.658647	1428.571429	-741.180994
8	DOHL4	8.0	0.077102	0.621057	1428.571429	110.145267
12	PDGR3	7.0	-0.581795	0.509204	1428.571429	-831.136163
18	TRIS3	7.0	-0.214404	0.625237	1428.571429	-306.292089
22	AELP3	7.0	0.269176	0.564093	1428.571429	384.536980
28	CLSC4	7.0	0.342877	0.308133	1428.571429	489.824390

```
Portfolio Return for year 2015 was: -0.0532
The number of stocks on the Portfolio was: 4
The Price to Book quintile for year 2015 was 0.53
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
0	BDLL4	8.0	-0.341657	0.257750	2500.0	-854.142470
6	SGPS3	7.0	0.111111	0.118729	2500.0	277.777778
14	ROMI3	7.0	-0.218647	0.307118	2500.0	-546.616936
20	BRPR3	7.0	0.236225	0.509039	2500.0	590.563325

```
Portfolio Return for year 2016 was: 0.279
The number of stocks on the Portfolio was: 3
The Price to Book quintile for year 2016 was 0.35
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
4	GFSA3	8.0	-0.175671	0.288477	3333.333333	-585.570075
13	BMEB4	7.0	-0.044561	0.273463	3333.333333	-148.536593
17	EMAE4	7.0	1.057332	0.203505	3333.333333	3524.441273

```
Portfolio Return for year 2017 was: 0.6706
The number of stocks on the Portfolio was: 3
The Price to Book quintile for year 2017 was 0.47
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
8	EEEL4	8.0	0.822486	0.310470	3333.333333	2741.620203
10	MTSA4	7.0	0.606876	0.431213	3333.333333	2022.920797
21	CRPG5	7.0	0.582465	0.329694	3333.333333	1941.550224

```
Portfolio Return for year 2018 was: 0.2429
The number of stocks on the Portfolio was: 6
The Price to Book quintile for year 2018 was 0.66
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss
10	CEDO4	8.0	-0.381747	0.481713	1666.666667	-636.244684
29	CLSC4	7.0	0.872016	0.567394	1666.666667	1453.359696
31	CMIG4	7.0	0.758945	0.603406	1666.666667	1264.908451
34	CTNM4	7.0	0.169454	0.231456	1666.666667	282.422891
36	BPAN4	7.0	0.147368	0.488580	1666.666667	245.614035
44	GSHP3	7.0	-0.108878	0.314770	1666.666667	-181.462870

Piotroski with Momentum Factor portfolio:

```
Portfolio Return for year 2005 was: -0.2567
The number of stocks on the Portfolio was: 2
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
0	MGEL4	7.0	-0.328263	0.555727	5000.0	-1641.313051	0.538651
1	HOOT4	7.0	-0.185185	0.102902	5000.0	-925.925926	0.687500

```
Portfolio Return for year 2006 was: 0.9665
The number of stocks on the Portfolio was: 2
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
0	SBSP3	8.0	0.402203	0.527117	5000.0	2011.015869	0.499036
1	VGOR4	7.0	1.530760	0.323259	5000.0	7653.800255	0.938765

```
Portfolio Return for year 2007 was: 0.8852
The number of stocks on the Portfolio was: 1
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
0	IGUA6	7.0	0.885187	0.704952	10000.0	8851.874232	0.517849

Portfolio Return for year 2008 was: 0.136
The number of stocks on the Portfolio was: 2

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
3	ENBR3	7.0	0.022950	1.181643	5000.0	114.748472	0.031659
5	CEDO4	7.0	0.249014	0.728277	5000.0	1245.069165	0.092188

Portfolio Return for year 2009 was: 0.9241
The number of stocks on the Portfolio was: 3

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
0	IENG3	8.0	0.800000	0.209881	3333.333333	2666.666667	1.058824
1	CTSA3	8.0	-0.008739	0.443928	3333.333333	-29.128768	1.144015
2	HBOR3	7.0	1.981062	0.399454	3333.333333	6603.541254	0.530333

Portfolio Return for year 2010 was: -0.0052
The number of stocks on the Portfolio was: 7

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
1	PNOR5	8.0	-0.526027	0.785998	1428.571429	-751.467710	0.351852
2	ENMT3	8.0	-0.387026	0.664280	1428.571429	-552.894252	0.221922
3	SULT3	7.0	0.005472	0.272113	1428.571429	7.816825	0.045817
5	CRPG5	7.0	-0.043444	0.803161	1428.571429	-62.062290	0.119502
6	DXTG4	7.0	0.579517	0.909170	1428.571429	827.881836	0.272222
7	HBTS5	7.0	0.337500	0.515435	1428.571429	482.142857	0.454545
8	IGUA6	7.0	-0.002194	0.949873	1428.571429	-3.133758	0.161848

Portfolio Return for year 2011 was: 0.2137
The number of stocks on the Portfolio was: 3

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
0	SPRI3	8.0	-0.393834	0.653602	3333.333333	-1312.779001	2.862069
2	TNCP3	7.0	0.499158	0.657185	3333.333333	1663.859540	0.326781
5	CRPG5	7.0	0.535836	0.796539	3333.333333	1786.120592	0.036269

Portfolio Return for year 2012 was: 0.4259
The number of stocks on the Portfolio was: 1

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
0	PRVI3	7.0	0.425897	0.718615	10000.0	4258.966168	0.116667

Portfolio Return for year 2013 was: -0.0569
The number of stocks on the Portfolio was: 2

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
0	TRIS3	7.0	-0.074561	0.486043	5000.0	-372.804346	0.872736
1	CEBR5	7.0	-0.039330	0.357804	5000.0	-196.649183	0.250000

Portfolio Return for year 2014 was: 0.0771
The number of stocks on the Portfolio was: 1

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
2	DOHL4	8.0	0.077102	0.621057	10000.0	771.016869	0.267413

Portfolio Return for year 2015 was: 0.1111
The number of stocks on the Portfolio was: 1

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
1	SGPS3	7.0	0.111111	0.118729	10000.0	1111.111111	0.304348

Portfolio Return for year 2016 was: 0.5064
The number of stocks on the Portfolio was: 2

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
1	BMEB4	7.0	-0.044561	0.273463	5000.0	-222.804889	0.418919
2	EMAE4	7.0	1.057332	0.203505	5000.0	5286.661909	0.122385

Portfolio Return for year 2017 was: 0.6706
The number of stocks on the Portfolio was: 3

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
0	EEEL4	8.0	0.822486	0.310470	3333.333333	2741.620203	0.429184
1	MTSA4	7.0	0.606876	0.431213	3333.333333	2022.920797	0.214503
2	CRPG5	7.0	0.582465	0.329694	3333.333333	1941.550224	1.683673

```
Portfolio Return for year 2018 was: 0.262
The number of stocks on the Portfolio was: 5
```

	Stock	F Score	Return	Price to Book	$ Invested	$ win/loss	MOM6
0	CEDO4	8.0	-0.381747	0.481713	2000.0	-763.493621	1.038000
1	CLSC4	7.0	0.872016	0.567394	2000.0	1744.031635	0.478239
2	CMIG4	7.0	0.758945	0.603406	2000.0	1517.890141	0.094437
3	CTNM4	7.0	0.169454	0.231456	2000.0	338.907469	0.535959
5	GSHP3	7.0	-0.108878	0.314770	2000.0	-217.755444	0.206061

8. Bibliography

ABARBANELL, J., BUSHEE, B. Financial Statement Analysis, Future Earnings and Stock Prices. Journal of Accounting Research v. 35, p. 1-24, 1997.

ABARBANELL, J., BUSHEE, B. Abnormal return to a fundamental analysis strategy. The Accounting Review. v. 73, n. 1, p. 19-45, 1998.

DURÁN-VÁZQUEZ, R., LORENZO-VALDÉS, A., Effectiveness of corporate finance valuation methods: Piotroski score in an Ohlson model: the case of Mexico. Journal of Economics, Finance and Adminstrative Science v.19 104-107, 2014.

FAMA, E. F.; FRENCH, K. R. Value versus Growth: The International Evidence. The Journal of Finance, v. 53, n. 6, pp. 1975-1999, 1998.

GALDI, F. C.; LOPES, A. B. Limits to arbitrage and value investing: Evidence from Brazil. Latin American Business Review, v. 14, n. 2, p. 107-137, 2013.

GRAHAM, B., DODD, D.L. Security Analysis. McGraw-Hill, New York, 1934.

HYDE, C.E., An Emerging Markets Analysis of the Piotroski F Score, 2013.

KANG, J., DING, D., 2005. Value and growth investing in Asian stock markets 1991-2002, in: Chen, A.H. (Eds.), Research in Finance. JAI Press, Greenwich, vol. 22, pp. 113-139.

LAKONISHOK, J., SHLEIFER, A., and VISHNY R. (1994). Contrarian Investments, extrapolation and risk. Journal of Finance 49, p. 1541-1578.

LOPES, A. B. Financial accounting in Brazil: an empirical examination. Latin American Business Review, v. 6, n. 4, p. 45-68, 2006.

LOPES, A. B., GALDI F. C. Financial statement analysis also separate winners from losers in Brazil. Anais do Seminário de pesquisa econômica da Fundação Getúlio Vargas, 2006.

LOPES, A. B., GALDI F. C. Does Financial Statement Analysis Generate Abnormal Returns Under Extremely Adverse Conditions? VII Encontro Brasileiro de Finanças. São Paulo, 2007.

MOHANRAM, P., 2005. 'Separating winners from losers among low book-to-market stocks using financial statement analysis', Review of Accounting Studies. 10, 133-70.

PIOTROSKI, J.D. Value Investing: The Use of Historical Financial Statement Information to Separate Winners from Losers. Journal of Accounting Research v.38, p. 1-41, 2000.

PULLEN, N.J. Evaluating the Effectiveness of the Piotroski F_Score Methodology within the South African Market. Research Dissertation, 2013.

RAMOS, P.; PICANÇO, M.; COSTA JR, N. Retornos e riscos das value e growth stocks no mercado brasileiro. COSTA JR., NCA da; LEAL, RPC; LEMGRUBER, EF Mercado de capitais. São Paulo: Atlas, 2000.

ROSENBERG, B., REID, K., and LANSTEIN, R. Persuasive evidence of market inefficiency. The Journal of Portfolio Management, v. 11, n. 3, p. 9-16, 1985.

ROSTAGNO, L. M., SOARES, R. O., SOARES, K. T. C., Estratégias de Valor no Mercado de Ações Brasileiro. REAd Ed.48 Vol.11 No.6, Nov-Dec, 2005.

SANTOS, L., MONTEZANO, R. (2011). Value and growth stocks in Brazil: risks and returns for one- and two-dimensional portfolios under different economic conditions. Revista Contabilidade & Finanças - USP, 22(56), 189-202.

TRIPATHY, T., PANI, B., Effect of F Score on Stock Performance: Evidence from Indian Equity Market. International Journal of Economics and Financeç vol.9 n.2, 2017.

VANSTRACEELE, P., DU TOIT, T., Quantitative Value Investing in Europe: What Works for Achieving Alpha, 2012.