

# Do good fundamentals generate alpha?

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## Abstract

**Objective:** To verify abnormal risk-adjusted returns in Brazilian stock portfolios formed according to the F-Score that indicates the presence of good fundamentals.

**Method:** The sample has an average of 146 companies per year, includes the period of adoption of the International Financial Reporting Standards (IFRS) from July 2008 to June 2018 and uses equally weighted portfolios formed at the end of June of each year with information from the previous year.

**Results:** The high F-Score portfolio showed greater average returns, lower beta, and a positive and significant alpha that disappeared in the sub-period initiating after the full adoption of IFRS. Significant coefficients for the small capitalization risk premium and egalitarian weighting suggest that large companies do not dominate its performance. High and low F-Score portfolios cannot be characterized as value stocks. The low F-Score portfolio displayed a negative and significant coefficient for the moment factor, suggesting persistence of negative returns.

**Contributions:** Portfolios with high F-Score may have less chance of catastrophic returns. The technique can be employed by less sophisticated investors to build defensive portfolios of companies with good fundamentals.

**Keywords:** F-Score, fundamental analysis, alpha, portfolio selection.

## 1. Introduction

Fundamental analysis uses accounting, financial, and economic variables, among other things, to estimate the intrinsic value of a company or stock. Graham (2007) claims that fundamental analysis is an important criterion to build stock portfolios because the market is inefficient. The seminal articles of Fama and French (1992, 1993) are an example of the use of fundamentalist metrics to price market inefficiencies relative to the Capital Asset Pricing Model (CAPM) because they account for the size and value anomalies. The fundamental indexation proposed by Arnott, Hsu and Moore (2005) is another example of portfolios formed according to fundamental metrics and analysis.

Piotroski (2000) proposed the F-Score as an objective measure that congregates several fundamental analysis metrics that is designed so that the higher this score, the higher the quality of a company's fundamentals. The F-Score metric may be relevant to investors in general because of its simple implementation. Those willing to create stock portfolios by themselves may not be capable to sift through the myriad of corporate information available. Thus, they may resort to a subjective evaluation of the available analysis offered by providers such as investment platforms and financial institutions or to use a few selected metrics. The F-Score considers a few selected fundamental metrics jointly that are easy to find and simple to compute and may serve individual investors (Carneiro and Leal, 2017; Piotroski, 2000).

The objective of this article is to assess if the merit of the F-Score to select stock portfolios in Brazil. The Brazilian stock market has gained more attention from investors in general, particularly from individual investors, recently. The Ibovespa index has reached successive historic highs while the base interest rate is at a current historical low at the time of the writing of this article. Many analysts include stocks as an alternative to attain higher investment gains in this new environment (Daltro and Leal, 2019). Thus, this new investment setting justifies looking at fundamental stock selection methods, such as the F-Score. This article builds portfolios of Brazilian stocks using the F-Score and evaluates whether they are capable of generating positive and significant alphas after their historical returns have been adjusted to the CAPM, Fama and French (1993) and Carhart (1997) risk factor models. Moreover, the F-Score could be a stock selection criterion for products such as an exchange-traded fund (ETF).

Naturally, most individual investors will not be capable to compute alphas, even though researchers should properly ascertain if portfolios based on the F-Score attain abnormal returns in an asset pricing setting to validate the F-Score before recommending it to investors. Thus, it is important to verify if any significant excess returns of portfolios formed according to the fundamentals, such as the F-Score in the case of this article, disappear after adjusting for well-known risk factors, some of them based on stock market anomalies. For example, Fama and French (1993) contemplate the size and value anomalies and Carhart (1997) adds the momentum anomaly to their asset pricing models. An anomaly is a characteristic that is associated with significant and regular excess returns that an asset-pricing model, such as the CAPM, does not explain. What is anomalous relative to one model may be consistent with the predictions of other models. Fama and French (2012, 1992) report higher returns for portfolios of smaller companies that the CAPM does not explain, which led to their size risk premium factor. Value stocks are considered undervalued because they trade at a low price relative to their fundamentals. Fama and French (2012, 1992) also acknowledged a value stock premium in the US and in the world that the CAPM did not explain. These two factors plus the CAPM market risk premium factor constitute their three-factor model (Fama and French, 1993). The momentum anomaly is the persistence of past positive returns and Carhart (1997) added it as a fourth risk factor to the Fama and French (1993) model when analyzing US mutual funds. Moreover, maybe the F-Score could be an anomaly if the F-Score consistently attains positive alphas after adjusting for these risk factors.

The analysis herein employs monthly returns over the ten-year period beginning in July 2008 and ending in June 2018. The formation of the various portfolios occurs at the end of June of each year to ensure that the accounting information was disclosed prior to portfolio building in order to avoid the look-ahead bias, following Fama and French (1992, 1993) and Machado and Medeiros (2011), for example, among several Brazilian authors. The look-ahead bias occurs when a researcher uses information that was not available to investors on a time period in the past. For example, if companies publicize their end of the year information by the end of April of the following year, then, if the investor formed her portfolios in April, companies that did not publicize the information in April would not be considered. However, in the future, the information, publicized late, would be available for a researcher forming portfolios for a historical analysis, and that researcher would have a biased sample. Thus, June is a safety margin to eliminate the chance of the sample being biased in this way (Fama and French, 1992, p. 429).

Piotroski (2000) and Galdi and Lima (2016), for the US and Brazil, respectively, applied the F-Score to value stocks because their low relative market value could be due to poor fundamentals. Hyde (2018), however, claims that investors would be more likely to employ the F-Score combined with another criterion, which opens the possibility of considering all kinds of stocks. The analysis in this article differentiates itself from these previous articles because it uses the most comprehensive Brazilian sample that could be obtained, rather than focusing solely on value stocks, which would further reduce the sample because there may be few value stocks to consider. Furthermore, the value stock effect in Brazil has not been consistently present in the last 25 years, which casts doubts about considering the F-Score as an explanatory metric exclusively for value stocks (Rayes, Araújo and Barbedo, 2012). Finally, adjusting the Fama and French (1993) and Carhart (1997) models allows assessing whether F-Score portfolios have characteristics related to the size, value, and momentum risk factors, and, if so, indicates that the F-Score may only be a criterion that leads to the formation of portfolios that have one or more of these characteristics as dominant.

This article contributes to the Brazilian literature on the potential of fundamental analysis, particularly for less sophisticated investors who cannot devote much time or resources to this activity or do not have in-depth knowledge of the process. Individuals, in particular the least sophisticated ones, would be the kind of investor who could most benefit from the potential, if any, of the F-Score to form portfolios of companies with good fundamentals as they would look for easily understood and obtainable indicators and would use them to build and weight their portfolios (Carneiro and Leal, 2017). In addition, the results may indicate that the F-Score is a reasonable criterion for the building of fundamentalist index funds, sometimes called smart beta funds, with Brazilian stocks. The Brazilian literature on the value stock premium is not unanimous in acknowledging its existence. Medeiros and Bressan (2015) and Machado and Medeiros (2014), for example, find significance for the value premium coefficient while Rayes et al. (2012) report antagonistic results. Thus, the ensuing analysis expands the evidence on the use of the F-Score because it applies it to a broad stock sample of a major emerging market. Finally, the study differentiates itself from previous Brazilian studies also because it uses a sample period in which the gradual introduction of the International Financial Reporting Standards (IFRS) occurred and is the first to consider the F-Score in a sub-period in which these standards have been fully adopted by all listed companies, relying on a sample of companies under a homogeneous accounting standard to obtain fundamentalist metrics.

The results indicated that only the portfolio with high F-Score companies showed positive and significant alphas as well as lower betas than the portfolio with low F-Score companies. This significance of alphas disappeared in the sub-period initiated in July 2011 when all companies in the sample had already adopted the IFRS. Market risk (beta) was higher for companies with low F-Score. Smaller companies with high F-Score had, on average, higher returns. There was no indication that companies with higher or lower F-Score were value or growth stocks, suggesting that this feature did not distinguish companies according to their F-Score. Finally, stocks with lower F-Score showed evidence of persistent negative returns. Overall, the evidence is consistent with the importance of the quality of corporate fundamentals for less exposure to market risk, particularly for midsize and small companies, and also for avoiding greater destruction of portfolio value potential. The F-Score is a simple and objective method that may help less sophisticated Brazilian investors to form a lower market risk portfolio that does not suffer catastrophic returns.

## 2. F-Score literature review

This section reviews the literature about the F-Score and details how it is obtained. Before proceeding, is worth noting that this article will use the Fama and French (1993) and Carhart (1997) asset-pricing models. Some Brazilian articles that investigated these models will be mentioned in the results section. They were not included in this literature review section for brevity because reviewing their evidence in detail is beyond the scope of this article. The reader could refer to Rayes et al. (2012) and Machado and Medeiros (2011), for instance, for a review of this literature.

Abarbanell and Bushee (1998) found significant abnormal returns after forming portfolios based on a set of fundamental analysis variables and that much of these returns are generated close to earnings announcements. Arnott et al. (2005) proposed building portfolios weighted by fundamental indicators and claim that their method leads to higher returns and lower volatility than using market value for weighting. Yet, Asness et al. (2015) argued that this fundamental indexation is nothing more than a value stocks strategy.

Combining fundamentalist metrics with portfolios that reflect size or value anomalies may improve the return-to-risk ratio. Asness et al. (2018) add the Quality Minus Junk (QMJ) factor resulting in a significant and more stable premium over time, which is not concentrated in very small companies, robust to size measures that are not based on price, and not captured by an illiquidity premium. Graham (2007) suggests that investors build diversified portfolios with stocks presenting low multiples and debt ratios, a history of dividend payout and earnings consistency, which would be a combination of good quality fundamentals and value stocks.

Piotroski (2000) also combined fundamental analysis with a value stocks strategy. He used the F-Score metric that combines the scores of nine items derived from accounting and financial metrics to measure the strength of corporate fundamentals. The performance of a portfolio of value stocks with good fundamentals was superior to a portfolio of value stocks in his study. The author also reported evidence that the market takes time to incorporate financial information as an evidence of inefficiency.

Piotroski (2000) argues that accounting and financial metrics that reflect changes in some fundamental dimensions are useful to predict stock performance. Table 1 shows the F-Score method proposed by the author, which consists of a zero or 1 score for each of nine statements related to fundamental metrics. The value 1 corresponds to a positive fundamental effect and the F-Score score ranges from 0 to 9. The statements are organized into three dimensions: profitability (1 to 4), operational efficiency (5 and 6), and leverage and financial liquidity (7 to 9). High F-Score (HF) companies have an F-Score of 8 or 9 and show greater improvement in their fundamental whereas Low F-Score (LF) companies are those with an F-Score of 0 or 1. Piotroski (2000) employed equal weighting and rebalanced his portfolios at the beginning of May of each year using the information from the balance sheet of the end of the previous year.

Table 1

**F-Score scoring criteria**

Item	Statement	If true
1	$ROA_t > 0$	+1
2	$CFO/Asset_t > 0$	+1
3	$ROA_t - ROA_{t-1} > 0$	+1
4	$CFO/Asset_t > ROA_t$	+1
5	$Gross\ margin_t - gross\ margin_{t-1} > 0$	+1
6	$Asset\ turnover_t - Asset\ turnover_{t-1} > 0$	+1
7	$Current\ ratio_t - current\ ratio_{t-1} > 0$	+1
8	$Debt\ ratio_t - debt\ ratio_{t-1} > 0$	+1
9	The company did not do a public stock offer	+1

**Note.:** The value assigned to each item will be 1 if the affirmative is true and 0 otherwise. The F-Score is the sum of the score of the nine items and ranges from 0 to 9. Year  $t$  is the year prior to portfolio formation. The portfolios are formed at the end of June of each year.  $ROA_t$  is the return on assets defined as net income before extraordinary items at the end of year  $t-1$  over assets at the beginning of year  $t-1$ .  $CFO/Asset_t$  is the operating cash flow of year  $t-1$  over assets at the beginning of year  $t-1$ . Gross margin equals the difference between net revenue and cost of goods sold over sales. Asset turnover is the net revenue from year  $t$  over the average of total assets at the beginning and end of year  $t$ . The current ratio is current assets divided by current liabilities in year  $t$ . Debt is long-term debt in year  $t$ , which includes the portion of long-term debt classified as current liabilities, over the average of total assets at the beginning and end of year  $t$ .

Statements 1 and 2 in Table 1 refer to  $ROA_t$  and  $CFO/Assets_t$ , which are measures of profitability, and contribute to the company's fundamentals when they are positive. Statement 3 refers to the year-on-year increase in ROA, which, if any, has a positive impact on the company. Statement 4 deals with the difference between profitability based on the cash flow and profits that indicates that there were no relevant accruals when positive, which may have a negative impact on the future corporate profitability and stock return (Piotroski, 2000).

Statements 5 and 6 are in the operational efficiency dimension of the F-Score. An increase in gross margin from one year to the next may indicate an improvement in costs or an increase in the company's product prices. An improvement in asset turnover may indicate a more efficient operation or an increase in revenue.



The leverage and financial liquidity dimension has three statements. The increase in the company's current liquidity ratio, a decrease in its debt level and the absence of public issuance of shares would be associated with an improvement in the company's fundamentals. Piotroski (2000) argues that a firm in financial distress may start to raise external financing because it is unable to generate funds internally and, furthermore, an increase in long-term debt may diminish its financial flexibility in the future. Moreover, the author also suggests that issuing shares when the share price is undervalued, as is the case with value stocks, highlights a company's poor financial condition.

The practicality and simplicity of the F-Score and its appeal to many investors who believe that companies with higher quality fundamentals should outperform over the long term have generated interest in the method outside the US. Hyde (2014) applied it to a set of emerging market stocks in the MSCI Emerging Markets Index between January 2000 (667 stocks) and December 2011 (805 stocks). The author found a positive premium for his high F-Score portfolio, except for Brazil, whereas the portfolio of Brazilian stocks with low F-Score performs better than that with high F-Score. The author neither divulges the number of Brazilian stocks in the sample nor explores the reasons for the negative premium in Brazil. Hyde (2018) applied the F-Score to the Australian market and did not find a positive and significant alpha, even though there was a positive excess return relative to a market index.

There is divergence in the Brazilian results. Galdi and Lopes (2013) find favorable evidence for the use of the F-Score in the Brazilian market between 1994 and 2004, in contrast to Hyde (2014), but argue that these returns disappear when controlled for arbitrage limits, as they are mainly determined by small companies that do not allow for arbitrage and also have low liquidity or are heavily indebted. Galdi and Lima (2016) and Werneck, Nossa, Lopes and Teixeira (2010) also applied the Piotroski (2000) method to the Brazilian market for the periods 2001 to 2011 and 1995 to 2004, respectively. Both found that fundamental analysis contributes positively to future returns in a period prior to the full adoption of IFRS, even though the findings of Werneck et al. (2010) favor the Ohlson's model.

Other Brazilian articles related market returns to fundamentals but did not employ the F-Score. Costa Jr., Meurer and Cupertino (2007) report that there is weak evidence that accounting returns anticipate market returns. Rostagno, Soares and Soares (2008) outline the fundamental profile of the monthly winning and losing portfolios of exchange-traded companies from 1995 to 2002. Malta and Camargos (2016) identify eight variables from fundamental analysis that are relevant in predicting stock returns, several of them analogous to those considered in Piotroski (2000). Roquete, Leal and Campani (2018) find evidence that the fundamental indexation strategy, as proposed by Arnott et al. (2005), can do better in times of market lows and resemble a value stock investment strategy.

There were positive and significant alphas in some cases and risk factor models could not fully explain the performance of equally weighted portfolios formed according to the F-Score in some stock markets (Hyde, 2018). Hyde (2018), however, found that alphas generally lost their significance when portfolios were weighted by market value in Australia, suggesting a size effect on the equally weighted F-Score portfolios, which is not surprising. Piotroski (2000), for example, finds evidence that the benefits of financial statement analysis and the F-Score are concentrated in small and medium sized enterprises with little or no analyst coverage. On the other hand, Hyde (2014) and Hyde (2018) find no evidence based on this hypothesis for the Australian and several emerging markets. Yet, there is some convergence regarding the hypothesis that the market takes time to incorporate financial information, which is a key aspect of the F-Score strategy (Piotroski, 2000; Hyde, 2014) and fundamental analysis in general (Graham, 2007).

### 3. Methodology

#### 3.1 Sample

The objective of this investigation is to verify if the F-Score of Piotroski (2000) applied in the construction of Brazilian stock portfolios is capable of generating abnormal returns after the Carhart (1997) four-factor model adjustment. The initial sample is the set of companies with shares listed in the Brazilian stock exchange, called Brazil Bolsa Balcão (B3), between June 2008 and June 2018. The IFRS was phased in during this period until all listed companies were required to adopt it by 2011, rendering possible to guarantee a uniform accounting standard for the F-Score variables. Tests were performed for the full sample period and also for the sub-period beginning in 2011. Portfolios were formed in June of each year to reduce the possibility of the look-ahead bias and, ensuring that the accounting data had been publicized prior to their formation. The source of the data was Bloomberg.

The initial sample consisted of 3427 company-years, an average of 343 companies per year in the ten years of the sample, ranging between 172 and 427. Financial firms have been excluded because their high leverage probably does not have the same meaning as in non-financial firms, in which high leverage may mean financial hardship. This resulted in the exclusion of 502 company-years from the sample. Subsequently, companies that did not have a market value at the end of year  $t-1$  and on the date of portfolio formation in year  $t$  were excluded, as this variable is necessary to calculate the parameters required for portfolio formation, resulting in the deletion of 878 companies-year. Companies with negative or zero book equity at the end of year  $t-1$  were also excluded, according to the methodology of Fama and French (1992), leading to the exclusion of 199 company-years.

The next filter excluded 221 company-years that did not have the necessary data to calculate the F-Score. Finally, 171 company-years that did not have consecutive monthly quotations in the 12 months prior to and 12 months after the portfolio formation date were also excluded, which reduces the effects of illiquidity and enables portfolio rebalancing (Machado and Medeiros, 2014). In case a company has more than one type of stock, the most liquid one was used. The average number of companies analyzed per year was 146 after this filtering (ranging between 74 and 180), which is close to 149 per year for Machado and Medeiros (2014).

#### 3.2 F-Score calculation

This section reports on the adaptations made to the Piotroski (2000) methodology to adjust it to the reality of the Brazilian market. Each scored statement in the F-Score received a value of 0 or 1 and is identical to what was presented in Table 1 that depicts the author's original procedure. The first difference from the original method is that the portfolios were formed at the end of June of each year, to be compatible with the factor calculation method of the Fama and French (1993) and Carhart (1997) models, while Piotroski (2000) formed them in early May. The second difference is that this article did not constrain the sample only to value stocks, such as in Piotroski (2000), because the Brazilian sample is much smaller than the US one and also because the existence of a value premium in Brazil is controversial according to some authors (Medeiros and Bressan, 2015; Machado and Medeiros, 2014; Rayes et al.; 2012). The third and last difference was in the way companies were classified as High (HF) and Low F-Score (LF). In this article the scores corresponding to High (HF) and Low F-Score are different. Piotroski (2000) classified as HF the companies with a score greater than or equal to 8 whereas this article classified companies with F-Score greater than or equal to 7 as HF. Companies classified as LF had an F-Score less than or equal to 4 in this article while Piotroski (2000) classified as LF those scoring less than or equal to 1. The other companies were classified as Medium F-Score (MF).

This third modification was introduced due to the smaller size of the Brazilian sample that would lead to very few companies classified as High and Low F-Score if the original Piotroski (2000) limit scores had been employed. The LF portfolio would have only one company per year in 7 out of 10 years and HF less than 10 companies in 5 out of 10 years if the classification proposed by Piotroski (2000) was applied to the Brazilian sample in this article. On average, 26%, 44% and 30% of the sample was classified each year as HF, MF and LF, respectively. These proportions were very close to the 30%, 40% and 30% proportions used in the portfolios formed to estimate the risk factors of the Fama and French (1993) and Carhart (1997) models described below. Detailed counts of the number of companies for each F-Score item and by year for each method are available from the authors.

### 3.3 Risk-adjustment models and hypotheses

Regressions with monthly returns for the HF and LF portfolios were estimated for the entire sample period (July 2008 to June 2018) and a sub-period from the full adoption of IFRS (July 2011 to June 2018) according to Equations 1, 2 and 3 for the CAPM, Fama and French (1993) three-factor model and Carhart (1997) four-factor model, respectively. Regressions were estimated using the ordinary least squares method with robust standard errors for heteroscedasticity to verify if the estimated alphas of the equally weighted HF and LF portfolios were positive and significant, as well as that for the series of monthly differences between the HF and LF (HMLF) portfolios, as in Hyde (2018, 2014).

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i \times (R_{m,t} - R_{f,t}) + \varepsilon_{i,t} \quad \text{Eq. 1}$$

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i \times (R_{m,t} - R_{f,t}) + s_i \times \text{SMB}_t + h_i \times \text{HML}_t + \varepsilon_{i,t} \quad \text{Eq. 2}$$

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i \times (R_{m,t} - R_{f,t}) + s_i \times \text{SMB}_t + h_i \times \text{HML}_t + w_i \times \text{WML}_t + \varepsilon_{i,t} \quad \text{Eq. 3}$$

$R_{i,t}$ ,  $R_{f,t}$  and  $R_{m,t}$  are the month  $t$  returns of portfolio  $i$ , the risk free rate, and the Ibovespa stock index, respectively, with  $\varepsilon_{i,t}$  being the corresponding error term in Equations 1, 2, and 3.  $\alpha_i$  is the estimated intercept of the regression that denotes the excess risk-adjusted return of portfolio  $i$ .

The first risk factor in Equations 1, 2 and 3 is the market risk premium (MRP), which is the difference between the observed return for the Ibovespa index ( $R_{m,t}$ ) and the Interbank Certificate of Deposit (CDI) rate for each month ( $R_{f,t}$ ), which stands as the risk-free rate. The Ibovespa index represents the market portfolio because it is the older and most followed Brazilian index, has a 0.99 correlation with the Brazil 100 Index (IBrX 100), which is broader and would be an alternative, is used in many Brazilian studies (Roquete et al., 2018). Thus, using any of these two indices would probably yield nearly the same results. An equally weighted portfolio of the stocks used to compute the four risk factors had a correlation of 0.83 with the Ibovespa and 0.82 with the IBrX 100. Thus, a value-weighted portfolio of these stocks would behave very similarly to these market indices.

The CDI rate is a repo rate and represents the risk-free rate because it is the most widely used benchmark, included as a comparative in the factsheets of almost all types of funds, stands as an opportunity cost in the Brazilian market, and behaves very closely to the federal government treasury bill rate, with a correlation of 0.99, even though it is not directly subjected to the monetary policy base treasury rate (Roquete et al., 2018).  $\beta_i$  is the coefficient of the MRP factor for portfolio  $i$ .



The sample stocks were ordered according to their market value in June of year  $t$ . The ordered sample was then divided into three groups that were named Big (30% of the sampled companies with the highest market value), Medium (next 40%) and Small (remaining 30% of the sampled companies with the lowest market value).  $SMB_t$  is the second risk factor, present in Equations 2 and 3, and is the difference between the equally weighted portfolios comprised of the Small and Big stocks.  $s_t$  is the coefficient of the SMB risk factor. This procedure is an adaptation of the one in Fama and French (1993) and analogous to that of several Brazilian authors (Roquete et al., 2018; Mussa et al., 2012; Rayes et al., 2012; Machado and Medeiros, 2011, for example). The calculation of the two remaining risk factors described below is similar.

The stocks in the sample were also ordered in June of year  $t$  according to the book-to-market ratio (BTM), which is the ratio of book equity to the market value of the company in December of year  $t-1$ . The sample was then divided into three groups named High (30% of the sampled companies with the highest BTM), which represents value stocks, Medium (next 40%) and Low (remaining 30% of the sampled companies with the lowest BTM), which represents growth stocks.  $HML_t$  is the third risk factor present in Equations 2 and 3 and is the difference between the equally weighted portfolios of the High and Low shares and  $h_t$  is its coefficient.

Finally, a new ordering of the sample was made according to the accumulated return over the last 12 months ending in June of year  $t$  excluding this month to avoid the bid-ask bounce, thus considering an 11-month window. The sampled stocks were rated Winners (the 30% with the highest cumulative returns in the 11-month window), Neutral (next 40%) and Losers (remaining 30% with the worst cumulative returns in the 11-month window).  $WML_t$  is the fourth risk factor, present only in Equation 3, and is the difference between the monthly returns of the equally weighted portfolio of the Winners and Losers portfolios and  $w_t$  is its coefficient.

The hypotheses derived from the literature review and tested in this article are that (H1) the HF portfolio posts higher average or median returns than the LF portfolio, even though (H2) HF and LF alphas are not significant after the adjustment of the Carhart (1997) model. The evidence in Hyde (2014) and Piotroski (2000), for the F-Score, and in Abarbanell and Bushee (1998) and Arnott et al. (2005), for fundamentals in general, among others, supports H1. The notion that a simple scoring method such as the F-Score offers positive and significant alphas consistently even after adjusting for well-known risk factors would indicate the inadequacy of the Carhart (1997) asset pricing model, and the evidence in Hyde (2018), for the F-Score, suggests that this does not happen and supports H2.

## 4. Results

### 4.1 Risk factors discussion

Table 2 shows descriptive statistics for the key portfolios and risk factors in the 120-month sample period from July 2008 to June 2018 as well as in the 84-month sample of the sub-period initiating in 2011. The MRP did not show an average significantly different from zero over the period but reached the highest volatility among the risk factors considered. This result indicates a period in which the stock market failed to achieve a cumulative return higher than the CDI rate, which is consistent with what Daltro and Leal (2019) report.

Table 2

#### Descriptive statistics of the returns of selected portfolios

Portfolio	Mean	Median	SD	M/SD	Min	Max
<b>Panel A: July 2008 to June 2018 (120 months)</b>						
SMB	-0.55	-1.16**	4.76	-0.11	-10.86	16.25
HML	-0.01	-1.00	4.48	0.00	-8.27	20.15
WML	1.14**	2.20**	5.38	0.21	-21.53	11.02
MRP	-0.52	-0.76	6.59	-0.08	-25.60	18.60
HF	1.03**	1.43**	5.52	0.19	-24.71	20.74
MF	0.85	0.70	6.79	0.12	-24.93	34.24
LF	0.35	0.37	8.47	0.04	-32.73	37.52
HMLF	0.68*	1.04**	4.27	0.16	-16.78	14.64
<b>Panel B: July 2011 to June 2018 (84 months)</b>						
SMB	-0.85*	-1.16**	4.76	-0.11	-8.95	16.25
HML	-0.02	-0.99	4.67	0.00	-8.27	20.15
WML	1.58**	2.67**	5.29	0.30	-21.53	11.02
MRP	-0.45	-0.98	6.18	-0.07	-13.75	18.60
HF	0.70	0.97*	4.32	0.16	-9.42	11.58
MF	0.63	0.35	5.48	0.12	-9.76	18.97
LF	0.07	-0.05	6.34	0.01	-13.64	22.58
HMLF	0.63*	1.05**	3.24	0.19	-11.18	8.42

**Note.:** All figures are percentages. The second period corresponds to that in which the convergence to international accounting standards had already been fully realized for Brazilian publicly traded companies. SMB (small minus big) is the monthly risk premium for small company stocks. HML (high minus low) is the risk premium for stocks with the highest book equity over their market value. WML (winners minus losers) is the risk premium for stocks with the highest cumulative returns in the previous 12 months. MRP is the market risk premium calculated as the difference between the Ibovespa return and the CDI rate for each month. HF is the portfolio of the companies with F-Score greater or equal to 7, LF is the portfolio of companies with F-Score less or equal to 4, and MF contains the other companies. HMLF is the difference between HF and LF portfolio returns in each month. Mean is the arithmetic average of monthly returns. Median is the median of monthly returns. Min and Max are the minimum and maximum monthly returns. SD is the standard deviation of monthly returns. M/SD is the relationship between the arithmetic mean and standard deviation of monthly returns. The Shapiro-Wilk normality test, not shown, rejected normality of all series depicted in the table. \*\* and \* denote that the mean is significantly different from zero according to a two-tailed t-test as well as that the median is significantly different from zero according to a Wilcoxon signed rank test at the 5% and 10% levels, respectively. The mean number of companies per year in HF, MF, and LF is 36.0, 60.1, and 41.2, respectively.

The average and median of the SMB factor are negative and reveal that larger companies performed better in the sample period, consistently with the Brazilian evidence of Cordeiro and Machado (2013), Mussa, Famá and Santos (2012), Machado and Medeiros (2011), among others, while contradicting the seminal US evidence in Fama and French (1993) for a much longer period. The absence of statistical significance for the mean of SMB confirms Machado, Faff and Silva (2017), Cordeiro and Machado (2013), Rayes et al. (2012) and Machado and Medeiros (2011) in Brazil and Alquist, Israel and Moskowitz (2018), which revealed negative statistical significance for other countries. It is also possible that the liquidity filters applied here excluded the stocks of smaller companies whose returns are naturally crucial to the size premium. In addition, Alquist et al. (2018) and Asness et al. (2018) claim that the size premium is not robust or statistically significant and is due to illiquidity, very small companies, the January effect or data mining.

The average HML factor in Panel A of Table 2 is basically zero over the period and corresponds to the results of several Brazilian authors suggesting some persistence of null or even negative premiums for value stocks in Brazil (Medeiros and Bressan, 2015; Machado and Medeiros, 2014; Cordeiro and Machado, 2013; Rayes et al., 2012; Machado and Medeiros, 2011). However, this is contrary to the seminal evidence in Fama and French (1993) and the Brazilian evidence in Mussa et al. (2011).

The average WML was positive and significant and the highest among the four factors of Carhart (1997), indicating persistence of positive returns among Brazilian companies, which corresponds to the evidence reported by several Brazilian (Machado et al., 2017; Machado and Medeiros, 2014; Machado and Medeiros, 2011) and international authors (Carhart, 1997), but contradicts Mussa et al. (2012), who did not find significance for the momentum risk factor.

Even though these results are consistent with various conjectures presented in the literature, the 10-year period analyzed is relatively short for substantive interpretations of each risk factor and this is not the purpose of this article anyway. Moreover, Welch and Goyal (2008) state that most models that attempt to predict returns do poorly out of the sample and are unstable over time, which is corroborated by Bahrami, Shamsuddin and Uylangco (2018) in emerging markets. Consequently, the results to be presented should be interpreted taking these warnings about the risk factors into consideration.

## 4.2 Descriptive statistics for the F-Score

Panel A of Table 2 shows that HF had a higher mean return and a lower standard deviation than MF and LF. The HMLF portfolio, which is the difference between the returns of HF and LF, offered a positive and marginally significant return, which is lower than HF. The standard deviation of the HF portfolio is lower than that of MF and LF, but is higher than that of HMLF.

Additional descriptive statistics in Panel B of Table 2 depict the period between July 2011 and June 2018 when the international convergence of accounting standards had already been fully accomplished. Overall, the results are consistent with those for the period beginning in July 2008, except for the loss of significance of the average monthly return on the HF portfolio, but not of its median return. The smaller values of the standard deviations of the HF, MF, LF and HMLF portfolios are also noticeable. Apparently, convergence to the international accounting standard did not substantially affect these initial results.

Portfolios of companies with good accounting fundamentals may offer higher returns with lower volatility, subject to the limitations of the length of the sample period. Thus, the evidence is consistent with H1 that average or median HF returns would be higher than the LF portfolio returns, preliminarily supporting the notion that a portfolio of companies with better fundamentals may outperform portfolios of companies with fundamentals that are not as good.

### 4.3 F-Score portfolios, risk adjustment and alphas

Panel A of Table 3 shows the coefficients of asset pricing models adjusted on the returns of the HF and LF equally weighted portfolios based on the F-Score. Only the HF portfolio exhibited a positive and significant alpha for the three models, consistently with Hyde (2018) for Australia. Moreover, it is worth noting that the alpha significance for the HF portfolio obtained with the CAPM remains even after the additional risk factors of the other models are used. This would probably suggest that the HF portfolio possibly has merit, but the results in Panel B of Table 3, in the IFRS sub-period, show non-significant alphas for HF in all models. Thus, the results in Panel A are probably simply period related and cannot be generalized. The beta coefficient was significant in all models as expected because the MRP continues to be the most important risk factor for portfolios of Brazilian stocks (Medeiros and Bressan, 2015; Machado and Medeiros, 2011). The LF portfolio had a higher beta than HF, also as expected, because the companies in this portfolio have lower quality fundamentals by construction, according to the F-Score, and thus it is not surprising that they present a higher systematic risk. These results are consistent with those of Asness, Frazzini and Pedersen (2019), who show that higher quality companies have lower beta.

Table 3

#### F-Score portfolios, risk adjustment and alphas

Model	Portfolio	$\alpha$	$\beta$	$s$	$H$	$w$	$R^2$ aj.
Panel A: July 2008 to June 2018 (120 months)							
CAPM	HF	0.56*	0.70**	-	-	-	0.68
	LF	0.06	1.04**	-	-	-	0.65
	HMLF	-0.32	-0.34**	-	-	-	0.27
F&F	HF	0.77**	0.67**	0.41**	-0.12	-	0.78
	LF	0.43	0.96**	0.75**	-0.11	-	0.80
	HMLF	-0.47	-0.29**	-0.33**	-0.02	-	0.40
Carhart	HF	0.74**	0.68**	0.44**	-0.11	0.05	0.78
	LF	0.50	0.95**	0.69**	-0.14	-0.10	0.80
	HMLF	-0.59*	-0.26**	-0.23**	0.02	0.16**	0.42
Panel B: July 2011 to June 2018 (84 months)							
CAPM	HF	0.14	0.58**	-	-	-	0.69
	LF	-0.37	0.85**	-	-	-	0.69
	HMLF	-0.31	-0.27**	-	-	-	0.26
F&F	HF	0.29	0.59**	0.17**	-0.02	-	0.72
	LF	0.11	0.86**	0.56**	-0.02	-	0.83
	HMLF	-0.64**	-0.27**	-0.38**	0.00	-	0.51
Carhart	HF	0.31	0.58**	0.16	-0.02	-0.02	0.72
	LF	0.28	0.79**	0.40**	-0.04	-0.21**	0.84
	HMLF	-0.80**	-0.20**	-0.24**	0.02	0.20**	0.56

**Note.:** Regressions estimated with ordinary least squares and robust standard errors with monthly returns. HF is the portfolio of the companies with F-Score greater or equal to 7 and LF is the portfolio of companies with F-Score less or equal to 4. HMLF is the difference between HF and LF portfolio returns in each month. The CAPM, Fama and French 3-factor (F&F) and Carhart models were defined in Equations 1, 2 and 3, respectively. The alpha ( $\alpha$ ) is in percent per month and is the intercept of the regression.  $\beta$  is the coefficient in relation to the market risk premium.  $s$ ,  $h$ , and  $w$  are the coefficients of the size (SMB), value (HML), and momentum (WML) risk factors, respectively. \*\* and \* indicate significance at the 5% and 10% levels, respectively.

The SMB factor coefficient was positive and significant in most cases, indicating that returns on the equally weighted HF and LF portfolios were dominated by those from the smaller and high HF companies, which is consistent with the findings in Galdi and Lopes (2013). Moreover, this coefficient was higher for the LF portfolio indicating that it tends to have smaller companies, which is also consistent with smaller companies having worse fundamentals (Fama and French, 1993). There was no significance for the HML factor coefficients suggesting that companies in the HF and LF portfolios cannot be characterized as value or growth stocks, corroborating evidence that the behavior of this factor in the Brazilian market varies with the period and portfolio studied (Machado et al., 2017; Machado and Medeiros, 2014; Cordeiro and Machado, 2013; Rayes et al., 2012; Machado and Medeiros, 2011). These results are about the same with or without the WML risk factor. Finally, the WML coefficient was negative and significant for the LF portfolio in the sub-period when the full IFRS adoption had been completed, providing some additional evidence that companies that had worse returns in the 12 months prior to portfolio formation dominated the return on the LF portfolio.

The portfolio long in the HF portfolio and short in the LF portfolio (HMLF) showed only a marginally significant and negative alpha for the Carhart (1997) model with all betas negative and significant, suggesting that this is a countercyclical portfolio with a potential for value destruction for the investor. The SMB factor coefficient was also negative and significant, indicating that medium and large companies concentrate stocks with better fundamentals than small companies. Once more, there was no significance for the HML factor coefficients but there was an indication of a momentum effect for HMLF with the positive and significant coefficient for the WML factor. If value-weighted portfolios were employed in lieu of the equally weighted portfolios, which favor smaller stocks, they would sway the results even more towards larger companies. Finally, the other results for the period beginning in July 2011, after completion of the accounting convergence to international standards, are in Panel B of Table 3 and are analogous to those presented in Panel A, with the notable exception of the loss of significance of the HF portfolios alphas.

Overall, these results confirm H2 that states that a high F-Score strategy is not able to generate alpha, even though it presents higher average and median returns and lower total and beta risks. These results, even in the absence of alpha, highlight the importance of corporate accounting fundamentals to investors.

## 5. Conclusions and implications

This article employed the Piotroski (2000) F-Score metric that assesses the quality of a firm's fundamentals to verify if they are related to the generation of abnormal returns. The gradual adoption of the IFRS is included in the sample period that initiates in July 2008 and ends in June 2018. The analysis was repeated for the period between July 2011 and June 2018 in which the adoption of the IFRS for listed companies had been completed. The sample includes an average of 146 companies per year. Equally weighted portfolios were built with companies according to their F-Scores at the end of June of each year with information available at the end of December of the previous year in order to avoid de look-ahead bias.



Only the high F-Score portfolio displayed a positive and significant alpha for the full sample period but it disappeared in the period initiating in 2011. The evidence on the alpha generation potential presented here was not conclusive, as it depended on the period studied and confirms the hypothesis that high F-Score portfolios may not generate alpha. This is consistent with what Hyde (2014) reports for Brazil but not consistent with what Hyde (2018, 2014) reports for other countries. The evidence regarding market risk (beta) was more robust and showed that the portfolio with companies with better fundamentals presented lower beta than the one with worse fundamentals, which is consistent with Asness et al. (2019). The high F-Score portfolio presented greater average and median returns than the low and medium F-Score portfolios, which supports the findings of Abarbanell and Bushee (1998) for greater returns for companies with better fundamentals. Equal weighting and the significant coefficients for the size premium risk factor suggest that large companies do not dominate the return of the high F-Score portfolio, which is in line with the Brazilian findings in Galdi and Lopes (2013). The risk factor of the premium for value stocks was not significant and did not appear to be related to portfolio composition according to the F-Score. The portfolios with the lowest F-Score presented a negative and significant coefficient for the momentum risk factor in the sub-period initiating in 2011, suggesting persistence of negative returns.

These results imply that portfolios composed of companies with higher F-Score and that preferably focus on stocks of medium or smaller companies have the potential to offer an attractive average return with less market risk and a lower risk of catastrophic returns, even though one should not expect to attain a positive and significant alpha. This portfolio is defensive and may be particularly relevant for less sophisticated individual investors that do not have the time, talent and resources to carry out a proper fundamental analysis. The F-Score may also be a criterion to form an index or ETF. The analysis presented herein also contributes to show that a high F-Score portfolio is not a value stock portfolio. This study was also the first to address the F-Score in a period of homogeneous accounting standards for Brazilian listed companies. Finally, it should be noted that the equal weighting of portfolios indicated that companies with good fundamentals and medium size might be a good choice for the investor.

Some suggestions for future research may be set forth. First, as the sample period is always relatively short in Brazil, simulation techniques can be employed on the return series of the F-Score portfolios to obtain an alpha distribution and have a more robust inference about it. Alternatively, it may be that omitted factors explain the achievement of a positive and significant alpha in the full sample period. Examples of candidates for such factors would be the Betting Against Beta (BAB), which reflects the tendency to buy low beta stocks, while avoiding high beta ones, and the Quality Minus Junk (QMJ) factor, which reflects a tendency to buy profitable, growing, safe and high dividend yield companies, proposed by Frazzini and Pedersen (2014) and Asness et al. (2019), respectively. Moreover, the two additional factors of the Fama and French (2015) five-factor model could also be considered. These additional factors would possibly eliminate the significance of alpha in all cases for companies with high F-Score because they also presented lower betas, which is a common feature between these companies and factors.

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