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ARTICLE

Piotroski, Graham and Greenblatt: an Empirical Approach to Value Investing in the Brazilian Stock Market

Carlos Henrique Souza Domingues[1]
carloshenriquedomingues@hotmail.com | 0000-0002-0659-8598

Alexandre Aronne[1]
alexandre.aronne@gmail.com | 0000-0002-2049-0751

Francisco Pereira[1]
fppj07@gmail.com | 0000-0002-6087-0572

Frank Magalhães[1]
frank_magalhaes@yahoo.com.br | 0000-0002-5063-3389

ABSTRACT

In this paper, multifactor asset pricing models are used to assess and compare the performance – through the analysis of Jensen's alpha – of three equity portfolios constructed according to the value investing strategies proposed by Joseph Piotroski, Benjamin Graham, and Joel Greenblatt. Three portfolios are constructed according to the methodologies developed by each author, using financial and accounting data from a sample of 598 stocks traded in the Brazilian stock exchange during the period Jan/2006-Dec/2019. Parameters of a five-factor model – an extended version of Carhart's four factor model with the inclusion of an illiquidity factor – are estimated for each of the three portfolios. Regression results indicate that the three strategies have generated positive and statistically significant Jensen's alpha in the five-factor model setting and other variations. However, the excess returns estimated according to different specifications vary substantially. The Capital Asset Pricing Model specification seems to underestimate Jensen's alpha when compared to other specifications that provide higher explanatory power (adjusted R^2).

KEYWORDS

Value Investing, Jensen's Alpha, Asset Pricing

[1]IBMEC. Belo Horizonte, MG, Brazil

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1. INTRODUCTION

Amongst the various possible principles that can be used to build a stock portfolio, the strategy of value investing has called attention for – allegedly – generating returns above the market in the long run, contradicting the hypothesis of an efficient market. This strategy is based on allocating resources in securities classified as "value stocks", which are issued by good companies that are traded below their intrinsic value.

Graham and Dodd (1934), with his book Security Analysis, was the first author to propose this methodology that, since then, has been adopted by several practitioners, including renowned investor Warren Buffett, the owner of Berkshire Hathaway, one of the biggest investment companies in the world.

In order to select the so-called value stocks, investors typically design screening methodologies which are based on the application of filters on the market, accounting and financial indicators of a large sample of companies. Given the vast number of indicators available, various methodologies can be developed using different filters, according to the individual preferences of each investor. Therefore, it is of fundamental importance to be able to measure and compare the performances of different methodologies.

Jensen (1967) was the first author to analyze the performance of investment strategies implemented by portfolio managers, introducing the analysis of the so-called Jensen's alpha. His analysis was based on the CAPM developed by Sharpe (1964), which was the prevailing asset pricing model at the time. However, the CAPM was later strongly criticized by Fama and French (1992, 1993) and current research argues that multifactor models can better explain returns and excess returns of investment portfolios (Fama & French, 2015).

In this paper, the two areas of research – value investing and multifactor asset pricing models – are combined for the assessment of performance for the three methodologies developed by renowned investors Joseph Piotroski (2000), Benjamin Graham and Jason Zweig (2003), and Joel Greenblatt (2006). Their methodologies were replicated in the Brazilian stock market using data from listed companies during the period 2006 to 2019.

Once the portfolios are constructed, parameters of multifactor asset pricing models are estimated, allowing for the analysis of risk factors associated with each portfolio and the excess return generated by each investment strategy, measured according to the portfolio's Jensen's alpha. Estimation procedures are based on multiple linear regression using ordinary least squares (OLS) with Newey-West tests for correction of heteroscedasticity and autocorrelation and with Variance Inflation Factor (VIF) for multicollinearity, when applicable.

2. RESEARCH PROBLEM AND GOALS

The main goal of this paper is to apply the value investing methodologies developed by Benjamin Graham, Joseph Piotroski, and Joel Greenblatt on the Brazilian stock market, to test if they generate excess return (positive Jensen's alpha) and to compare their performances.

At the best knowledge of the authors, previous value investing research in Brazil is based on the CAPM model, despite the tantamount evidence of its limitations in explaining portfolio returns. The research presented in this paper is justified by the use of multifactor asset pricing models, allowing for more accurate specification of the return generating process of each value investing portfolio and associated estimates, when comparing to the CAPM.

3. LITERATURE REVIEW

In this section a literature review on value investing and performance assessment is presented.

The finance literature contemplates several authors that have been proposing different methodologies to perform stock screening. In this section, the value investing strategies of three well-known authors – Benjamin Graham, Joseph Piotroski and Joel Greenblatt – will be presented and discussed, as well as the main models used for the analysis of performance.

3.1. Piotroski's Value Investing Strategy

Piotroski (2000) developed a fundamentalist analysis based on accounting indicators which focused mainly on companies with high book-to-market ratios and created the now famous F_SCORE index. This index is the sum of nine binary indicators (each of them receiving a score of 1 if they are considered positive/good and 0 if they are negative/bad), which are divided into three categories: i) profitability; ii) leverage, liquidity and source of funds and iii) operating efficiency. Table 1 presents the items considered in each category, as well as their calculation formulas and scoring rationale:

It is worth mentioning that the score rationale of item 4 may seem counterintuitive at first sight, but, as proposed by Sloan (1996), it is a negative sign for companies with a high book-to-market to have net income (and ROA) greater than cash flow generated from operations (and CFO yield), which tends to jeopardize the company's profitability and future returns.

Table 1
Piotroski's F_SCORE

Category	Item Number	Indicator	Formula / Description	Score Rationale
Profitability	**1**	Return on assets (ROA)	(Net income – nonrecurring items)/ total assets in the beginning of the year	Positive: 1 Negative: 0
	2	Cash flow from operations yield (CFO)	Cash flow from operations/total assets in the beginning of the year	Positive: 1 Negative: 0
	3	Yearly evolution of ROA	$ROA_t - ROA_{t-1}$	Positive: 1 Negative: 0
	4	Provisions	ROA – (CFO/total assets in the beginning of the year)	Positive: 0 Negative: 1
Leverage, liquidity and source of funds	**5**	Yearly evolution of long-term debt to average asset ratio	$(\text{Long term debt}_t/\text{Average asset}_t) - (\text{Long term debt}_{t-1}/\text{Average Asset}_{t-1})$	Positive: 1 Negative: 0
	6	Yearly evolution of current assets to current liabilities ratio	$(\text{Current assets}_t/\text{current liabilities}_t) - (\text{Current assets}_{t-1}/\text{current liabilities}_{t-1})$	Positive: 0 Negative: 1
	7	Funding sources	Issue of new shares	Positive: 0 Negative: 1
Operating Efficiency	**8**	Yearly evolution of gross margin	$(\text{Gross profit}_t/\text{net revenue}_t) - (\text{Gross profit}_{t-1}/\text{net revenue}_{t-1})$	Positive: 1 Negative: 0
	9	Asset turnover	$(\text{Net revenue}_t - \text{net revenue}_{t-1})$/total asset in the beginning of the year	Positive: 1 Negative: 0

Source: Elaborated by the authors.

Once the indicators are computed, one can obtain the score of the stock under analysis – which can vary in the range of a minimum of 0 and a maximum of 9. The F_SCORE is expected to be positively correlated with changes in the company's future performance and with the returns offered by the company's stocks. Companies that receive a score of 8 or 9 are classified as winners and those that receive 0 or 1 are considered losers.

Piotroski (2000) has provided an important contribution to the area of value investing, demonstrating that, using his strategy during the period 1976 to 1996, it would be possible to increase the return of a portfolio composed of stocks with a high book-to-market by at least 7.5% annually. Furthermore, the author showed that by buying the shares that obtained the best grades, from 5 to 9, and selling the ones with the worst results, from 0 to 4, the portfolio would have an average annual return of 23% during the period above mentioned.

3.2. Graham's Value Investing Strategy

Graham and Zweig (2003) is another author of great importance in the context of value investing. He is commonly known as the father of the strategy and the mentor of Warren Buffett – his most famous and successful student. In his first book – Security Analysis, published in 1934 – Graham and Dodd (1934) has coined one of the most valuable concepts in finance: the Safety Margin. According to Graham and Dodd (1934) the lower the purchase price of a stock compared to its intrinsic value, the greater the Safety Margin. In his second book – The Intelligent Investor, published in 1949 – Graham and Zweig (2003) presents a concise guide to help investors with their investment strategies, guiding against areas of substantial errors and aiming for satisfactory returns in the long term.

Furthermore, Graham and Zweig (2003) suggests the application of some filters – presented in Table 2 – to find companies with the following features: strong balance sheet, profitable, and undervalued.

Table 2
Graham's Filters

Item Number	Indicator	Formula / Description
1	Revenue	Not less than US$ 100 million in annual sales
2	Current Ratio	Current assets to current liabilities (CA/CL), greater than or equal to 2
3	Net Income	Absence of loss in the last 10 years
4	Dividend Payout	Payment of dividends in the last 20 years
5	Net Income Growth	Nominal net income growth of 30% in the last 10 years
6	P/E Ratio	Price-to-earnings ratio (P/E) equal or lower than 15
7	P/B x P/E	The multiplication of price-to-book ratio (P/B) by the price-to-earnings ratio (P/E) must not be greater than 22.5

Source: Elaborated by the authors.

3.3. Greenblatt's Value Investing Strategy

More recently, the work of Joel Greenblatt (2006) has received attention. In his book The Little Book That Beats the Market, he presents the so-called Magic Formula, the name he attributed to his strategy for stock selection. His investment strategy, based on value investing, is focused on buying above-average (highly profitable) companies at below-average (cheap) prices.

To accomplish that, he ranks companies based on two indicators, ROIC (Return on Invested Capital) and EV/EBITDA (Enterprise Value to EBITDA). That said, he creates two rankings in which each company receives a position based on their respective indicators, with 1 being the best and so on. Then he mergers the two rankings into a third one and buys the top 20 - 30 stocks.

In line with the philosophy of value investing, the author focuses on the long term and points out that the Magic Formula may not work in the short term, which may result in many (or most) investors not following the proposed strategy, given their preference for short term returns.

The results presented by Greenblatt were consistently above the market over the 17 years period analyzed (1988 to 2004), with an annualized return of 22.5% when no restrictions are considered on any filter. According to the author, his investment strategy offers returns which are higher than those offered by the S&P 500 index in at least 96% of the period. As a manager at Gotham Capital – an American Investment Company – Greenblatt achieved an average annualized return of 40% between 1985 and 2006.

3.4. Performance Analysis of Managed Portfolios

The CAPM developed by Sharpe (1964) was the first risk and return model used in the assessment of performance of investment strategies. The model is based on the linear relationship between systematic risk and expected return of any financial asset within an efficient market. In other words, the model suggests that for a given level of risk, it is not possible – on average – to obtain higher return levels than what is expected for the amount of risk taken. The specification of the CAPM is presented in equation (1):

$$R_{i,t} - R_{f,t} = a_i + \beta_i (R_{M,t} - R_{f,t}) + \varepsilon_{i,t} \quad (1)$$

where:

$R_{i,t}$ = the return of portfolio i in month t;

$R_{f,t}$ = the return of the risk-free asset in month t;

$R_{M,t}$ = the return of the market portfolio in month t;

a_i = the intercept of the regression equation for portfolio i (or Jensen's alpha);

β_i = the slope of the regression equation for portfolio i (traditionally called beta);

$\varepsilon_{i,t}$ = the error term (assumed to be a white noise process with normal distribution, zero mean and constant variance).

Jensen (1967) was the pioneer in using the CAPM to measure the performance of investment strategies, estimating the intercept of the regression, which became known as Jensen's alpha in this context. Strategies that present statistically significant alpha would be the ones that generate excess returns with respect to the expected returns. Such methodology continues to be adopted nowadays and has been applied in the brazilian context, as presented in section 3.8.

3.5. Fama and French Three-Factor Models

Taking the CAPM model as reference, Fama and French (1992) proposed their now famous three-factor model in which expected returns are explained as a function of the market factor (Rm - Rf) used in the CAPM and two additional factors: i) the book-to-market factor (High Minus Low – HML), which suggests that high book-to-market companies (value stocks) tend to

outperform low book-to-market companies (growth stocks) and ii) the size factor (Small Minus Big – SMB), which suggests that small and mid-cap stocks tends to outperform large-cap stocks. Equation (2) presents the specification proposed by Fama and French (1992):

$$R_{i,t} - R_{f,t} = a_i + \beta_i (R_{M,t} - R_{f,t}) + H_i (HML_t) + S_i (SMB_t) + \varepsilon_{i,t} \quad (2)$$

where:

HML_t = return obtained by buying stocks with high P/B ratio and selling stocks with low P/B ratio in month t;

SMB_t = return obtained by buying stocks with small market cap and selling stocks with high market cap in month t;

S_i = coefficient of the SMB factor for portfolio i; and

H_i = coefficient of the HML factor for portfolio i.

It is worth mentioning that Fama and French (1993) have presented strong evidence against the CAPM based on empirical features of the data which cannot be captured nor explained by the single factor model, the so-called anomalies.

3.6. Carhart's Four-Factor Model

Carhart (1997) proposed an extension of the Fama and French (1992) model with the addition of a momentum factor (Winners Minus Losers – WML), representing the return of a portfolio composed of long positions on stocks that have performed well in the last 12 months and a short position on stocks that have performed poorly. Equation (3) represents the four-factor model:

$$R_{i,t} - R_{f,t} = a_i + \beta_i (R_{M,t} - R_{f,t}) + H_i (HML_t) + S_i (SMB_t) + W_i (WML_t) + \varepsilon_{i,t} \quad (3)$$

where:

WML_t = return obtained by buying stocks that have performed well in the last 12 months and selling stocks that have performed poorly in month t; and

W_i = coefficient of the WML factor for portfolio i.

3.7. Five-Factor Model

Liu (2006) argues that, in addition to the traditional factors of Fama and French (1993), a liquidity factor is relevant in the context of asset pricing models. The author tested a two-factor model composed of the market factor (Rm - Rf) and a liquidity factor (Illiquid Minus Liquid – IML), obtaining results which indicate the existence of a liquidity premium in stocks expected returns.

Lam and Tam (2011) have further corroborated the results obtained by Liu (2006) regarding the influence of a liquidity premium on the expected stock returns, suggesting that the best way to explain asset returns traded on the Hong Kong stock exchange is through a four-factor model (market, size, book-to-market, and liquidity factors), since the momentum factor has not proved to be a good explanatory variable in their study.

The five-factor model coupling Carhart's (1997) four-factor model with the liquidity factor proposed by Liu (2006) is represented in equation (4).

$$R_{i,t} - R_{f,t} = a_i + \beta_i (R_{M,t} - R_{f,t}) + H_i (HML_t) + S_i (SMB_t) + W_i (WML_t) + I_i (IML_t) + \varepsilon_{i,t} \quad (4)$$

where:

IML_t = represents the return obtained of a portfolio composed of long position in illiquid stocks and short position in liquid stocks in month t; and

I_i = coefficient of the IML factor for portfolio i.

3.8. Empirical Value Investing Studies in Brazil

The value investing methodologies proposed by the renowned investors detailed in the previous sections have been applied and tested in the Brazilian context. These applications have shown the need for adjusting some of the thresholds of the filters used in the stock screening process. Table 3 presents an overview of the research on value investing in the Brazilian market:

Table 3
Empirical Value Investing Studies in Brazil

Study	Author(s)	Year	Key Findings
Estratégias de Investimento em Bolsa de Valores: Uma Pesquisa Exploratória da Visão Fundamentalista de Benjamin Graham	Passos and Pinheiro	2006	The author built 3 equity portfolios based on Graham's proposition for the period of 1994-2005 (backtest from 2001-2005). Two of them offered returns which are 2.5 and 3.0 times greater than the return provided by the Ibovespa index in the same period.
O Canto da Sereia: Aplicação da Teoria de Graham na BM&FBOVESPA	Testa and Lima	2012	The restrictiveness of Graham's filters would have to be reduced due to the impossibility of building a diversified portfolio, since only a small number of companies would satisfy all of the original restrictions of the method. The authors have not found any abnormal return during the period of 2004 to 2009 when using Graham's (adapted) methodology.
Eficiência do Mercado de Capitais Brasileiro na Aplicação das Teorias de Graham, Greenblatt e Lynch	Santos	2016	Considering the period 2005-2015, Graham´s methodology has not provided an abnormal return. On the other hand, portfolios built using Greenblatt's and Lynch's methodologies have provided excess returns.
Estratégia de Investimento Baseada em Informações Contábeis: Teste Empírico do Score de Piotroski no Mercado Brasileiro	Baldo	2016	Considering the period 2005-2015, the portfolio built using Piotroski's methodology has presented excess returns in the Brazilian market.

Source: Elaborated by the authors.

An important limitation of the above-mentioned studies is the use of the CAPM as the benchmark risk-return model. As previously discussed, multifactor models have the potential to better explain the returns of different value investing methodologies, as these investment strategies can, eventually, be based on exploring risk factors – such as those developed by Fama and French (1992), Carhart (1997) and Liu (2006) – whose effects cannot be captured by the single-factor CAPM.

4. METHODOLOGY AND DATA

In this section, the methodology used to construct the portfolios and to perform the statistical analysis of their returns is detailed and the data used in the study is presented.

4.1. Data

The database used encompasses the accounting, financial, and market data of companies listed on the Brazilian stock exchange for the period Jan/2006-Dec/2019. The use of this period has two justifications: i) value investing strategies are based on the long term; ii) many indicators needed for the implementation of the value investing methodologies were not available in our data source before 2006.

Data were obtained from Economatica on April 1st, 2020. Companies in the financial sector – such as banks, card processing, and insurance companies – were removed from the sample, since their financial statements differ greatly from the other sectors of the economy. Companies that did not have data available were also excluded specifically for the period when data were not available. After these exclusions, a sample composed of 598 securities was obtained.

In addition, only economic and financial data available at the time of the construction of the portfolios were used. For example, a portfolio constructed at the end of 1Q2010 is based on the accounting data available on Jan/2010, and not the accounting data reported for the first quarter of 2010, which would only be available after the end of 1Q2010. This procedure aims at guaranteeing that the portfolios are created using data that was already available at the time the portfolios are constructed.

The methodology is based on three steps:

i. Construction of the value investing portfolios according to the methodologies proposed in the literature and adapted to the Brazilian market;
ii. Estimation of the coefficients of three concurrent models:
    c. the five-factor model;
    d. the multifactor adjusted model (the specification which excludes regressors whose coefficients are not statistically significant at the 90% confidence level);
    e. the CAPM.
iii. Hypothesis testing related to the estimated coefficients and comparison between the portfolio's alpha coefficients.

4.2. Construction of the Value Investing Portfolios

It is important to note that, due to the limitation of the Brazilian market regarding the number of companies listed on the stock market, their respective trading volume and liquidity, the amount of available information, market maturity and restrictiveness of the filters, the parameters initially proposed by Piotroski (2000), Graham & Zweig (2003) and Greenblatt (2006) have been slightly changed to better reflect the context of the this study, as the original parameters used by these authors would lead to the selection of a small number of securities for the portfolio. The portfolios were named Piotroski's Portfolio, Graham's Portfolio, and Greenblatt's Portfolio, based on the names of the pioneer authors.

In this work, the construction of Piotroski's Portfolio followed the methodology described in section 3.1. Additionally, the portfolio has been rebalanced with quarterly frequency, in contrast with Piotroski's original work which considered annual rebalancing.

With respect to the book-to-market ratio, the studied companies were grouped into quintiles, the ones located at the fifth quintile having the highest book-to-market ratios. The composition of the portfolio was made by companies located in the two largest quintiles (considered cheap) and with scores greater than or equal to 7 (considered winners).

As suggested by Baldo (2016), the definition of winners was expanded from 7 to 9, as opposed to the range from 8 to 9 used in the pioneer study. The selection of the book-to-market indicator was also expanded, from the largest quintile to the second largest quintile. The expansions are intended to adapt to the Brazilian market, otherwise the filters would be too restrictive, greatly impacting the number of selected companies.

The construction of Graham's Portfolio relied on the use of the adaptation of the filters to the Brazilian market developed by Testa and Lima (2012). The adjusted filters are:

i. revenue greater than R$ 300 million;
ii. current liquidity: current assets to current liabilities greater than or equal to 1;
iii. no accounting losses within the last 10 years;
iv. dividend payments in the last quarter;
v. 30% of nominal increase on the net income over the last 10 years;
vi. P/E ratio lower than 15; and
vii. P/B times P/E lower than 22.5.

The constructed portfolio consists of securities that pass at least six of the seven filters simultaneously.

The third portfolio, based on Greenblatt's methodology, consists of ranking companies based on two indicators, ROIC (Return on Invested Capital) and EV/EBIT (Enterprise Value to EBIT). Following the pioneer author's methodology, securities with EV/EBIT lower than 5 and with market value less than R$ 160 million – which is equivalent to approximately US$ 40 million considering an average exchange rate for the period May/2018-May/2020 of R$/US$ of 4.10 – were excluded from the sample.

Another adaptation of the methodology to the Brazilian context was the reduction of the minimum ROIC level from 25% to 20%. Using these criteria, two rankings are created: one that classifies companies with high ROIC first and another that classifies companies with low EV/EBIT first.

A final ranking is then constructed by summing up the positions obtained by each company in the ROIC and EV/EBIT rankings. Finally, as suggested by Greenblatt (2006), the number of securities in the portfolio was limited between 20 to 30 companies best placed in the final ranking.

4.3. Estimation of Parameters of Multifactor Asset Pricing Models

Following the construction of the value investing portfolios, three different specifications were estimated for each portfolio: the five-factor specification, the adjusted model specification (the specification which contains all the statistically significant parameters, at least, at the level of 10%) and the CAPM. Estimation was performed using OLS with the correction of heteroscedasticity and autocorrelation through the Newey-West procedure. Multicollinearity diagnostics relied on VIF (Variance Inflation Factor) tests.

4.4. Hypothesis Tests and Comparison of Estimated Alphas

Following the procedures mentioned above, Student's t- tests were performed on each portfolio. The hypotheses of the work are:

- **H0:** *Jensen's alpha* = 0
- **H1:** *Jensen's alpha* > 0

Finally, the Jensen's alpha of the 3 portfolios were compared to determine which strategy presented higher excess return over the investment period.

5. RESULTS

In this section, the results obtained are presented and discussed.

5.1. Piotroski's Portfolio

Figure 1 presents the number of companies of Piotroski's Portfolio during each quarter of the studied period:

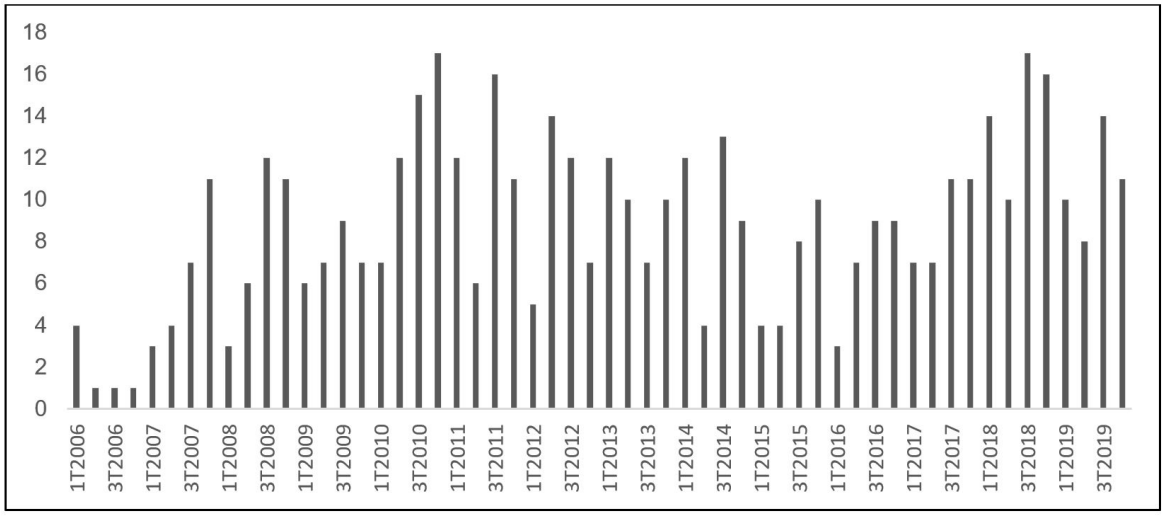

Figure 1. Number of Securities in Piotroski's Portfolio
Source: Elaborated by the authors.

Even with the expanded definition of winners and book-to-market indicator, Piotroski's Porfolio have presented the lowest number of companies on its portfolio, when compared to other portfolios. Piotroski's Portfolio had, on average, 9 securities.

Table 4 presents the results of the five-factor model regression for Piotroski's Portfolio:

The results indicate that, for Piotroski's Portfolio, only α, β and *S* have a statistically significant coefficient (at least) at the 90% confidence level, according to the obtained t-statistics. Therefore, it was possible to conclude that the portfolio generated a higher than expected return (with respect to the risks taken), of 4.83% per year in the period from 2006 to 2019. Nevertheless, the market factor coefficient β of roughly 0.58 indicates a lower exposure to market risk.

Table 5 presents the results of the adjusted model regression for Piotroski's Portfolio:

Table 4
Five-Factor Regression for Piotroski's Portfolio

Coefficient	Estimate	t-statistic	Adjusted R^2
α	0.0483 ***	5.3274	0.5477
β	0.5738 ***	3.7510	
H	0.0163 ***	0.1473	
S	0.4886 ***	1.5762	
W	-0.1341 ***	-0.8160	
I	0.0395 ***	0.1363	

Note: *p<0.1; **p<0.05; ***p<0.01
Source: Elaborated by the authors.

Table 5
Adjusted Regression for Piotroski's Portfolio

Coefficient	Estimate	t-statistic	Adjusted R^2
α	0.0454 ***	4.9880	0.5673
β	0.5909 ***	4.3924	
S	0.5944 ***	4.8513	

Note: *p<0.1; **p<0.05; ***p<0.01
Source: Elaborated by the authors.

The positive SMB coefficient *S* indicates that the portfolio is exposed to small companies with low market value, corroborating the results found by Piotroski (2000) and in contrast to those obtained by Baldo (2016). This specification results in a slightly increase in the Adjusted R^2.

From 2006 to 2019, Piotroski's Portfolio generated a return of 3,864%, which is equivalent to an annualized return of 30,06%. In the same period, the Ibovespa appreciated 246%, generating an annualized return of 9,26%.

5.2. Graham's Portfolio

Figure 2 presents the number of companies of Graham's Portfolio during each quarter of the studied period:

Graham's Portfolio had an average number of companies slightly higher than Piotroski's. Nonetheless, the restrictiveness of the filters used has led to the selection of a small number of securities in some periods, such as 2Q 2007, when only one company was selected, which goes against Graham's diversification pillar. Graham's Portfolio had, on average, 10 securities.

The results obtained are in line with Testa and Lima (2012) who argue that the number of selected companies using Graham's methodology has increased after the 2008 financial crisis.

Table 6 presents the results of the five-factor model regression for Graham's Portfolio:

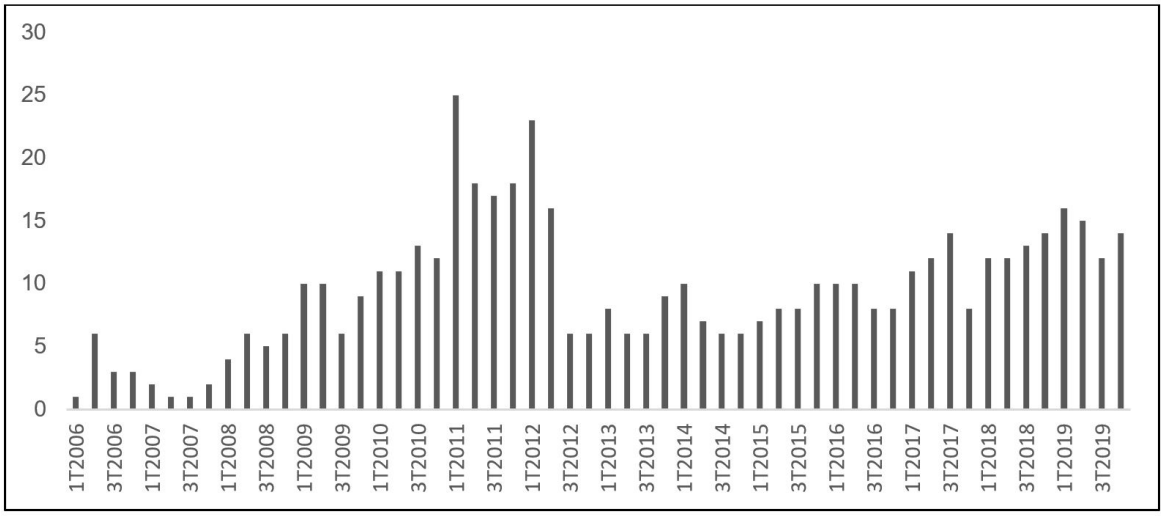

Figure 2. Number of Securities in Graham's Portfolio
Source: Elaborated by the authors.

Table 6
Five-Factor Regression for Graham's Portfolio

Coefficient	Estimate	t-statistic	Adjusted R^2
α	0.0476 ***	2.8692	0.4482
β	0.9968 ***	4.8671	
H	-0.2964 ***	-1.5759	
S	0.4604 ***	0.7998	
W	0.2707 ***	1.8314	
I	-0.1158 ***	-0.2385	

Note: *p<0.1; **p<0.05; ***p<0.01
Source: Elaborated by the authors.

Based on the t-statistics, results indicate that only α, β and *W* were statistically significant (at least) at the 90% confidence level. The portfolio generated excess return with respect to the expected return (adjusted for risks) of 4.76% per year. It is worth noticing that the portfolio carries the same level of systematic risk than the Ibovespa, as the β of the portfolio is roughly equals to 1.0.

Table 7 presents the results of the adjusted model regression for Graham's Portfolio:

Table 7
Adjusted Regression for Graham's Portfolio

Coefficient	Estimate	t-statistic	Adjusted R^2
α	0.0490 ***	2.7154	0.4359
β	1.0387 ***	7.2949	

Note: *p<0.1; **p<0.05; ***p<0.01
Source: Elaborated by the authors.

Furthermore, since only the β coefficient proved to be significant, the adjusted model for Graham's Portfolio is the CAPM. The portfolio's total return was 7,412% in the studied period, while Ibovespa's was 246%. In terms of annualized returns, the portfolio had an average return of 36.14%, against 9.26% from Ibovespa. It is also important to highlight the slightly decrease in the Adjusted R^2.

The results obtained contrast with the findings of Testa and Lima (2012) and Santos (2016) since their value investing portfolios have generated positive – but not statistically significant – excess returns with respect to the Ibovespa.

5.3. Greenblatt's Portfolio

Figure 3 presents the number of companies of Greenblatt's Portfolio during each quarter of the studied period:

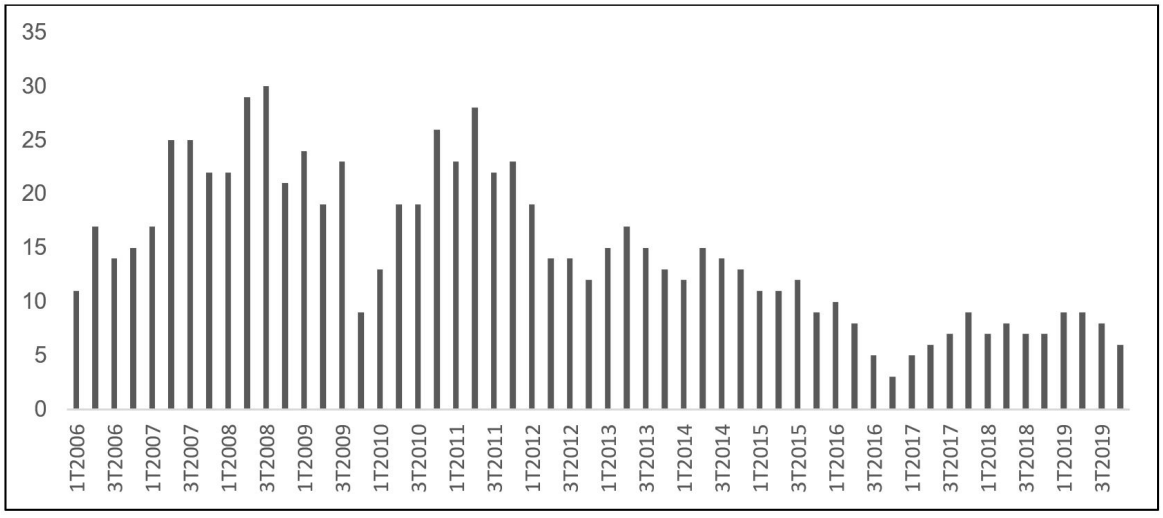

Figure 3. Number of Securities in Greenblatt's Portfolio
Source: Elaborated by the authors.

Greenblatt's Portfolio, on average, presented the largest number of securities when compared to the others. According to Greenblatt (2006), the ideal is to keep between 20 to 30 securities in the portfolio, however, due to the limited number of securities obtained after the filtering procedure, it was not possible to satisfy this rule. Greenblatt's Portfolio had, on average, 15 securities.

Table 8 presents the results of the five-factor model regression for Greenblatt's Portfolio:

Table 8
Five-Factor Regression for Greenblatt's Portfolio

Coefficient	Estimate	t-statistic	Adjusted R^2
α	0.0268 ***	3.7822	0.7268
β	0.9110 ***	6.1795	
H	-0.4664 ***	-2.4590	
S	-0.1395 ***	-0.5629	
W	0.0413 ***	0.5109	
I	0.7262 ***	2.7827	

Note: *p<0.1; **p<0.05; ***p<0.01
Source: Elaborated by the authors.

Results obtained suggest that α, β, *H* and *I* were significant (at least) at the 90% confidence level, based on the t-statistics. The portfolio generated a higher than expected return of 2.68% per year and carries less risk than the Ibovespa, with a β of 0.91, which is lower but close to that of the market. The *H* coefficient showed a negative sign, suggesting an exposure to growth rather than value shares, which is not an expected result. Additionally, the positive sign of the IML coefficient indicates that the portfolio is exposed to illiquidity.

Table 9 presents the results of the adjusted model regression for Greenblatt's Portfolio:

Table 9
Adjusted Regression for Greenblatt's Portfolio

Coefficient	Estimate	t-statistic	Adjusted R^2
α	0.0288 ***	3.8908	0.7330
β	0.8521 ***	8.0865	
H	-0.4487 ***	-2.6121	
I	0.5861 ***	6.0818	

Note: *p<0.1; **p<0.05; ***p<0.01
Source: Elaborated by the authors.

Results indicate a higher expected return (α) carrying less risk (β), when compared to the five-factor model. Furthermore, the Adjusted R^2 have found a slightly increase and it is the greater than other specifications of Piotroski and Graham's Porfolio.

In line with Santos (2016), this research also found higher return than the Ibovespa for a portfolio based on Greenblatt (2006) filters. The total return of Greenblatt's Portfolio for the period analyzed was 1,504%, well above that of the market (246%). The average annualized return of Greenblatt's Portfolio is 21.92%, in contrast to Ibovespa's (9.26%).

5.4. Comparative Analysis

Figure 4 shows the quarterly return of the three portfolios, as well as the one from Ibovespa:

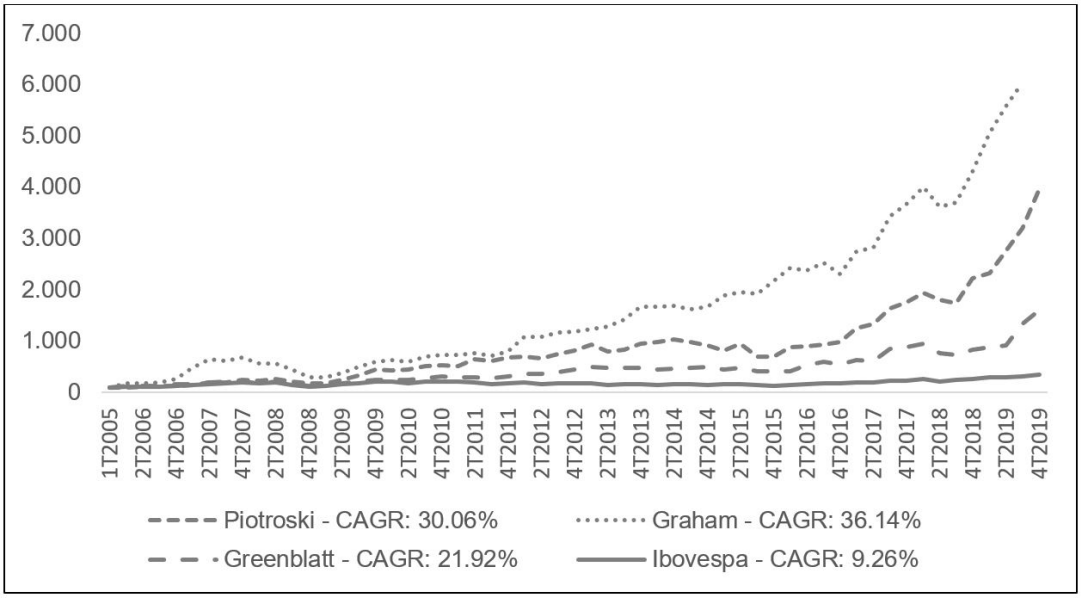

Figure 4. Price Evolution of Value Investing Portfolios and Ibovespa
Source: Elaborated by the authors.

As presented in Figure 4, all of the value investing portfolios have presented higher capital gains than the Ibovespa.

The CAPM model was also estimated for the three portfolios, in order to compare the results of the single-factor model with those obtained with the adjusted model which excludes regressors whose coefficients are not statistically significant with 90% confidence. Table 10 presents alphas and betas obtained with these different specifications:

Table 10
Adjusted Model vs CAPM

	Piotroski's Portfolio		Graham's Portfolio		Greenblatt's Portfolio	
Coefficient	Adjusted Model	CAPM	Adjusted Model	CAPM	Adjusted Model	CAPM
α	0.0454 ***	0.0380 ***	0.0490 ***	0.0490 ***	0.0288 ***	0.0218 ***
β	0.5909 ***	0.9222 ***	1.0387 ***	1.0387 ***	0.8521 ***	0.9381 ***

Note: *p<0.1; **p<0.05; ***p<0.01
Source: Elaborated by the authors.

For the CAPM model, the three portfolios generated positive Jensen's alpha when adjusted to the market risk factor, rejecting the null hypothesis. Additionally, Piotroski's and Greenblatt's portfolios carry a lower level of systematic risk than the Ibovespa.

It is important to remark that Jensen's alpha and beta estimates vary substantially from one specification to another, reinforcing the importance of the use of multifactor models which can better capture relevant features of the data. Piotroski's Portfolio, in special, seems to provide higher excess returns (Jensen's alpha) and lower levels of systematic risk (beta) than indicated by the results of the single-factor specification.

6. FINAL REMARKS

Considering the period 2006-2019, this study aimed at testing whether the Jensen's alpha generated by the value investing methodologies of Joseph Piotroski, Benjamin Graham, and Joel Greenblatt is positive and statistically significant. In contrast to the existing literature of asset pricing in Brazil, which is based on the CAPM, and as suggested by Santos (2016), multifactor asset pricing models were used in this study.

Piotroski's, Graham's and Greenblatt's portfolios generated an annualized return of 30.06%, 36.14% and 21.92% respectively, exceeding the annualized return of the Ibovespa, which was only 9.26% in the same period.

Regression results indicate that, after controlling for well-known risk factors, the three methodologies – five-factor model, adjusted model, and CAPM – have generated positive and statistically significant excess returns.

Interestingly, the market factor (Rm - Rf) seems to be relevant in all of the asset allocation methodologies, as the estimated betas were all positive and statistically significant.

Additional factors, however, also seem to be important. Piotroski's Portfolio has presented statistically significant coefficient for the size factor, suggesting that the portfolio was exposed to small companies. Graham's Portfolio has presented statistically significant coefficients for the WML factor, indicating that the portfolio was exposed to momentum stocks (winners). Greenblatt's Portfolio has presented statistically significant coefficients for the factors HML and IML, indicating that the portfolio was exposed to growth companies with low liquidity.

It is important to remark that both alpha and beta estimates can vary substantially in different specifications, suggesting that multifactor models may be better suited than the CAPM for the assessment of value investing strategies.

One of the limitations of this study is the assumption that the coefficients of the models are constant throughout the whole estimation period. The use of models with time-varying coefficients may be a promising way forward for future research.

Secondly, it is suggested to implement Markowitz's efficient frontier in value investing strategy, since a portfolio containing equal weights for shares – like the current study – may not be efficient according to the Markowitz's theory, even if they have generated Jesen's Alpha.

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CONFLICT OF INTEREST

We have no conflict of interest to disclose.

AUTHOR CONTRIBUTIONS

Author 1 has contributed regarding the conceptualization and administration of the project, being responsible for writing-review & editing, in addition to the data curation, analysis, validation and supervision. Author 2 has contributed regarding the conceptualization and administration of the project, in addition to the data curation, analysis, validation and supervision. Author 3 has contributed with the draft writing-review, in addition to the supporting analysis, supervision and validation. Author 4 has contributed with supporting analysis, supervision, validation and writing-review