Revista de Educação e Pesquisa em Contabilidade
Journal of Education and Research in Accounting

Periódico Trimestral, digital e gratuito publicado pela Academia Brasileira de Ciências Contábeis | Available online at www.repec.org.br

REPeC, Brasília, v. 18, n. 4, art. 4, p. 509-529 Oct./Dec. 2024 | DOI: http://dx.doi.org/10.17524/repec.v18i4.3346 | ISSN 1981-8610

Value Investing in Brazil: A Novel Application of Benjamin Graham's Criteria to Generating Abnormal Returns

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Abstract

Objective: This study aimed to adapt Benjamin Graham's criteria to the Brazilian stock market, using a ranking strategy to build winning portfolios that offer abnormal returns.

Method: We have collected data from all companies traded on the stock exchange in Brazil between the 4th quarter of 1998 and the 2nd quarter of 2020. Graham's criteria were adapted using each indicator's quarterly median and sector-wise. We employed the Greenblatt (2006) ranking strategy in the portfolio construction.

Results: We employed the five-factor asset pricing model to analyze the abnormal returns of the portfolios. Our findings indicate that portfolios formed with the adapted criteria consistently outperformed the market average. Notably, the portfolios with 10, 20, and 30 assets demonstrated superior returns compared to the Ibovespa, IBrX 100, and LFTs, with the 10-asset portfolio generating the highest Alpha.

Contributions: This research advances the literature on value investing in emerging markets by adapting Benjamin Graham's criteria to the Brazilian context using quarterly sector medians and a ranking strategy. The study demonstrates the potential for generating abnormal returns, outperforming benchmarks such as the Ibovespa and IBrX 100. It underscores the importance of periodic adjustments and sector-specific adaptations, providing valuable insights for investors applying fundamental analysis in emerging markets. These contributions bridge traditional value investing principles with the unique dynamics of emerging markets, aiding in more informed portfolio management decisions.

Keywords: Fundamental analysis. Benjamin Graham. Stock portfolios. Value investing. Adapted criteria.

Published in Portuguese and English. Original Version in Portuguese.

Round 1: Received in 6/18/2023. Review requested on 12/5/2024. Round 2: Resubmited on 12/18/2023. Review requested on 4/2/2024. Round 3: Resubmited on 5/25/2024. Accepted on 5/27/2024 by Renato Henrique Gurgel Mota, PhD (Editor assistant) and by Gerlando Augusto Sampaio Franco de Lima, PhD (Editor). Published on 12/20/024. Organization responsible for the journal: Abracicon.

Introduction

The formation of stock portfolios has long been a central topic in accounting, finance, and investments. The financial literature of the 1950s and 1960s, primarily developed in influential markets such as the United States and the United Kingdom, introduced various theories on stock price predictability and capital market behavior (Fama, 1965; 1970).

The research presented here aims to innovatively adapt Benjamin Graham's fundamentalist assumptions to the Brazilian stock market and use a ranking strategy to build winning portfolios that offer abnormal returns. Our main innovation is the attempt to apply a new adaptation of the so-called "Graham criteria", a strategy based on fundamental analysis, to an emerging market, which may provide a diverse set of challenges and opportunities. In addition to adapting the criteria, we also adapt how stocks are selected for a portfolio by using a ranking derived from the classification of firms according to these criteria.

The financial literature presents various approaches to optimal portfolio formation and asset selection. Beyond Graham (1965), influential studies by Fama and French (1992, 1993, 2012) introduced additional factors to the Capital Asset Pricing Model (CAPM), originally developed by Treynor (1962) and Sharpe (1963). More recently, Frazzini, Kabiller, and Pedersen (2019) have attempted to explain Warren Buffett's exceptional returns, a prominent investor adhering to Graham's value investing principles. However, the literature on applying "Graham criteria" in the Brazilian context is still scarce and limited by methodological choices that distance the results from the reality of potential research users.

For example, Testa and Lima (2012) made adjustments to the values used by Graham's original proposal to make them closer to the situation in Brazil. However, we believe that this still does not solve the problem because in investments we need to relativize things to find the best options available among all those that are available, which is why we always compare the company's criteria with its comparables within the same sector.

Passos and Pinheiro (2009) considered a 5-year buy-and-hold portfolio. We believe that this is not the most appropriate methodology, especially in a country like Brazil, because businesses are more sensitive and less mature. Our differential in this case is the application of quarterly rebalancing of portfolios.

Finally, on performance evaluation of the strategy, Domingues et al. (2022) and Palazzo, Savoia, and Securato (2018), evaluated the performance of the strategy using standard Jensen's Alpha, with only one risk factor controlled (market beta). Based on modern asset pricing literature, the alpha presented by them may be affected by other risk factors that have not yet been incorporated, whereas our research applies the classic 5 risk factors (Taib & Benfeddoul, 2023).To achieve the study's objective, we applied Graham's fundamentalist methodology to stock selection in the Brazilian market and the formation of stock portfolios, proposing adjustments and rankings that make sense for applying research results in real life. Through empirical analysis, we evaluated the performance of portfolios constructed according to these criteria and examined whether these portfolios can generate risk-adjusted returns above the market. Our analysis strategy allows more stocks to be available for selection and portfolio construction, solving a common problem with applying Graham's original criteria in Brazil (they generally restrict the majority of stocks from Brazil, a market significantly smaller than the United States).

The original Graham criteria were adapted for the Brazilian market, considering differences between the US and Brazilian markets. We have ranked the firms by quarter and used the average score of the rankings to select the best companies. This approach considered sensitivity to outliers, allowing companies with unsatisfactory performance in some criteria to be part of the sample. After building the portfolios, we used a five-factor asset pricing model to evaluate whether the strategy could generate abnormal returns.

Our main results demonstrate that the stock selection strategy, based on Graham's adjusted criteria, can be effective in the Brazilian market. Portfolios formed by this strategy outperform the overall market, suggesting that a value investing approach may be applicable even in emerging markets like Brazil. These results contrast with previous studies conducted in developed markets, which found mixed evidence regarding the effectiveness of value investing (Fama & French, 1992, 2012).

This research contributes to the financial literature by introducing a novel methodology for stock selection based on value investing in an emerging context. Furthermore, the research sought to comprehensively analyze the returns of portfolios formed based on the adapted Graham criteria in the Brazilian context. Portfolios created based on the strategy presented in the research with adapted Graham criteria and ten assets exhibited significant abnormal returns. In comparison, portfolios with 20 and 30 assets did not exhibit significant abnormal returns. These findings are significant for Brazil, an emerging market with less than 10% of total shares traded in the United States, where the original model was developed.

Finally, the methodology employed in this research provides valuable insights into the efficiency and applicability of these criteria in the Brazilian market. The results contribute to the academic literature and may be helpful for investors interested in value investing strategies and stock portfolio construction in Brazil. Graham's criteria are primarily known to small investors through the best-selling book "The Intelligent Investor". With this study, we can add information to these investors in the Brazilian market. Furthermore, it is essential to emphasize that the analysis of risk factors and ongoing strategy monitoring are recommended to understand better the returns and risks involved.

2 Literature Review

In the Brazilian market, research has emerged aiming to find performance differences between the Sharpe (1964) and Markowitz (1952) models. Some of these studies aimed to compare the two models and also motivated to analyze specific markets. In this regard, Brochmann et al. (2000) conducted a comparative analysis between the models, whose evidence demonstrates that the Markowitz model outperformed the Sharpe model. In this regard, Bruni and Famá (1998) and Hieda and Oda (1998) conducted similar analyses, evaluating portfolio performance in the Brazilian market scenario, using Markowitz's portfolio optimization theory as a basis.

From this perspective, Graham (1965) presents strategies for selecting companies based on fundamental assumptions (value investing). Then, he evaluates these to identify prices traded below the intrinsic value of the pre-selected companies. Graham (1965) suggests that his strategy is valid for long-term investment, believing that the value will prevail and that it would not be safe to adequately infer the possibility of obtaining abnormal returns in the short term.

Value investing consists of an investment strategy disseminated especially by Graham and Dodd (1934), establishing specific criteria that need to be identified in companies, such as, for example, presenting good corporate governance, a good profit history, and low risk. Such criteria would become crucial for the shares of these companies to outperform the market average. Subsequently, to guide investors when carrying out their investment analyses with a long-term focus, Graham and Dodd (1951) presented their asset selection strategies based on the perspectives of value investing. In its latest version, Graham (2007) listed seven criteria with a quantitative scope for selecting stocks:

1. Adequate Size: Minimum revenue of US$ 100 million for industrial companies and minimum total assets of US$ 50 million for utility companies.
2. Sufficiently financial solid condition:
   a. For industrial companies, current assets must be at least twice the current liabilities (typical liquidity ratio). Long-term debt should not exceed the working capital of the company (current assets - current liabilities); and,
   b. For utility companies, the debt should be at most two times the shareholders' equity (book value).
3. Uninterrupted dividends for at least the past twenty years.
4. No losses in the past ten years, only profits.
5. Minimum growth of one-third in earnings per share in the past ten years.
6. Price should not exceed 15 times the average earnings of the past three years.
7. The stock price should be at most 1.5 times the equity book value.

When analyzing portfolios based on value investing, Oppenheimer (1984) found results that outperformed the market average for the period studied between 1974 and 1981. Using equivalent parameters based on the value investment assumptions to select assets, Klerck and Maritz (1997) also observed positive results during the analysis period from 1977 to 1994. In Brazil, Vasconcelos and Martins (2019) analyzed the creation of shareholder value and its relationship with value and growth investing strategies. The authors found different results from the US market, observing that in Brazil, the formation of portfolios with growth stocks have higher returns than value stocks and that growth companies have higher dividend growth than value companies.

The application of Graham's criteria in their original version to construct a portfolio in the Brazilian context can be overly restrictive, considering not only the maturity of the capital market in Brazil but also the characteristics of companies with traded stocks in the country. Thus, although these criteria are widely studied in the investment literature, this study assumes that adopting Graham's criteria in their original format is unsuitable for the Brazilian stock market because many companies do not meet them.

Graham stated that applying some of his criteria can be rigorously restrictive, posing a significant challenge to their implementation in the Brazilian market. Artuso and Chaves Neto (2010) considered adjusting certain cutoff levels suggested by Graham, looking at the potential loss of information generated by applying the criteria in their original terms. In this regard, the research hypothesis of this study is:

Hipótese: Carteiras construídas com base nos critérios ajustados de Benjamin Graham podem gerar retornos anormais no mercado de ações brasileiro.

Hypothesis: Portfolios built based on Benjamin Graham's adjusted criteria can generate abnormal returns in the Brazilian stock market.

The notion that value investing only entails finding undervalued or "cheap" stocks becomes inaccurate, as the representativeness of value investment transcends this bias and reaches a more profound point of analysis. Deep analysis inherent in the value investment strategy would enable relevant informational gains about the business. Thus, this study aims to verify the utility of these criteria in Brazil and to adapt them to the national context in search of build winning portfolios that offer abnormal returns.

3 Method

The scope of this research encompasses all companies listed on B3 (Brazilian stock exchange) from the fourth quarter of 1998 to the second quarter of 2020. The analyzed period, consisting of approximately 22 years, represents the most extended possible timeframe based on the data availability in Refinitiv Eikon. To ensure the feasibility of the analysis, data from companies whose stocks ceased trading at any point or lacked the necessary data were excluded.

Given the selected timeframe, we employed a Python-programmed machine-learning model to form and rebalance the portfolios every quarter. We created a script to automate this task. We excluded all financial companies from the sample due to their unique regulatory requirements and specific capital structure characteristics. The Ibovespa index, IBrX 100 index, and Treasury Financial Notes (LFTs) were considered benchmark comparisons. The Selic rate was chosen as Risk-free for portfolio evaluation purposes because it closely approximates the zero-risk concept. The Brazilian government bond represents the lowest default probability in the local market, thereby representing low reinvestment risk and lower volatility.

3.1. A Novel Application of Graham's Criteria in Brazil

We considered their most recent original form to apply Graham's criteria (2007) in Brazil. The quarterly application was defined to ensure the proper portfolio rebalancing, aiming to include only winning companies according to the criteria. Furthermore, the rebalancing makes the portfolio simulation more aligned with real market practices and represents one of the main differentiators of this study compared to previous publications. In practice, the average investor tends to review their assets whenever there is a new balance sheet disclosure.

In the second step, we modified the original criteria to achieve better suitability and efficiency in the Brazilian market. This adaptation was necessary because the original criteria were developed and applied to a different US market. Differences in factors such as the number of companies, maturity, and performance significantly contribute to the divergence between these markets.

Palazzo et al. (2018) took a similar approach to analyze the Brazilian market and suggest a series of modifications to these criteria, indicating a possible need for adjustments in the Brazilian context. However, their study should have noticed the necessity of portfolio rebalancing, thereby presenting evidence with limitations. While the study demonstrated concern regarding the economic context, which was an advancement compared to previous research (such as Artuso & Chaves Neto, 2010, and Almeida et al., 2011), the authors limited the research and its practical application by setting fixed values as parameters, deviating from results that would be more closely aligned with the reality of the average Brazilian investor.

In this study, we present an advancement in that, in addition to suggesting a more efficient asset selection applicable in Brazil, we also focus on providing period-relative results closer to the reality of the local financial market. This advance is particularly relevant when considering that, in practice, investors do not tend to hold assets in a portfolio for approximately ten years, as treated by Palazzo et al. (2018). Conversely, this work applies adjusted criteria quarterly, resulting in potentially more helpful information for investors in the practical implementation of investment portfolios. Despite this, we clarify that this study does not consider operational costs and tax implications. It is a limitation of this analysis.

Regarding the number of assets in the portfolio, the research adopts the composition of an equal-weighted portfolio, which entails assigning equal weights to all available assets. In this regard, DeMiguel, Garlappi, and Uppal (2009) demonstrated that the performance of this type of portfolio consistently outperforms various other strategies. Other studies have argued for establishing an appropriate number of assets in the portfolio and concluded that a portfolio composed of 10 assets significantly reduces risk and yields superior results compared to other investments (Battaglia, 2013; Ceretta & Costa Jr, 1998; Demiguel et al., 2009). Therefore, this study employs the Greenblatt ranking methodology (2006) to select the best stocks for inclusion in the portfolio.

Based on the above, Table 1 presents the adapted criteria and the modifications made by Palazzo et al. (2018). It is important to emphasize that the need to adapt the criteria to the Brazilian market is based on the distinction between the characteristics of the Brazilian market and the US market. To exemplify, one of Graham's original criteria requires a company to have a 20-year history of uninterrupted dividend payments to be included in the portfolio, which proves restrictive in the Brazilian stock market.

Therefore, adapting these criteria aligns with the Brazilian context by using the median as a selection parameter. The selection based on the median was chosen based on the understanding that such a measure can capture the reality of each criterion within the context of Brazilian companies. Additionally, the median provides the best value estimation as it is less affected by extreme values (outliers), whether high or low.

The choice to calculate the medians with sensitivity for each sector (NAICS) reinforces the concern about offering results closer to the Brazilian investor's reality, as assuming a general median for sectors with distinct characteristics would be unfair.

Table 1

Graham's (2007) criteria adjusted to the Brazilian market.

Nº	Criteria of Graham (2007)	Criteria of Palazzo *et al*. (2018)	Criteria used in this study
1	Appropriate Size: Minimum revenues of US$100 million for industrial companies and minimum total assets of US$50 million for utilities.	Adequate Size: annual or annualized gross operating revenue greater than R$ 300,000,000.00 (three hundred million reais).	Adequate Size: Operating income above the median for listed companies in the industry each quarter. Due to the characteristics of the emerging market, we want companies that can generate operating profit. Revenue is often not properly "monetized", as seen with major retailers. Therefore, we consider operating profit a more suitable substitute for measuring the size of companies.
2	A sufficiently strong financial condition: a) In industrial companies, current assets must be at least twice the current liabilities. b) Long-term debt must not exceed current shareholders' equity. c) In the case of public service concessionaires, the debt must not exceed twice the share capital.	A sufficiently strong financial condition: Current ratio (Current Asset/Current Liabilities) with a median of 1.22.	A sufficiently strong financial condition: being above the industry's median Interest Coverage ratio in each quarter. Current liquidity involves a more subjective analysis than the interest coverage ratio. For some companies, high liquidity may be good, while for others, it may be detrimental. For some companies, a current liquidity of 1.0 might be high, for others, it might be low. The interest coverage ratio is a more direct measure to assess the ability to pay debt service.
3	Uninterrupted dividends for at least the last 20 years.	Uninterrupted dividends for at least the last five years.	Uninterrupted dividends for at least the last five years. Why not 10 or 20 years? Because, unfortunately, in Brazil, we cannot find companies with a very long history of dividend distribution due to specific corporate issues but also due to macroeconomic and political factors.
4	No losses in the last ten years, just profits.	No losses in the last five years, just profits.	No losses in the last five years, just profits.
5	Minimum growth of at least one-third in Earnings Per Share (EPS) over the past ten years.	Minimum growth of at least 2.66% each year.	Minimum growth of at least the median of industry earnings growth each quarter.
6	Price to Earnings (P/E) should not exceed 15 times the average earnings of the last three years.	The stock selection at level 7 for the P/E ratio.	The P/E ratio must be less than or equal to the industry median in each quarter.
7	Price to Book Value (P/BV) must not be greater than 1.5 times the book value of equity.	Selection of stocks with a P/BV ratio greater than 1.00 provided that their P/E x P/BV multiple was not greater than 7.00.	The P/BV ratio must be less than or equal to the industry median each quarter.
8	–	Liquidity: Thus, only the ten most liquid stocks were chosen among the stocks selected in each criterion.	Ranking: The ranking methodology was used to select the best firms concerning the medians of the criteria by sector.

Source: adapted from Graham (2007) and Palazzo et al. (2018).

3.2. Ranking of stocks for portfolio construction

We used a ranking strategy inspired by Greenblatt (2006) to build the portfolios. Therefore, we order the stocks each quarter to select those that are part of each portfolio (whether with 10, 20, or 30 assets). However, unlike Greenblatt (2006), who used only two criteria (Return on Assets – ROA – and Price-to-Earnings – P/E – ratio), we constructed the stock classification ranking based on the seven criteria proposed by Benjamin Graham (i.e., large companies with strong financial conditions, no losses, paying dividends, etc.).

Our methodology involves ranking the stocks each quarter according to the adapted criterion. For example, in the first criterion of size, companies are ranked based on the value of their revenues, with higher values indicating a closer position to the top. Table 2 presents the adaptation through the ranking strategy.

Table 2
Adaptation by ranking

N	Rankings by Criterion
1	Ranking by Revenue of firms with stock trading during the period.
2	Ranking by Financial Condition in each B3 sector.
3	Ranking by number of uninterrupted dividends for at least the last five years. Companies with all dividends received ranking 1.
4	Ranking by the amount of positive net income. Companies with all positive earnings were ranked 1.
5	Ranking by earnings growth in each B3 sector.
6	Ranking by P/BV ratio in each B3 sector.
7	Ranking by P/E ratio in each B3 sector.

Source: prepared by the authors..

Then, we added the positions in the seven rankings for each stock and divided this result by 7 to find the "average position" each stock obtained in the set of rankings using Graham's adapted criteria. We decided to use the mean and not the median of positions because it is sensitive to the presence of outliers. Moreover, this sensitivity matters in this case because we want to avoid companies that are very poorly classified in any of the criteria. Therefore, a company may score well in specific criteria but will be penalized if it performs unsatisfactorily in other criteria.

Table 3 exemplifies the choice of using the average. In the example, let us assume that when selecting the top five stocks among the six available, stock B presents an outlier in criterion #7 and would likely be excluded from the sample by the original criteria of Graham (2007). However, with our adaptation, this company is retained but downgraded from the 2nd to the last position due to its ranking of 50 in criterion #7.

Table 3

Example of application of the ranking's methodology

Stock	Rankings of Criteria							Statistics	
	#1	#2	#3	#4	#5	#6	#7	Mean	Median
A	1	1	1	1	1	1	1	1	1
B	2	2	2	2	2	2	50	8.85	2
C	3	3	3	3	3	3	3	3	3
D	4	4	4	4	4	4	4	4	4
E	5	5	5	5	5	5	5	5	5
F	6	6	6	6	6	6	6	6	6

Source: prepared by the authors..

Using rankings to construct portfolios based on Graham's adapted criteria is an innovation in this study, as it prevents a company from being excluded from the portfolio because it performed poorly in just one criterion. However, the methodology used here still penalizes the company for this. We used a method that allows it to remain in the sample but be penalized for poor performance in any analyzed criteria. Thus, the companies with the highest final rankings in the average ranking were selected to form the portfolios.

In Brazil, this strategy is essential due to the small number of listed companies (compared to the USA), which makes using the original criteria unfeasible. Thus, we do not reduce the sample and maintain the essence of selecting companies with better positions in the adapted criteria of Graham (2007). Using the average of the rankings, deliberately sensitive to outliers, causes the company to fall out of the top five positions. If we formed portfolios with five assets, the resulting portfolio would be A, C, D, E, and F. On the other hand, if the median were used, the selection would be A, B, C, D, E - which would not solve the problem.

The application of the ranking model involves the following steps:

1. The firms are ordered according to the specific criterion in each quarter Q of year Y. Using revenue as an example, we rank the companies as those with the highest revenue, followed by the second company, then the third, and so on.
2. Once all the rankings are done, the values are standardized so that the first company in the ranking presents a value of 1, and the last company in the ranking, for that criterion, presents a value of 100. In other words, we normalize stocks between the 1% and 100% percentiles to make the ranking averages easier to interpret.
3. The final ranking is obtained by calculating the average of the criteria rankings.

3.3. Models for calculating returns

After defining the rankings and forming the portfolios, it is necessary to calculate both the daily returns of the portfolio assets and the market returns to identify the abnormal returns of the assets. For this purpose, we used the market model, according to the same statistical model used by Ball and Brown (1968). The formulas are described by Equations 2 and 3.

$$R_{p,t} = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{P_{i,t}}{P_{i,t-1}} - 1\right) \qquad (2)$$

Where $R_{p,t}$ represents the equally weighted return of portfolio p in period t; P_t represents the closing price of stock i in period t; P_{t-1} represents the closing price of the period $t-1$; N is the number of assets in the portfolio.

$$r_{i,t} = \alpha_i + \beta_i r_{m,t} + \varepsilon_{i,t} \quad (3)$$

Where $r_{i,t}$ represents the return of stock i in period t; α_i represents the interceptor of firm i; β_i represents the coefficient of variation of firm i in period t; $r_{m,t}$ represents the market return in period t; $\varepsilon_{i,t}$ represents the error of firm i in period t.

We used the Ordinary Least Squares (OLS) model to estimate the regression. We had correct standard errors with Newey-West, as it is robust in the presence of autocorrelation of regression errors (the main problem of the asset pricing model presented).

3.4. Multifactor models for portfolio Alpha analysis

To evaluate and explain the possible abnormal return of the portfolios, we used a five-factor asset pricing model to test the generation of portfolio Alpha. This model was chosen for its more robust estimation, as it includes the liquidity risk premium () as the fifth factor, proposed by Amihud (2002), in addition to the three factors (market, Size, and value) of Fama and French (1993), and the momentum factor of Carhart (1997). The regression described in Equation 4 is performed to analyze the Alpha of the formed portfolios. Finally, the risk factors for the Brazilian market were obtained from the NEFIN/USP website.

$$r_t - r_t^f = \alpha + \beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WML_t + \beta_5 LIQ_t + \varepsilon_{it} \quad (3)$$

Where $r_t - r_t^f$ represents the portfolio return above the risk-free rate in period t; α represents the intercept, which economically expresses the portfolio's abnormal return; MKT_t represents the market risk factor; SMB_t represents the size factor; HML_t represents the value factor; WML_t represents the moment factor; LIQ_t represents the liquidity risk factor, and represents the error term of the regression.

4. Results

The initial results of the analysis confirmed suspicions that no company met all the original criteria proposed by Benjamin Graham during the period analyzed in this study. Because of this, it was impossible to calculate a series of returns, and the analysis moved on to calculating the returns of the portfolios formed by the adapted criteria. One factor that may have contributed to companies not meeting the criteria is the dividend criterion. According to DeAngelo, DeAngelo, and Skinner (2004), dividends are replaced by share repurchases and concentrated in large companies.

Table 4 summarizes the number of eligible companies for portfolio formation each quarter, starting from the fourth quarter of 1998 in Brazil, using the sectorial median criterion. The criterion that proved to be most restrictive was the dividend criterion, with an average of 30 eligible companies. Next, the most significant restriction was found in the criterion regarding the need to show profits in the last five years, with an average of 48 companies passing each quarter (not tabulated). The final criterion is the intersection of these criteria.

Table 4

Summary of companies eligible for adapted criteria to Brazil

	Size	CF	$Dividends_{5y}$	$Earnings_{5y}$	gEarnings	P/L	P/VP	Final Criterion
Mean	103,61	113,60	30,46	48,79	95,13	103,31	103,31	7,95
Median	119,00	147,00	14,00	49,00	114,00	119,00	119,00	4,00
SD	54,91	56,45	29,29	39,72	57,61	54,78	54,78	7,80
Min	1,00	0,00	0,00	0,00	0,00	1,00	1,00	0,00
Max	174,00	177,00	77,00	108,00	165,00	173,00	173,00	23,00

Source: prepared by the authors.

If the original criteria were considered, only from the first quarter of 2005 would it be possible to observe the entry of companies eligible to build the stock portfolio? At this point, an investor who intends to adopt such criteria and choose a fixed number of stocks (such as 10 or 20 stocks) would need to choose an alternative method for selecting the remaining stocks to complete their portfolio. This situation represents one of the flaws in Graham's methodology, which does not classify companies; it selects only those actions that "pass" the filters, excluding all others.

Another problem is determining which stocks go into the portfolio. For example, imagine that 20 stocks pass all of Graham's original criteria, and you want to form a portfolio with 10 stocks. Which ones would be selected? As there is no priority ranking, this task becomes complex. To solve this problem, we combined Graham's adapted criteria methodology with a ranking methodology similar to that of Greenblatt (2006).

4.1. Portfolio Performance Statistics

This section presents the results of adapting Benjamin Graham's criteria for Brazil. In the portfolio results, when the criteria do not yield eligible companies for portfolio construction in each period, we assume that the investor allocates their resources to risk-free assets.

Table 5 shows the descriptive statistics of the benchmarks and the Adapted Portfolio () which is composed of the Brazilian sample using the adapted Graham filters (sample of this study). We considered the returns of the Ibovespa, IBrX 100, and Brazilian government bonds (LFT) as benchmarks. The findings demonstrate that the average portfolio return (1.02%) was like the Ibovespa (1.02%), higher than the LFT (0.97%), and second only to the IBrX 100 (1.29%). When considering the median of returns as a performance measure, the portfolio formed in this study had the best performance (1.30%), surpassing all benchmarks (Ibovespa with 0.82%, LFT with 0.94%, and IBrX 100 with 1.13%). However, this portfolio had a higher standard deviation than all benchmarks (0.82%).

Additionally, we used the Sharpe ratio to compare the risk-adjusted returns for the portfolios and benchmarks. The best performance was obtained by the IBrX 100 (0.048411), followed by the Ibovespa (0.007042), and the Rp_Adap portfolio return series (0.0060976). This result demonstrates that the IBrX 100, an index with greater diversification, exhibits a higher risk-adjusted return measured by the Sharpe ratio.

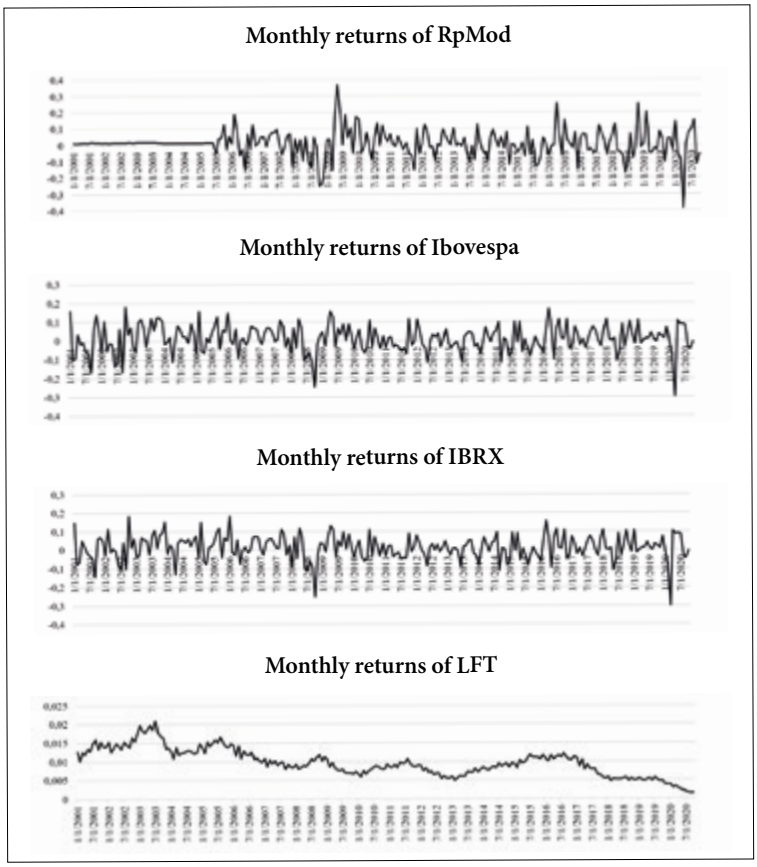
Table 5

Descriptive statistics of the portfolios

Statistics	Rp_{Adap} (%)	Ibovespa (%)	IBrX 100 (%)	LFT (%)
Mean	1,02	1,02	1,29	0,97
Median	1.30	0,82	1,13	0,94
Min	-38,55	-29,90	-30,09	0,16
Max	36,80	17,92	18,34	2,08
SD	0,820	0,710	0,661	0,38
Sharpe	0,0060976	0,007042	0,048411	–

Source: prepared by the authors.

Figure 1 shows the monthly return of the series over time. It is noticed that the portfolio presented concentrated volatility in some points. This occurred due to the rebalancing with risk-free assets and the inclusion of a few companies in the criteria. It is bearing in mind that only in 2005 did assets enter the adapted portfolio, which explains the initial behavior in Figure 1. Before that, the capital was invested in the LFT. It explains the low volatility of returns in the previous period. These results reinforce that applying Benjamin Graham's methodology to the national context requires caution, as it exposes the investor to the risk of few assets that pass the criterion.



Source: prepared by the authors.

Figure 1. Real monthly returns of the methodology adapted to Brazil

4.2. Portfolio Statistics by Ranking (10, 20, and 30 Assets)

Table 6 presents the descriptive statistics of the return series for portfolios formed by 10, 20, and 30 assets. Once again included the Ibovespa, IBrX 100, and LFTs as benchmarks. represents the return series of the portfolio formed by ten assets, and the same applies to 20 and 30 assets. According to the results, the portfolio formed by the top 10 ranking stocks had the highest average monthly return (1.77%) and a better median (1.86%) than the other portfolios and benchmarks.

The portfolios the top 10 companies formed exhibited the highest maximum monthly return (27.46%) among the portfolios and benchmarks. However, the standard deviation of the portfolios formed in this study is similar to that of the benchmarks. This result is justifiable due to diversification, as the Ibovespa and IBrX 100 are indices with more stocks.

The Sharpe ratio was included to control the risk-return relationship better. The best portfolio was formed with a ranking of 10 stocks, followed by the 20-stock portfolio and then the 30-stock portfolio, in that order. All ranking portfolios exhibited risk-adjusted returns above the benchmarks.

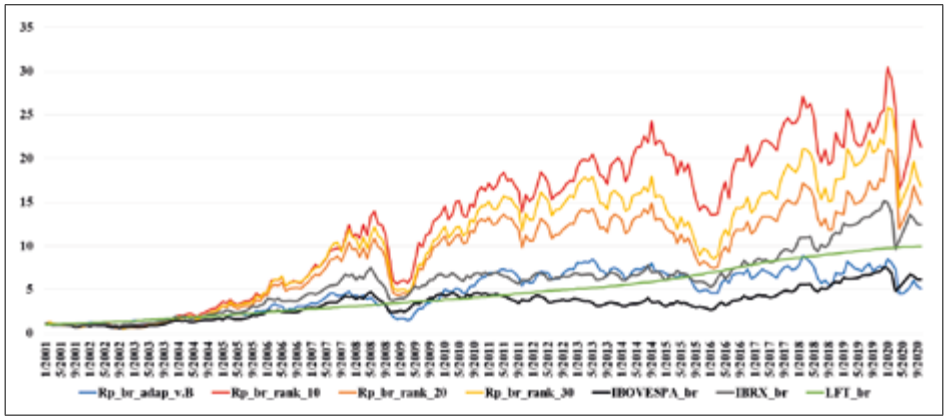
Table 6

Portfolio and benchmark returns statistics

	$Rp_{Rank_{10}}$	$Rp_{Rank_{20}}$	$Rp_{Rank_{30}}$	***Ibovespa***	***IBrX 100***	***LFT***
Mean (%)	1,77	1,61	1,67	1,02	1,29	0,97
Median (%)	1,86	1,37	1,55	0,82	1,13	0,94
Min (%)	-35,77	-36,51	-36,91	-29,9	-30,09	0,16
Max (%)	27,46	24,5	25,25	17,92	18,34	2,08
SD	0,0965	0,0958	0,0964	0,071	0,0661	0,0038
Sharpe	0,0829	0,0668	0,0726	0,007	0,0484	-

Source: prepared by the authors.

Analyzing the returns of the portfolios formed via an adapted model (Rp_{Adap}), and an adapted ranking (($Rp_{Rank_{10}}$, $Rp_{Rank_{20}}$ e, $Rp_{Rank_{30}}$), it is believed that the best way to visualize the results is through a graph of accumulated returns. Again, the leading market indices and high-liquidity, low-risk fixed-income assets were added for comparison in Figure 2.



Source: prepared by the authors.

Note: Rp_br_adap is the series of returns formed by the portfolio resulting from the modified Graham criteria. Rp_rank_10 are portfolios formed by Graham's criteria following the ranking methodology. The number 10 indicates the number of companies in the ranking. All other portfolios follow the same logic.

Figure 2. Cumulative returns of portfolios adapted to Brazil

The Y-axis shows the evolution for each R$ 1.00 (one Brazilian real) invested in the formed portfolios and benchmarks. The graph shows that the portfolio with modified Graham criteria (*Rr_mod*) had the worst result in comparison: R$ 1.00 invested in it at the beginning of 2001 would generate an accumulated wealth of just over R$ 3.00 in October 2020. However, the portfolios formed by rankings exhibited higher cumulative returns than the Ibovespa and IBrX 100. Considering the accumulated return, the best portfolios were those with ten stocks, followed by the 30-stock and then the 20-stock portfolios.

We expected that the 20-stock portfolio would yield higher returns than the 30-stock portfolio, as it has a greater concentration in companies in a mispricing situation: undervalued relative to their fundamental value. However, given the limitation of the return series, it is possible that there was a selection bias, where some companies with low-performing returns influenced the series.

Table 7 presents the annualized cumulative returns for each portfolio and benchmark and the number of times each portfolio outperformed the benchmark. Panel A presents the accumulated returns from 2001 to 2020. Panel B shows the number of times the benchmark was surpassed: over 20 years, the adapted Graham portfolios (Ranking 10, 20, and 30) outperformed the Ibovespa 9, 13, 13, and 13 times, respectively.

Table 7

Accumulated annual returns for each portfolioa

Panel A: Accumulated annual returns							
Year	Rp_{Adap}	Classificação 10	Classificação 20	Classificação 20	Ibovespa	IBrX 100	LFT
2001	17,96%	-9,68%	-12,47%	-11,27%	-11,02%	-0,90%	17,32%
2002	19,38%	-21,42%	-29,44%	-28,57%	-17,01%	5,72%	19,17%
2003	22,71%	140,42%	140,60%	139,43%	97,34%	78,48%	23,35%
2004	16,02%	91,29%	85,69%	87,58%	17,81%	29,85%	16,25%
2005	29,79%	40,22%	54,41%	62,88%	27,71%	37,33%	19,05%
2006	24,83%	44,38%	36,58%	41,02%	32,93%	36,06%	15,08%
2007	29,28%	67,76%	64,42%	68,87%	43,65%	47,83%	11,88%
2008	-61,37%	-49,30%	-54,09%	-55,53%	-41,22%	-41,77%	12,48%
2009	166,98%	142,91%	142,12%	136,57%	82,66%	72,84%	9,93%
2010	49,53%	19,78%	20,70%	25,81%	1,04%	2,62%	9,78%
2011	-11,13%	-7,48%	-17,25%	-11,04%	-18,11%	-11,39%	11,62%
2012	27,52%	15,13%	17,64%	19,38%	7,40%	11,55%	8,49%
2013	-1,54%	15,34%	7,50%	2,63%	-15,50%	-3,13%	8,22%
2014	-1,98%	8,30%	-3,75%	-2,82%	-2,91%	-2,78%	10,90%
2015	-29,74%	-34,00%	-37,71%	-38,46%	-13,31%	-12,41%	13,27%
2016	25,40%	32,77%	41,24%	44,26%	38,94%	36,70%	14,02%
2017	18,59%	26,29%	30,11%	34,10%	26,86%	27,55%	9,94%
2018	-8,30%	-10,25%	-7,27%	-4,18%	15,03%	15,42%	6,43%
2019	9,61%	18,08%	26,52%	22,11%	31,58%	33,39%	5,96%
2020	-31,68%	-16,27%	-15,33%	-22,14%	-18,76%	-17,87%	2,44%

Panel B: Number of times the benchmark is exceeded				
Benchmark	Rp Adap	Classificação 10	Classificação 20	Classificação 20
Ibovespa	9	13	13	13
IBrX 100	8	12	12	12
LFT	11	12	11	11

Source: prepared by the authors.

The methodology, adapted through rankings, has yielded returns that outperform the Ibovespa, IBrX 100, and LFTs. However, caution is still necessary when analyzing the portfolios, as it is crucial to consider the risk factors to which the investor is typically exposed to achieve such returns. The obtained return is compensation for the assumed risks. This analysis will be addressed in the following sections.

4.3. Analysis of abnormal returns

We need to analyze the return series using an asset pricing model to determine whether the stock selection strategy generates returns that traditional market risk factors cannot explain. In this case, we have adopted the five-factor model. This model incorporates the three factors from Fama and French (1992, 1993): market (MKT), Size (SMB), and value (HML), the momentum factor (WML) from Cahart (1997), and the liquidity risk premium factor (LIQ) from Amihud (2002). Equation 5 presents the model.

$$Rp_{Rank_n} - r_t^f = \alpha + \beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WML_t + \beta_5 LIQ_t + \varepsilon_t \quad (5)$$

Rp_{Rank_n} is the portfolio's return being studied, and is the return on the risk-free asset. Alpha (α) is the central coefficient of interest: it can be interpreted as the average abnormal return of the strategy adopted in the studied period. is the stock market risk premium. In this case, it is already measured by the return on the market portfolio minus the return on the risk-free asset.

Next, SMB_t measures the risk premium of small-cap stocks compared to the return of large-cap stocks. HML_t measures the risk premium of value stocks, i.e., high book-to-market, compared to the return of growth stocks with high book-to-market. WML_t measures the risk premium of high-momentum stocks compared to low-momentum stocks. IML_t measures the risk premium of low-liquidity stocks compared to high-liquidity stocks. ε_it is the regression's error term, which can be interpreted as all variations not explained by abnormal return (α) and the identified risk factors (MKT_t, SMB_t, HML_t, WML_t, and IML_t). All the risk factors used for the Brazilian market were obtained from the NEFIN website.

The interpretation of the model results is straightforward: when the risk factor return varies by one percentage point, the portfolio return varies by β_n percentage points. In this case, if β_n equals 2, it means that when the risk factor varies by one percentage point, the portfolio varies by two percentage points. Thus, the interpretation of Alpha is sensitive to the scale at which the data are observed.

Regarding applying the five-factor model, we divided the return series into returns obtained by the 10-stock, 20-stock, and 30-stock portfolios. Table 8 shows the results of applying the five-factor model to the 10-stock, 20-stock, and 30-stock portfolios. We have observed that both the adapted portfolio and the 10-stock portfolio exhibited abnormal returns during the analyzed period, with the adapted portfolio showing the highest level of statistical significance with a p-value below 5%. On the other hand, the 10-stock portfolio exhibited statistical significance at a 10% level. These results can be observed through the positive and significant coefficients of the alphas in both regressions. However, the portfolios formed with 20 and 30 stocks did not generate statistically significant abnormal returns.

The analysis of the factors yields the following interpretation: the return of the adapted strategy is sensitive to the market factor (MKT), exhibiting a positive coefficient (between 0.9672 and 1.2240) with statistical significance at 1% in all analyzed strategies. Next, the size factor (SMB) indicates an association with returns (0.6792) at a 5% level for the adapted portfolio and the 10-stock portfolio (0.2761). For the portfolios containing 20 and 30 stocks, this relationship showed statistical significance at 1% and coefficients of 0.3824 and 0.4142, respectively. It should be noted that considering the models that include the size factor (SMB), a one-percentage-point variation in the size factor is associated with a variation of 0.5501% to 0.5796% in the portfolio returns, respectively.

Additionally, the momentum factor (WML) showed a negative and significant relationship (between -0.3979 and -0.1253) in all strategies. On the other hand, the value factor (HML) did not show statistical significance in any of the strategies. Moreover, the fifth factor (IML) was significant only in the 30-stock strategy (-0.2179) at a 10% level.

Table 8

Application of asset pricing models in the Brazilian market

Rp_{Adap}	**Coefficient**	**p-valor**		
alpha	0,0153	0,0289**		
MKT	0,9672	0,0000***	R^2	0,565
SMB	0,6792	0,0296**	Adjusted R^2	0,550
HML	0,1684	0,3577	Durbin-Watson:	2,029
IML	0,1468	0,6293	Jarque-Bera (Prob):	0,495
WML	-0,3979	0,0126**	Observations	151
$Rp_{Rank_{10}}$	**Coefficient**	**p-valor**		
alpha	0,0058	0,0784*		
MKT	1,2240	0,0000***	R^2	0,754
SMB	0,2761	0,0235**	Adjusted R^2	0,748
HML	0,0057	0,9370	Durbin-Watson:	2,247
IML	-0,1821	0,1272	Jarque-Bera (Prob):	0,951
WML	-0,1351	0,0347**	Observations	237
$Rp_{Rank_{20}}$	**Coefficient**	**p-valor**		
alpha	0,0039	0,2141		
MKT	1,1912	0,0000***	R^2	0,768
SMB	0,3824	0,0012***	Adjusted R^2	0,763
HML	0,0445	0,5231	Durbin-Watson:	2,288
IML	-0,1785	0,1215	Jarque-Bera (Prob):	0,679
WML	-0,1253	0,0424**	Observations	237
$Rp_{Rank_{30}}$	**Coefficient**	**p-valor**		
alpha	0,0051	0,1020		
MKT	1,1793	0,0000***	R^2	0,778
SMB	0,4142	0,0004***	Adjusted R^2	0,773
HML	0,0632	0,3560	Durbin-Watson:	2,196
IML	-0,2174	0,0552*	Jarque-Bera (Prob):	0,432
WML	-0,1707	0,0050***	Observations	237

Note: This table presents the estimation results of the five-factor asset pricing model for the Brazilian market. They were estimated for Adap, Rank10, Rank20, and Rank30. Standard errors were obtained using the robust Newey-West matrix, which is robust in the presence of error autocorrelation. *** = p-value < 1%, ** = p-value < 5%, * = p-value < 10%.

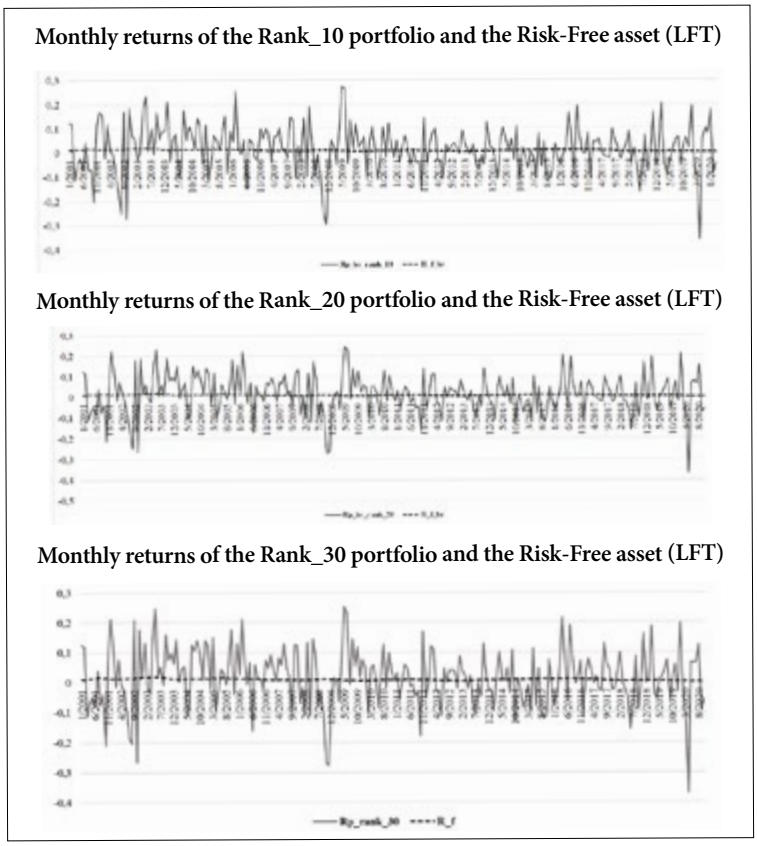
Source: prepared by the authors.

The results indicate that the strategy generated abnormal returns when applied in Brazil following the adapted portfolio strategy (suggested in this research) and the portfolio formed by ranking the top 10 stocks. This finding corroborates previous research that also found the possibility of generating Alpha (Frazzini et al., 2019).

It is essential to highlight some points. First, the regressions showed adequate R2 and adjusted R2 values in all strategies, suggesting that the model is appropriate and reasonably explains return variations. The adjusted R2 was higher than 0.55 in all strategies, surpassing 0.70 in the portfolios with 10, 20, and 30 stocks. The portfolio formed by ranking the top 30 stocks exhibited the highest explanatory power (adjusted R2 of 0.773). Therefore, return variations are explained by the risk factors, given their statistical significance.

Another essential point in this research is the significance of Alpha (α). This was only observed for 3 of the four portfolios, namely the Adapted and Rank10 portfolios. This suggests that for these portfolios, it is possible to affirm that the strategy generated Alpha (incremental return). Although the strategy performed well in Brazil, abnormal returns were statistically significant only in two strategies. This finding is not confirmed for the portfolios with 20 and 30 stocks.

These results explain the choice of the risk-free asset for the Brazilian market. Various research studies use the LFT, Selic, CDI, or longer-term government bonds (the latter presenting higher duration and default risks, which is why they are not commonly used as risk-free assets). Thus, one of the issues with this practice is that these assets have yielded high returns in Brazil, outperforming the stock market when analyzing the series since the 2000s. Figure 3 presents the monthly returns of the formed portfolios.

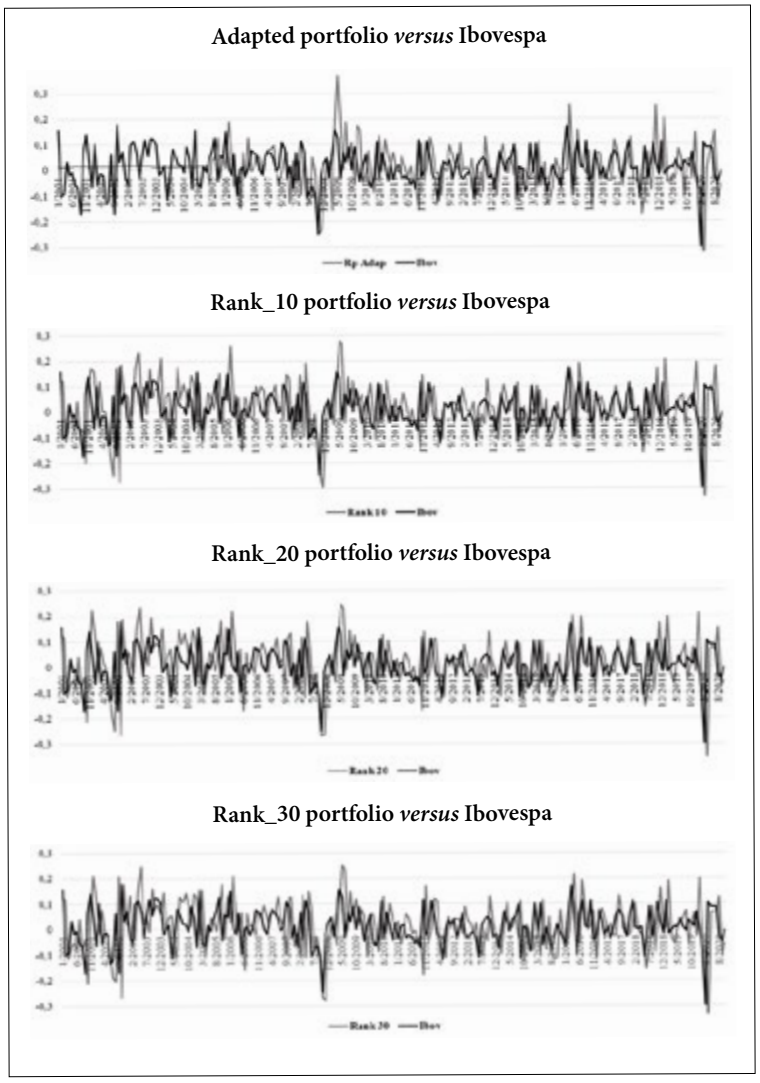


Source: prepared by the authors.

Figure 3. Monthly returns of portfolios (with 10, 20, 30 assets) and the risk-free asset

We notice that the series of ranking portfolio returns exhibit high volatility. Additionally, the risk-free asset has a high return. These two factors imply that the risk premium is, on average, close to zero. This is a relevant point that investors should consider when deciding to build a stock portfolio. This strategy tends to have better results in periods of lower interest rates (risk-free).

Finally, Figure 4 presents the returns of the portfolios, comparing them to the Ibovespa returns. We noticed a positive correlation between the series, but this correlation could be better; in some periods, the portfolios perform better than the Ibovespa (and the opposite is true).



Source: prepared by the authors.

Figure 4. Monthly returns of portfolios (with 10, 20, 30 assets) and Ibovespa

5 Conclusion

This study aimed to adapt Benjamin Graham's criteria to the Brazilian stock market using a ranking strategy to build winning portfolios that generate abnormal returns. The findings indicate that Graham's original criteria are too stringent for the Brazilian context, necessitating adaptations for practical application. By employing quarterly sector medians and a ranking methodology, we developed a strategy that allowed for a greater selection of eligible stocks, thereby making the criteria more applicable in the Brazilian market.

Our analysis revealed that portfolios constructed using the adapted criteria consistently generated Alpha, indicating superior performance relative to market benchmarks such as the Ibovespa, IBrX 100, and risk-free assets (LFTs). Specifically, the portfolios with 10, 20, and 30 assets demonstrated notable returns, with the 10-asset portfolio showing the highest Alpha. These results confirm that the adapted strategy can effectively generate risk-adjusted abnormal returns in an emerging market context.

Furthermore, the application of the five-factor asset pricing model underscored the robustness of the adopted criteria, as portfolios formed by ranking the top 10 stocks exhibited significant abnormal returns. However, portfolios with 20 and 30 stocks did not generate significant Alpha, suggesting that a more concentrated portfolio might be more effective.

The main contribution of this study lies in demonstrating the viability and efficiency of adapting Graham's criteria to the Brazilian market. By integrating these criteria with Greenblatt's ranking strategy, we provide a refined approach for investors, highlighting the importance of periodic adjustments and sector-specific medians. These findings are particularly relevant for market participants, offering practical insights into constructing value-driven portfolios in Brazil. This study contributes to the financial literature by bridging the gap between traditional value investing principles and the unique dynamics of emerging markets.

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