Stock splits and reverse splits in the Brazilian capital market

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Received 23 August 2021
Revised 30 December 2021
11 November 2022
7 April 2023
29 September 2023
10 February 2024
23 March 2024
Accepted 23 March 2024

Abstract

Purpose – This study aims to evaluate the presence of abnormal returns due to stock splits or reverse stock splits in the Brazilian capital market context.

Design/methodology/approach – The event study technique was used on data from 518 events that occurred in a 30-year period (1987–2016), comprising 167 stock splits and 351 reverse stock splits.

Findings – The results revealed the occurrence of abnormal returns around the time the shares began trading stock splits or reverse stock splits at a statistical significance level of 5%. The main conclusion is that stock split and reverse stock split operations represent opportunities for extraordinary gains and may serve as a reference for investment strategies in the Brazilian stock market.

Originality/value – This study innovates by including reverse stock splits, as the existing literature focuses on stock splits, and by testing two distinct "zero" dates that of the ordinary general meeting that approved the share alteration and the "ex" date of the alteration, when the shares were effectively traded, reverse split or split.

Keywords Stock split, Reverse stock split, Market efficiency, Investment strategies

Paper type Research paper

1. Introduction

A stock split is a common investment practice that involves dividing a company's shares into multiple units, often with the aim of making the shares more accessible to investors. Understanding the effects of this phenomenon on the stock market has been a subject of study for decades. At the heart of this discussion lies the seminal work of Fama *et al.* (1969), which laid the foundations for understanding the process by which stock prices adjust to the information implied in a stock split. The authors found that the stock prices of companies that underwent splits increased in the months leading up to their operations. The rationale is that investors anticipate an increase in dividends that typically follows stock splits. This is a common effect when viewed in light of Fama's (1970) Efficient Market Hypothesis, which assumes that all available information is reflected in stock prices.

JEL Classification — G14, G12, G32

We appreciate the support of ChatGPT's AI tool, which assisted in the English-language spelling review of the manuscript.

Journal of Economics, Finance and Administrative Science
Emerald Publishing Limited
2077-1886
DOI 10.1108/JEFAS-08-2021-0168

However, an interesting perspective is that the stock split effect can be interpreted as a market anomaly. This occurs when the stock prices of companies that have undergone a split significantly increase after the announcement of the split. This anomaly contradicts the market efficiency hypothesis. Nichols and McDonald (1983) argue that stock splits often coincide with periods of large increases in corporate earnings. Recently, Shue and Townsend (2021) demonstrated that the total return volatility, idiosyncratic volatility and market beta immediately increased by approximately 30% following a 2-for-1 stock split. In contrast, in a reverse stock split (when two shares become one), volatility decreases significantly. Kong *et al.* (2017) demonstrated that active information-seeking helps mitigate the effects of price-based return co-movement, a common anomaly associated with stock splits.

Empirical studies have traditionally focused on evaluating the effects of stock split announcements, and the evidence points to a significant increase in returns after these announcements. Evidence shows a significant increase in post-announcement returns (McNichols and Dravid, 1990; Brown *et al.*, 1995; Ikenberry *et al.*, 1996; Ikenberry and Ramnath, 2002; Walker, 2021). This effect is observed not only in the stock market but also in the options market (Gharghori *et al.*, 2021) and analyst forecasts (Payne and Thomas, 2003).

However, stock reverse splits represent a less-explored strategy and have generated controversies in the literature (Zaremba *et al.*, 2019). Investors often interpret reverse splits as desperate measures to meet the minimum listing requirements of stock exchanges (Martell and Webb, 2008). Unlike stock splits, there is a debate on whether abnormal returns after reverse splits are positive or negative (Hwang *et al.*, 2008; Hwang *et al.*, 2012).

The reaction of the market to stock split announcements is a puzzle to be unraveled, especially in emerging markets with less stringent regulations. Nguyen *et al.* (2017) suggest that abnormal returns, especially those near announcement dates, may indicate insider trading abuse, particularly in countries with weaker regulatory structures. They highlight that emerging markets may behave differently from developed ones.

It is important to note that the literature on stock splits has primarily focused on developed countries; however, emerging markets have recently gained attention (Pandow and Ganai, 2023; Pandey *et al.*, 2022; Gupta and Arya, 2020; Pandow and Butt, 2019; Bodhanwala, 2015; Charitou *et al.*, 2005; Gorkittisunthorn *et al.*, 2006). Surprisingly, the Brazilian stock market, one of the largest in Latin America (World Bank, 2021), has received relatively little academic attention (Vieira and Procianoy, 2003; Vieira and Becker, 2011; Antônio *et al.*, 2018). The literature is limited and restricted to the Portuguese language.

This study examines whether abnormal returns occur after stock splits and reverse splits of Brazilian companies. We assume that markets exhibiting abnormal returns in stock split events may not be semi-strongly efficient, as discussed by Fama (1970), which opens the door to discussions of market anomalies and investment strategies. To the best of our knowledge, this is the first study to analyze the effects of stock splits and reverse stock splits in the context of the Brazilian market in light of the efficient market hypothesis (EMH) and market anomalies.

This study contributes to the literature in three ways. First, we investigated stock splits and reverse stock splits in stock markets, a topic that continues to intrigue the academic community. Brealey *et al.* (2017) commented that corporate events are an unsolved puzzle in corporate finance. Investigating market reactions to unfolding events helps us better understand market anomalies. Second, we analyze abnormal returns in the Brazilian context, expanding the horizons of research in emerging markets. Expanding these boundaries is crucial, particularly in Latin American countries, as argued by Aguinis *et al.* (2020). Brazil is one of the world's largest economies, making its stock market one of the most dynamic and significant in Latin America and the world. The Brazilian stock market also has peculiarities that set it apart from other international markets, such as having one of the highest interest rates in the world and a regulatory role played by the Securities and Exchange Commission (CVM, by its initials in Portuguese). Third, we employ event methodology on two distinct

"zero" dates: the date of the announcement of the stock change and the "ex" date of the change, when the stocks were actually traded after the split.

Our main results indicate that the effects of stock splits and reverse stock splits in the Brazilian market do not significantly differ from those in developed markets. Abnormal returns are positive after stock splits and negative after reverse stock splits, while the effects of announcements are irrelevant. This similarity can be attributed to the integration of the Brazilian market into the global scene (see Verma and Rani, 2016; Mensi *et al.*, 2016) and efforts to adhere to international standards, even with its regulatory and economic peculiarities. The Brazilian stock market has been developing and approaching the standards of developed markets in terms of regulations, corporate governance, and transparency (Talamo, 2011).

The remainder of this paper is organized as follows: Section 2 reviews the literature. Section 3 describes the data and presents the methodology used. Sections 4 and 5 present and discuss the empirical results of the study. Finally, conclusions are presented in Section 6.

2. Literature review and hypotheses

2.1 Efficient market hypothesis

Stock price analysis has deep roots in the history of financial markets and has been the subject of study and debate over the years. One of the earliest studies was Louis Bachelier's thesis (see Bachelier, 1900), which argued that stock prices follow random and unpredictable movements, an idea that influenced the development of modern finance theory.

From Bachelier onwards, several research studies (see Alexander, 1961; Osborne, 1962; Fama, 1965; Fama and Blume, 1966; Neiderhoffer and Osborne, 1966) began to question the predictability of prices, which raised doubts about the strategies of investment fund managers. Among relevant researchers, Eugene Fama began to analyze the behavior of stock prices in response to market information (see Fama *et al.*, 1969). His work suggests that asset prices quickly reflect all available information. This evidence is consistent with the fact that technical analysis or fundamental analysis cannot generate above-average returns.

Building on his findings and a comprehensive review of the literature at the time, Fama (1970) developed the EMH based on the idea that investors are rational and seek to maximize their returns. The theory states that asset prices reflect the available information. In an efficient market, asset allocation based on past information is futile to achieve gains above the market. In this case, the most viable strategy is to invest in a diversified portfolio of assets.

Fama (1970) conceptualized efficiency at three informational levels: (1) weak form, where asset prices reflect all historical information, including past prices and volumes, typically used in technical analysis of assets; (2) semi-strong form, where asset prices reflect all historical information and all publicly available information, including financial reports released by companies, typically used in fundamental analysis of assets and (3) strong form, where asset prices reflect all public and private information, including insider information.

After various pieces of contrary evidence emerged (e.g. Basu, 1977; Rosenberg *et al.*, 1985) regarding the efficient market hypothesis for long-term events, known as anomalies, Fama (1998) conducted an extensive investigation showing that the evidence does not suggest that market efficiency should be abandoned. According to him, anomalies are random outcomes and the apparently exaggerated reaction of stock prices to information. Eugene Fama's research was instrumental in opening the debate on market efficiency. After his 1970 work (Fama, 1970), numerous other studies have emerged to test the EMH.

2.2 Financial market anomalies

Financial anomalies are price behavior patterns that are inconsistent with efficient market theory (Schwert, 2003; De Bondt and Thaler, 1985). While efficient market theory asserts that

asset prices reflect all available information, thereby eliminating opportunities for excessive returns without assuming excessive risk (Fama, 1970), anomalies represent unusual market behaviors in response to specific events, allowing for gains to be made in light of these events.

According to Tversky and Kahneman (1986), an anomaly is a significant and consistent departure from price behavior that cannot be dismissed or treated as a random error. The literature describes various financial anomalies, the most well-known of which challenge the efficient market hypothesis in two ways: Firstly, in calendar anomalies, stock returns are typically higher during certain times of the year or month. Examples of these anomalies include the weekend effect, the end-of-month effect and the January effect. Secondly, in fundamental anomalies, stock prices behave in relation to the economic and accounting fundamentals of companies. Examples include market value anomalies, book value anomalies, profit-related anomalies and technical anomalies, where prices follow repeating patterns over time (Naseer and Tariq, 2015). According to Fama (1998), the issue of stock splits can also be considered an anomaly. Li *et al.* (2023) demonstrated that stock splits can have a psychological impact on investors, making them feel more comfortable investing in stocks that now have a lower price. This can lead to price movements that are not necessarily justified by a company's fundamentals.

However, Schwert (2003) noted that many anomalies prove to be mere statistical aberrations, which sometimes seem to disappear, reverse or attenuate.

2.3 Market reaction to stock split

With the firm unaffected by its investment, financing and dividend policies, there is no reason for investors to react to stock splits or reverse stock splits (Brennan and Copeland, 1988). Although the final value is the same, as it is just an accounting transaction that does not influence the company's cash flow, the increase in the number of stocks causes a different feeling among investors. Empirical evidence shows that stock prices rise after a split is announced and fall in a reverse split (Ikenberry *et al.*, 1996; Ikenberry and Ramnath, 2002; He and Wang, 2012; West *et al.*, 2020). There are cases in which there is no impact associated with stock splits, but there is an increase in stock liquidity in the days following stock splits (Fuenzalida *et al.*, 2008).

The literature investigates different hypotheses that explain the changes in prices resulting from stock splits. He and Wang (2012) analyzed several studies on three major hypotheses (optimal price/tick, signaling and procedure/structure). The optimal price/tick hypothesis describes the optimal range of stock prices and relative tick size (minimum price movement divided by stock price). For companies with high prices, a split event can help reduce prices to the optimal level (Koski, 1998). Reverse splits help companies with low prices (Koski, 2007; He and Wang, 2012). The signaling hypothesis states that the split announcement conveys information about the company's future performance. A direct division reveals good news, whereas a reverse split reveals bad news (He and Wang, 2012). The procedure and structure hypothesis explores the features of the split procedure, the market structure of trading and regulatory rules. The results of He and Wang's (2012) study show that the optimal price/tick hypothesis and the procedure/structure hypothesis are largely supported by empirical findings. Research on signaling hypotheses has yielded inconclusive results.

Li *et al.* (2023) demonstrated that a stock split can also be a strategy to correct pricing, especially when it results from behavioral biases, such as the anchoring bias addressed in their study. The authors suggest that companies carry out stock splits when their prices are close to their 52-week high. If this strategy is implemented, undervaluation gradually dissipates after the split.

Tao *et al.* (2021) showed that stock splits can occur due to pressure on the margin call from controlling shareholders. They initiate stock splits to support stock prices and secure pledged

shares. Hu *et al.* (2017) examined the aggregate determinants of stock split events. The authors showed that good market conditions and business cycle variations drive companies' decisions to split shares and increase the associated returns. This study analyzed the results in light of two theories: the neoclassical efficiency hypothesis and market-driven theory. The results showed that the neoclassical efficiency hypothesis was more consistent with these findings.

As an example of alternative theories, in the case of the Brazilian capital market, Vieira and Procianoy (2003) propose that high levels of inflation encourage stock splits and reverse stock splits, but mainly the former. The highly inflationary environment would make it difficult to conceive of a constant nominal price in the minds of investors. Companies can perform stock splits or reverse stock splits to adjust prices during periods of strong monetary changes caused by inflation.

The reaction time to the announcement of the split is an important factor to investigate in the literature. Knowing that the company will present positive abnormal returns after split announcements, as evidenced by empirical studies (Fama *et al.*, 1969; West *et al.*, 2020), and that after the split, abnormal returns tend to zero (Byun and Rozeff, 2003), one strategy for the management of companies is to carry out multiple splits. Desai and Jain (1997) showed that the market underreacts to split announcements. However, long-term abnormal returns are positively associated with increases in company dividends. Walker (2021) showed that half of the companies that split their stocks announced new divisions. However, Walker (2021) states that the success of this strategy assumes that all events announced by the company will exhibit an underreaction, regardless of their number.

The explanation for the multiple stock split strategy lies in the signaling hypothesis. Company management will use the events as a way of reporting on the positive outlook, whether from abnormal earnings growth, analysts' earnings expectations or improved future profitability (Huang *et al.*, 2009; Lakonishok and Lev, 2017; Walker, 2021).

Although the split tends to signal that the company has good financial results, the reverse split shows the opposite result. In practice, companies opt for a reverse split in the hope of increasing their share prices as a result of an unfavorable financial situation. Ads produce a negative stock price reaction (Peterson and Peterson, 1992; Zaremba *et al.*, 2019). Studies show that most companies do not survive reverse stock splits (Neuhauser and Thompson, 2014, 2016; Crutchley and Swidler, 2015). On the other hand, a reverse split improves stock liquidity (Lamoureux and Poon, 1987; Han, 1995), reduces volatility (Koski, 2007), reduces the total risk of securities returns (Peterson and Peterson, 1992), generates positive signals to the market (Masse *et al.*, 1997), reduces transaction costs and helps investors buy stocks on a margin (Hwang *et al.*, 2012). In addition, Chung and Yang (2015) show that both the number of institutional investors and the percentage of shares held by institutional investors increased significantly after the reverse split. A rise in the number of institutional investors is associated with an increase in share prices.

2.4 Hypotheses

The research hypotheses were formulated considering the results of the empirical literature. We assume two groups for the hypotheses: the first refers to the split announcement, while the second refers to the time after the stock split.

Evidence from McNichols and Dravid (1990), Brown *et al.* (1995), Ikenberry *et al.* (1996), Ikenberry and Ramnath (2002), He and Wang (2012), West *et al.* (2020) and Walker (2021) indicates that the market reacts positively to the unfolding of the announcement and the event. Stock prices rise after the split is announced and fall on a reverse split. According to Ikenberry *et al.* (1996), price increases occur when stock splits send positive signals to the market. Companies are confident about their future earnings growth. Thus, we formulated the following hypothesis:

H1a. Stocks show positive abnormal returns after stock split announcements.

H1b. Stocks show positive abnormal returns after realizing stock splits.

The studies by Zaremba *et al.* (2019), West *et al.* (2020) and Shue and Townsend (2021) show negative behavior after announcements and reverse unfolding events. The abnormal stock returns are negative. Thus, we formulate the following hypotheses:

H2a. Stocks show negative abnormal returns after reverse stock split announcements.

H2b. Stocks show negative abnormal returns after reverse stock split realization.

3. Methodology

3.1 Data

This study used information from the shares of companies traded on the B3 (Stock Exchange in Brazil). The study sample was based on a set of 518 events that occurred over a 30-year period (1987–2016). The sample contained 167 stock splits and 351 reverse stock splits. The sample was divided into three groups. The first group included stock split events. The second is reverse stock split events. The third is a complete sample containing all events. The complete sample was called the combined sample.

3.2 Research design

The event study method was employed to detect possible abnormal returns and their statistical significance, considering the consolidated position of this practice in the literature and to measure market informational efficiency in its semi-strong form. The method used was similar to those used by Pagin *et al.* (2021) and Fuenzalida *et al.* (2013), both of which were based on MacKinlay (1997).

The reaction of companies in the Brazilian capital market to stock splits and reverse splits is considered an event of interest. In this sense, we separated the sample into two groups in time, as follows: (1) Announcement of the event: Considers data at the time of deliberation on a stock split. We adopted the "zero" date, in the first instance, as the date for deliberation on the reverse split or split of shares by the Ordinary General Meeting (OGM) of shareholders. Although it is an important period for investigation, the effects on stock prices on the day when the stock split is deliberated may be influenced by other events that also occurred on that date. This is especially true in meetings that address various topics besides stock splits, such as dividend decisions, board composition, company results, etc. Due to the complexity of analyzing the content of each meeting, we chose not to exclude companies that also had important decisions at the same Annual General Meeting (AGM). Therefore, we also preferred to analyze a second date; (2) Event date: Composed of data at the time of the stock split and reverse split. We consider the "zero" date to be the "ex" date: the date on which shares began to be traded in a split or reverse split. Although the announcement is of great importance, similar to dividends, the financial market tends to react close to the "ex" date rather than immediately after the announcement (see Blau *et al.*, 2011). Therefore, we understand that the "ex" date generates a cleaner event, as it is not contaminated by other company news throughout the period, as could occur solely with the announcement date.

Two time windows are considered. Window I is the three-day window around date zero, i.e., the period from day -1 (date immediately preceding the event date) to day $+1$ (date immediately after the date of the event). Window II is the eleven-day window around date zero, i.e., the period from -5 (date of the fifth day prior to the date of the event) to $+5$ (the fifth day after the date of the event).

Figure 1 summarizes the distribution of the analyzed samples and events.

3.3 Analytical procedure

This event study analyzes the variation in abnormal returns over time. The analytical procedure consisted of three stages. The first step is the estimation of abnormal returns, where stock returns (see Eq. (1)) and abnormal returns (see Eq. (3)) and the averages and variances of the returns (see Eq. (5) and (6)) are estimated. The second step is the estimation of the average returns accumulated during the events (see Eq. (7)). The third step is the estimation of the returns' J-statistics (see Eq. (10)).

Abnormal returns are estimated using the daily-closing prices of shares. This study considers common and preferred stocks. The returns were calculated as logarithmic returns according to Equation (1), since this method, according to MacKinlay (1997), presents a distribution of returns closer to the normal distribution, which is a presupposition for parametric statistical tests.

$$R = ln\frac{P_t}{P_{t-1}} \tag{1}$$

The return generation model is the market-adjusted return model. This model assumes that the expected return of stock i is the expected return of a given market portfolio or the equivalence given by Equation (2).

$$E(R_{i,t}) = E(R_{m,t}) \tag{2}$$

where $R_{i,t}$ is the return of stock i at time t and $R_{m,t}$ is the return of the market at time t.

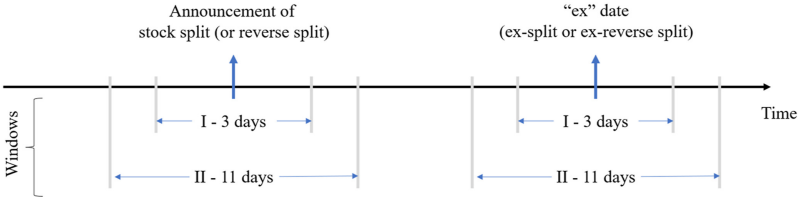
According to MacKinlay (1997), the abnormal return will be the difference between the observed return on the security and the return on the market portfolio, as calculated in Equation (3).

$$AR_{i,t} = R_{i,t} - R_{m,t} \tag{3}$$

In the case of studies performed on the Brazilian capital market, the most commonly used index is Ibovespa (Vieira and Procianoy, 2003; Vieira and Becker, 2011). We use the Ibovespa index return as a proxy for the return on the market portfolio. In the case of the market model, it is assumed that the intercept (α) is null (MacKinlay, 1997).

$$R_{i,t} = \alpha + \beta R_{m,t} + \varepsilon \tag{4}$$

Because the analysis model employed here is designed to detect and measure the impact of events on a market's security prices comprehensively and not in isolated cases, it is reasonable to consider accumulated returns – over time and for the entire set of securities – to work with averages of abnormal returns within certain time intervals. This approach assumes that there is no correlation between the abnormal returns of different securities, which is the case when there is no clustering, that is, any overlap in the event window of the



Source(s): Own elaboration

Figure 1.
Event windows

sample securities. Thus, the mean sample of abnormal returns is obtained using Equation (5) (MacKinlay, 1997).

$$\overline{AR}_t = \frac{1}{N}\sum_{i=1}^{N} AR_{i,t} \tag{5}$$

And its variance given by Equation (6).

$$Var(AR_t) = \frac{1}{N^2}\sum_{i=1}^{N} \sigma_{ei}^2 \tag{6}$$

Similarly, the cumulative average return of a sample with N events was obtained using Equation (7).

$$\overline{CAR}_t(t_1, t_2) = \frac{1}{N}\sum_{i=1}^{N} CAR_i(t_1, t_2) \tag{7}$$

where t_1 and t_2 correspond to the period before (t_1) and after (t_2) the event.

The variance is given by Equation (8).

$$Var\left[\overline{CAR}_t(t_1, t_2)\right] = \frac{1}{N^2}\sum_{i=1}^{N} \sigma_i^2(t_1, t_2) \tag{8}$$

Observing the assumption that the event window of N securities does not overlap with the covariance term set to zero. Thus, under the null hypothesis, the cumulative average abnormal returns have the following distribution, as per Equation (9).

$$\overline{CAR}_t(t_1, t_2) \sim N\left[0, \sigma^2(t_1, t_2)\right] \tag{9}$$

With the expectation of abnormal returns under H_0 to be zero.

In practical terms, for cases where the value of $\sigma^2(t_1, t_2)$ is unknown, $\frac{1}{N}\sum_{i=1}^{N}\sigma^2(t_1, t_2)$ can be used as an estimator and proceed to the H_0 tests using Equation (10).

$$J_1 = \frac{\overline{CAR}_t(t_1, t_2)}{\sqrt{\sigma^2(t_1, t_2)}} \approx N(0, 1) \tag{10}$$

The J_1 statistic was used at a level of statistical significance of 95%. MacKinlay (1997) posits that the distribution is asymptotic with respect to the number of securities N and the length of the estimation window. He also adds that it is possible to make modifications to the basic approach presented. A common modification is to standardize each abnormal return using an estimator of its standard deviation. However, for this study, a choice was made not to standardize the estimator but instead to use the J_1 statistic with the estimated standard deviation.

The decision was made to use the parametric J_1 statistic, based on the assumption that cumulative abnormal returns follow a normal distribution. Nonparametric tests, such as the sign test and the rank test, can be employed when there is no specific assumption about the distribution of abnormal returns.

4. Results

The results of this study are presented in Tables 1 and 2. The number of events varied according to the availability of data and events that did not present data throughout the window under analysis were excluded from the study. The period prior to the ex-date is important to ascertain the use of inside information and the subsequent period in gauging the speed and accuracy of price adequacy to new market information (Camargos and Barbosa, 2003).

Tables 1 and 2 summarize the results obtained from the event studies for different samples and window types. The nomenclature used in the column, called "Window Type" is the size of the analysis window type. Type I indicates a three-day window and Type II indicates an 11-day window. Data from Tables 1 and 2 also show that no study had a statistically reduced number of events ($N < 30$). Table 1 displays the results of the impact of the stock split and reverse stock split after the announcement. The date considered is the Ordinary General Meeting (OGM) of the company's shareholders.

With the adoption of a significance level of 95% for the J1 test statistic (critical value $|J_1| \geq 1.96$), Table 1 shows that none of the results are statistically significant. Therefore, it is possible to reject hypotheses H1a and H2a. In this sense, the results differ from the empirical evidence. Split announcements do not increase share prices. The company's value does not change without changes in investment, financing or distribution of result policies.

Table 2 presents the results of the impact of the stock split and reverse stock split after the ex-date of the event.

In Table 2, the results of studies 1, 2, 5 and 6 are statistically significant. In study 1, for a three-day window around the date shares started trading as a stock split, Hypothesis H1b may not be rejected, indicating the presence of statistically significant abnormal returns. Thus, it is possible for an investor to make abnormal gains by adopting a strategy of buying stocks by referring to the ex-stock split date.

Study	Sample type	Window type	CAR	J_1 statistic	Number of events
1	Stock split	I	0.0157	1.85	69
2	Reverse stock split	I	−0.0045	−0.76	152
3	Combined	I	0.0028	0.57	237
4	Stock split	II	0.0193	1.59	38
5	Reverse stock split	II	−0.0113	−1.34	69
6	Combined	II	−0.0004	−0.06	107

Note(s): (*) significant at the 5% level
Source(s): Own elaboration

Table 1.
Results of event studies with date zero being the date of the OGM

Study	Sample type	Window type	CAR	J_1 statistic	Number of events
1	Stock split	I	0.0243*	2.87	81
2	Reverse stock split	I	−0.0333*	−4.09	71
3	Combined	I	−0.0026	−0.44	152
4	Stock split	II	−0.0055	−0.47	41
5	Reverse stock split	II	−0.0362*	−3.09	43
6	Combined	II	−0.0212*	−2.58	84

Note(s): (*) significant at the 5% level
Source(s): Own elaboration

Table 2.
Results of event studies with date zero being the ex-split or ex-reverse split date

The same result does not hold when the window is enlarged to a period of 11 days because, according to the data in Table 2, hypothesis H1a can be rejected.

For reverse stock splits, the three-day window study shows negative abnormal returns on the days before, after and on the day the stock began trading as a reverse stock split. The J_1 test statistic (−4.09) indicates that the results obtained are statistically significant. In this case, an accumulated abnormal return of −3.33% at the end of the period was observed for the 71 events analyzed. Hypothesis H2b cannot be rejected, indicating the existence of negative abnormal returns.

For an 11-day window, the statistical significance of the results remains, with a negative cumulative abnormal return of −3.62% for a total of 43 events analyzed. The presence of returns below those produced by the market model is evident, with their minimum on the day the shares traded reverse stock split. Hypothesis H2b cannot be rejected for this 11-day window study, indicating the existence of abnormal returns.

For the combined sample (stock splits and reverse stock splits) with 84 events, considering the 11-day window (Type II), the J_1 statistic value (−2.58) reveals an accumulated abnormal return of −2.12% in the period. However, for the Type I window, the results were not statistically significant.

Figure 2 presents the average abnormal returns for each day of the event, i.e. in graph A of Figure 2, we can see that the value of the abnormal return 1 day before (day −1) of the ex-date

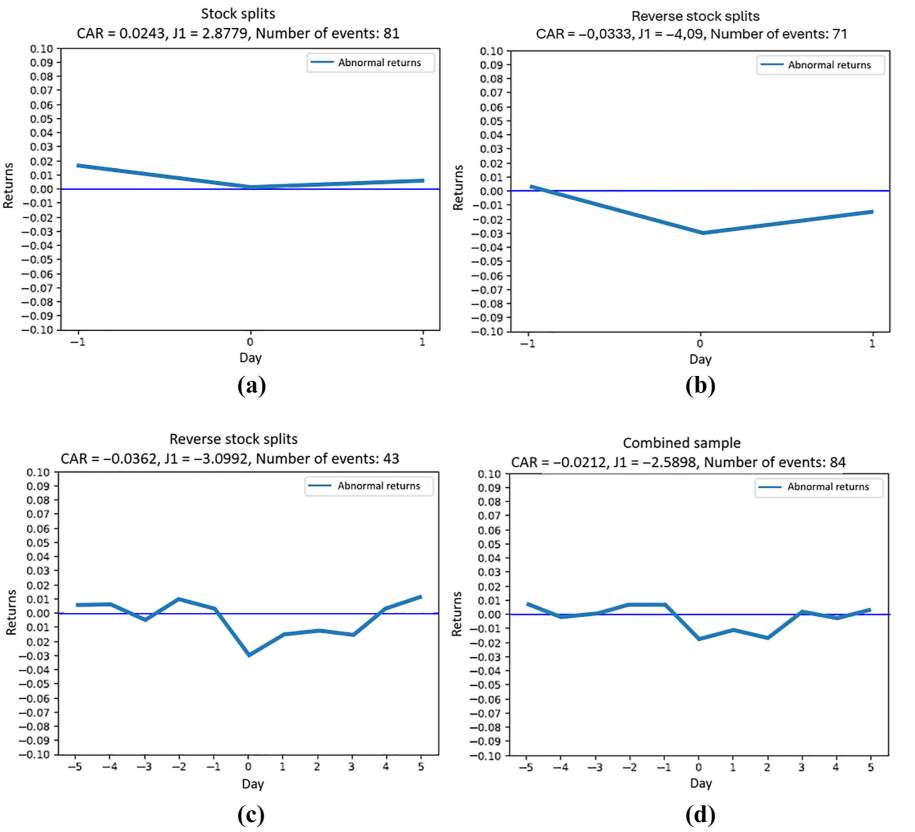


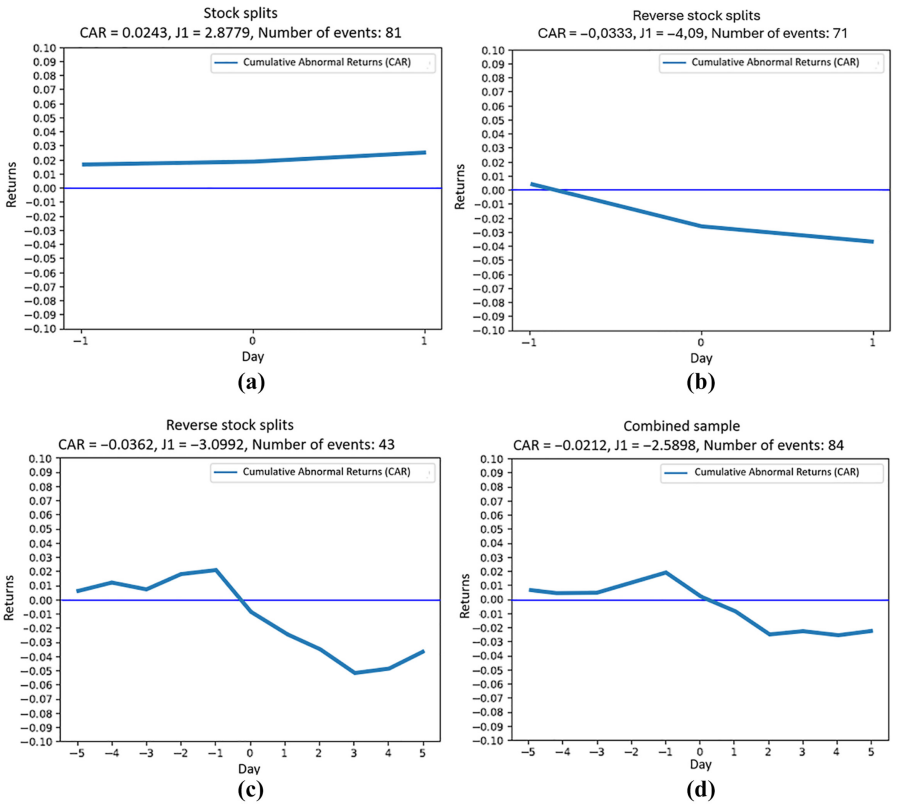
Figure 2.
Daily abnormal returns around the stock split and reverse stock split ex-date

Source(s): Own elaboration

was approximately 2%, close to 0% on the date 0 and close to 1% on the date 1 after. Graphs A and B correspond to the 3-day window, while graphs C and D correspond to the 11-day window. In general, we can observe that, except for graph A (stock split), the others (reverse stock split and combined) show negative returns after the event. This highlights the difference in returns with the stock split event. The trend of negative returns after the event only reverses on the fourth day, as shown in Figure 2 (graph C).

Figure 3 presents the cumulative abnormal returns, allowing for the analysis of how returns accumulate over time. This enables the observation of the gains or losses associated with a potential investment strategy before the ex-date. The organization of Figure 3 mirrors that of Figure 2, with graphs A and B representing the three-day window and graphs C and D representing the 11-day window, displaying only statistically significant statistics. The visualization provided by Figure 3 facilitates the observation of the cumulative decline in the case of reverse stock splits, particularly within the 11-day window as well as the increase observed with stock splits.

Table 3 presents the synthesis of the results for each hypothesis test. To enable a better comparison of the results with those obtained by Vieira and Procianoy (2003), abnormal returns were accumulated over the 11-day window.



Source(s): Own elaboration

Figure 3. Cumulative abnormal returns around the ex-date of the stock split and reverse stock split

Event	Hypothesis	Window	Result	Implication
Stock split announcement	H1a	3 days	H1a Rejected	No abnormal returns
		11 days	H1a Rejected	No abnormal returns
Reverse stock split announcement	H2a	3 days	H2a Rejected	No abnormal returns
		11 days	H2a Rejected	No abnormal returns
Stock split realization	H1b	3 days	H1b Not Rejected	Abnormal returns
		11 days	H1b Rejected	No abnormal returns
Reverse stock split realization	H2b	3 days	H2b Not Rejected	Abnormal returns
		11 days	H2b Not Rejected	Abnormal returns

Table 3.
Hypothesis test results

Source(s): Own elaboration

5. Discussion

5.1 Theoretical implications

The results of this study have several theoretical implications. As Aguinis *et al.* (2020) note, Latin America represents a unique region for management researchers to investigate phenomena and build theories owing to its social, cultural and economic characteristics. This study contributes to the literature by investigating the Brazilian financial market.

While the academic literature has shown a consensus on the reactions of investors to stock split announcements, with evidence suggesting positive reactions to future splits and negative reactions to reverse splits (He and Wang, 2012; West *et al.*, 2020), the results of this study challenge this consensus. Split announcements do not impact Brazilian financial markets, and empirical evidence suggests that Brazilian investors behave rationally and reject short-term price anomalies, as Bondt and Thaler (1985) describe. Additionally, nonproportional thinking, as discussed by West *et al.* (2020), is rejected.

Despite this, evidence for stock split and reverse stock split events in Brazil is similar to that in the literature, with investors reacting to sudden changes in share prices. This suggests that the Brazilian market rejects the EMH in its semi-strong form. Furthermore, evidence shows that abnormal gains can be obtained by purchasing shares in companies before a split and by taking a short position in companies that have announced a reverse split, which is consistent with the findings of previous studies (Kim *et al.*, 2008; Hwang *et al.*, 2012; Zaremba *et al.*, 2019; West *et al.*, 2020; Shue and Townsend, 2021).

Therefore, while this study challenges the efficiency of the Brazilian market in its semi-strong form, it also suggests that abnormal gains can be obtained through investment strategies surrounding stock splits and reverse stock split events. However, it should be noted that the Brazilian market does not react to announcements of stock split events and returns for reverse split events are lower than market returns.

5.2 Policy/managerial implications

In practice, the results indicate that stock split and reverse stock split operations represent opportunities for extraordinary gains, which may be relevant in defining investment strategies in the Brazilian stock market. However, it is important to highlight that the significant impact does not necessarily occur at the time of the announcement of these operations, but rather on the date of the split (ex-date). The results suggest that market participants do not believe that stock split announcements contain information about the company's short-term future performance. On the other hand, the split date (or reverse split) triggers a market reaction, which can be compared to the effect observed in the dividend distribution market. As stated by Blau *et al.* (2011), demand for a particular stock by pattern-trading traders can drive stock prices above their fundamental value, thus providing a lucrative trading opportunity for market players.

For investors, this information can be useful in identifying short-term profit opportunities. A split action may indicate that the company is doing well financially and may lead to an increase in demand for its shares. Additionally, split actions can make stocks more accessible to a broader audience of investors, which can increase liquidity and trading volume.

For asset managers, the survey results suggest that strategies based on corporate events, such as split stocks, can be effective in generating windfall gains. This may lead managers to consider strategies based on corporate events when making their investment decisions. This implies the use of trader algorithms installed within an exchange system programmed to detect such events. Saucedo and González (2021) and Vergara Garavito and Chión (2021) show that the results can be useful for investors in making better decisions when trying to predict stock market performance. Investors can improve the risk-return ratio. This evidence shows the need for regulatory agencies and policymakers to encourage financial market efficiency and avoid distortions.

5.3 Limitations and future research agenda

This study focused on analyzing the Brazilian stock market up to 2016. Future research could explore whether the financial variables of companies can predict stock splits and mergers. It would be interesting to identify the determinants of splits and mergers for both the group with abnormal returns and the group without. Regarding the methodology, nonparametric statistics such as sign tests, BMP and Corrado can be applied in future research. It would be valuable to investigate evidence of information leakage, overreactions and mean reversion. Another suggestion would be to use a larger database that includes periods of crisis in Brazil and the COVID-19 outbreak period. Additionally, an investigation that differentiates between companies with and without financial difficulties could be tested.

6. Conclusion

The present study aims to identify possible abnormal returns upon the announcement and execution of operations called stock split and reverse stock split and to relate these returns to the efficient market hypothesis proposed by Fama (1970). In this sense, a sample of companies that performed such operations in the last decades of the Brazilian capital market was collected and an event study methodology was used to calculate and test abnormal returns in relation to those given by a market model (IBOVESPA).

In general, the results of the studies rejected hypotheses H1a and H2a, which analyzed the effect of the advertisement. The stocks do not show positive abnormal returns after the announcements. However, the results confirmed hypotheses H1b and H2b. The market reacts positively to the split (and reverse split).

The results obtained here are in line with those of the study by Vieira and Procianoy (2003), as the latter mention that well-informed investors can in fact make extra gains despite the EMH proposed by Fama (1970). It is clear from the results obtained for inefficiency in the Brazilian capital market in its semi-strong form and the realization that it may be possible to use stock splits and reverse stock splits as investment strategies.

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