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The top-5 Brazilian stocks' resilience over 13 years of political-economic events

Resiliência das ações top-5 brasileiras ao longo de 13 anos de eventos político-econômicos

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Abstract

Purpose: This study analyzes how political-economic events have affected the Brazilian capital market over 13 years by evaluating the abnormal returns of the five most liquid stocks (Top-5).

Originality/value: This research proceeds from previous studies by analyzing various political-economic events that impacted, to some extent, the prices of companies listed on the Brazilian Stock Exchange over 13 years. Considering both favorable and opposing evidence to the efficient market hypothesis (EMH), this study provides an original and robust test to evaluate market efficiency, considering various events and companies.

Design/methodology/approach: We used the event study methodology to measure the impact of each event on stock prices by using the day before and after the event analyzed. We performed capital asset pricing model (CAPM) estimations with 110 observations before the event to assess abnormal returns. To assess the research hypotheses, we used the average abnormal return test around the event (Window – 1.1).

Findings: We found that the five major companies in the Brazilian stock market were efficient in the EMH semi-strong form test despite 13 years of extreme events. Their returns did not change significantly after the events, differentiating themselves from studies that question market efficiency. Therefore, market participants should not expect abnormal returns in similar events.

Keywords: crises, extreme events, liquidity, efficient market hypothesis, event study

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Resumo

Objetivo: Este artigo visa analisar como os eventos político-econômicos afetaram o mercado de capitais brasileiro ao longo de 13 anos, avaliando os retornos anormais das cinco ações mais líquidas (Top-5).

Originalidade/valor: Este estudo avança sobre pesquisas anteriores ao analisar vários eventos político-econômicos ocorridos ao longo de 13 anos que impactaram, em alguma medida, os preços de empresas listadas na Bolsa de Valores Brasileira. Considerando evidências favoráveis e contrárias à Hipótese de Eficiência de Mercado (HEM), esta pesquisa oferece um teste original e robusto para avaliar a eficiência de mercado, considerando diversos eventos e empresas.

Design/metodologia/abordagem: Utilizamos a técnica de estudo de eventos para medir o impacto de cada evento nos preços das ações utilizando o dia que precede e que sucede o evento analisado. A análise do retorno anormal das empresas foi realizada por meio de estimações do modelo de precificação de ativos de capital (CAPM) com 110 observações anteriores ao evento. Os testes das hipóteses de pesquisa foram realizados por meio do teste de médias do retorno anormal em torno do evento (Janela – 1,1).

Resultados: Verificamos que as cinco principais empresas do mercado acionário brasileiro foram eficientes na forma semiforte da HEM diante de 13 anos de eventos extremos. Seus retornos não sofreram mudanças significativas após os eventos, diferenciando-se de estudos que questionam a eficiência do mercado. Diante dos resultados encontrados, participantes do mercado não devem esperar retornos anormais diante de eventos similares.

Palavras-chave: crises, eventos extremos, liquidez, eficiência de mercado, estudo de eventos

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INTRODUCTION

According to the efficient market hypothesis (EMH), stock prices fully reflect the available information. Studies have examined how companies react to unique events like earnings announcements or stock splits to assess the EMH theory (Fama, 1970). More recent research has focused on specific events affecting one or a few companies (Padula & Albuquerque, 2018; Dias & Malaquias, 2021; Camelo et al., 2022; Pordeus et al., 2021). Our study aims to contribute to the understanding of EMH in the Brazilian market by examining the price reactions of companies to relevant events.

Therefore, with the most comprehensive sample of political-economic events documented up to this point, through the study of events (MacKinlay, 1997), we observe abnormal returns on the prices of the major stocks in the Brazilian stock market in only 11.25% of events within a one-day window around the event. This observation supports the semi-strong EMH form in most events. "Good" events lead to positive average returns, and "bad" events lead to negative returns within a one-day window, although statistically indifferent. Thus, there is no window of opportunity for abnormal gains for managers in securities issuance, nor for investors to trade unfoundedly in response to extreme systematic events, meaning events that theoretically impact all companies.

Previous researches has only focused on limited and isolated events, looking at a small number of companies or a broad index. Batista et al. (2018) and Schmidt et al. (2018) have suggested that the market is efficient. However, other studies, such as those by Padula and Albuquerque (2018), Almeida et al. (2020), Dias and Malaquias (2021), and Gregory (2022), provide contrasting evidence. Most researches has looked at specific reported events in exploring the potential for abnormal returns resulting from public information. Our study stands out by analyzing a range of nationally significant events over 13 years to better understand abnormal returns and their relation to various themes, such as politics, economy, or corporate matters. As such, our study provides a robust test of the practical validity of the EMH.

In recent years, various corporate, political, economic, and regulatory events have reverberated in the media, causing positive and negative effects on the Brazilian market. On September 15, 2008, the collapse of Lehman Brothers, then the fourth-largest investment bank in the United States, sent shockwaves globally, triggering the most significant crisis in the US financial system since the 1929 Crash, famously known as the subprime crisis. During this period, Brazil was experiencing a favorable economic environment. In the same year, 2008, it achieved an investment-grade rating and, on April 10, 2009, became a creditor to the International Monetary Fund (IMF).

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In 2014, the "winds of change" for Brazil as the Lava Jato operation became one of the largest corruption scandals ever recorded. Two years later, the Brazilian National Congress approved President Dilma Rousseff's impeachment amidst Brazil's worst economic crisis in over a century (Maia et al., 2019). In 2017, an event entitled "Joesley Day" shook the political landscape again. These events share extensive media coverage and their impact, to varying degrees, on the Brazilian stock market. Both national and international origin events were widely covered by the media and can be considered either "good" or "bad" from an investor's perspective. By influencing optimism about the future political and economic landscape, these events could drive individuals to trade, either boosting prices through increased optimism or causing a decline due to pessimism.

Can an investor gain higher than usual returns by using specific information? Fama (1970, 1991) claims that it is impossible since the market is efficient, meaning that stock prices quickly reflect all available information. This study aims to contribute to the EMH debate in the national market by examining the market's response to events over 13 years. The study asks: What political-economic events have impacted the Brazilian capital market over 13 years? The research objective is to identify the political-economic events that have influenced the Brazilian capital market over this period.

This study is critical because it helps us understand whose events contribute to market efficiency or inefficiency. It can be a starting point for future studies to explore specific events and identify similarities and differences. Furthermore, we justify that we chose companies that are popular in the Brazilian market, representing about 35% of the Ibovespa index, with three million individual investors, and have a historical significance dating back to before 1990. Our goal is to provide practical insights that will significantly impact the Brazilian market, particularly given the increasing interest in day trading, which is popular among less-informed investors. However, these strategies may have failed to be successful as the market efficiently priced those bigger companies.

LITERATURE REVIEW

Market efficiency and event studies

An event study examines how stock prices react to new information. According to the semi-strong form (Figure 1) of the efficient market

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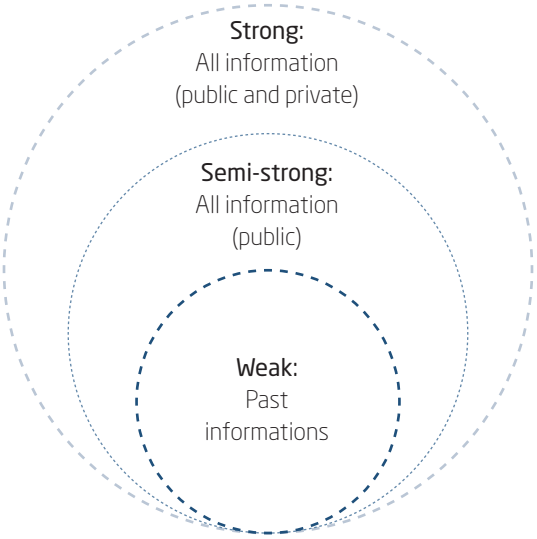
hypothesis (Fama, 1970, 1991), prices should react immediately and appropriately (not excessively) to the event. In other words, positive news should cause prices to rise immediately and stabilize at a new level, while negative news should immediately reduce prices to a new level (Fama et al., 1969; MacKinlay, 1997). Thus, as a test of the semi-strong efficiency hypothesis, an event study predicts that the reaction around new information should not be greater than expected, anticipated, or delayed.

Figure 1

Market efficiency forms



Source: *Adapted from Fama (1970).*

Therefore, if the market is semi-strong and efficient, knowing the news at the time of release does not offer any advantage to investors because prices would have already adjusted before there was time to act. Similarly, managers should not expect to receive more than the fair value of the securities they issue, eliminating the possibility of "deceiving" investors.

Fama (1970) presents evidence of price reactions consistent with the semi-strong form of efficiency in announcements of stock splits, earnings, and changes in interest rates. On the other hand, he reports early reactions and reversals after news of large block sales of stocks and new stock issuance. Thus, the evidence contradicts the semi-strong efficiency form if price reactions are above or below expected levels, anticipated or delayed relative to the event.

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Since the introduction of the event study technique by Fama et al. (1969), numerous research studies have examined the hypothesis that an event has no impact on the distribution of returns. We highlight more recent studies that associate corporate, political, or economic events: Padula and Albuquerque (2018), Schmidt et al. (2018), Batista et al. (2018), Almeida et al. (2020), Dias and Malaquias (2021), Camelo et al. (2022), Cavalcante et al. (2022), Mendes and Lucena (2022), Pordeus et al. (2021) and Gomes and do Carmo (2023).

This research covers several topics, such as the impact of government corruption on the stock returns of significant companies like Petrobras, Vale, and Banco do Brasil following the Lava Jato operation (Padula & Alburquerque, 2018). It also analyzes the reaction of Santander, Gerdau, and Bradesco stocks in light of the Zelotes operation (Schmidt et al., 2018). The study also found a significant negative effect on the stock returns of companies associated with corruption-related news (Dias & Malaquias, 2021). Additionally, it examines the effect of the announcement of the presidential impeachment in 2016 on the Brazilian stock market (Batista et al., 2018) and the impact of Quantitative Easing on the stock market (Almeida et al., 2020; Gregory, 2022).

It is necessary to have more conclusive evidence on the semi-strong form of the efficient market hypothesis, particularly in the Brazilian market. However, most studies focus on specific themes, such as corruption (Schmidt et al., 2018; Padula & Albuquerque, 2018; Dias & Malaquias, 2021) or corporate events (Mendes & Lucena, 2022; Pordeus et al., 2021; Gomes & do Carmo, 2023). To bring innovation, we have compiled events of a diverse nature, including positive and negative occurrences over 13 years.

Although relevant events occur, experts now have widespread access to current information and advanced analytical tools that extensively cover financial markets. As a result, prices reflect this informational efficiency, making it plausible that markets are becoming increasingly efficient. This context allows us to formulate the first research hypothesis according to the semi-strong form of the efficient market hypothesis (Fama, 1970, 1991).

- H1: The top five stocks in the Brazilian market have prices that quickly and accurately respond to political and economic events.

Based on the first hypothesis of this research, we assumed that if the Brazilian market is semi-strong efficient, positive events will result in immediate positive stock returns, and negative events will cause negative returns.

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Prospect theory and behavioral finance

The EMH (Fama, 1970) predicts that prices at any given moment reflect all available information in the market, following a random walk pattern, thus rendering them unpredictable. Assuming investors are risk-averse and rational, as in the capital asset pricing model (CAPM) by Sharpe (1964), the market price would be considered "fair". Even if temporary distortions occur, arbitrageurs will correct them.

Subsequently, Fama (1991) elaborated on a weaker and more economically plausible version of efficiency, in which prices reflect information until its benefits do not outweigh its costs. This version recognizes that prices may not be perfectly efficient or "fair" as initially posited. In this sense, Fama and Thaler (2016) discuss two practical implications of the efficient market hypothesis: it is difficult to beat the market, and prices are rational. There is more significant agreement regarding the former implication than the latter.

The field of behavioral finance seeks to fill the gap about the irrationality of an actual investor who cannot completely avoid their biases and cognitive and emotional preferences over uncertain decisions. Thus, investors cannot be perfectly rational in their decisions. One example of a bias that can lead to financial bubbles is overconfidence, as evidenced during the 1999-2000 Internet bubble (Malkiel, 2003). Additionally, the "herd effect" can explain market crashes such as those in the US in 1929 and 1987.

The prospect theory (Kahneman & Tversky, 1979) was developed in behavioral finance to address preferences. This theory discusses the expected utility function concept, asserting that the decision-maker asymmetrically weights gain and loss functions. Consequently, the authors identified that individuals perceive gains more rapidly than losses since they exhibit risk aversion towards gains and losses. Loss aversion could explain high trading volume even with low returns and high risks (Daniel & Hirshleifer, 2015). Therefore, it is crucial to have a benchmark pricing model, such as the CAPM (Sharpe, 1964). Otherwise, it would be impossible to determine if investors' beliefs are exaggerated (Zhou, 2018).

Therefore, based on the prospect theory (Kahneman & Tversky, 1979), it can be inferred that the magnitude of "happiness" from gains is not as large as the magnitude of the "pain" from losses in financial transactions. Consequently, we expect investors to delay liquidating their losing positions even in the face of bad news revealing adverse scenarios. Hence, it is plausible that the magnitude of abnormal returns derived from good news would

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be smaller than those derived from bad news (Seok et al., 2019). Thus, it is possible to outline the second research hypothesis.

- H2: The prices of the top five stocks in the Brazilian market react with greater magnitude to adverse events than positive ones.

Finally, behavioral finance can explain why the market exaggeratedly interprets events. This erratic behavior can result in systematic anomalies such as bubbles, overreactions to new information, and excessive volatility. These behaviors often define the overall state of the market, whether it is optimistic, pessimistic, or uncertain, named by the literature as sentiment and uncertainty (Zhou, 2018). As a result, sentiment and uncertainty can contribute to the misconceptions surrounding securities valuation.

METHODOLOGY

Time, events, and firms

Over 13 years, we gathered information on political, economic, and regulatory events that affected the Brazilian economy, both within the country and abroad. We aimed to identify any influence on the prices of the top stocks traded in the domestic market during this period. Our data collection began with the collapse of Lehman Brothers on September 15, 2008, which occurred during the subprime crisis. This event was highly negative as it intensified concerns about the stability of the world's biggest financial market, the US capital market. Our collection concluded with a highly positive event that had a global impact, that was the commencement of COVID-19 vaccination in the UK on December 8, 2020, also known as V-Day.

The selected period, beginning in 2007 justifies the pivotal transformation witnessed within the Brazilian market. Specifically, from 2000 to 2007, the trading volume and market capitalization grew by 6.8 and six times (World Federation Exchanges [WFE], 2019). At the same time, we did not observe a similar growth trajectory between 2007 and 2019. Thus, our study starts in the years after 2007 for enhanced comparability. The comprehensive listing of events is presented in Table 1, as outlined below.

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Table 1

Chronological list of events

Event description	Date	Type	Source
Lehman Brothers Crash – subprime crisis	2008-09-15	bad	external
Brazil becomes a creditor of the IMF	2009-04-10	good	internal
Adoption of IFRS standards in Brazil	2010-01-04	good	internal
Denial of loan to Greece – eurozone crisis	2010-05-03	bad	external
Brazil rises to the sixth-largest world economy	2011-12-26	good	internal
New retirement regime – FUNPRESP	2013-02-04	good	internal
Commencement of the Lava Jato Operation	2014-03-17	bad	internal
Recession in Brazil – 3 negative GDP growth quarters	2014-09-01	bad	internal
Implementation of a new retirement rule – Rule 85/95	2015-06-18	good	internal
Impeachment of President Dilma Rousseff	2016-08-31	bad	internal
Government's spending ceiling – PEC 241/2016	2016-10-10	good	internal
The leak of the conversation between Joesley Batista and Michel Temer President – Joesley Day	2017-05-18	bad	internal
Implementation of labor reform in Brazil	2017-07-13	good	internal
Declaration of Pandemic by the WHO	2020-03-11	bad	external
Election of Joe Biden as President of the US	2020-11-09	good	external
Initiation of COVID-19 vaccination in the UK	2020-12-08	good	external

The selection of these events was predicated upon their widespread resonance as amplified by media coverage in specialized media outlets, characterized by national reference newspapers of the highest circulation within the country (Associação Nacional de Jornais [ANJ], 2020). Thus, we classified the events as good or bad based on their potential to influence market reactions in positive and negative directions. Certain news items can instigate stock price fluctuations, causing them to rise or fall (Da et al., 2011; Statman, 2020). When economic agents construe news positively, stock prices tend to ascend, and conversely. In specific contexts in the domestic financial market, investors perceived certain events unfavorably, leading to circuit breakers (mandatory and momentary trading halts) on the stock exchange (Ferreira, 2020).

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Following identifying events and corresponding dates, companies were selected for inclusion in the sample, encompassing the foremost entities within the Brazilian capital market. These entities comprise Vale, Itaú Unibanco, Petrobras, Bradesco, and Ambev. Hence, the sample consists of corporations capable of influencing systemic risk in Brazil. The ensuing Table 2 duly exemplifies the significance of these enterprises within the Brazilian capital market.

Table 2

Sample

Name (code)	Proportion Ibovespa (%)	Series beginning	Institutional (proportion > 5%)	Individual investors
Vale (VALE3)	16.01	1986-01-02	BlackRock Inc. (6,33%) Mitsui & Co., Ltd. (5,99%) Capital World Investors (6,69%)	510,874
Itaú Unibanco (ITUB4)	6.06	1986-01-02	GQG Partners LLC (2,59%) BlackRock.INC (3,57%)	458,530
Petrobras (PETR4)	5.94	1986-01-02	BlackRock Inc (2,01%) GQG Partners LLC (5,45%)	858,992
Bradesco (BBDC4)	3.61	1986-01-02	Cidade de Deus Cia Cial Participações (22,95%)	798,152
Ambev (ABEV3)	2.99	1986-06-03	Interbrew International BV (53,60%)	354,893
Sum	34.61			2,981,441

Source: Daily Market Report (Boletim Diário do Mercado [B3], 2023).

We underscored the rationale behind designating these enterprises as the "Top 5" within the Brazilian capital market, based on Table 2 values. In this categorization, we encompass approximately 35% of the Ibovespa index and garner the engagement of nearly three million individual retail investors. Furthermore, their historical background as entities that went public before 1990 confers upon them a seasoned and mature standing within the market landscape. It is worth emphasizing the pivotal role that the globally renowned asset management firm BlackRock assumes in shaping the operational landscape of Vale, Itaú Unibanco, and Petrobras.

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Event study

This study aims to evaluate the effect of specific events (as shown in Table 1) on the five major companies listed on the B3 exchange in Brazil. The event study methodology is used to measure the impact of each event on a company's value by analyzing stock prices and defining analysis windows (MacKinlay, 1997). The study assumes that the chosen events have the potential to affect one or more significant entities in the Brazilian stock market. We investigate the hypothesis of market efficiency using this approach and examine whether these events immediately impact the companies' prices. Following MacKinlay's (1997) approach, the next section outlines the steps in conducting the event study.

For each event, we established a one-day window following the event and a one-day window preceding it because the information might have been leaked prior to the event or could reverberate after its impact. The event window constitutes the timeframe in which we assess the news's repercussions on prices. Despite this rationale, in event studies, the selection of the event window is arbitrary (Nogueira & Angotti, 2011), and it remains at the researcher's discretion to define its boundaries, considering the justification for its temporal effect.

We evaluate the effects of each event on stock returns, comparing the expected return with the company's actual return. Thus, we define abnormal return as the difference between the actual return and its expectation. We calculate the actual return through the linear return between prices, according to Equation 1:

$$R_{i,t} = \frac{P_{i,t}}{P_{i,t-1}} - 1 \tag{1}$$

where $R_{i,t}$ is the return of stock i on day t; $P_{i,t}$ is the price of stock i on day t; $P_{i,t-1}$ is the price of stock i on day t-1.

We measured the expected return under the assumption of a linear relationship between the stock's return and the market return, as per the CAPM proposed by Sharpe in 1964. We estimated the parameters α and β through simple linear regression (ordinary least squares [OLS]), as shown in Equation 2.

$$E\left(R_{i,t}\right) = \alpha_i + \beta_i Rm_t + \varepsilon_{i,t} \tag{2}$$

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where $E(R_{i,t})$ is the expected return of stock i on day t; α_i is the intercept of the regression that defines the return of stock i when it does not have the effect of the market return; β_i is the effect of market return on stock i's return; $\varepsilon_{i,t}$ is the error term of the regression that represents the variance of the stock's return not explained by the proposed model.

Since it is a simple linear regression model, we do not need to mention multicollinearity issues. We observed assumptions of normality of residuals, homoscedasticity, and autocorrelation to achieve good forecasting quality of returns with the CAPM (Fávero & Belfiore, 2017). With Equation 2, we performed estimations 80 times (16 events for each company) and would need to report 80 results about the assumptions. We did not meet some assumptions and relaxed the normality assumption of residuals (less than 50% of the estimations), as the Central Limit Theorem applies due to a relevant sample size of 110 days (observations) for estimation. We did not use robust error estimators that address heteroscedasticity and autocorrelation issues in the residuals, as they do not change the coefficient values. Then, we used the parameters obtained from the estimation of the OLS. The estimation was conducted in a window of 110 days before the event, excluding ten days immediately before the event to mitigate effects around the event day. Thus, we performed the estimation in the period from 120 to 10 days before the event.

After calculating the actual return (Equation 1) and estimating the expected return using the estimators from Equation 2, we computed the abnormal return according to Equation 3.

$$AR_{i,t} = R_{i,t} - \left(\alpha_i + \beta_i Rm_t\right)$$

or (3)

$$AR_{i,t} = R_{i,t} - E\left(R_{i,t}\right)$$

where: $AR_{i,t}$ represents the abnormal return of stock i at time t.

Considering that events influence prices over days, not just on the event day, we employed the cumulative abnormal return (CAR) to assess aggregated abnormal returns (AR). We computed the CAR as per Equation 4.

$$CAR_{i,t}\left(t_1 t_2\right) = \sum_{t=t_1}^{t2} AR_{i,t} \quad (4)$$

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where CAR (t1, t2) represents the CAR of stock i measured within the time window from t1 to t2, at time t2.

To analyze the research hypotheses, we conducted mean tests. We evaluated the research H1 using the mean test (t-test) of the daily abnormal returns in the event window (Fama et al., 1969; Mackinlay, 1997), considering the market efficient if the mean is indistinguishable from zero, thereby failing to reject the research hypothesis. For H2, we assessed whether the means of daily abnormal returns and CARs for events categorized as good differ statistically (t-test) from those categorized as bad and examined if the latter is greater than the former.

RESULTS AND ANALYSIS

Initially, we conducted an exploratory analysis of the collected returns during the 13-year research period for the companies under study. We demonstrate the outcomes in Table 3.

Table 3

Accumulated and annual returns of the top 5 Brazilian stocks

Period	BVSP	VALE3	PETR4	ITUB4	BBDC4	ABEV3
2008-2020	90%	140%	-13%	246%	68%	402%
Yearly	5.07%	6.96%	-1.08%	10.01%	4.06%	13.21%

Note: The accumulated return (2008-2020) considers an investment of R$ 1.00 in each company on January 2, 2008, and redemption on December 29, 2020; the annual return is the geometric mean of the accumulated returns, considering the 13 years; BVSP represents the Ibovespa index.

After examining Table 3, we noticed that Ambev demonstrated the most robust performance during the period, while Petrobras had the weakest. Nonetheless, these companies remain important for Brazilian investors as some have surpassed the Ibovespa's performance. Figure 2 displays the daily price changes by investing R$ 1.00 in each company on January 2, 2008, and redeeming on December 29, 2020.

We observe in Figure 2 that the prices react uniformly and appropriately to both good and bad events. We highlight the negative effects on companies' prices and the Ibovespa between 2008 and 2009 during the subprime crisis, as well as in early 2020 with the announcement of the COVID-19 pandemic. Subsequently, we observed positive effects with the beginning of vaccination towards the end of 2020. Consequently, we will conduct the

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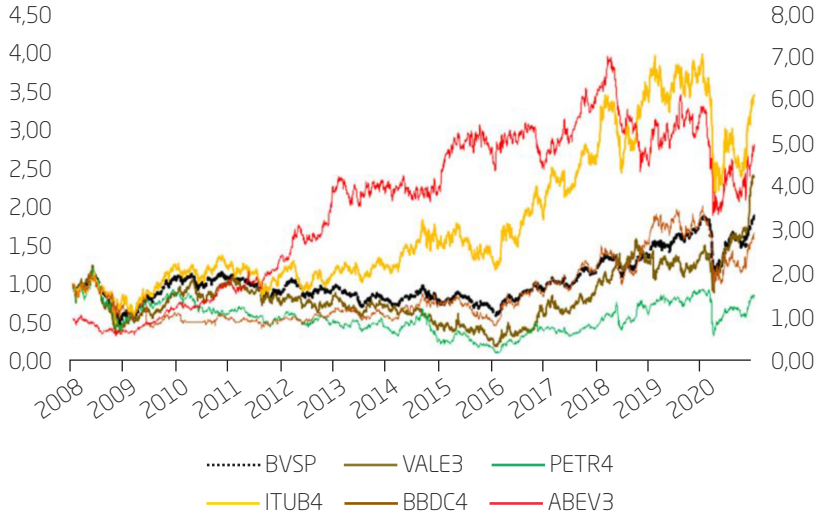
event study to examine the research hypotheses, first estimating the return using the CAPM market model (Sharpe, 1964), as shown in Table 4.

Figure 2

Evolution of companies' stock values from 2008 to 2020, scaled to a starting value of R$ 1.00



Note. The right axis shows the ABEV4 prices, and the left axis shows the other companies' prices.

Table 4

Descriptive statistics of the estimated parameter for the expected return

Panel A. Vale						
	mean	minimum	Q1	Q2	Q3	maximum
alfa	0.0000	-0.0020	-0.0011	-0.0002	0.0013	0.0030
beta	1.2063	0.7148	0.9030	1.1790	1.4524	1.8153
Panel B. Itaú Unibanco						
	mean	minimum	Q1	Q2	Q3	maximum
alfa	0.0000	-0.0010	-0.0005	-0.0001	0.0006	0.0013
beta	1.0673	0.6305	0.9927	1.0746	1.1937	1.2607

(continues)

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Table 4 (conclusion)

Descriptive statistics of the estimated parameter for the expected return

Panel C. Petrobras						
	mean	minimum	Q1	Q2	Q3	maximum
alfa	-0.0002	-0.0018	-0.0013	-0.0003	0.0006	0.0023
beta	1.4137	0.5240	1.1016	1.4241	1.7853	2.0775
Panel D. Bradesco						
	mean	minimum	Q1	Q2	Q3	maximum
alfa	-0.0002	-0.0017	-0.0006	0.0000	0.0005	0.0009
beta	1.0495	0.6530	0.9034	1.0197	1.2524	1.3679
Panel E. Ambev						
	mean	minimum	Q1	Q2	Q3	maximum
alfa	0.0006	-0.0019	-0.0006	0.0007	0.0011	0.0038
beta	0.5212	0.2684	0.3389	0.4651	0.6375	1.0574

Note. We estimated the expected returns using CAPM. We assessed the assumptions of the regressions for normality of residuals (Jarque-Bera and Shapiro-Wilk tests), heteroskedasticity (White test), and autocorrelation (Durbin-Watson statistic).

To ensure that we can rely on the expected returns of the sample companies, we need to have a reliable regression model of company returns against the market. After our analysis, we found that 79 betas were significant at the 1% level and one beta at the 10% level, while only two alphas were significant at the 5% level. Based on these results, the market model adequately fits the expected returns of the sample stocks. Additionally, we conducted tests to assess the assumptions of the OLS regressions. The tests showed that there were no significant issues with the normality of residuals (Jarque-Bera and Shapiro-Wilk tests), heteroskedasticity (White test), and autocorrelation (Durbin-Watson statistic).

In our initial analysis of the research hypothesis, we examined whether the event significantly impacted returns by assessing whether the average abnormal returns during the event window were statistically different from zero. Additionally, we evaluated whether the event had the desired effect on returns by confirming the expectation of CAR. This process involved determining if positive events resulted in positive CARs while negative events led to negative CARs.

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Subsequently, we present the analysis of the first research hypothesis through Tables 5 to 9. In this analysis, we will evaluate the average daily abnormal returns over three days (average 11 – window [-1,1]) and seven days (average 33 – window [-3,3]). The "CAR 11" and "CAR 33" columns represent the cumulative abnormal returns for one-day and three-day windows, respectively. The "expec 11" and "expec 33" columns represent the judgments confirming whether the event's CAR aligns with the expectation of being positive or negative.

Table 5

Mean daily returns and CARs of VALE3 around the event

event	mean 11	mean 33	CAR 11	CAR 33	type	source	expec 11	expec 33
2008-09-15	0.004	0.010**	0.013	0.073	bad	external		
2009-04-10	0.018**	0.005	0.054	0.037	good	internal	yes	yes
2010-01-04	0.004	0.002	0.011	0.017	good	internal	yes	yes
2010-05-03	-0.015*	-0.003	-0.045	-0.018	bad	external	yes	yes
2011-12-26	-0.001	0.000	-0.002	-0.002	good	internal		
2013-02-04	-0.004	0.003	-0.013	0.021	good	internal		yes
2014-03-17	0.001	-0.003	0.002	-0.021	bad	internal		yes
2014-09-01	-0.011*	-0.011	-0.033	-0.075	bad	internal	yes	yes
2015-06-18	0.011	-0.009	0.034	-0.063	good	internal	yes	
2016-08-31	-0.007	-0.009	-0.021	-0.064	bad	internal	yes	yes
2016-10-10	0.012	-0.005	0.037	-0.038	good	internal	yes	
2017-05-18	0.052	0.034	0.157	0.240	bad	internal		
2017-07-13	-0.012	0.000	-0.036	0.000	good	internal		yes
2020-03-11	0.057	0.046**	0.172	0.320	bad	external		
2020-11-09	-0.009	-0.010	-0.027	-0.070	good	external		
2020-12-08	0.002	0.002	0.007	0.016	good	external	yes	yes
Sum	3	2	-	-	16	16	8	9

Note. *** p-value <= 0.01; ** p-value <= 0.05; * p-value <= 0.10.

In Table 5, we observe only five average abnormal returns that are different from zero at a significance level of less than 10% for the stock prices of the company Vale, considering the researched events. Of these five, three

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are within the one-day window, and two are within the three-day window. Additionally, approximately 50% of the CARs in both the one-day and three-day windows were consistent with the expected response, i.e., they exhibited a positive CAR for good events and a negative CAR for bad events. In Table 6, we present the results for Itaú Unibanco.

Table 6

Mean daily returns and CARs of ITUB4 around the event

event	mean 11	mean 33	CAR 11	CAR 33	type	source	expec 11	expec 33
2008-09-15	-0.005	-0.004	-0.016	-0.027	bad	external	yes	yes
2009-04-10	-0.018	-0.005	-0.053	-0.037	good	internal		
2010-01-04	0.012*	0.001	0.036	0.004	good	internal	yes	yes
2010-05-03	0.007**	0.007*	0.022	0.052	bad	external		
2011-12-26	-0.003	0.001	-0.009	0.007	good	internal		yes
2013-02-04	0.000	-0.001	0.001	-0.009	good	internal	yes	
2014-03-17	-0.001	-0.003	-0.003	-0.022	bad	internal	yes	yes
2014-09-01	0.004*	0.003	0.011	0.018	bad	internal		
2015-06-18	-0.001	0.006	-0.003	0.044	good	internal		yes
2016-08-31	0.001	0.000	0.004	0.002	bad	internal		
2016-10-10	0.000	0.003	-0.001	0.019	good	internal		yes
2017-05-18	-0.009	-0.006	-0.026	-0.039	bad	internal	yes	yes
2017-07-13	-0.005	-0.004**	-0.014	-0.026	good	internal		
2020-03-11	-0.019	-0.003	-0.056	-0.021	bad	external	yes	yes
2020-11-09	0.025	0.012	0.074	0.081	good	external	yes	yes
2020-12-08	0.007	0.001	0.020	0.010	good	external	yes	yes
Sum	3	2	-	-	16	16	8	10

Note. *** p-value <= 0.01; ** p-value <= 0.05; * p-value <= 0.10.

In Table 6, we noticed that the Itaú Unibanco and Vale stock prices only had five returns that differed from zero in response to events like Vale's. We also discovered that around 50% of the CARs aligned with the expected outcomes.

However, certain events affected the returns of Vale but not Itaú Unibanco, and vice versa. The subprime crisis (2008-09-15), Brazil becoming a creditor

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of the IMF (2009-04-10), and the coronavirus pandemic (2020-03-11) impacted Vale but not Itaú Unibanco. Conversely, Itaú Unibanco was impacted by adopting IFRS (2010-01-04) and labor reform (2017-07-13), but not Vale.

Additionally, a bad event for one company may not have the same effect on another. For instance, Vale experienced negative impacts due to the Eurozone crisis (2010-05-03) and the start of Brazil's technical recession (2014-09-01), but not Itaú Unibanco. It is reasonable to assume that a mining company would be more affected by crises that impact productive activities than a bank. In turn, labor reform could have a more significant effect on a labor-intensive sector like banking and a lesser effect on a mining company. Padula and Albuquerque (2018) and Camelo et al. (2022) have evidenced this asymmetry in the effects of positive and negative events. Moving forward, Table 7 will analyze the results for Petrobras.

Table 7

Mean daily returns and CARs of PETR4 around the event

event	mean 11	mean 33	CAR 11	CAR 33	type	source	expec 11	expec 33
2008-09-15	0.013	0.020	0.039	0.139	bad	external		
2009-04-10	0.000	-0.007	-0.001	-0.050	good	internal		
2010-01-04	-0.006	-0.003	-0.018	-0.024	good	internal		
2010-05-03	-0.010	-0.002	-0.029	-0.015	bad	external	yes	yes
2011-12-26	-0.001	-0.004	-0.003	-0.026	good	internal		
2013-02-04	0.004	-0.005	0.012	-0.035	good	internal	yes	
2014-03-17	-0.009	0.003	-0.026	0.019	bad	internal	yes	
2014-09-01	0.006	0.001	0.017	0.007	bad	internal		
2015-06-18	-0.008	-0.005	-0.024	-0.032	good	internal		
2016-08-31	0.005	0.003	0.016	0.023	bad	internal		
2016-10-10	0.001	0.008*	0.002	0.059	good	internal	yes	yes
2017-05-18	0.003	0.002	0.009	0.011	bad	internal		
2017-07-13	0.007	0.002	0.021	0.013	good	internal	yes	yes
2020-03-11	0.021	0.004	0.062	0.031	bad	external		
2020-11-09	0.035	0.006	0.104	0.042	good	external	yes	yes
2020-12-08	-0.003	0.003	-0.010	0.020	good	external		yes
Sum	0	1	-	-	16	16	6	5

Note: *** p-value <= 0.01; ** p-value <= 0.05; * p-value <= 0.10.

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Table 7 shows only one statistically significant average abnormal return for Petrobras' stock prices in response to a political-regulatory event, the Constitutional Amendment Proposal (PEC) no. 241 (2016-10-10), which established the public spending ceiling. Specifically, the prices reacted positively within a three-day window, especially for a company where the Federal Government is its main shareholder. However, fewer events in Petrobras confirmed alignment with expectations compared to the two previous companies, with fewer than 40% of CARs aligning with the anticipated outcomes.

These results indicate the efficiency of Petrobras' stock prices, given that it has historically been sought after by both Brazilian and foreign investors, leading to high liquidity. Our findings contrast with those of Padula and Albuquerque (2018), who found abnormal returns at the beginning of the Lava Jato operation, albeit within longer five-day windows. Next, we present the results for Bradesco.

Table 8

Mean daily returns and CARs of BBDC4 around the event

event	mean 11	mean 33	CAR 11	CAR 33	type	source	expec 11	expec 33
2008-09-15	-0.012	-0.007	-0.036	-0.046	bad	external	yes	yes
2009-04-10	-0.006	0.001	-0.019	0.007	good	internal		yes
2010-01-04	0.002	-0.001	0.007	-0.005	good	internal	yes	
2010-05-03	0.015	0.007	0.044	0.051	bad	external		
2011-12-26	-0.004*	0.000	-0.013	-0.003	good	internal		
2013-02-04	-0.006	-0.001	-0.019	-0.007	good	internal		
2014-03-17	0.002	0.002	0.006	0.011	bad	internal		
2014-09-01	0.001	0.002	0.004	0.011	bad	internal		
2015-06-18	0.000	0.005	0.000	0.038	good	internal		yes
2016-08-31	-0.001	0.001	-0.004	0.009	bad	internal	yes	
2016-10-10	0.001	-0.003	0.003	-0.022	good	internal	yes	
2017-05-18	-0.014	-0.010*	-0.043	-0.073	bad	internal	yes	yes
2017-07-13	0.001	0.001	0.003	0.006	good	internal	yes	yes
2020-03-11	-0.028***	-0.006	-0.083	-0.041	bad	external	yes	yes
2020-11-09	0.036	0.007	0.107	0.049	good	external	yes	yes
2020-12-08	0.003	-0.002	0.008	-0.013	good	external	yes	
Sum	2	1	-	-	16	16	9	7

Note. *** p-value <= 0.01; ** p-value <= 0.05; * p-value <= 0.10.

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Table 8 shows significantly different results concerning the events that impacted Bradesco compared to Itaú Unibanco. We did not expect the difference between them as they belong to the same sector. The commonality lies in their vulnerability to events triggering crises, such as Joesley Day (2017-05-18) and the coronavirus pandemic (2020-03-11), hinting at the susceptibility of the financial sector to uncertainties. Regarding alignment with expectations, the results were like those of Vale and Itaú Unibanco, with approximately 50% of CARs aligning with the anticipated outcomes. Finally, in Table 9, we analyzed the results for Ambev.

Table 9

Mean daily returns and CARs of ABEV3 around the event

event	mean 11	mean 33	CAR 11	CAR 33	type	source	expec 11	expec 33
2008-09-15	-0.010	0.002	-0.030	0.014	bad	external	yes	
2009-04-10	0.013	-0.006	0.038	-0.042	good	internal	yes	
2010-01-04	0.000	0.005	0.001	0.032	good	internal	yes	yes
2010-05-03	0.009	0.006	0.028	0.039	bad	external		
2011-12-26	0.000	-0.002	0.001	-0.014	good	internal	yes	
2013-02-04	-0.003	-0.003	-0.009	-0.024	good	internal		
2014-03-17	0.000	-0.004	-0.001	-0.026	bad	internal	yes	yes
2014-09-01	-0.011	-0.002	-0.032	-0.013	bad	internal	yes	yes
2015-06-18	0.001	0.000	0.004	0.000	good	internal	yes	yes
2016-08-31	0.008	0.003	0.024	0.021	bad	internal		
2016-10-10	-0.004	-0.002	-0.012	-0.014	good	internal		
2017-05-18	-0.005	0.000	-0.015	-0.002	bad	internal	yes	yes
2017-07-13	-0.001	0.001	-0.003	0.009	good	internal		yes
2020-03-11	-0.055	-0.025	-0.164	-0.172	bad	external	yes	yes
2020-11-09	0.032	0.012	0.097	0.082	good	external	yes	yes
2020-12-08	0.015*	0.002	0.046	0.013	good	external	yes	yes
Sum	1	0	-	-	16	16	11	9

Note. *** p-value <= 0.01; ** p-value <= 0.05; * p-value <= 0.10.

In Table 9, we observe that only the initiation of COVID-19 vaccination (2020-12-08) significantly and positively impacted the returns of Ambev.

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Furthermore, the company's stock prices exhibited a high degree of efficiency, as most of the events did not abnormally affect them, like the case of Petrobras. Given that Ambev is a consumer goods company, we may expect a positive effect on stock prices, as COVID-19 vaccination could encourage people to return to leisure activities and consume beverages at bars, restaurants, and events. Regarding alignment with expectations, Ambev's CARs were the most congruent with the anticipated outcomes, with a consistency rate exceeding 60%.

Considering all the companies, we observed only nine statistically significant abnormal returns in the one-day window around the event and six in the three-day window. These abnormal returns represent a market inefficiency of 11.25% and 7.50%, respectively, in 80 events. Thus, there are indications that the efficient behavior, in the semi-strong form, of the stock prices of the top five Brazilian market companies prevails in response to most of the events studied.

In both estimation windows, about half of the events confirmed the expected positive CARs for good and negative CARs for bad events. When only considering external events, this percentage increased to 60%. This result means that external information affects companies more uniformly. For instance, the US presidential election outcome (2020-11-09) and the start of COVID-19 vaccination (2020-12-08) were considered good events beforehand and resulted in positive CARs across all companies.

Considering this evidence, we cannot reject the first hypothesis of this research. Thus, there is no expectation of obtaining abnormal returns by trading based on events or anticipating whether the event will be positive or negative. As observed, events can impact companies asymmetrically.

Our findings align with studies confirming semi-strong efficiency in the Brazilian market, such as those of Schmidt et al. (2018) and Batista et al. (2018). Conversely, we challenge studies that identified abnormal returns. We argue that they did so within a specific thematic context, such as corruption, as seen in Dias and Malaquias (2021) when the topic held significant public appeal in Brazil. Alternatively, studies might have focused on events within companies that inherently exhibit inefficient pricing dynamics within short time frames, as observed in Mendes and Lucena (2022), Pordeus et al. (2021), and Gomes and Carmo (2023).

To assess the second hypothesis of our research, we compared the daily abnormal returns of all negative and positive events across all companies. The hypothesis suggests that stock prices react more strongly to negative than positive events. We also analyzed the CARs in one-day and three-day windows, as shown in Table 10.

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Table 10

Mean daily returns and CAR11 and CAR33 for one-day and three-day windows

Events (n)	mean 11	mean 33	CAR11	CAR33
Bad (35)	-0.029%	0.171%	-0.087%	1.196%
Good (45)	0.324%*	0.024%	0.972%*	0.166%

Note. * p-value < = 0.10.

Despite predictions from the prospect theory, the average absolute value of returns for positive events is higher than it is for negative events in the one-day window. However, this trend does reverse in the [-3,3] window. Despite this, none of the means showed statistical significance and were not statistically different from each other, according to the t-test. However, the means of returns for positive events and their CARs were statistically significant in the one-day window. The coronavirus pandemic announcement (2020-03-11) impacted the Vale's mean returns and CARs for the 33-day window. This evidence is because the stock prices dropped significantly the day before and then rose significantly, leading to disparate data (see Table 5).

Thus, based on the results, no evidence supports the second research hypothesis. Therefore, agents in the Brazilian market are relatively liquidating their positions in the top five stocks in response to bad news. This unexpected result may be related to the significant presence of rational agents in the Brazilian market. For instance, as of February 2023, institutional investors, financial institutions, and foreigners accounted for 85.25% of the trading activity (buying + selling) (B3, 2023). We assume that these participants possess a high degree of sophistication and rationality. However, our findings align with the evidence that negative events lead to negative returns, consistent with Dias and Malaquias (2021) and Mendes and Lucena (2022), as they identified decreases in stock prices in response to bad news.

CONCLUSIONS

Through an extensive range of systematic events that occurred from the 2008 subprime crisis to the beginning of COVID-19 vaccination in 2020, we demonstrate a high degree of semi-strong market efficiency in the Brazilian market from the perspective of the price behavior of its top five stocks, the Top-5. In contrast to previous studies that not only did not find the same

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result but also argued against the efficiency of the Brazilian market, we achieved this with a scope previously undocumented for companies that inherently possess efficient pricing due to liquidity.

The events chosen for this study received extensive coverage from specialized media and market attention, showing high potential for impact a priori. However, the arrival of information seems uniform and timely, hence insufficient to generate irrational (inefficient) prices and provide an advantage for those who traded based on these facts. In only 11.25% of the events within a one-day window, returns exhibited abnormal behavior, but this effect decreased to 7.5% of the events within a three-day window. Moreover, the effects of events that produced abnormal returns are asymmetrical, meaning events considered detrimental to some companies were beneficial for others, suggesting that attempting to anticipate such events could result in an ineffective strategy.

Given the extensive time window and the variety of events, the results allow us to infer that systematic events pricing is correct, and it is plausible that price behavior exhibits a higher degree of efficiency than indicated in specific corporate events of smaller firms that lack the same liquidity as the major stocks on the Brazilian exchange. Therefore, there is evidence that investors can expect regular returns when selecting large and liquid companies, even in fragile and emerging countries such as Brazil. Furthermore, this suggests no reason for a "desperate" sell-off in response to bad news since their effects dissipate at the expected speed for a minimally efficient market.

This study provides a historical overview of how various events affected the Brazilian market over 13 years. It examines the behavior of major Brazilian stocks in response to each event. Additionally, the study contributes to pricing literature by evaluating the effectiveness of the CAPM in predicting the expected returns of the top five stocks. It also provides insights into the efficiency of the Brazilian market for passive asset management.

Although we made a significant effort to ensure the relevance of each event by confirming the date through news archives, the main limitation of this study is that some selected events occurred over an extended period. To improve future research, one may compare the effects of the post-pandemic and Russia-Ukraine conflict on more recent events. Additionally, analyzing the effects of events on passive and active management returns and external impacts in other emerging markets would be a valuable advancement.

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