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Brazilian stock market reaction to the Covid-19 pandemic and firm characteristics

Reação no mercado acionário brasileiro à pandemia de Covid-19 e características das firmas

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Abstract

Purpose: This article investigated the reaction of the Brazilian stock market to the Covid-19 pandemic and the characteristics that made some companies less vulnerable than others based on the measurement of abnormal returns using the event study methodology.

Originality/value: The article contributes to informed decision-making, as the results expand the literature on the impacts of extreme events on the stock market of an emerging country, contributing to investors' risk and portfolio management strategies.

Design/methodology/approach: March 11, 2020, was considered the reference date, the day of the pandemic announcement by the World Health Organization. The event window included five days before and after the reference date, which covers some of the milestones of the pandemic's beginning, such as the first internal transmission, the first death in Brazil, and the record of community transmission. The abnormal return was estimated using the market model, and the regression model was used to explain the accumulated abnormal return, analyzing the importance of the characteristics of the companies.

Findings: The results showed that 98 companies presented negative and significant cumulative abnormal return (CAR), representing 71.53% of the total sample. Furthermore, the shares of the companies in the sample had an accumulated abnormal return of -26.85%, indicating the magnitude of the influence on companies' prices. In specific terms, it was found that publicly traded companies that are larger, less leveraged, with lower turnover, and that adhere to responsibility practices suffered less adverse impact at the beginning of the pandemic.

Keywords: Covid-19, market reaction, cumulative abnormal return, characteristics of firms, Brazil

Resumo

Objetivo: Este artigo investiga a reação do mercado acionário brasileiro à pandemia da Covid-19 e as características que tornaram algumas empresas menos vulneráveis do que outras, a partir da mensuração do retorno anormal utilizando a metodologia de estudo de eventos.

Originalidade/valor: O artigo fornece informações para a tomada de decisões fundamentadas, pois os resultados expandem a literatura sobre os impactos de eventos extremos no mercado acionário de um país emergente, contribuindo para as estratégias de gestão de riscos e portfólios dos investidores.

Design/metodologia/abordagem: Considerou-se o dia 11 de março de 2020 como data de referência, dia do anúncio da pandemia pela Organização Mundial da Saúde. A janela do evento incluiu cinco dias anteriores e posteriores à data de referência, que abrange alguns dos marcos do início da pandemia, como a primeira transmissão interna, a primeira morte no Brasil e o registro de transmissão comunitária. O retorno anormal foi estimado a partir do modelo de mercado, e utilizou-se o modelo de regressão para explicar o retorno anormal acumulado, analisando-se a importância das características das empresas.

Resultados: Os resultados mostraram que 98 empresas apresentaram retorno anormal acumulado negativo e significativo, representando 71,53% do total da amostra. Ainda, as ações das empresas da amostra tiveram um retorno anormal acumulado de -26,85%, indicando a magnitude da influência nos preços das empresas. Em termos específicos, observou-se que as empresas de capital aberto de maior tamanho, menos alavancadas, de menor *turnover* e que aderem a práticas de sustentabilidade empresarial, sofreram menor impacto adverso no início da pandemia.

Palavras-chave: Covid-19, reação do mercado, retorno anormal acumulado, características das firmas, Brasil

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INTRODUCTION

The Covid-19 resulting from the new Coronavirus (SARS-CoV-2) became public knowledge in December 2019. In that month, there was a noticeable increase in the number of people diagnosed with respiratory failure in the Chinese city of Wuhan (Moreira et al., 2020). Quickly, the virus spread throughout China and, gradually, to other countries. Given this, on March 11, 2020, the World Health Organization (WHO) declared Covid-19 a pandemic, as 114 countries had already reported cases of the disease in their territories (WHO, 2020).

Thus, various measures were adopted by governments, such as isolation and, in the most extreme case, lockdown[1], to address the Covid-19 pandemic. For Smales (2021a), the behavior of the financial market in response to the restrictions imposed provided the first example of a market crash caused by a health crisis, affecting both economic and social aspects. The pandemic resulted in an unprecedented negative impact on human lives and the global economy, mainly due to economic activities disrupted by the quarantine implemented in several countries (Rahman et al., 2021). This effect on the economy can be illustrated in the reduction by at least 2.8% of the gross domestic product (GDP) of different countries (Harjoto et al., 2021) and the decrease in demand and supply, as part of the population was prevented from leaving home. Some workers were laid off, losing their income (Park et al., 2020).

In this sense, Covid-19 influenced the financial markets, causing a significant increase in the level of risk (Zhang et al., 2020; Amar et al., 2021). According to Baker et al. (2020), disease exposure has affected stock markets most severely among all infectious diseases since 1900. As Ding et al. (2021) pointed out, it caused a substantial heterogeneous trigger in stock prices. According to the authors, during the first five months of 2020, the Standard & Poor's (S&P) 500 index fell by 34% and stock markets in Brazil, Hong Kong, Italy and Japan experienced declines of 46%, 25%, 41% and 31%, respectively. In March 2020, the S&P index fell by 12.5%. The Bovespa index (Ibovespa), B3's main indicator, lost more than 30% during March

[1] Lockdown is an English expression that means confinement or total closure. Although it does not have a unique definition, it has been used to designate a more radical measure for social distancing, and to reduce the dissemination and/or circulation of the virus (National Health Council, 2020).

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2020 (Avelar et al., 2020), the largest monthly drop in 22 years, with the occurrence of six circuit breakers[2] in that period.

Thus, the unprecedented spread of the Covid-19 virus made it difficult for investors and even economists to predict the adverse impacts caused by the pandemic (Takahashi & Yamada, 2021). Baker et al. (2020) endorsed this argument, highlighting the large effect of limiting economic activities in the stock market, partly caused by investors withdrawing their investments.

In the Brazilian context, February 26, 2020, was marked by the first case of Coronavirus, a time when the Brazilian government had not yet adopted proactive measures to combat the virus (Pereira, 2021). Within days of the first case of the disease, Brazil already had seven states with at least one case of Covid-19, and on March 12, the first death from the virus occurred. Still, in the same month, two major Brazilian cities had already registered community transmission, *i.e.*, it was no longer possible to monitor where the virus's origin was disseminated. However, on March 22, Decree no. 64,881/2020 was released, in which the most populous state in Brazil – São Paulo – declared a quarantine and introduced measures to suspend services, such as restaurants, aiming to combat this health crisis, adding to the Decree no. 64,865/2020 of March 18, 2020, which already contained recommendations for restrictions on the activities of shopping malls and gyms. In this sense, Moreira et al. (2020) point out that the pandemic deepened the health crisis in the country.

According to Ding et al. (2021), the market and stock price can be influenced by the characteristics of firms in periods of high volatility, such as the pandemic. From this perspective, Xiong et al. (2020) examine which characteristics of Chinese firms are related to their performance in the context of the Covid-19 pandemic. To do so, the authors used the event study methodology and found that firms with institutional investors and belonging to industries vulnerable to the virus experienced a greater impact around the outbreak, exhibiting a significantly lower cumulative abnormal return (CAR). On the other hand, companies with larger sizes, better growth opportunities, higher leverage levels, fewer tangible assets, and higher profitability were less affected by the pandemic.

[2] The circuit breaker allows, in the event of more abrupt price fluctuations, for buy and sell orders to be rebalanced and dampened. It is a protection against exacerbated price variation at atypical times in the market (Securities and Exchange Commission of Brazil, 2020).

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Following the work of Xiong et al. (2020), the present article seeks to expand the analysis to Brazilian companies since studies along these lines are still scarce in the national scenario. The methodology applied was the event study, using the market model to provide a forecast between the risk of an asset and its expected return (Santos, 2020). By using this model, it becomes possible to find the accumulated abnormal return and, thus, perform an analysis of which specific characteristics of the companies listed on B3 minimize the impact caused by the pandemic on stock returns in the window around the pandemic decree, which occurred on March 11, 2022. Thus, the objective of the present research was to investigate the reactions of the financial market to the Covid-19 pandemic, focusing on the specific characteristics of companies listed on B3 that make some more vulnerable to the Coronavirus pandemic than others.

In this regard, this paper makes at least three clear contributions. First, it expands the scope of the literature focusing on asset performance during extreme events by investigating the relationship between firm-specific characteristics and stock market reactions in Brazil since previous studies have shown that firm characteristics influence market reaction (Xiong et al., 2020; Akron, 2011). Second, the contribution of analyzing the impacts of a pandemic on the stock market in an emerging country, adding to the existing literature in the context of developing countries (Harjoto et al., 2021; Mishra et al., 2020; Haroon & Rizvi, 2020; Arora et al., 2021), however, specifically analyzing the Brazilian stock market and the relationship with the characteristics of the firms, because the impact of the pandemic is unique in each country (Arora et al., 2021), adding to the scarce national literature of the present topic. Third, it contributes to investors' portfolio strategies and informed decision-making by understanding how the market behaves in extreme events, adding to existing studies (Ding et al., 2021; Xiong et al., 2020).

In addition to this introduction, the paper is structured with four more sections. The second section presents the background of the Covid-19 pandemic and a brief literature review of recent studies on its economic and financial impacts. The third section describes the methodological aspects. The fourth section presents the main results, and the last section concludes the study.

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LITERATURE REVIEW

The pandemic of Covid-19 impacted the global economy more rapidly and critically compared to the 2008 financial crisis and the great depression (Roubini, 2020). Similarly, the S&P 500 VIX volatility index, also titled the market fear index, pointed to a high level of oscillation in 2020 with higher peaks than the 2008 financial crisis. In this perspective, the study by Baker et al. (2020) analyzed newspaper articles in order to support the hypothesis that the Covid-19 pandemic was the outbreak that affected the stock market the most when compared to other contagious diseases, causing the financial market to reach an unprecedented level of volatility. The authors justify this market reaction by government restrictions on business activities and social distancing, which in a service-oriented economy have a large effect on financial markets.

The work of Smales (2021b) used Google Search Volume (GSV) as a proxy for the level of investor attention to analyze the relationship between increased attention and stock returns in eleven sectors during the pandemic period. From this, the author finds, in general, that increased investor attention has a negative impact on stock returns in the United States of America (USA). However, some sectors benefit from this rational action of investors and have a lower probability of loss in this context, such as those that provide essential goods and services.

As stock returns decline and investor attention increases, the market and the stock price become influenced by the characteristics of firms that can reduce the loss in this period of high volatility (Ding et al., 2021). In this regard, the work of Ding et al. (2021) seeks to evaluate the relationship between corporate characteristics in 61 countries and stock price reactions to the Covid-19 pandemic. The authors found that the firms that show the smallest decline in this period are those with greater financial conditions in the year before the event, socially responsible companies due to greater loyalty and stronger stakeholder ties, making them more likely to support the business even in adverse times. In addition, companies with less entrenched executives, family-controlled firms, large corporations, and companies with low managerial ownership, which are positively evaluated by the stock market, performed better in this context.

In the work of Xiong et al. (2020), the reaction of Chinese listed stocks to the impacts of the Covid-19 pandemic was examined, depending on their specific characteristics, using the event study approach. The authors found that companies with institutional investors and belonging to industries

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vulnerable to the virus experienced a greater impact around the outbreak, showing a significantly lower CAR. On the other hand, companies with larger sizes, better growth opportunities, higher leverage levels, fewer fixed assets, and higher profitability were less affected by the pandemic.

In the Brazilian context, in general, some researchers analyze the impact of the pandemic on the economy and financial markets. The work of Ferreira and Rita (2020) sought to investigate the economic effect of the Covid-19 pandemic, and it suggests that the social isolation required by governments during this pandemic period generated a significant decrease in economic activity. This caused a major imbalance in asset prices and exchange rates, increased unemployment rates, and public debt in the country.

In this perspective, Avelar et al. (2020) investigated how the pandemic affected the financial sustainability of publicly traded companies. The authors presented that social isolation, uncertainty about the duration of the outbreak of Covid-19, and other governmental actions to fight the pandemic resulted in substantial losses of value in the capital market, worsening the economic-financial indicators and increasing company defaults.

The study by Nakamura et al. (2020) also addressed the effects of the Covid-19 pandemic on the Brazilian stock market, highlighting in their analysis the risk associated with periods of uncertainty. The results indicate that the beta is influenced by the level of debt in the capital structure and can impact stock prices. Still, in the Brazilian context, Carvalhal and Nakahodo (2022) investigated the impacts of environmental, social, and governance (ESG) practices on the CAR of Brazilian stocks during the pandemic and found that companies with a high level of ESG have significantly better returns and are more resilient to stock market declines during the crisis.

Considering what has been presented, Brazilian papers have already investigated the influence of the pandemic on the stock market and the economy, emphasizing the consequences caused by social isolation and government actions. However, there is still room to explore the issue of firms' characteristics and how they can affect stock returns in this scenario.

METHODOLOGICAL PROCEDURES

Data and sample

Daily asset prices adjusted for corporate events and Ibovespa data were collected from 2019 through the Economática database. Similarly, the

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accounting information of publicly traded firms on B3 and the Bovespa economic sector are part of what was collected on the same data platform for the last quarter of 2019. Meanwhile, information on auditing and corporate governance firms was collected from Comdinheiro's database for the same period.

For the final sample, the asset of the firm's most liquid class was used, and companies in the financial sector were excluded, as well as those firms that did not present complete information for all variables used in the regression and firms that presented negative equity, resulting in a total of 137 firms in the sample.

Normal return and expected return

The event study methodology makes it possible to separate the component of the movement of firms' stock prices attributed to specific events that affect market behavior (Chen et al., 2007). To this end, the expected return and the actual return of a stock in the context of the Covid-19 pandemic were related using the date of the declaration of the pandemic by the WHO as the event day. According to Xiong et al. (2020), the evaluation of the impact of an event on stock prices needs an estimate of the abnormal return, in which the authors adopted the market model.

In this sense, the asset return was calculated from the difference in the logarithm of the prices. An estimation window comprising 200 days before the last business day of the year 2019 was considered, where the market model parameters were estimated. For the reference date of the event, the 11th day of March 2020 was adopted, the date marked by the decree of the new Coronavirus pandemic by the WHO. In the main analysis, an event window of [-5,+5] was defined, with March 04, 2020, as the starting date and March 18, 2020, as the last day of analysis. An additional analysis considered a [-10,+10] window from February 26 to March 25, 2020. The latter allows capturing the event effect of the virus's rapid spread over a longer window.

For MacKinlay (1997), the market model is a statistical model that relates the return of any security to the return of the market portfolio. Based on the methodology presented by the author, the parameters of the model (Equation 1) were estimated within the estimation window, and then, the expected return (Equation 2) and the abnormal return (Equation 3) during the event window:

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$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t} \quad \text{(Equation 1)}$$

where $R_{i,t}$ represents the normal return for firm i at time t; $R_{m,t}$ represents the Ibovespa return at time t. In addition, α_i, β_i and $\varepsilon_{i,t}$ are intercept, slope of ordinary least squares (OLS) model parameters, and error term, respectively. Once the parameters, α_i and β_i were defined, the expected return for each asset i in period t was calculated.

$$E(R_{i,t}) = \hat{a}_i + \hat{\beta}_i R_{m,t} \quad \text{(Equation 2)}$$

where $E(R_{i,t})$ represents the expected return for each asset i at time t and $\hat{a}_i$ and $\hat{\beta}_i$ are estimated parameters for asset i.

Finally, the abnormal return is obtained from the following equation:

$$AR_{i,t} = R_{i,t} - E(R_{i,t}) \quad \text{(Equation 3)}$$

where, $AR_{i,t}$ is the abnormal return of firm i at time t; $R_{i,t}$ is the actual return of stock i at time t; $E(R_{i,t})$ is the expected return of stock i at time t.

The average abnormal return per event day was calculated to allow an aggregate analysis of asset behavior from Equation 4.

$$\overline{AR_t} = \frac{1}{N} \sum_{i=1}^{N} AR_{i,t} \quad \text{(Equation 4)}$$

where N represents the sample size. The t-test and the Wilcoxon signed-rank test were used, the first being parametric and the second a non-parametric test, to evaluate the statistical significance of the average abnormal returns on the days that compose the event window.

Calculating the accumulated abnormal return is an extension of the abnormal return equation that seeks to analyze the common reaction of the companies' assets cumulatively during the window period and not at each day in isolation. For this, the Equation 5 was used:

$$CAR_i(\tau_0, \tau_1) = \sum_{\tau=\tau_0}^{\tau_1} AR_{i,t} \quad \text{(Equation 5)}$$

where, τ_0 and τ_1 represent the interval of days of the event window.

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Characteristics of the firms

Based on Chen et al. (2007), Xiong et al. (2020) and Avelar et al. (2020), firm-specific characteristics that may influence their reaction to the Covid-19 pandemic were used, these being: firm size (SIZE), calculated as the natural logarithm of total assets; growth opportunity (GOPP), calculated as the ratio of the sum of book value of assets and market value of equity less the book value of equity to book value of assets; operating capacity (OCAP), measured as the ratio of total revenue to total assets; cash flow (OCF), measured by the ratio between operational cash flow and total assets; tangible assets (TANG), calculated as fixed assets over total assets; return on assets (REBIT), measured by the ratio between Earnings Before Interest and Taxes (EBIT) and total assets; leverage (LEV), defined by the ratio between total debt and total assets; big-4 external auditor (BIG4), a dummy variable that represents a value equal to one (1) if the firm is audited by one of the big-4 consulting firms and zero (0) otherwise; corporate governance (CG), another dummy variable that reaches a value equal to one (1) if the firm is listed at any B3 governance level (Level 1, Level 2 and Novo Mercado) and zero (0) otherwise; and turnover (TURN), calculated by the ratio between the number of traded shares and the number of outstanding shares. In addition, dummies variables for the sector were included, considering the public utility sector as the reference.

Empirical model and expected results

Given this, the empirical model used to verify which firm characteristics can influence the stock market reaction to the pandemic was adapted from the work of Xiong et al. (2020), according to Equation 6.

$$\begin{aligned} CAR_i = {} & \alpha_0 + \alpha_1 SIZE_i + \alpha_2 GOPP_i + \alpha_3 OCAP_i + \alpha_4 OCF_i \\ & + \alpha_5 TANG_i + \alpha_6 REBIT_i + \alpha_7 LEV + \alpha_8 BIG4_i + \alpha_9 CG_i \\ & + \alpha_{10} TURN_i + \alpha_{11} Industry\ Dummies_i + \varepsilon_1 \end{aligned} \quad \text{(Equation 6)}$$

where: CAR_i is the dependent variable representing cumulative abnormal return, and i represents the firm. The explanatory variables firm size (SIZE), growth opportunity (GOPP), operating capacity (OCAP), cash flow (OCF), fixed assets (TANG), return on assets (REBIT), leverage (LEV), big-4 external auditor (BIG4), corporate governance (CG) and turnover (TURN) were

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calculated as mentioned in section "Characteristics of the firms". Larger firms with higher returns on assets and lower fixed asset levels are expected to have higher CARs (Xiong et al., 2020). In addition, firms with greater growth opportunities are expected to be less impacted in periods of crisis (Heyden & Heyden, 2021), and more leveraged firms are expected to have lower CARs (Carvalhal & Nakahodo, 2022). Also, a positive effect on CAR is anticipated if the firm is audited by one of the big-4 consulting firms (Almeida & Almeida, 2009; Salgado & Souza, 2021) and if it adheres to some level of corporate governance (Mitton, 2002; Pereira & Martins, 2015; Arora et al., 2021). On the other hand, the CAR is expected to be negatively affected the higher the turnover, *i.e.*, it is more traded (Duong et al., 2022).

Aiming to verify a possible combined effect between firm size (SIZE) and its level of corporate governance (CG), the interaction between them was included in the model. In this specification, the SIZE variable was first centered on the mean to facilitate interpretation (Aiken & West, 1991).

Finally, the continuous variables were winsorized at 1% and 99%, adjusting discrepant values toward the largest data volume to mitigate the effects of outliers (Khan et al., 2007), and all statistical estimations were performed using R version 3.6.3, operated within the RStudio integrated development environment, version 1.2.5033.

ANALYSIS AND DISCUSSION OF THE RESULTS

Descriptive analysis

Table 1 displays the mean abnormal returns of the Brazilian stocks within the event window, providing an analysis of the market's aggregate behavior. It is possible to observe that the event date, March 11, and the other days of the window, except March 4 and 10, presented negative average abnormal returns, especially on March 18, when it presented a value of -9.3%. This result corroborates the works of Naidu and Ranjeeni (2021) and Rahman et al. (2021) for Australia and China, respectively, in which the authors point out that the fear of the spread of this new virus and the declaration of the pandemic by the WHO influenced the average abnormal returns of these countries.

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Table 1

Abnormal return, t-test and Wilcoxon test

Date	N	$\overline{AR}$	t-Test	Wilcoxon test	CAR	CAR t-test
03/04/2020	137	0.002	1.034	0.823	0.002	1.034
03/05/2020	136	-0.025	-11.632***	-5.595***	-0.023	-7.504***
03/06/2020	136	-0.011	-5.102***	-2.848***	-0.034	-9.073***
03/09/2020	137	-0.036	-16.844***	-3.704***	-0.070	-16.273***
03/10/2020	136	0.023	11.644***	3.436***	-0.047	-10.002***
03/11/2020	135	-0.009	-4.542***	-1.706**	-0.056	-10.979***
03/12/2020	135	-0.059	-27.305***	-5.793***	-0.115	-20.730***
03/13/2020	136	-0.004	-1.970*	-0.416	-0.120	-20.048***
03/16/2020	136	-0.035	-16.313***	-3.706***	-0.155	-24.391***
03/17/2020	136	-0.023	-10.778***	-2.691***	-0.178	-26.559***
03/18/2020	137	-0.093	-43.176***	-6.057***	-0.271	-38.500***

Note. The table presents the average abnormal return (AR) for each day in the event window, with March 11, 2020, as the zero date, and the CAR. N is the number of stocks used to calculate the average abnormal return. T-test and Wilcoxon's Test represent the statistics of these tests. ***, **, * represent statistical significance at the 1%, 5% and 10% level, respectively.

The t-test and the Wilcoxon test, which represent a parametric and non-parametric test, respectively, were analyzed in order to assess whether the average abnormal return was statistically different from zero, as shown in Table 1. In this sense, it was observed that the abnormal returns were, in general, highly significant (at a significance level of 1%), indicating that there was a reaction to the analyzed event, with a reduction in stock prices. Specifically, it was found that 98 companies had negative and significant CAR at the 5% level, representing 71.53% of the total sample, and 19 companies (13.87%) had a negative but not significant CAR value. In addition, 14 assets (10.22%) showed a positive but not significant CAR, and only six firms (4.38%) showed positive and significant CAR.

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Table 2

Descriptive statistics of the variables in the regression model

Variables	N	Mean	Median	Minimum	Maximum	Standard deviation
CAR	137	-0.2685	-0.2561	-0.9617	0.2131	0.2472
SIZE	137	15.6815	15.4629	11.9284	19.4639	1.5853
GOPP	137	1.7891	1.3955	0.7002	4.8943	0.9742
OCAP	137	0.1682	0.1527	0.0352	0.5003	0.0985
OCF	137	0.0341	0.0309	-0.0284	0.1179	0.0274
TANG	137	0.2401	0.2209	0	0.7513	0.1881
REBIT	137	0.0186	0.0190	-0.0496	0.0795	0.0218
LEV	137	0.2692	0.2655	0	0.6874	0.1703
TURN	137	0.4130	0.2801	0.0013	2.7134	0.4663

Note. CAR = cumulative abnormal return [-5,+5]; SIZE = firm size; GOPP = growth opportunity; OCAP = operating capacity; OCF = operating cash flow; TANG = fixed assets; REBIT = return on assets; LEV = leverage; BIG4 = dummy (=1) for audit among the top 4; CG = dummy (=1) for differentiated corporate governance levels; TURN = turnover. N is the number of shares used to calculate the average abnormal return.

Table 2 presents the descriptive statistics of the variables used in this study. It can be seen that the median (mean) CAR was -25.61% (-26.85%) in the 11-day [-5,+5] event period. Considering the other variables, we have that the companies in the sample have a median (mean) of SIZE, GOPP, OCAP, OCF, TANG, REBIT, LEV, TURN of 15.46 (15.68), 1.40 (1.79), 15.27% (16.82%), 3.09% (3.41%), 22.09% (24.01%), 1.90% (1.86%), 26.55% (26.92%), and 28.01% (41.30%), respectively. Moreover, for the categorical variables audit (BIG4) and corporate governance (CG), 81.02% of the sample companies are audited by one of the big-4, and 83.94% of the companies are part of the differentiated level of CG.

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Table 3

Cumulative abnormal return (CAR) by corporate governance segment and economic sector

	N	Mean	Median	Minimum	Maximum	Standard deviation
Corporate governance						
Level 1	15	-0.1495	-0.1071	-0.5070	0.0806	0.2004
Level 2	3	-0.2964	-0.2610	-0.4724	-0.1558	0.1612
New Market	97	-0.2982	-0.2655	-0.9617	0.2131	0.2651
Traditional	22	-0.2147	-0.2117	-0.5205	0.2079	0.1671
Economic sector						
Industrial goods	23	-0.2587	-0.2751	-0.4735	0.0511	0.1528
Cyclical consumption	43	-0.3716	-0.3073	-0.9617	0.0690	0.2496
Non-cyclical consumption	12	-0.2072	-0.2024	-0.5856	0.2131	0.2761
Basic materials	13	-0.2154	-0.2567	-0.5577	0.2131	0.2362
Oil, gas and biofuels	6	-0.3613	-0.3288	-0.9617	0.0113	0.3506
Health	11	-0.2674	-0.2608	-0.7255	0.0798	0.2556
Information technology, communications	8	-0.2577	-0.2679	-0.8394	0.2079	0.3400
Utilities	21	-0.1141	-0.1471	-0.4511	0.1992	0.1584

Note: CAR = cumulative abnormal return [-5,+5]; N is the number of stocks used to calculate the average abnormal return; companies in the information technology and communications sector were grouped in the same sector.

In order to deepen the understanding of asset performance in terms of CAR during the event window, Table 3 presents the descriptive statistics by corporate governance segment and economic sector. Arora et al. (2021) state that the pandemic represented a financial shock, making it possible to examine the effect of corporate social responsibility (CSR) in a crisis context. Among the metrics analyzed by the authors, only governance is positively and significantly related to stock value.

Also, Pereira and Martins (2015) and Mitton (2002) state that strong corporate governance benefits the company in periods of financial crisis, as investors value companies with strong governance. However, for this period

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studied, the analyzed data did not reveal the same pattern, *i.e.*, it is not evident that companies belonging to differentiated levels of corporate governance suffered a less adverse impact to the pandemic than traditional companies.

Moreover, Table 3 shows that the most affected sectors were cyclical consumption, oil, gas, biofuels, and health care (a statistically significant difference was found only in the public utility sector concerning cyclical consumption, p-value = 0.002). Such results are similar to the list published in the September 15, 2020, Ministry of Economy's Special Secretariat for Productivity, Employment and Productivity (Sepec/ME), which presented the most affected sectors after the decree of a state of public calamity in Brazil, with the cyclical consumption sector being one of the top ten.

In the case of the oil, gas, and biofuels sector, there was already an imbalance. Still, the pandemic brought even more instability that, along with isolation measures, reduced mobility, impacting the demand for oil (Losekann et al., 2020). According to the International Energy Agency (IEA, 2022), in 2020, 57% of the world's oil demand was used in the transportation segment.

Table 4

Pearson's correlation matrix

Variables	1	2	3	4	5	6	7	8	9
CAR [1]	1								
SIZE [2]	***0.408***	1							
GOPP [3]	0.120	*-0.157*	1						
OCAP [4]	0.088	-0.120	***0.255***	1					
OCF [5]	0.119	0.033	***0.329***	*0.146*	1				
TANG[6]	0.094	*0.142*	-0.106	0.097	***0.251***	1			
REBIT [7]	*0.142*	0.017	***0.391***	0.183	***0.436***	0.009	1		
LEV [8]	-0.091	***0.364***	***-0.330***	-0.074	-0.008	0.138	-0.080	1	
TURN [9]	*-0.152*	0.135	0.036	-0.036	-0.071	0.026	0.011	0.055	1

Note. CAR= cumulative abnormal return [-5,+5]; SIZE= firm size; GOPP = growth opportunity; OCAP = operating capacity; OCF = operating cash flow; TANG = fixed assets; REBIT = return on assets; LEV = leverage; TURN = turnover. The values in bold and italic represent statistical significance at the 1% level, those only in bold portray significance at the 5% level, and values only in italics correspond to statistical significance at the 10% level.

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Pearson's correlation between the continuous variables used in the regression is presented in Table 4. It is possible to observe that there are no high correlations between the variables, and it is noteworthy that the characteristics of the firms that showed positive and significant correlation with CAR[-5,+5] were firm size and return (EBIT) on assets, while turnover had negative and significant correlation.

Results of regressions

Table 5 presents the results of the regressions that seek to analyze the relationship between firms' characteristics and the stock market reaction to the Covid-19 pandemic, reflected in their CAR. For this purpose, the CAR event window [-5,+5] was used. It is noteworthy that models one (1), two (2), three (3), and four (4) presented in Table 5 indicate Adjusted R^2 values of 26.37%, 28.00%, 30.86%, and 31.03%, respectively, demonstrating a good explanation capacity of the regression compared to the work of Xiong et al. (2020) which presented an Adjusted R^2 of 1.66%. Furthermore, the variance inflation factor (VIF) analysis for each model shows the absence of multicollinearity problems between the variables, with values lower than ten (Hair et al., 2009), and no heteroscedasticity problems were found in the regressions.

Models 1 and 2 presented in Table 5 are differentiated by the insertion of the interaction between firm size and corporate governance and do not include sector dummies in the CAR analysis. Starting with model 3, sector dummies were inserted. In general, the SIZE variable positively influences the CAR, with statistical significance at the 1% level in models 1 and 3, at the 5% level in model 4, and at the 10% level in model 2. This indicates that larger firms had a higher abnormal return in the context studied. This finding corroborates Xiong et al.'s (2020) and Heyden and Heyden (2021) results. It can be explained by the perspective that larger firms are more diversified and have greater credibility in the debt market for obtaining external resources in times of high uncertainty (Frank & Goyal, 2009).

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Table 5

Relationship between firm characteristics and cumulative abnormal return [-5,+5]

	CAR [-5,+5]			
Variables	(1)	(2)	(3)	(4)
SIZE	0.0853***	0.0449*	0.0775***	0.0540**
	(0.0132)	(0.0244)	(0.0140)	(0.0249)
GOPP	0.0253	0.0257	0.0338	0.0325
	(0.0237)	(0.0234)	(0.0246)	(0.0246)
OCAP	0.1888	0.1466	0.2130	0.1862
	(0.1959)	(0.1949)	(0.2004)	(0.2015)
OCF	-0.0085	0.0980	0.5142	0.5605
	(0.7958)	(0.7888)	(0.8019)	(0.8020)
TANG	0.0719	0.0474	0.0588	0.0403
	(0.1042)	(0.1038)	(0.1132)	(0.1142)
REBIT	0.5259	0.5682	0.2768	0.3753
	-10.010	(0.9900)	-10.204	-10.228
LEV	-0.3272***	-0.3100**	-0.4099***	-0.3914***
	(0.1223)	(0.1212)	(0.1227)	(0.1236)
BIG4	0.0217	0.0345	-0.0032	0.0063
	(0.0520)	(0.0518)	(0.0533)	(0.0539)
CG	-0,0755	-0.0513	-0.0044	0.0053
	(0.0565)	(0.0573)	(0.0591)	(0.0597)
TURN	-0.0976**	-0.0996**	-0.0944**	-0.0965**
	(0.0415)	(0.0411)	(0.0428)	(0.0428)
SIZE:CG		0.0533*		0.0315
		(0.0272)		(0.0278)
Industrial goods sector			-0.0553	-0.0502
			(0.0692)	(0.0692)

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Table 5 (conclusion)

Relationship between firm characteristics and cumulative abnormal return [-5,+5]

	CAR [-5,+5]			
Variables	(1)	(2)	(3)	(4)
Cyclical consumption sector			-0.2091***	-0.1922***
			(0.0623)	(0.0640)
Non-cyclical consumption sector			-0.1384	-0.1283
			(0.0846)	(0.0849)
Basic materials sector			-0.0785	-0.0616
			(0.0852)	(0.0863)
Oil, gas and biofuels sector			-0.1809*	-0.1707
			(0.1029)	(0.1031)
Health sector			-0.1670*	-0.1493
			(0.0888)	(0.0901)
Information technology & communications sector			-0.1200	-0.1010
			(0.0936)	(0.0949)
Constant	-1.5353***	-0.2316***	-1.3380***	-0.1510*
	(0.2003)	(0.0815)	(0.2206)	(0.0887)
Observations	137	137	137	137
Adjusted R^2	0.2637	0.2800	0.3086	0.3103

Note. CAR = cumulative abnormal return [-5,+5]; SIZE = firm size; GOPP = growth opportunity; OCAP = operating capacity; OCF = operating cash flow; TANG = fixed assets; REBIT = return on assets; LEV = leverage; BIG4 = dummy (=1) for audit among the top 4; CG= dummy (=1) for differentiated levels of corporate governance; TURN = turnover; SIZE:CG = interaction between size and corporate governance variable. Standard errors in parentheses. ***, **, * represent statistical significance at the 1%, 5% and 10% level, respectively.

Still, it is possible to observe a statistically significant and negative relationship between CAR and LEV, suggesting that less leveraged companies, that is, that made less use of debt (short and long-term loans and financing) performed better in the initial period of the pandemic, corroborating the expected results concerning the study of Carvalhal and Nakahodo (2022) who analyzed the effects of Covid-19 from the first case of the virus in Brazil

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and found that less leveraged companies suffered a lower impact to the crisis compared to those more indebted.

It is observed that the relationship between CG and CAR was not significant in this window of the event, agreeing with the work of Carvalhal and Nakahodo (2022), who used the same event date and found that good corporate governance practices did not contribute significantly to better company performance. However, it is important to emphasize that this result does not necessarily imply that investors do not value the transparency of firms but that it may be due to the liquidity of assets since studies argue that companies that migrate to differentiated levels of CG have greater liquidity (Camargos & Barbosa, 2010; Silva et al., 2014). In this sense, it can be observed that the variable TURN was negative and significant at the 5% level, indicating that companies with more traded shares had lower returns. Such a fact agrees with the work of Duong et al. (2022), who, when examining abnormal returns, found that a high stock turnover rate negatively influences returns due to lower liquidity risk during the Covid-19 pandemic.

When the interaction between company size and corporate governance (SIZE:CG) was considered, and without the inclusion of sectors, as presented in model 2 of Table 5, the results point out that larger companies and those that adhered to a differentiated level of governance demonstrated better performance during the investigated event window, the interaction being positive and marginally significant (10% significance). However, the significance is lost in the presence of the dummies for the sector.

Furthermore, it is noteworthy that the cyclical consumption sector presented a coefficient with a negative sign and highly significant (1% significance) in both models in which it was considered, which is in line with the repercussions of the pandemic on the economy, corroborating what was published by the Ministry of Economy, which pointed out the cyclical consumption sector as one of the most affected sectors.

Additional analyses

In this section, additional analyses were performed in order to extend and verify the robustness of the results. To this end, the variable of the corporate sustainability index (ISE) was included, following the study of Carvalhal and Nakahodo (2022), who used the ISE index as a proxy of good ESG practices to investigate whether these practices influenced the abnormal returns of Brazilian companies during the Covid-19 pandemic. Also,

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models were tested from the expansion of the CAR event window to [-10, +10], as shown in Table 6.

Table 6

Relationship between firms' characteristics and the cumulative abnormal return

	CAR [-5,+5]	CAR [-10,+10]	CAR [-10,+10]	CAR [-10,+10]
	(1)	(2)	(3)	(4)
SIZE	0.0552**	0.0440*	0.0448*	-0.0091
	(0.0246)	(0.0234)	(0.0233)	(0.0435)
GOPP	0.0239	0.0781***	0.0724***	0.0506*
	(0.0246)	(0.0231)	(0.0233)	(0.0286)
OCAP	0.2035	0.0008	0.0122	0.1693
	(0.1992)	(0.1892)	(0.1886)	(0.2334)
OCF	0.5435	0.3693	0.3580	0.2664
	(0.7919)	(0.7528)	(0.7498)	(0.8162)
TANG	0.0555	0.0467	0.0568	0.0194
	(0.1130)	(0.1072)	(0.1070)	(0.1166)
REBIT	0.4415	1.0660	1.1097	0.8469
	(1.0104)	(0.9601)	(0.9567)	(1.0089)
LEV	-0.4291***	-0.3257***	-0.3506***	-0.2138
	(0.1235)	(0.1161)	(0.1169)	(0.1580)
BIG4	0.0038	0.0185	0.0168	0.0154
	(0.0533)	(0.0506)	(0.0504)	(0.0558)
CG	-0.0098	-0.0054	-0.0154	-0.0542
	(0.0594)	(0.0560)	(0.0562)	(0.0845)
TURN	-0.0985**	-0.0551	-0.0564	-0.0281
	(0.0423)	(0.0402)	(0.0400)	(0.0419)
ISE	0.1274**		0.0842	-0.0021
	(0.0634)		(0.0601)	(0.1162)

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Table 6 (conclusion)

Relationship between firms' characteristics and the cumulative abnormal return

	CAR [-5,+5]	CAR [-10,+10]	CAR [-10,+10]	CAR [-10,+10]
	(1)	(2)	(3)	(4)
SIZE:CG	0.0214	0.0550**	0.0483*	0.0898**
	(0.0279)	(0.0261)	(0.0264)	(0.0442)
Industrial goods sector	-0.0408	0.0295	0.0357	
	(0.0685)	(0.0650)	(0.0649)	
Cyclical consumption sector	-0.1753***	-0.0844	-0.0733	
	(0.0637)	(0.0600)	(0.0603)	
Non-cyclical consumption sector	-0.1048	0.0024	0.0179	
	(0.0847)	(0.0797)	(0.0802)	
Basic materials sector	-0.0411	0.0357	0.0493	
	(0.0859)	(0.0810)	(0.0813)	
Oil, gas and biofuels sector	-0.1359	-0.0423	-0.0193	
	(0.1033)	(0.0968)	(0.0978)	
Health sector	-0.1255	-0.0320	-0.0163	
	(0.0897)	(0.0846)	(0.0850)	
Information technology and communications sector	-0.0745	-0.0242	-0.0067	
	(0.0947)	(0.0891)	(0.0896)	
Constant	-0.1456*	-0.3405***	-0.3370***	-0.4987***
	(0.0876)	(0.0833)	(0.0830)	(0.1046)
Observations	137	137	137	83
Adjusted R^2	0.3276	0.3880	0.3929	0.1991

Note. CAR = cumulative abnormal return; SIZE = firm size; GOPP = growth opportunity; OCAP = operating capacity; OCF = operating cash flow; TANG = fixed assets; REBIT = return on assets; LEV = leverage; BIG4 = dummy (=1) for audit among the top 4; CG = dummy (=1) for differentiated levels of corporate governance; TURN = turnover; ISE = dummy(=1) if the company was part of the ISE index in December 2019. SIZE:CG = interaction between the variable size and corporate governance. Standard errors in parentheses. ***, **, * represent statistical significance at the 1%, 5% and 10% level, respectively.

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From model 1, which considers the event window [-5,+5], one can see that even with the inclusion of the ISE, the variables SIZE, LEV, and TURN have a similar behavior concerning the main analysis. Furthermore, the ISE is a variable contributing to better CARs during this period, while CG and the interaction SIZE:CG do not present significant results in explaining the CAR. This corroborates the work of Carvalhal and Nakahodo (2022) that brings this positive and significant relationship between CAR and ESG, besides verifying that when analyzing companies in differentiated governance levels in isolation, they find that this characteristic did not make the company less vulnerable to the pandemic shock.

In the second additional test, the event window was expanded to [-10,+10], for which the model of column 2 was presented and the results obtained for the SIZE and LEV variables were similar to those found in the models of Table 5. Also, the GOPP variable demonstrated to be a characteristic that positively influences the abnormal returns of companies in this window, with statistical significance at the 1% level, in line with the results of Heyden and Heyden (2021), who pointed out that this characteristic positively influences companies in terms of CAR from an event window [-10,+10] around the arrival dates of Covid-19 and the political measures adopted in the US and Europe. On the other hand, the dummies variables for sector and turnover lose significance as the estimation window increases.

Moreover, considering the interaction between size and governance in the [-10,+10] window, the results of model 2 allow us to realize that although the CG variable alone is not statistically significant, the combined effect with the SIZE variable is associated with the behavior of assets in terms of CAR significantly at the 5% significance level, indicating that the characteristic of being a large company with a differentiated level of corporate governance is related to better performance during the investigated time window linked to the Covid-19 pandemic.

From model 3, which maintains the window's expansion to [-10,+10], controlling from the insertion of the ISE variable, it can be observed that the ISE does not present significance, and the SIZE:CG interaction becomes marginally significant. Finally, in model 4, we restrict the sample to firms with negative CAR and statistical significance at the 5% level in the window of [-10,+10], and, given the restriction on the number of observations, this regression did not include industry dummies. In this model growth opportunity is marginally significant and positive, while the SIZE:CG interaction remains significant at 5%. In this sense, it can be observed that over a more extended period of days around the event, there is a combined

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effect in which large firms with a differentiated level of corporate governance performed better.

It is important to mention that in the window [-10,+10] of Table 6, the first resolution of the Federal Reserve System (FED) had already happened on March 3, 2020, cutting 0.5 percentage point in the North American interest rate, with rates of 1% (minimum) and 1.25% (maximum). This decision had positive repercussions on the stock market. In this sense, other financial institutions, such as those in Australia, followed the same action as the FED. On March 4, other central banks, such as England and Japan, positioned themselves, stating that they would soon change their policies (Haas et al., 2020). After the reactions of the market and governments to the Coronavirus outbreak, on March 3, the Central Bank of Brazil stated that it would monitor the impacts of the pandemic on the country's financial conditions and economy. However, it was necessary to analyze during the following two weeks the effects of the virus on the prospective path of inflation in monetary policy, adopting various measures to support the continued functioning of the economy (Banco Central do Brasil, 2020).

Also, following the work of Xiong et al. (2020), a reduction in the estimation window to 100 days was tested, and the results were similar to that found in the previous analysis period in which SIZE, LEV, TURN, and the interaction SIZE:CG showed statistical significance concerning the CAR.

CONCLUDING REMARKS

The onset of the Covid-19 pandemic caused important changes in the business environment in Brazil and worldwide. In this sense, this article investigated the reactions of the Brazilian stock market to the Covid-19 pandemic, analyzing the specific characteristics of the firms from the analysis of the CAR, aiming to advance in the existing literature that seeks to analyze the performance of assets in the occurrence of extreme events, from the specific characteristics of each company, especially in the context of emerging countries such as the case of Brazil, which was the second country with the highest number of deaths due to the virus (WHO, 2020). In addition, this study contributes to investors' portfolio strategy and risk management.

For this, the event window [-5,+5] around March 11, 2020, the date when the spread of the Covid-19 virus was taken to pandemic status by the WHO, was used. In this interval, the sample companies had an average CAR of -26.85%, which indicates the magnitude of the influence on the prices of

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Brazilian companies. The results found were that larger firms performed better relative to smaller firms, and more leveraged firms were negatively associated with CAR, indicating that debt can bring financial constraints during this period of shock and extreme events, where uncertainty and high interest rates can impact firm performance (Koning, 2021). Furthermore, the results for the event window of [-5,+5] also showed that higher turnover firms were more negatively affected by the Covid-19 pandemic, which can be explained by the lower liquidity risk consequent to high stock turnover rates (Duong et al., 2022).

Among the additional analyses, it was also possible to identify that companies with more sustainable practices, reflected in the ISE, perform better in the main window [-5,+5]. On the other hand, by extending the window to [-10,+10], it is observed that size, growth opportunity, and leverage are characteristics of the firms that influenced the CAR. Moreover, considering the combined effect between size and corporate governance, larger firms that belong to a differentiated level of governance performed better in terms of CAR in this window.

The results from the inclusion of different sectors in the analysis allowed us to verify that the only sector that presents strong statistical significance in the event window [-5,+5] was cyclical consumption, demonstrating a negative relationship with CAR, being consistent with the list released by the Ministry of Economy (2020) of the most affected sectors after the decree of a state of public calamity in Brazil. However, the results for this variable are not robust enough for a longer time window.

Finally, this work is subject to limitations since the present analysis was restricted to only one event date, without considering possible political issues in fighting the pandemic that may also influence the accumulated abnormal return of assets in this period. In this sense, as a future suggestion, it would be interesting to conduct a study that encompasses the behavior of assets with the specific characteristics of the firms considering the political character.

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