

## **Efficient Market Hypothesis, Covid-19 and Accumulated Return of Common Shares: Event Study of the Top Chinese Financial Institutions by Market Value Criterion**

*Hipótese de mercado eficiente, Covid-19 e retorno acumulado anormal de ações ordinárias – estudo de evento das principais instituições financeiras Chinesas pelo critério de valor de mercado*

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### Resumo

Este trabalho analisou, através da metodologia de estudo de eventos, o impacto da divulgação de dois decretos relevantes em 2020 (1. quarentena na cidade de Wuhan, China, em 22 de janeiro; 2. pandemia de Covid-19 pela OMS em 11 de março) no retorno acumulado das ações ordinárias dos quatro maiores bancos chineses pelo critério do valor de mercado. O evento 1 apresentou valores de p-values superiores a 0,05 na janela de estimativa, não demonstrando impacto estatisticamente significativo no comportamento do retorno acumulado anormal das ações ordinárias selecionadas, caracterizando ineficiência informacional. Para o evento 2, o oposto foi observado nos dias próximos à divulgação (p-values inferiores a 0,05), de acordo com o comportamento esperado de ajuste de preços em mercados eficientes.

**Palavras-chave:** estudo de evento, Covid-19, retorno, mercado eficiente

### *Abstract*

*This work analyzed, via event study methodology, the impact of the disclosure of two relevant decrees in 2020 (1. quarantine in the city of Wuhan by the Chinese government on January 22; 2. COVID-19 pandemic by the WHO on March 11) in the cumulative return of the common shares of the four largest Chinese banks by the market value criterion. Event 1 presented p-values greater than 0.05 in the estimation window, showing no statistically significant impact on the behavior of the abnormal cumulative return of selected common shares, characterizing informational inefficiency. For event 2, the opposite is in the days close to the disclosure (p-values lower than 0.05) under the expected behavior of price adjustment in efficient markets.*

**Keywords:** event study, Covid-19, return, efficient market

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## Introduction

Covid-19 was brought to the world's attention in January 2020. The rapid spread of the virus and the rising number of infected people and deaths triggered punctual combat measures such as the lockdown of human circulation for a determined period.

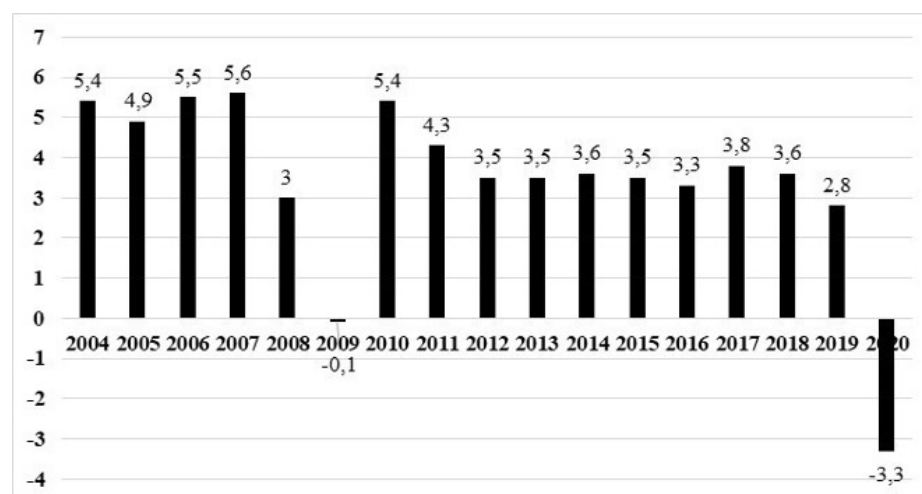
The number of people infected and killed by Covid-19 has been growing exponentially worldwide since the detection of cases of pneumonia by unknown cause on December 31, 2019, in the Chinese city of Wuhan. According to data released by the Johns Hopkins University, on September 07, 2021, 222,071,491 of people were infected by Covid-19 in the world. From this total, the number of deaths was 4,590,618.

From an economic point of view, the impact of the coronavirus outbreak was devastating for most companies, consequence of the adoption of measures to combat the spread of the virus. Those measures included business shutdown and other social distancing restrictions that held back revenues in businesses that depends on the presence of people or consumers, such as restaurants, bars, retail stores, hospitality, public transportation, aviation etc.

Differently from classic economic crises, which start with the deterioration of the fundamentals that provide stability to national economies and propagate with the loss of credibility, postponement of investments, reduction of employment, among other factors, the current crisis was originated by a drastic reduction in demand of products and services in the regions affected by the epidemic. As it is a pandemic, the impact is global. The limitation of coming and going reduces the consumption of families and companies, which is reinforced by the prohibition of certain economic activities carried out in places that concentrate people. In this context, there is a combination of a negative demand shock with a negative supply shock, potentiating the effects on the economies of different countries.

To have an approximate dimension of the adverse impact of Covid-19, the International Monetary Fund (IMF) reported a sharp drop of 3,3% in the gross domestic product (GDP) of the global economy in 2020.

Figure 1  
Growth in global Gross Domestic Product (GDP), from 2004 to 2020.



Source: Elaborated by the authors with data from IMF.

When considering the relationship between the level of activity of companies and the performance of capital markets, the occasion was considered opportune to analyze the extent to which the announcement of selected information about Covid-19 contributed to the generation of abnormal returns in the common shares of the four largest Chinese banking institutions by market value criterion. The selection of companies in the banking sector is justified by the high exposure of its main operating activity (lending and financing) to default by individual and corporate clients. In adverse economic scenarios, such as the current Covid-19, the performance of the banking sector tends to be affected by the significant fall in the activity level of the companies and, consequently, by the reduction of jobs, which lowers borrowers' repayment capacity and increases default rate and financial losses in the credit portfolio.

Consequently, it was observed a sharp drop in the consumption level of products and services around the world that affected in a severe way the revenue and profit of a bulk part of the companies.

For this reason, the occasion was considered opportune to analyze the impact of the announcements related to the growth of infections and deaths by Covid-19 on the return of ordinary shares of large financial institutions established in the economy of the country where the first cases were reported. The research methodology used is the event study, proposed by Mackinlay (1997).

As motivation to develop this research, it was considered a rare opportunity to study how the markets are efficient in adverse conditions caused by pandemics.

The sample study is composed of the four largest publicly traded Chinese banks by market value criterion, according to data extracted from the Finance Yahoo website: Industrial and Commercial Bank of China (ICBC), Bank of China (BC), Agricultural Bank of China (ABC), and China Construction Bank (CCB). As a parameter for comparison, it was selected as a market portfolio for one of the most important Chinese stock exchange indexes, the Hong Kong Hang Seng Index (HK Index).

It was selected two relevant events to explore the relation between share return and the evolution of infections and deaths by Covid-19 in China and abroad, being the first or event 1 the decree of the quarantine in Wuhan city by Chinese Government, on January 22, 2020, and the second or event 2 the decree of the Covid-19 pandemic announced by the World Health Organization (WHO), on March 11, 2020.

The results showed different behaviors of the return of the shares in the predominance of the days of the study window for the two events.

For the decree of the quarantine in Wuhan (January 22, 2020) results for all Chinese banking institutions studied indicate that there is a possible significant effect of information disclosed in the price and return behavior of the shares, with an accumulation of abnormal negative returns and a possible imperfection of inefficient behavior in the Chinese market. This result also corroborates with evidence of an imperfect market that processes the price adjustment in an anticipated, gradual and imprecise manner, when new relevant information is disclosed.

As for the second event (March 9, 2020), results indicate a significant effect of the information disclosed in the stock price and return behavior. It was observed an

accumulation of abnormal return the day before and in most of the days of ex-post window. The results suggest the condition of an imperfect and even admissible capital market for dynamic events that demand the performance of specific adjustments as new relevant information is disclosed for the same study phenomenon.

This paper contributes for the understanding of the market efficiency in the context of a low likelihood occurrence event, but with a high social and economic impact. Additionally, it supports the understanding of Efficient Market Hypothesis in the scenario of emerging markets, such as China.

## Theoretical framework

This section presents a brief review of the literature on the most relevant topics for the study design.

### Efficient market hypothesis

The Efficient Markets Hypothesis (Fama, 1970) proposes that in each market, price works as a mechanism for transmitting information about investment securities, such as stocks, capable of incorporating all relevant data of the companies in the market.

According to this author, there are three forms of EMH:

- Weak Form: assumes that future prices can be predicted merely by reviewing past prices. So that, excess returns cannot be made over time based on investment strategy on historical share prices or other data.
- Semi-Strong Form: considers that share prices adjust to publicly available new information quickly, and in an unbiased manner, so that no excess returns can be made trading on that information.
- Strong Form: proposes that share prices reflect the entirety of available information, both public and private, meaning no individual can make excess returns, or "beat the market". This form of market efficiency is not possible where there are legal barriers that prevent private information to become public. An example of legal barriers to that prohibits private information to become public is insider trading laws.

The double test of market efficiency and CAPM (Sharpe, 1964) would be the verification format. The rationality of agents when deciding, the non-availability of privileged information and the irrelevance of transaction costs would then make markets efficient.

MacKinlay (1997) proposes an event study format to verify the semi-strong case. Copeland, Weston and Shastri (2005) also raise other possible market efficiency test models based on variations in the measurement of abnormal return and CAPM, among other specifications, for the strong and semi-strong form.

Questions about the assumptions of these three forms of EMH frequently are raised by academic researchers (Fama, 1991, regarding the CAPM) and by proponents of new paradigms (Barberis & Thaler, 2003; Chui, Titman & Wei, 2010; Barberis, Shleifer & Vishny, 1998, among others). Likewise, the debate on anomalies and the defense of market efficiency remains active (Fama & French, 2012, on the momentum effect).

## Event studies with different focus

There is a tradition in finance to employ event studies in explore possible impact of relevant information upon asset returns, such as earnings announcements, dividend announcements, investment announcements, index rebalancing and regulatory changes.

Among the academic research that used the event study methodology to analyze the impact upon stock returns, we can detach different focus, such as Miyajima and Yafeh (2007) for financial crises, Cimini (2015) for traditional financial issues, Fertzl, Utz and Wimmer (2012) for natural catastrophes and Combs, Ketchen and Perryman (2007) for sudden CEO deaths.

## Event studies in China

Market efficiency was originally formulated considering in the North American capital market. Event studies and other indirect empirical methods have been used to test this hypothesis in other contexts.

Especially in China, several market conditions are different from those found in the North American market. The ownership structure present in the Chinese market is also different from that verified in the North American market, where the Modern Theory of Finance first developed.

The presence of State Owned Enterprises (SOE's) and Non-SOE's (Privately Owned Enterprises) in the Chinese capital market generates interest in studying the differences between these two groups. Chinese SOE's have executive officers appointed by the state, and whose careers intersect periods in SOE's and positions in the public sector. This element can be considered as a transmission channel of information between government, state and company, affecting the performance and governance of the listed SOE's.

Evidence of the specific return behavior of SOEs in the Chinese market is brought by some studies. Lin et al. (2016) measures the effects of the change in corporate governance regulation and anti-corruption rules that occurred in China in 2012 and finds that the return behavior differs between SOE's and Non-SOE's.

Using a study of events, they identify that both, state-owned companies and Non SOEs located in provinces where market rules are more developed, have benefited from the reform related to the reduction of agency costs of managers linked to the Chinese Communist Party. Conversely, Non SOEs located in provinces where market rules are weakly implemented have not captured value. This result would be indirect evidence that market investors would recognize the value of the reforms implemented.

Lin et al (2016) study comprises a series of event studies with different sub samples, to understand the dimensions of the anti-corruption law announcement. First, for Hong Kong Stock Exchange listed firms, they compared mainland-based firms with other Hong Kong Listed firms, since the former would be subject to possible impact of the announcement during the event window. "Shares of the 81 mainland-based firms trading in Hong Kong (H shares) rose significantly relative to all other Hong Kong listings, by 1.59% and 2.26% in 3- and 5-day windows, respectively, around the December 4, 2012, announcement date." (Lin et al. 2016, p2-3). Second, they analyze

2,260 listed companies from mainland China, divided in two portfolios representing the top tercile and bottom tercile of firms in terms of its location in most or least liberalized provinces, or market driven provinces. The National Economic Research Institute's Marketization index (Fan et al. 2011) is used to create these portfolios. The most market driven located portfolio obtains returns of 3.20% for the 3 day window and 4.46% in the 5 day window, from the announcement of December 4, 2012. The least market driven tercile, on the other hand, obtains lower gains that were not significant, of 0.54% in the 3 day window and 0.98% in the 5 day window. The researchers of that article concluded that this evidence was consistent to investor's expectation that anti-corruption laws of December 4, 2012 could be more beneficial for firms located in more market-oriented regions, and could then capture value from those reforms, which apparently could not be perceived on the firms located on the less market-oriented provinces, where other institutional factors could withhold the effects of possible constraints to corruption in these firms.

In another event study, Liu, Lin and Wu (2018) tested for the presence of abnormal stock returns of Chinese firms for the announcement of the 18th Decree of 19 October 2013, as it is known the "Opinions on Further Regulation on Party and Political Leaders and Cadres Working Part-Time (Holding Office) in Enterprises" (PT), aimed at regulating the part time participation of government officials / communist party members in corporate boards in China. Since the relevance of such connections for firm value in the institutional context in China, this new regulatory event could be a potential source of abnormal returns.

The study use univariate and multivariate models. In the univariate study with multiple event windows, firms with politically exposed directors on the board suffer significantly more than those that don't have politically exposed directors on the (0,4) event window, at 5%. In the multivariate study, considering among others firm location, board structure, market structure, regulatory and institutional environment of the headquarters location, ownership structure, size, the results are even more significant in various event windows, indicating that politically exposed firms suffered more than the ones that are not.

Results are coherent to a negative market reaction to the 18th Decree for firms that politically exposed independent directors, whilst the report demonstrates (?) stronger negative return for privately owned firms, especially those located on the less institutionally market oriented regions in China. For firms that don't dispose of politically exposed directors on their board, the negative effect on their value is temporary, in a 25 day window, which lead the authors of that study to conclude that firms with political connections suffered more than those that with no political connections.

The cited event studies are based on only one selected relevant event, but there are researchers comparing classes of similar events across countries, using China as one of the samples. For example, Zhao, Li and Flinn (2013) compare the effects of product recall on Chinese and American firms, concluding that the negative abnormal return is greater for Chinese firms, especially when the recall is passive.

## Event study with news related to infectious diseases and Covid-19

Donadelli, Kizys and Riedel (2017) presented the concept of Disease Related News (DRN) and identified evidence of non-rational reactions in the prices of North American pharmaceutical companies, varying by size and involvement or not in the business of developing vaccines.

Capital markets were affected by the Covid-19 pandemic and research suggests that reactions are not based on rational expectations alone.

Zhang, Hu and Ji (2020) analyzed 10 capital markets (including Mainland China) in February and March 2020 (60 days after the WHO PHEIC announcement on January 30) and identified a correlation between the severity of the Covid-19 outbreak and the negative reaction of the markets in the period. The correlation between markets globally varies in the pre- and post-crisis period. It also proposes that the greater risk, expressed in terms of greater volatility, does not only represent expectations of long-term returns, but also investors' sentiment towards the Covid-19 pandemic.

Event studies were used to analyze health events to detect their impact on the stock markets in terms of checking for abnormal returns. Schell, Wang and Huynh (2020) tested the effect of six events of Public Health Risk of International Concern (PHEIC), which fits as pandemic, on 26 stock market indices between April 22, 2008, and March 12, 2020. These authors point out that although the six events fit the same classification, only the announcement of covid-19 generates abnormal negative returns for at least 30 days. The study considers six PHEIC Events from post WW2. H1N1, or Swine Influenza (April 8, 2009); Polio (05 May 2014); Ebola in west Africa (08 August 2014); Zika Virus (1 February 2016); Ebola in DRC (17 July 2019); and Covid-19 (January 30, 2020).

Taking as market return the MSCI (Morgan Stanley Composite Index), the event study methodology based on McKinlay (1997) uses seven event windows to estimate immediate  $([-2, 2], [0, 2], [-3, 3], [0, 3], [0, 13])$  or long term  $([0, 30])$  effects of each PHEIC mentioned before in twenty six developed countries' markets and two multi market indexes, Eurostoxx and MSCI EM (for the Emerging Markets).

The difference in the pervasiveness of the PHEIC's effect shows possible evidence of the relevance and uniqueness of COVID-19's impact over financial markets compared to the other events analyzed, considering the significant abnormal returns observed. For H1N1 abnormal return is observed for just one market (Singapore, in  $[0,30]$ ), but a positive one. For Polio, only in Portugal it was observed a negative abnormal return  $([0,0])$ . For the 2014 Ebola outbreak, eleven markets presented abnormal negative returns, concentrated in the event day  $[0,0]$ , but not in the US, where the return was positive in  $[0,0]$ . For the Zika outbreak, three negative returns in different dates and two positives. For the Ebola event in 2019- two? negative and one positive abnormal return is mentioned. And for the Covid-19 in 2020, 14 markets presented negative compounded abnormal returns in the long event window  $[0,30]$ , but US market presented a positive compounded abnormal return for the same window. And for the announcement day window  $[0,0]$ , 17 countries and the 2 multi market indexes presented negative abnormal returns. Again, US market presented a positive

abnormal return for the event. China presented abnormal returns only for Covid-19, negative ones for  $[-2, 2]$  ( $-8.15\%$ ) and  $[0, 2]$  ( $-7.75\%$ ), both at 1% significance.

Donadelli, Kizys and Riedel (2020) identified that small pharmaceutical companies with less relation to vaccine production have high returns above the market after the announcement of news related to diseases (DRN). Based on an event study, they indicated to be a (indirect) evidence of investors' irrational sentiment and expectations, which could generate strategy opportunities with abnormal returns above the market.

Ozdurak and Guvenbas (2020) employed EGARCH and News Impact Curves in the analysis of pandemic-related news announcements in the pharmaceutical and biotechnology market. Their findings for a sample of incumbents and startups indicate that possibly Gilead and Dynavac stock prices were valued as if they could play some positive role to overcome the Covid-19 pandemic, due to the positive findings on returns observed for these two assets.

Ramelli and Wagner (2020) analyzed the amplification of the effects of Covid-19 on the value of American shares, identifying that companies with more business ties with China suffer a greater negative impact at the beginning of the post-announcement period. However, they consider the impact of the information day by day and its incorporation in the stock price. Additionally, they mention the impact of other unrelated events in the same period.

Chowdhury and Abedin (2020) found abnormal negative returns for different dates related to pandemic announcements for the S&P500 and Dow Jones, indicating the effect of these on highly efficient markets such as the American stock exchanges.

Heyden and Heyden (2020) identified that for the European and North American markets, the negative abnormal returns are related to the announcement of the first deaths in the countries where the companies are traded.

## Methodology, sample and research hypothesis

### Event study methodology

The event study method was applied in this work, as proposed by Campbell, Lo e Mackinley (1997), to examine the impact of the announcements of the worldwide increase of infections and deaths by Covid-19 in the return of common stocks of the 4 largest publicly traded Chinese banks by market value criterion, according to data extracted from the Finance Yahoo website: Industrial and Commercial Bank of China (ICBC), Bank of China (BC), Agricultural Bank of China (ABC), and China Construction Bank (CCB).

As a parameter for comparison, it was selected as a market portfolio of one of the most important Chinese stock exchange indexes, the Hong Kong Hang Seng Index (HK Index).

For operationalization of the statistical tests, it was used MS-Excel and SPSS (Statistical Package for the Social Sciences).



The zero date of events 1 and 2 corresponds to January 22, 2020 (Chinese government announces quarantine in Wuhan city, January 22, 2020) and March 11, 2020 (World Health Organization (WHO) declares Covid -19 as a pandemic). The event window corresponds to the period  $t-5$  and  $t + 5$ , that is, the five days before the event and five days after the event.

The calculation of the normal return for the shares was based on a series of returns observed before the occurrence of the selected events. After defining what these normal returns would be, a comparison was made with the returns observed, seeking to identify abnormal return behaviors in periods close to the announced event.

To calculate the abnormal returns, it was used the following market model proposed by Mackinlay (1997):

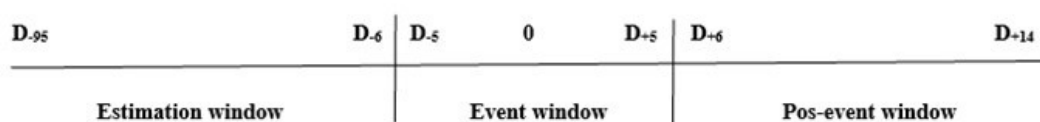
$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t} \quad (1)$$

- $R_{i,t}$ : Return of asset in a period  $t$
- $\alpha_i$ : Intercept
- $\beta_i$ : Slope
- $R_{m,t}$ : Return of the market portfolio in period  $t$
- $\varepsilon_{i,t}$ : Estimated error

For the estimation of the normal return, the alpha coefficient (intercept) and the beta coefficient (slope), the 90-day period preceding the event window was considered. Mackinlay (1997) recommend that the estimation window is not the same as the event window so that the estimated parameters of the model are not influenced.

Figure 2 illustrates, in general, the windows designed to fulfill the main objective of this research.

Figure 2  
Estimation window and event window – analyzed period in days



Source: Elaborated by the authors.

The research hypothesis is as follows:

H1: There is abnormal return upon the common stocks of the Chinese banks selected after the disclosure of relevant information

## Statistical results and analysis

### Statistical results

The following tables and figures present the statistical results of each bank selected for event 1 (Chinese government announces quarantine in Wuhan city, January 22, 2020) and

event 2 (World Health Organization declares Covid -19 as a pandemic, March 11, 2020).

The analysis of statistical results is presented in the section 4.2.

Table 1

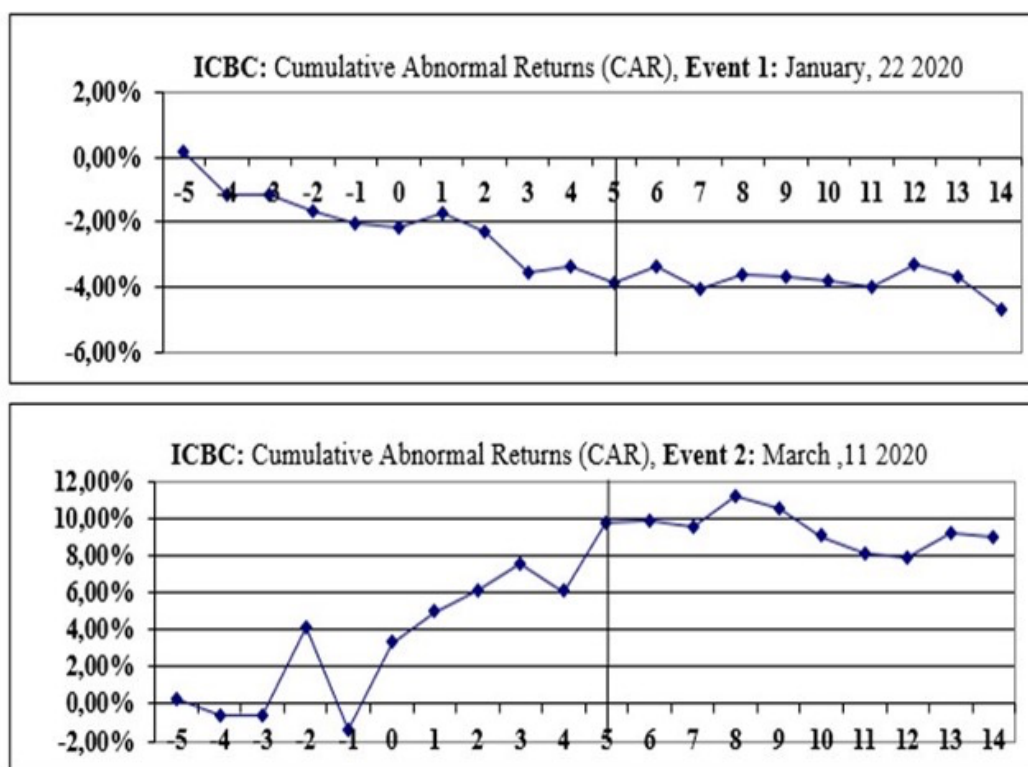
Industrial and Commercial Bank of China (ICBC): Abnormal return (AR) and Cumulative Abnormal Return (CAR)

	Event 1: January 22 2020				Event 2: March 11 2020			
	AR	CAR	p-value AR	p-value CAR	AR	CAR	p-value AR	p-value CAR
-5	0,00148	0,00148	0,39965	0,39965	0,00238	0,00238	0,34181	0,34181
-4	-0,01296	-0,01148	0,9422	0,91828	-0,00902	-0,00664	0,86041	0,78719
-3	0,00019	-0,01128	0,49241	0,86838	0,00064	-0,006	0,47493	0,72059
-2	-0,00539	-0,01668	0,67815	0,92367	0,04729	0,04129	0,00004	0,00030
-1	-0,00376	-0,02043	0,61232	0,93976	-0,05475	-0,01345	0,99998	0,84232
0	-0,00087	-0,02131	0,52416	0,93045	0,04645	0,033	0,00074	0,01201
1	0,00401	-0,01729	0,39826	0,86665	0,01652	0,04952	0,14899	0,00091
2	-0,00567	-0,02296	0,63344	0,91642	0,0119	0,06142	0,24093	0,00014
3	-0,01213	-0,03509	0,75346	0,97628	0,01427	0,07569	0,21457	0,00001
4	0,00135	-0,03374	0,47122	0,96432	-0,01515	0,06054	0,78769	0,00071
5	-0,00506	-0,0388	0,60187	0,97613	0,03692	0,09746	0,03235	0,00000

Source: Elaborated by the authors

Figure 3

Industrial and Commercial Bank of China (ICBC): Cumulative Abnormal Returns (CAR)



Source: Elaborated by the authors

Table 2  
Industrial and Commercial Bank of China (ICBC): Kolmogorov-Smirnov Normality Test

Test	Significance level	Sig.	Decision
Kolmogorov-Smirnov Test – Event 1	0,05	0,963	Retain the null hypothesis.
Kolmogorov-Smirnov Test – Event 2	0,05	0,873	Retain the null hypothesis.

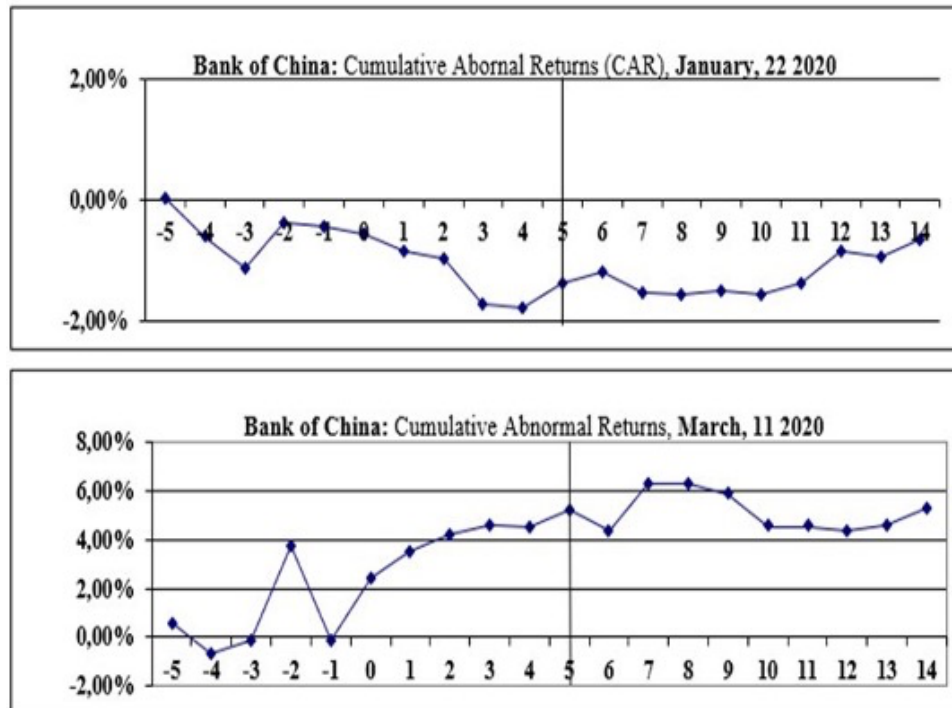
Source: Elaborated by the authors

Table 3  
Bank of China (BC): Abnormal return (AR) and Cumulative Abnormal Return (CAR)

	Event 1: January, 22 2020				Event 2: March, 11 2020			
	AR	CAR	p-value AR	p-value CAR	AR	CAR	p-value AR	p-value CAR
-5	0,00019	0,00019	0,48526	0,48526	0,00547	0,00547	0,12386	0,12386
-4	-0,00626	-0,00608	0,81060	0,80343	-0,01218	-0,00671	0,96437	0,83992
-3	-0,00507	-0,01115	0,71980	0,89963	0,00531	-0,00140	0,26134	0,56699
-2	0,00752	-0,00363	0,22781	0,64079	0,03925	0,03785	0,00003	0,00005
-1	-0,00061	-0,00424	0,52124	0,64535	-0,03879	-0,00094	0,99982	0,53434
0	-0,00138	-0,00562	0,54423	0,67424	0,02559	0,02465	0,01537	0,01869
1	-0,00265	-0,00827	0,57815	0,73074	0,01077	0,03542	0,20115	0,00294
2	-0,00127	-0,00954	0,53512	0,74675	0,00710	0,04253	0,30219	0,00096
3	-0,00774	-0,01728	0,69366	0,87074	0,00337	0,04590	0,40881	0,00084
4	-0,00059	-0,01787	0,51456	0,86552	-0,00084	0,04506	0,52178	0,00168
5	0,00430	-0,01357	0,39981	0,78860	0,00734	0,05239	0,32524	0,00061

Source: Elaborated by the authors

Figure 4  
Bank of China: Cumulative Abnormal Returns (CAR)



Source: Elaborated by the authors

Table 4  
Bank of China: Kolmogorov-Smirnov Normality Test

Test	Significance level	Sig.	Decision
Kolmogorov-Smirnov Test – Event 1	0,05	0,984	Retain the null hypothesis.
Kolmogorov-Smirnov Test – Event 2	0,05	0,670	Retain the null hypothesis.

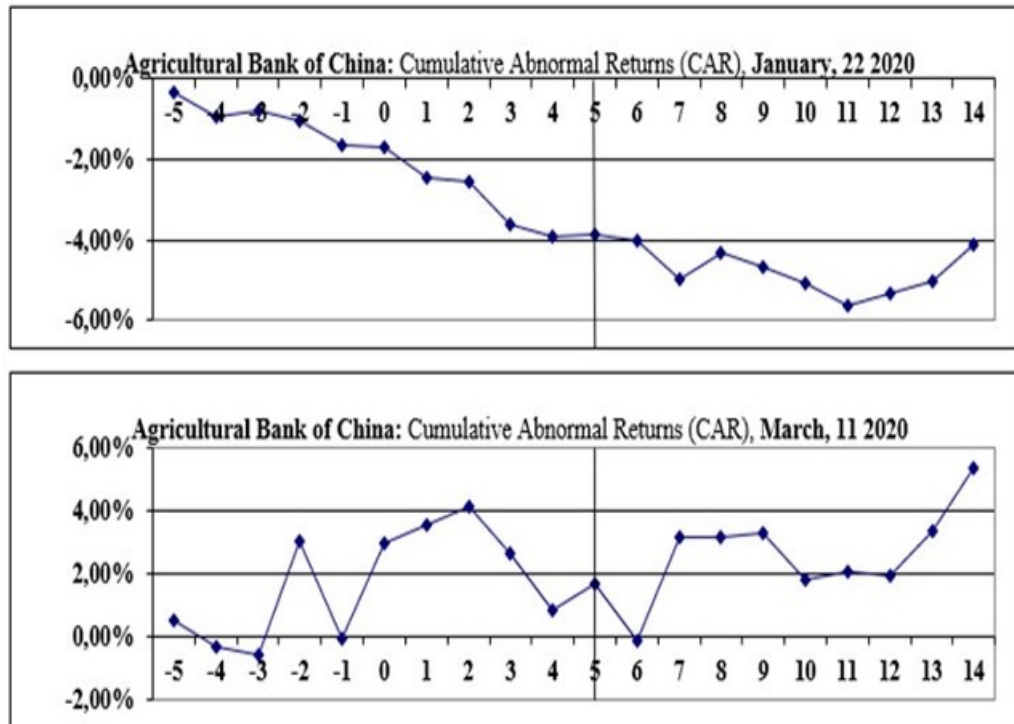
Source: Elaborated by the authors

Table 5  
Agricultural Bank of China: Abnormal return (AR) and Cumulative Abnormal Return (CAR)

	Event 1: January, 22 2020				Event 2: March, 11 2020			
	AR	CAR	p-value AR	p-value CAR	AR	CAR	p-value AR	p-value CAR
-5	-0,00328	-0,00328	0,73910	0,73910	0,00487	0,00487	0,19610	0,19610
-4	-0,00609	-0,00936	0,80004	0,90234	-0,00823	-0,00337	0,84467	0,66074
-3	0,00125	-0,00811	0,44382	0,82016	-0,00234	-0,00571	0,59272	0,71613
-2	-0,00243	-0,01054	0,59376	0,84838	0,03598	0,03027	0,00108	0,00493
-1	-0,00618	-0,01672	0,70354	0,92604	-0,03099	-0,00072	0,99120	0,52212
0	-0,00050	-0,01722	0,51587	0,91334	0,03040	0,02967	0,01642	0,01862
1	-0,00722	-0,02444	0,70134	0,96312	0,00565	0,03532	0,35747	0,01119
2	-0,00132	-0,02576	0,53599	0,96124	0,00612	0,04144	0,35531	0,00598
3	-0,01038	-0,03614	0,74788	0,98997	-0,01518	0,02626	0,80607	0,06762
4	-0,00305	-0,03918	0,57357	0,99146	-0,01767	0,00859	0,83050	0,32111
5	0,00037	-0,03881	0,49138	0,98795	0,00783	0,01642	0,34378	0,19956

Source: Elaborated by the authors

Figure 5  
Agricultural Bank of China: Cumulative Abnormal Returns (CAR)



Source: Elaborated by the authors

Table 6  
 Agricultural Bank of China: Kolmogorov-Smirnov Normality Test

Test	Significance level	Sig.	Decision
Kolmogorov-Smirnov Test – Event 1	0,05	0,950	Retain the null hypothesis.
Kolmogorov-Smirnov Test – Event 2	0,05	0,904	Retain the null hypothesis.

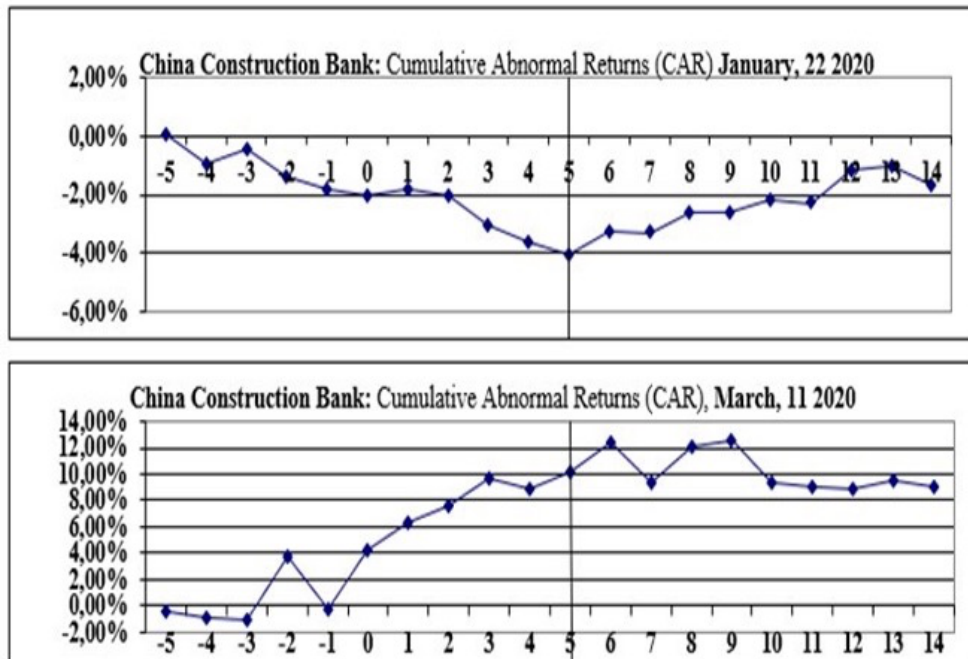
Source: Elaborated by the authors

Table 7  
 China Construction Bank: Abnormal return (AR) and Cumulative Abnormal Return (CAR)

	Event 1: January 22 2020				Event 2: March 11 2020			
	AR	CAR	p-value AR	p-value CAR	AR	CAR	p-value AR	p-value CAR
-5	0,00035	0,00035	0,47465	0,47465	-0,00411	-0,00411	0,77184	0,77184
-4	-0,01013	-0,00978	0,90556	0,89776	-0,00436	-0,00847	0,71015	0,85896
-3	0,00559	-0,00419	0,27703	0,67158	-0,00289	-0,01136	0,61718	0,87946
-2	-0,00956	-0,01375	0,80940	0,89616	0,04813	0,03677	0,00001	0,00061
-1	-0,00469	-0,01844	0,64829	0,93283	-0,03955	-0,00278	0,99911	0,58698
0	-0,00197	-0,02042	0,55822	0,93502	0,04435	0,04156	0,00066	0,00131
1	0,00216	-0,01826	0,44111	0,89488	0,02127	0,06283	0,07810	0,00001
2	-0,00188	-0,02013	0,54802	0,90222	0,01352	0,07635	0,19887	0,00000
3	-0,01056	-0,03069	0,73802	0,96801	0,02037	0,09672	0,11606	0,00000
4	-0,00574	-0,03643	0,62834	0,98123	-0,00828	0,08845	0,67794	0,00000
5	-0,00378	-0,04021	0,58164	0,98580	0,01316	0,10161	0,24286	0,00000

Source: Elaborated by the authors

Figure 6  
 China Construction Bank: Cumulative Abnormal Returns (CAR)



Source: Elaborated by the authors

Table 8  
 China Construction Bank: Kolmogorov-Smirnov Normality Test

Test	Significance level	Sig.	Decision
Kolmogorov-Smirnov Test – Event 1	0,05	0,817	Retain the null hypothesis.
Kolmogorov-Smirnov Test – Event 2	0,05	0,696	Retain the null hypothesis.

Source: Elaborated by the authors

## Analysis of statistical results

The main findings from events 1 and 2 are highlighted as follow.

### Event 1: Quarantine decree in Wuhan city, China, on January 22, 2020

In relation to event 1, all p-values for the ex-ante and ex-post periods were greater than 0.05, for all Chinese banking institutions in the sample, indicating the non-rejection of the null hypothesis, which considers a non-significant effect of the selected information disclosed in the accumulated abnormal return behavior of their common shares.

However, what is observed is the accumulation of abnormal negative returns, that is, destruction of the wealth of investors. In part, it can be admitted that this behavior is typical of events of a "dynamic" nature, when the current results are influenced by a series of disclosure of historical information that are directly related to the research focus - in this case related to the spread of Covid-19 virus in China.

As evidence, it can be highlighted that the main factor that determined the quarantine of the city of Wuhan was the dissemination of adverse information that attested the increase in the number of infections and deaths caused by covid-19 in China and in several countries. For this reason, one could admit a possible imperfection and inefficient behavior of the Chinese market, with the anticipation of arbitrage operations and inaccurate adjustments in the share price. What supports this assumption is that a linear behavior of abnormal returns was not observed, both in the ex-ante and ex-post periods, when it was adopted social distancing restrictions and business closure in the city of Wuhan.

The Smirnov-Kolmogorov normality test for all selected banking institutions assumes that abnormal returns tend to be normally distributed, with p-values greater than the 5% level across the study window. This result also corroborates with the evidence of an imperfect market that processes the price adjustment in an anticipated, gradual and imprecise manner, as new relevant information is disclosed.

### Event 2: Announcement of the Covid-19 Pandemic by the WHO on March 11, 2020

In relation to event 2, the predominance of p-values from the ex-post period was lower than 0.05 for all Chinese banking institutions in the sample, indicating the rejection of the null hypothesis, which considers a non-significant effect of the information disclosed on accumulated abnormal return behavior of their common shares.

What draws attention is that, even with the collapse caused by the increase in cases of infection and death in several countries, there was an accumulation of abnormal returns the day before, on the day of event 2 disclosure and in the predominance of the days of ex-post window. A priori, this result is considered contradictory given the significant increase in the number of diagnoses and deaths by Covid-19 outside China, which forced WHO to decree the pandemic situation.

In part, this behavior was influenced by the announcement of preventive measures to combat Covid-19 by representative bodies of the Chinese government. Initially, the internal media, monitored by the government, announced that Covid-19 was the top national priority. For the success of the actions, mandatory quarantine would be decreed in critical locations and structural investments in the health area would be made, such as the construction of large emergency hospitals. In addition, digital surveillance would be implemented to ensure that no infected persons (or persons who have had contact with infected persons) travel in public spaces.

From the point of view of monetary policy, actions stand out, such as that implemented by the People's Bank of China (PBOC), which injected 1.2 trillion yuan (about US \$ 173.3 billion) into the market through repurchase operations securities to reinforce liquidity in the banking system. This is the process in which the central bank buys bonds from commercial banks through bidding, with an agreement to resell them in the future. According to the bank, that figure was 900 billion yuan more than in the same period of 2019. In addition, PBOC announced that it would provide funds of 300 billion yuan to major national banks and some local banks in major provinces such as Hubei to increase credit support for the manufacturing sector, as well as for small, micro and private companies.

In view of the facts cited and, later, of announcements that reported the control of the progress of Covid-19, as on the day before event 2 (March 9, 2020), which highlighted the record of the lowest daily number of cases since the adoption of radical measures of coping, one could admit the generation of abnormal positive returns in the studied event window (-5 to +5).

It should be noted that the punctual accumulation of abnormal returns and in the predominance of the days of the ex-post window is a typical behavior of events of a "dynamic" nature, which are continuously influenced by the disclosure of various information that are directly related to the research focus.

Therefore, it could be admitted that the Chinese market behaved efficiently on the date of the announcement of the decree of the pandemic by the WHO and inefficiently ex-ante and ex-post, with early and post-adjusted adjustments in the share price. What supports this assumption is that there was no linear behavior of the abnormal returns, both in the ex-ante and ex-post periods, in which the event was disseminated.

The Smirnov-Kolmogorov normality test for all selected banking institutions assumes that abnormal returns are normally distributed, with p-values more significant than the 5% level across the study window. This result also corroborates with evidence of an imperfect market that processes the price adjustment in advance, participating gradually and imprecise as new relevant information is disclosed.

## Final remarks

The objective of this research was to analyze whether the announcement of two relevant events contributed, in a statistically significant way, to the generation of abnormal returns in the shares of the four largest banking institutions in China by the market value criterion. Event 1 refers to the decree of the quarantine in Wuhan city, on January 22, 2020, and Event 2 considers the decree of the Covid-19 pandemic by WHO, on March 11, 2020. In part, it was intended to analyze to what extent the behavior of the price and the return of the shares captured the evolution in the number of infections and deaths by Covid-19 in China.

It is important to highlight that the events selected for study are classified as “dynamic”, that is, when the current results are influenced by a series of disclosure of historical information that are directly related to the focus of the research - in this case related to the advancement of Covid-19 in China.

It should be noted that the focus of this research was not to analyze the level of veracity of the information released by representative bodies of the Chinese government on quantitative data from Covid-19.

The results showed different behaviors of the return of the shares in the predominance of the days of the study window for the two events.

In relation to Event 1, all p-values for the ex-ante and ex-post periods were greater than 0.05, for all Chinese banking institutions in the sample, indicating the non-rejection of the null hypothesis, which considers a non-significant effect of information disclosed in the price and return behavior of the shares. During the study period, there was an accumulation of abnormal negative returns and a possible imperfection of inefficient behavior in the Chinese market, with the anticipation of arbitrage operations and inaccurate adjustments in the share price. What supports this assumption is that a linear behavior of abnormal returns was not observed, both in the ex-ante and ex-post periods, when the city of Wuhan announced lockdown and other social distancing restriction measures. The Smirnov-Kolmogorov normality test for all selected banking institutions assumes that abnormal returns tend to be normally distributed, with p-values greater than the 5% level across the study window. This result also corroborates with evidence of an imperfect market that processes the price adjustment in an anticipated, gradual and imprecise manner, as new relevant information is disclosed.

As for Event 2, it was observed that the predominance of p-values from the ex-post period was lower than 0.05 for all Chinese banking institutions in the sample, indicating the rejection of the null hypothesis, which considers a non-significant effect of the information disclosed in the stock price and return behavior. What draws attention is that, even with the collapse caused by the increase in cases the number of infections and deaths in several countries, there was an accumulation of abnormal returns the day before, on the day of event 2 disclosure and in the predominance of the days of ex-post window. A priori, this result is considered contradictory given the significant increase in diagnoses and deaths by Covid-19 outside China, which forced WHO to decree the pandemic situation. In part, this behavior was influenced by the announcement of preventive measures to combat Covid-19 by representative bodies of the Chinese government. Initially, the internal media, monitored by the government, announced that Covid-19 was the top national priority. For the success of the actions, mandatory quarantine would be decreed in critical locations and structural investments in the health area would be made, such as the construction of large emergency hospitals.



In addition, digital surveillance would be implemented to ensure that no infected persons (or persons who have had contact with infected persons) travel in public spaces. From the point of view of monetary policy, actions stand out, such as that implemented by the People's Bank of China (PBOC), which injected 1.2 trillion yuan (about US \$ 173.3 billion) into the market through repurchase operations securities to reinforce liquidity in the banking system. This is the process in which the central bank buys bonds from commercial banks through bidding, with an agreement to resell them in the future. According to the bank, that figure was 900 billion yuan more than in the same period of 2019. In addition, PBOC announced that it would provide funds of 300 billion yuan to major national banks and some local banks in major provinces such as Hubei and would increase credit support for the manufacturing sector, as well as for small, micro and private companies. In view of the facts cited and, later, of announcements that reported the control of the progress of Covid-19 outbreak, as on the day before event 2 (March 9, 2020), which highlighted the record of the lowest daily number of cases since the adoption of radical preventive measures, one could admit the generation of abnormal positive returns in the studied event window (-5 to +5).

The results suggest the condition of an imperfect and even admissible capital market for dynamic events that conditions the performance of specific adjustments as new relevant information is disclosed about the same study phenomenon.

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