

COVID–19’s Impact on the Chinese Stock Market An Empirical Study Based on China’s ACG Industry

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ABSTRACT

The COVID-19 has had an uncertain impact on the world's stock markets, bringing challenges or opportunities to all industries. This article adopts the descriptive statistical analysis and an event study approach to evaluate whether and how the COVID-19 has affected the animation, comic, and game (ACG) industry in China and discusses the possible reasons for the empirical results. The study found that COVID-19 has a significant positive impact on China's ACG industry and the reasons for this phenomenon can be explained by the development status of China's ACG industry and the impact of the policies of lockdown and quarantine during the event. In response to this result, timely risk warnings to ensure market security are important and investors are suggested to pay attention to the impact of policy changes on the market. This article will play a certain reference significance for future investors to deal with similar events.

Keywords: COVID-19, Stock price, Event study, China’s ACG industry

1. INTRODUCTION

In 2020, the spread of COVID-19 across the world has had a tremendous impact on people's work and life, offering a more serious obstacle to the recovery of the global economy. Inevitably, the coronavirus pandemic has taken a toll on China's stock market. This kind of shock is not a regular fluctuation, but a calamity brought on by a sudden public event. Although China has now passed the most difficult phase of the COVID-19 pandemic, it is still of great significance to understand and study the stock market's response to a pandemic event.

As a very popular industry among young people, the ACG industry has received increasing attention from investors with the popularization of the Internet and the progress of technology in China, especially since practically all of China's major Internet companies have made significant breakthroughs in this industry. The ACG industry is very different from the traditional entertainment industry. It relies heavily on the Internet and its products are mainly virtual online products. These characteristics determine its particularity. Under the premise of the general impact of COVID-19 on China's economy, it is meaningful to study the impact of COVID-19 on China's ACG industry and how China's

ACG industry responds. Moreover, investor psychology in the context of the epidemic can also be reflected in this particular industry to a certain extent.

The research on the stock market of emergencies often used the event study approach. Huang and Li summarized the event study method from nearly 30 articles, introduced the method's research design, and summarized the calculation of the average abnormal return rate and cumulative average abnormal return rate, before introducing the statistical test methods. Huang and Li also discussed the current application and development trend of event research methodologies [1]. Dimitris et al. focused on the possible influence of COVID-19 on shipping markets. To evaluate the economic impact of COVID-19, the research mainly used a market-model event study approach and estimated the abnormal returns. To do stock analysis and freight study, Dimitris et al. used a major shipping index and all main Baltic indices, and the results showed that depending on the key date set as the event window, the dry market, the tanker market, and the shipping stock market all showed different results throughout response to the pandemic [2]. He et al. mainly focused on the impact of COVID-19 on the stock prices in China. The research adopted an event study approach, and examined the stock prices of many different industries. The results showed that the COVID-19 has

had a severe impact on China’s traditional industries, such as transportation, mining, electricity and heating, and environment. In contrast, it created opportunities for the development of high-tech fields. The manufacturing, information technology, education, and health industries responded positively to the pandemic [3].

There are also many studies on the economic and financial impact of COVID-19. Bing and Ma focused on how institutional and foreign investors respond to the event of COVID-19 in China and mainly analysed the flow-return relationship before and during the pandemic. The results showed that foreign investors played a market stabilization role, whereas institution investors didn’t [4]. Cristian et al. focused on the volatility of daily returns on the Romanian stock market during one period of COVID-19. The research was performed adopting the GARCH approach. The results showed that conditional volatility for the daily return series showed noticeable evidence of volatility that shifts over the explored period [5]. Hu et al. focused on the effects of COVID-19 on China’s Stock Market. Using the method of descriptive statistics and the ADF test and VAR model, the research studied the correlation between money supply and stock prices to study the impact of money supply on stock prices under different monetary policy backgrounds. The results showed the different kinds of influences of COVID-19 and also made some suggestions [6]. Nguyen et al. used an event study approach to research different epidemics’ effects on firms’ market performance. More than 3,000 firms during periods of SARS, H5N1, H7N9, and COVID 19 were chosen. The result showed that COVID-19 has the greatest impact and it’s uneven across industries [7].

Some studies have focused on the role of video games during the pandemic. Matthew and Alicia focused on the effects of playing video games during the COVID-19 Pandemic on players’ well-being. Based on a survey, the results emphasized the socio-cultural significance of video games and the potentially positive

nature of games’ effects on well-being [8]. Steve and Manuel focused on social gaming during the pandemic and its association with perceived loneliness. Mainly based on an online survey, the results indicated that the use of social gaming in times of social distancing seemed to play a small but significant factor in perceived loneliness [9].

The objective of this article is to research whether and how the COVID-19 has affected the ACG industry in China. The second chapter uses the comparative analysis of time nodes and historical volatility and descriptive statistical analysis to discuss the possible impact of COVID-19 on China's ACG industry. Chapter three empirically analyses the impact of COVID-19 on China's ACG industry by using an event study approach. Chapter four gives a qualitative analysis of the possible causes of the empirical results.

2. DESCRIPTIVE ANALYSIS OF CHINA'S STOCK MARKET AND ACG INDUSTRY UNDER COVID-19

2.1. Sample Selection and Major Time Nodes of COVID-19 in China

This research selects CSI ACG Index (930901) as the representative of China’s ACG industry. To know how the emergency of COVID-19 influenced China's ACG industry, CSI 300 Index (000300) is selected to represent China's stock market for comparison in this part. The descriptive analysis in this section is based on the daily closing prices of the two indices from 02/09/2019 to 30/6/2020. After excluding the data without trading during holidays, a total of 198 daily closing prices each are obtained.

Meanwhile, to fully consider the dynamic evolution of this emergency in China, this section identified some important time nodes to record the development and change of COVID-19, as shown in Table 1.

Table 1. Major time nodes of COVID-19 in China.

Time of event	Event
20/01/2020	ZHONG Nanshan said there is a human-to-human transmission of COVID-19.
23/01/2020	Wuhan declared a lockdown.
12/03/2020	China's National Health Commission announced that the peak of the epidemic has passed.
08/04/2020	Wuhan lifted the lockdown.

2.2. Descriptive Statistical Analysis

The descriptive statistical analysis in this section takes logarithmic rate of return () as the indicator to explore the characteristics of stock market volatility:

$$r_t = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (1)$$

As shown in equation (1), P_t is the closing price of the index on the day, and P_{t-1} is the closing price of the index on the previous trading day. Thus, the series of the logarithmic rate of return of these two indices are shown respectively in Figure 1 and Figure 2.

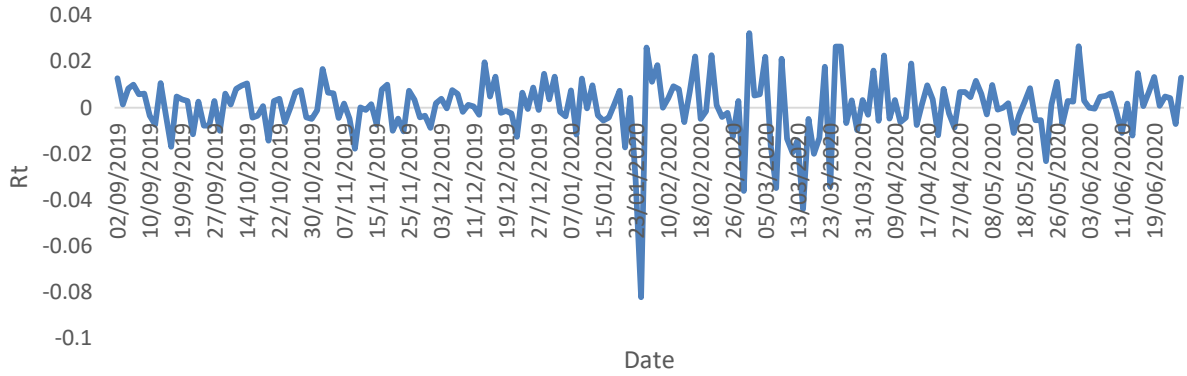


Figure 1. The series of the logarithmic rate of return of CSI 300 Index.

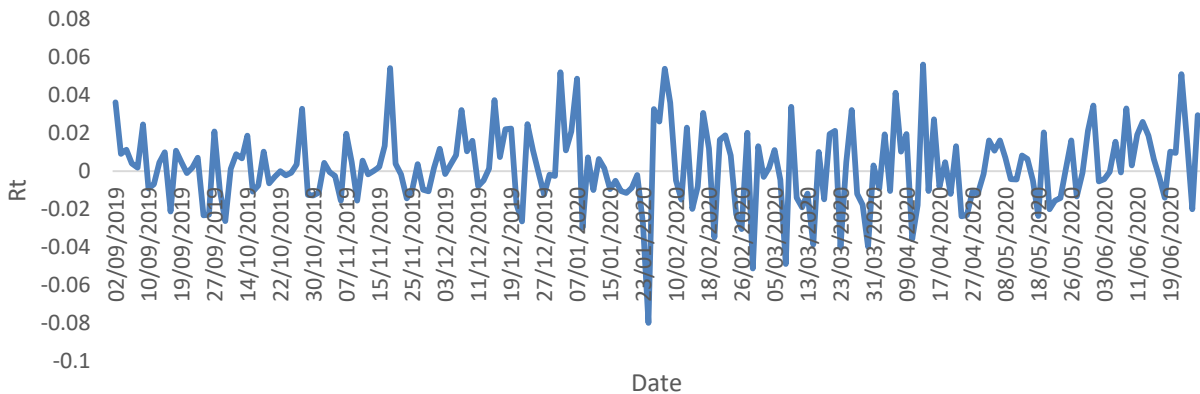


Figure 2. The series of the logarithmic rate of return of CSI ACG Index

As shown in FIG. 1 and FIG. 2, the series of the logarithmic rate of return of these two indices both show a certain feature of "volatility aggregation".

The results of descriptive statistics for the daily return series of the two indices are summarized in Table 2.

Table 2. Descriptive statistics for the logarithmic rate of return series of CSI 300 & CSI ACG

	Mean	Std. Dev.	Skewness	Kurtosis
CSI 300	0.000462	0.012760	-1.672691	12.04414
CSI ACG	0.002099	0.020197	-0.084699	4.286365

As shown in Table 2, firstly, the mean of the series of daily return rates of CSI ACG is significantly higher than that of CSI 300, which to some extent reflects that during the research period, the overall performance of China's ACG industry is better than the average market level. However, the standard deviation of the series of daily return rates of CSI ACG is larger than that of CSI 300, which to some extent reflects that during the research period, the stability of China's ACG industry is lower than that of the whole market. Secondly, theoretically speaking, the skewness and kurtosis of the time series of daily return with a normal distribution are respectively 0 and 3. The skewness of the two series is both less than 0, and there is an obvious left-skewness characteristic. The kurtosis of the two series is both greater than 3, indicating that the data are more densely distributed around the mode. However, the kurtosis of

the series of CSI ACG is smaller which means that to some extent, the rate of return is more dispersed than the market level.

In general, the series of daily return rates of the two indices have obvious distribution characteristics of "peak and thick tail", which does not conform to the normal distribution.

2.3. Historical Volatility Analysis

The historical volatility of CSI 300 Index and CSI ACG Index is calculated from formula:

$$\sigma = \sqrt{\frac{1}{244} \sum_{t=1}^{244} r_t^2} \quad (2)$$

In the Equation (2), 244 means 244 trading days

from 02/09/2019 to 02/09/2020; $P_{j,t}$ is the closing price of the index on the day, and $P_{j,t-1}$ is the closing price of the index on the previous trading day, N is selected to be

50. The results of the historical volatility are shown in Figure 3.

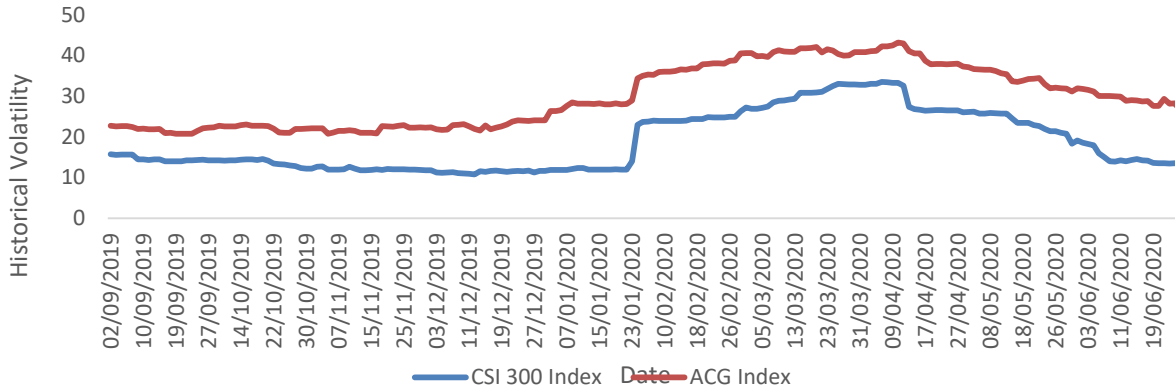


Figure 3. The annualized historical volatility of the CSI 300 Index and CSI ACG Index

As shown in FIG. 3, the figure of historical volatility is divided into three parts.

The first part is from 02/09/2019 to 20/01/2020. In this period, the historical volatility graph is generally stable and doesn't change very much. The second part is from 20/01/2020 to 09/04/2020. The historical volatility of the two indexes suddenly and rapidly increased around 23/01/2020, and the graph became very steep. After that, the historical volatility of the two indexes showed an upward trend. The third part is from 09/04/2020 to 30/06/2020. The historical volatility of the two indices suddenly and rapidly drops around 09/04/2020, and the graph becomes steeper. After that, the historical volatility of both indexes shows a trend of fluctuation decline.

Taking the major time nodes of COVID-19 in China into consideration, the historical volatility trends of the two indices are strikingly consistent with the time nodes of COVID-19. It's reasonable to assume that the COVID-19 pandemic has had an impact on The Chinese stock market and the Chinese ACG industry.

3. EVENT STUDY

3.1. Research Model

This section uses event study to research the impact of COVID-19 on the stock price return rate of China's ACG industry. In the following empirical analysis, this article chooses the market model [10] as the econometric model, which is as follows:

$$(3)$$

where, α_j are regression coefficients, $\epsilon_{j,t}$ is random error, $R_{j,t}$ is the simple rate of return of index j on the trading day t and $R_{m,t}$ is the market rate of return on the trading day t .

The expected rate of return obtained by regression of

actual data is as follows:

$$(4)$$

where, β_j are ordinary least squares (OLS) estimate values, $R_{j,t}$ is the expected return rate of index j on the trading day t .

In this article, this approach is divided into six main steps:

Step 1: Select a specific event according to the research purpose, and define the time period in which the event has an impact as the "event window" (T).

Step 2: Calculate the index's actual return:

$$(5)$$

As shown in equation (5), $P_{j,t}$ is the closing price of index j on the trading day t , and $P_{j,t-1}$ is the closing price of the index on the previous trading day.

Step 3: Calculate the abnormal return rate ($AR_{j,t}$):

$$(6)$$

Step 4: Calculate the standardized abnormal return rate ($SAR_{j,t}$):

$$(7)$$

In equation (7),

$$(8)$$

$$(9)$$

As shown in equation (7), $SAR_{j,t}$ is the standardized abnormal return rate of index j on the trading day t . T is the number of days in the event window.

Step 5: Calculate the cumulative standardized

abnormal return rate ():

$$= \tag{10}$$

As shown in equation (8), is the cumulative abnormal return rate of index *j* in the event window period (), *m* is the number of days in the event window.

Step 6: Use a T-test to observe the abnormal rate of return during the window period.

3.2. Event Window and Sample Selection

Based on the previous study of major time nodes of COVID-19 in China and analysis of the historical volatility of China's ACG industry, this article selected 20/01/2020, when Zhong Nanshan announced the human-to-human transmission of COVID-19, as the event occurrence date, marked as T=0, set 10 trading days before and after the event occurrence date as the

event window, marked as T=-10, -9, ..., 8, 9, 10. The forecast period is the 120 trading days before the event window.

This section selects the daily closing prices of CSI 300 index and CSI ACG index from 11/7/2019 to 11/2/2020 as the sample, a total of 141 prices.

3.3. Empirical Results

Through regression analysis of the data, the expected return rate model of the CSI ACG index is obtained, shown as follows:

$$\tag{11}$$

By using the event window, the results of the actual return rate of the CSI ACG index (), the market return rate (), the expected return rate (E ()), the abnormal return rate () and the standardized abnormal return rate () are shown in Table 3.

Table 3. Empirical Results

Date	E ()				
-10	2.107%	-0.378%	-0.264%	2.371%	125.117%
-9	4.990%	0.749%	0.971%	4.019%	211.072%
-8	-2.932%	-1.152%	-1.113%	-1.819%	-95.556%
-7	0.739%	1.266%	1.538%	-0.799%	-41.680%
-6	-0.983%	-0.029%	0.119%	-1.102%	-58.129%
-5	0.645%	0.980%	1.225%	-0.580%	-30.364%
-4	0.157%	-0.335%	-0.218%	0.375%	19.792%
-3	-0.930%	-0.553%	-0.456%	-0.474%	-24.982%
-2	-0.493%	-0.425%	-0.315%	-0.177%	-9.346%
-1	-1.023%	0.140%	0.304%	-1.327%	-69.961%
0	-1.126%	0.746%	0.968%	-2.094%	-109.978%
1	-0.872%	-1.709%	-1.723%	0.851%	44.385%
2	-0.189%	0.428%	0.620%	-0.809%	-42.606%
3	-2.736%	-3.099%	-3.247%	0.511%	25.873%
4	-7.663%	-7.881%	-8.491%	0.828%	34.445%
5	3.329%	2.637%	3.042%	0.287%	14.555%
6	2.645%	1.133%	1.392%	1.253%	65.509%
7	5.532%	1.861%	2.190%	3.342%	172.599%
8	3.669%	0.002%	0.153%	3.517%	185.531%
9	-0.485%	0.414%	0.604%	-1.088%	-57.319%
10	-1.473%	0.931%	1.171%	-2.644%	-138.605%

Next, this section conducted a T-test of cumulative abnormal return rate and the following assumptions are established:

: Cumulative abnormal return rate () equals zero, that is, COVID-19 has no impact on the returns of

China's ACG industry;

: Cumulative abnormal return rate () is not equal to zero, that is, COVID-19 has an impact on the returns of China's ACG industry.

The test results are shown in Table 4.

Table 4. T-test result of cumulative abnormal return rate ().

	t-statistic	p-value	star
220.353%	2.203527792	0.0278	**

As shown in Table 4, during the event window, the cumulative abnormal return rate of CSI ACG Index () finally reached 2.20, with a p-value less than 0.05. "***" indicates that the test result is significant at 95% confidence level and we need to refuse .

3.4. Analysis of empirical Results

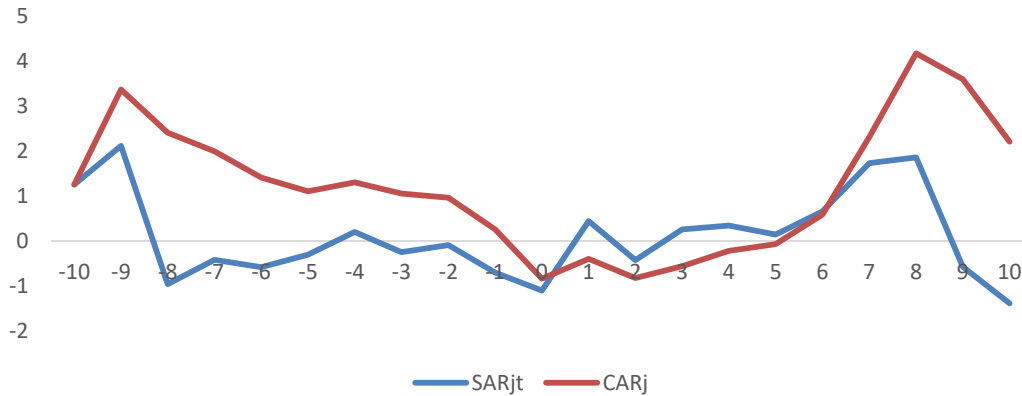


Figure 4. CSI ACG Index standard abnormal return rate and daily cumulative abnormal return rate curve

As shown in FIG. 4, In the 10 trading days before the event occurrence date, the standard abnormal return of the CSI ACG Index was above zero for only 3 times. The standard abnormal return rate on the event occurrence date was close to -1. In the 10 trading days after the event occurrence date, the standard abnormal return rate of CSI ACG Index showed an upward fluctuation trend, showing positive value for 7 times, and the negative value was mainly concentrated in the last two days.

The cumulative abnormal return rate has obvious segmentation. In the ten trading days before the event occurrence date, the cumulative abnormal return rate showed a downward trend, and dropped to close to -1 when the event occurred. In the first two trading days after the event occurrence date, possibly due to the delayed response of the capital markets, the cumulative abnormal return rate fluctuated. In the third to eighth trading days after the event occurrence date, the cumulative abnormal return rate showed a very obvious upward trend, and the final peak exceeded 4. In the last two days, the cumulative abnormal return rate showed a downward trend.

In general, during the event window period, the cumulative abnormal return rate of China's ACG industry was 220.353%, and was significant at the 95% confidence level. Meanwhile, the rate basically showed an upward trend after the event occurred. As a result, it's reasonable to believe that COVID-19 has had a significant positive impact on the returns of China's ACG industry.

4. FURTHER ANALYSES OF REASONS

From the above analysis, it can be seen that although COVID-19 has had a certain impact on the Chinese stock market, China's ACG industry has not only withstood the negative impact of epidemic, but even showed a more positive performance than before, with the stock price rising after the event. Next, the reasons for this phenomenon will be analysed qualitatively from the perspectives of the development of China's ACG industry and the impact of COVID-19.

From the perspective of the development of China's ACG industry, overall, after nearly a decade of rapid growth, China's ACG industry is entering a mature stage of its life cycle and the mobile game is the main driver of growth. On the one hand, thanks to the rise of mobile Internet in China and the popularity of smart phones, the potential consumer groups of mobile games in China have increased greatly. On the other hand, thanks to technological advances of game makers, the number and quality of mobile games in China has greatly improved, with many more interesting and attractive games appearing in the market, giving consumers more choices and stimulating players' consumption.

From the perspective of the impact of COVID-19, on the one hand, the epidemic officially occurred during the Chinese Spring Festival. As a result, almost all of China is on holiday and people have a great demand for entertainment. On the other hand, due to the impact of the epidemic, China has taken lockdown and quarantine measures. Products of the ACG industry, especially

games, have played a dual role of entertainment and "replacing social contact" to a certain extent. Because of isolation, people choose to meet their friends in the game to alleviate loneliness and to expand the user base to some extent. As people are unable to engage in offline entertainment activities, such as watching movies and shopping, they are more likely to consume in virtual products.

5. CONCLUSIONS

5.1 Conclusions

In order to study the impact of COVID-19 on China's ACG industry, this article can be divided into three steps. First of all, analysis of time nodes and descriptive statistical analysis were used to discuss the possible impact of COVID-19 on China's ACG industry. Then, this article used an event study approach to explore the effect of the impact. Finally, the possible causes of the results were also analysed.

Through this research, it's shown that COVID-19 has a significant positive impact on China's ACG industry, leading to a rise in stock prices. In other words, China's ACG industry is showing a positive attitude to the impact of the epidemic. The reasons for this phenomenon can be explained from the development status of China's ACG industry and the impact of lockdown and quarantine measures during the event.

5.2 Recommendations

The occurrence of possible emergencies is always easy to influence the capital market. On the one hand, it may endanger market security, cause market fluctuations and bring losses to investors. On the other hand, it may bring some opportunities for the development of the industry, while bringing profits to investors. Based on the research, this paper puts forward relevant suggestions on the supervision and investment of China's ACG industry stock market.

For supervision, first of all, supervisors should understand the characteristics of the industry, anticipate and estimate the possible fluctuations of relevant stocks, and give timely risk warnings to the relevant information of emergencies to ensure investors' right to know. Second, after the event, supervisors need to actively respond to market fluctuations and strictly protect market security.

For investment, first of all, investors can choose investment strategies reasonably according to their risk appetite and risk tolerance, especially pay attention to the impact of policy changes on the market, and take preventive measures in advance. Second, when investing in the stock market of China's ACG industry

during the epidemic, investors should fully consider the extent of the epidemic and the duration and scope of the quarantine policy. When the epidemic is more serious and the quarantine policy is tightened, the stock market can be considered to go up. When the epidemic is relatively stable and the isolation policy is relaxed, the stock market can be considered to go down.

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