

An Empirical Study of the Impact of the Black Swan Event on the Stock Prices of Listed Companies - A Case Study of the BMW "Ice Cream" Event

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Abstract. Over the past few years, the frequent occurrence of black swan events in enterprises has caused serious harm to the life safety of employees in listed companies, daily production and operation and social environment. At the same time, it will also cause investors' panic and have a huge impact on the stability of the financial market. Although people's awareness of risk prevention continues to increase, the new black swan is still impossible to prevent. The popularity of the Internet has expanded the scope of influence of the black swan incident and intensified people's panic. At present, the impact of the black swan event is mostly focused on the impact on the national macro-economy and financial stock market, while the impact of the enterprise black swan event on the company's share price is less studied. This paper takes the BMW "ice cream" event as an example to conduct an empirical study and draws the conclusion that the black swan event will return to normal in the long run after its short-term impact on the company's share price. Finally, based on empirical evidence, this paper presents the corresponding suggestions for aspects of government regulation, business management and investor education.

Keywords: Black Swan incident, Stock price impact, Media coverage, ARIMA model.

1. Introduction

According to 'Research Report on the Current Situation and Development Prospects of the Global and Chinese Automotive Industry Market' published in 2023, China has become the world's largest automotive consumption market, ranking first in the world. According to the data in the report, China's auto sales reached 26.275 million and 26.864 million units in 2021 and 2022, respectively [1]. Along with the development of the economy and improving the living conditions of people, China's future automotive market will also continue to maintain steady growth and become one of the most influential automotive markets in the world. A large number of international carmakers have flooded into the Chinese automotive market to reap huge benefits, but some negative incidents that have occurred in the course of these companies' development have also had an impact on the companies, for example, an advert published by Toyota in 2003 that allegedly insulted China, which immediately led to a unanimous boycott by the Chinese people; The Volkswagen Group's use of "cheat software" to "comply" with emissions standards in 2015 not only damaged the company's reputation, but also resulted in a hefty fine. These incidents are a lesson learnt from the past, but despite this there was still an incident on 20 April 2023 when the staff of the BMW MINI stand at the Shanghai Salon discriminated between Chinese and foreign visitors when distributing ice cream. BMW's share price was put under pressure by the "ice cream" event", and the stock of BMW of Germany plunged by 3.62% on the 20th [2].

This incident was a sudden and extremely disruptive event for BMW, which Taleb defines as a "black swan" event, an event with a slight chance of occurring, which could not have been predicted beforehand, and which can have a significant impact after it occurs [3]. Olson et al. and Lin et al. found that "black swan" events are closely related to the ups and downs of financial markets [4, 5]. In addition, black swan events also trigger correlated fluctuations in related markets. Panagiotis Liargovas and Spyridon Repousis use the event study method to analyse the reaction of Greek bank stocks to 9/11, the Madrid train bombings, the London train bombings and 9/11, and the study shows that each of these events had a significant impact on the stock price [6]. Domestic scholars have also

begun to pay attention to the impact of "black swan" events on the product market, but domestic scholars more often use uncertainty, risk, or unexpected events to define this type of event. Zhou Siqing and Zhao Yuehua analysed the impact of the tainted capsule incident from the perspectives of the A-share pharmaceutical industry and pharmaceutical stocks, pointing out that the tainted capsule incident had a negative impact on the whole industry and brought different degrees of impact on different pharmaceutical stocks [7].

Meanwhile, in the case of emergencies, media reports play an irreplaceable role. Merton believes that in the financial market, the acquisition of information is very important for investors. Investors can form their own price expectations based on the information they receive and invest in turn [8]. As a disseminator and digger of market information, the media is the way most individual investors obtain information, and the form and content of media reports also affect investor behaviour and have an impact on asset prices and market direction. Hong and Stein found that the emotions conveyed by media reports not only cause short-term reactions but may also affect the long-term direction of the market [9]. Nikolaos and Raphael, by constructing a measure of browser searches, find that when a stock's search volume increases, that is, when the demand for information about that stock rises, the intensity of stock price volatility becomes greater [10]. Wang Chun and Wang Jinhong argued that investors will consciously pay selective attention to the decision in the face of a multitude of information, due to the fact that China's stock market is dominated by one retail investor, the retail investor's source of information is a single channel, and the transaction is driven mainly by paying attention to the latest news [11]. The objective of this paper is to examine whether breaking news and its coverage have an impact on a company's share price, using the BMW "ice cream" incident as an example.

The following contents of this paper is organized as follows: the second component focuses on research design, including model design, variable definition, and data selection. After that, the third part will analyse ARIMA model using the relevant data obtained. Through the results of empirical analysis to demonstrate the impact of BMW "ice cream" event on the company's share price. Then the fourth part discusses the results of the demonstration, and references and relevant suggestions from different perspectives for dealing with such emergencies is provided. Finally, the conclusion is drawn.

2. Research Design

2.1. Data source

This paper chooses the daily closing price and daily trade volume of BMW since 2010 to be the data basis of empirical analysis. Firstly, the paper use both data from 2010.1.1 to 2023.4.19 to predict the fitted value after 2023.4.20 and then compare the difference between actual value and fitted value to study the impact of BMW "ice cream" incident. All the data is downloaded from n.investing.com and has been transformed by formula $\ln(1+x)$. Some missing data is omitted in order to make sure the study is robust. With the updated edited data, Stata16 was used to analyse the data and construct models for further exploration.

2.2. Weak Stationarity Test

The first step before proceeding is to test whether or not the data are stationary. The p-values in Table 1 for the raw BMW closing price is 0.05 based on the ADF test conducted in Stata, while the p-value of BMW trade volume, 1st order difference closing price and 1st trade volume equal 0, which is regarded as statistically significant. Because of these results, sufficient evidence exists to reject the fact that the variable has a unitary root. To put it simply, the model constructed on the data is feasible and the data is stationary.

Table 1. Weak stationarity test

	t	p
Closing price		
Raw	-3.405	0.0508
1st order difference	-39.039	0.0000
Volume		
Raw	-22.540	0.0000
1st order difference	-61.742	0.0000

2.3. ARIMA Model

The ARIMA (p, d, q) model could be seen as an extension of ARMA model and is used to predict the closing price and trade volume of BMW after the incident based on the data before the incident. The equation listed above is developed from ARIMA model. The AR(q) model is represented by the component $\phi_0 + \sum_{i=1}^p \phi_i X_{t-i}$, it is originally used to do prediction using historical data but there is an assumption that the stochastic disturbance term is white noise sequence. The other important part is MA(q) $\varepsilon_t + \sum_{i=1}^q \theta_i \varepsilon_{t-i}$ is added in the equation to break the assumption in order to make the equation more accurate. As a difference between ARIMA model and ARMA model, X is transferred to finite difference operator $(1 - L)^d X_t$ and the exponent number is d. A more robust prediction can be made by using the ARIMA model based on index (p, d, q).

$$(1 - \sum_{i=1}^p \phi_i L^i)(1 - L)^d X_t = (1 - \sum_{i=1}^q \theta_i L^i) \varepsilon_t \quad (1)$$

3. Empirical Results and Analysis

3.1. Order selection

Ordering the first log-return series using the PACF and ACF pairs is necessary, and the results are shown in Figure 1.

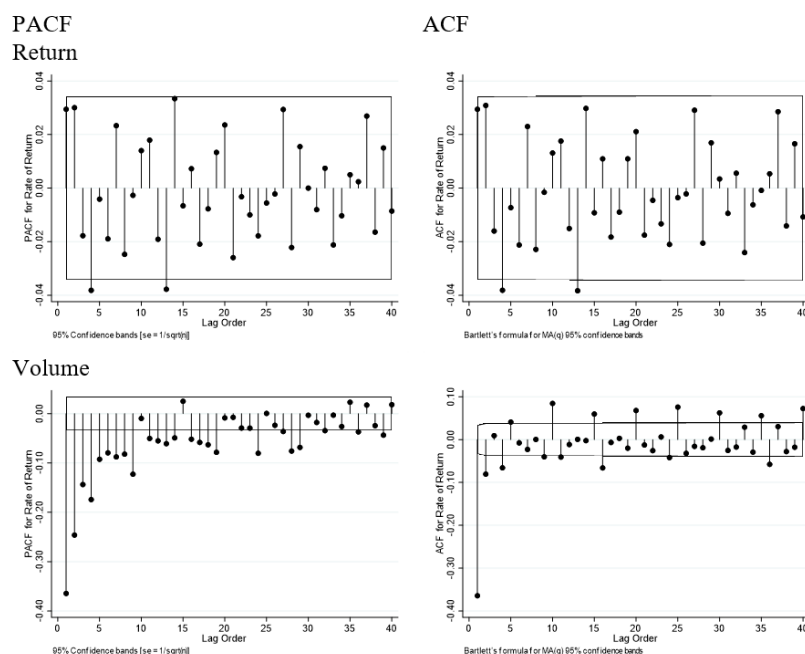


Figure 1. ARMA (p, q) identification (Photo credit: Original)

First, this paper is responsible for ordering the log returns of the closing price and show the results in the Figure 1. The fixed order result of the two images indicates that the first part beyond the x-axis is 4, resulting in AR(p) being of order 4, and MA(q) being of order 4. In other words, the value of p and q is 4.

Then, ordering the log-returns of the trading volume and presenting the results in the Figure 1 is necessary for this paper. Based on the fixed order result of the two images, the first part beyond the x-axis is 9, resulting in AR(p) being of order 4, and MA(q) being of order 2, so 9 and 2 are the values for p and q.

3.2. Prediction Results and Explanations

In this paper, the residual test is performed before describing the regression results. The original hypothesis is that the residual sequence is not correlated, that is, white noise. However, according to the test results, the p value of the closing price is 0.8420, which is not significant, and only the p value of the trading volume is 0.0000. However, the focus of this article is on delineating future trends rather than making precise predictions, so you can still use the ARIMA model to make predictions.

Table 2. Residual test

Model	Portmanteau (Q) statistic	Prob > chi2
Closing price ARIMA (4, 1, 4)	31.1114	0.8420
Volume ARIMA (9, 1, 2)	102.4963	0.0000

The results of ARIMA model regression are shown in Table 2. For the closing price, the stock price should remain stable based on the predicted stock price, but in fact, the actual stock price fell significantly on the activity day of April 20th. Despite a short-term recovery afterwards, the stock price was much lower than the estimated stock price. This indicates that the "ice cream" incident has had a negative impact on BMW's stock price for a period of time (please see Figure 2), causing its stock price to deviate significantly from the normal trend. But from the long-term trend, the stock price is slowly rebounding, with a trend of returning to the predicted stock price.

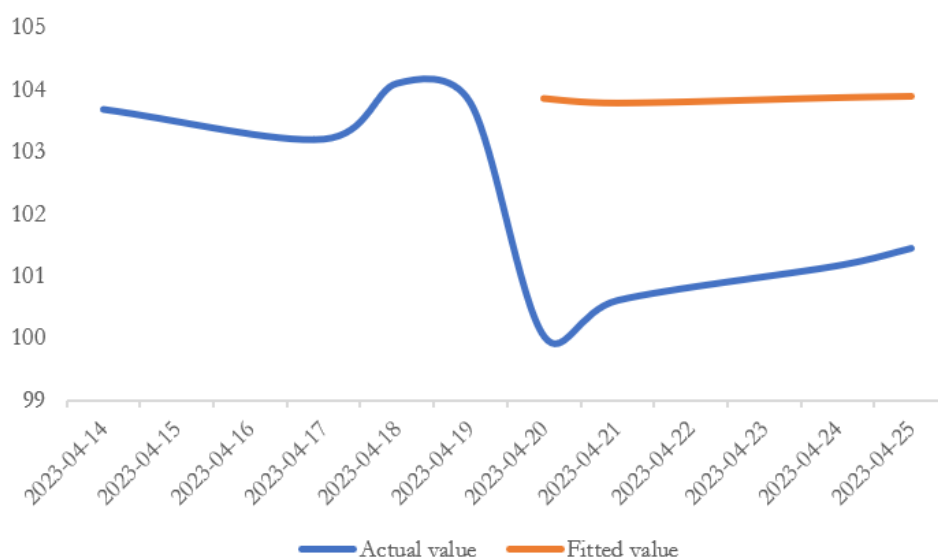


Figure 2. Actual value and fitted value, Closing price(Photo credit: Original)



Figure 3. Actual value and fitted value, Volume (Photo credit: Original)

As far as the volume is concerned, the expected volume is stable (please see Figure 3), but the volume on the day of the event rose sharply, which may be explained by the market's main shipment, which hit the stock price hard, and then the volume ushered in a sharp decline, indicating that market investors are not optimistic about the future stock price, and the volume after the event is volatile. It further illustrates the seriousness of the negative impact of the "ice cream incident" on BMW.

4. Discussion

Existing research on the impact of emergencies is mostly analysed from the perspective of financial market or product market volatility, through the identification of breakpoints, impulse response analysis based on the VAR model to study the impact of emergencies on the market, to provide a reference for macro-policymaking, while not many studies have been conducted on the impact of emergencies on micro-enterprises.

The policy implications of the study are as follows: first, media coverage will significantly affect the stock price, thus exerting pressure on the management of the company, which shows that although the media cannot directly affect the management of the company, it can still play the role of corporate governance through media supervision. With the continuous growth of the economy, the role of the media in China's corporate governance is increasing. It is important for the government to fully utilize the media's role in overseeing enterprises. Second, in China, the number of stocks owned by institutional investors has an absolute advantage, and the buying and selling of stocks by institutional investors is easy to cause small and medium-sized investors to blindly follow suit. Therefore, regulators should strictly regulate the behaviour of institutional investors and stabilise share price volatility by guiding their rational decision-making, thereby stabilising investor sentiment in the stock market as a whole and reducing the impact of the incident on the share price of enterprises. For institutional investors who maliciously mislead individual investors and illegally seek their own interests, the market should impose serious penalties to purify the capital market environment. As far as enterprises are concerned, it is necessary to establish a control mechanism for online public opinion, master the dominant power of public opinion just before the event or even before it is exposed, and actively resolve the untrue or even harmful remarks against the company. After the event, guide investor sentiment through positive response. First of all, investors can know the truth of the matter by issuing clarification announcements to ease the unease; Secondly, actively follow up the progress of the survey, timely release the survey results, obtain the trust of investors and stabilize investor sentiment; Finally, release the company's relevant good news to enhance consumer confidence, stimulate investor sentiment, and make the company emerge from the shadow of emergencies as soon as possible. Individual investors should recognise the role of their own emotions on stock prices and

learn to control their emotions. Become a professional investor by improving your professional knowledge, raising your awareness of professional investment, and establishing the concept of value investment. After an emergency, use professional knowledge to consider the intrinsic value of the company's stock and whether the company has the ability to survive the crisis, and avoid blindly following the trend caused by panic.

5. Conclusion

In China, where the Internet is developing rapidly, it is very easy for mass investors to obtain investment information from the news media. As China's capital market is still in the development stage, investors are more susceptible to the influence of news media reports than in mature markets. Against this background, this paper focuses on the impact of corporate emergencies on the stock prices of listed companies. Taking the BMW "ice cream" incident as an example, the article mainly uses the ARIMA model to analyse and integrate the relevant data, and concludes that the share price of BMW will be affected by emergencies in the short term, while in the long term, the impact is not significant. It is recommended that the government and enterprises pay attention to the various emergencies they face, establish an effective risk warning mechanism, and formulate timely response strategies. In addition, due to individual investors, the lack of systematic and comprehensive experience as well as professional knowledge, it is difficult for individual investors to obtain accurate stock information in the mass of information. It is important to provide good guidance to prevent investors from blindly making decisions that amplify the market's response to emergencies. There are still some shortcomings in this article. Firstly, this article only studies the impact of events in listed companies on stock prices and does not conduct research on the subsequent progress of announcements. Due to reasons such as untimely investigation information, listed companies often issue supplementary announcements after events occur. These announcements are more detailed, and future research can be conducted on these subsequent announcements, Explore the further impact of these announcements on the stock prices of listed companies. In addition, analyst recommendations, different media reports, and investor sentiment were not included as influencing factors in the model design. In future research, quantitative research on the impact of relevant indicators can be attempted.

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