

Economic Impacts of Environmental Violations: Evidence from the BYD's Changsha Factory Pollution Incident

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Abstract. In the post-COVID-19 era, environmental issues have garnered heightened societal attention. This study takes BYD's Changsha factory pollution incident that occurred in May 2022 as an example and analyzes the economic impact of environmental violations on BYD and its impact on long-term strategy based on the Efficient Market Hypothesis and Resource-Based View. It finds that the pollution incident at BYD's Changsha factory triggered negative market sentiment in the short term, causing stock price fluctuations and damage to investor confidence. In the long term, the incident prompted BYD to increase its environmental protection investment, enhancing its ESG performance and sustainable development capabilities. Environmental pollution incidents not only affect a company's reputation and market performance but also remind manufacturing enterprises to take preventive measures in advance, actively respond to crises, and strengthen communication and responsibility with the public. The findings highlight the necessity for firms to integrate environmental stewardship into their strategic and operational decisions. This thesis provides insights for environmental compliance management of similar manufacturing enterprises.

Keywords: Environmental violations, economic consequences, BYD, ESG performance

1. Introduction

Following the COVID-19 pandemic, environmental governance has attracted increasing attention and has undergone continuous reform. In the 20th Communist Party of China National Congress, "Accelerating the transition to a model of green development", "Modernize the environmental governance system" were proposed. "Lucid waters and lush mountains are invaluable assets," was emphasized by President Xi Jinping. In this context, while improving economic benefits, enterprises need to take the initiative to fulfill their environmental protection responsibilities and prevent environmental pollution. The public's awareness of environmental protection has increased, and if a pollution incident occurs in an enterprise, it is very likely to trigger a storm of public opinion and bring about cascading consequences. In 2022, BYD's factory in Yuhua District, Changsha, was exposed by the media for exceeding the emission standards of exhaust gas, which triggered collective rights protection by surrounding residents. Public opinion quickly heated up, and BYD also quickly responded.

This study uses the Efficient Market Hypothesis and Resource-Based View to analyze the economic consequences and long-term strategic impacts of BYD's environmental violations. Securities market efficiency varies depending on the types of information reflected in prices, categorizing it into three forms: Weak-form Efficient Market, in which technical analysis cannot yield excess returns. Semi-strong-form Efficient Market, in which neither technical nor fundamental analysis can generate abnormal profits. Strong-form Efficient Market, in which no investor can consistently achieve excess returns [1]. China's stock market exhibits characteristics consistent with weak-form efficiency, implying that prices largely incorporate historical information and thus preclude abnormal profits from technical trading strategies [2]. When applying EMH in China, it is necessary to combine local realities. They believe that the Chinese security market is evolving towards efficiency, but there are still obvious gaps, and continuous improvement is needed in terms of institutional frameworks, regulation, investor education, and other aspects [3]. Against the backdrop of China's weak-form efficient market, the BYD Changsha pollution incident constitutes a representative environmental violation. Its impact on stock prices and corporate long-term strategies can be verified through event study and multi-dimensional analysis. Unique resources and capabilities are the core competitiveness of an enterprise, including intangible assets such as reputation, culture, and environmental management capabilities. The company will suffer from environmental infractions since they will damage the company's brand and make it less competitive in the long run [4]. Based on the theories above, this study hypothesizes that BYD's Changsha Factory pollution incident will trigger a series of adverse economic consequences for the company.

This study contributes to the literature in two key aspects. Firstly, enriching research on the economic consequences of environmental violations. While existing studies by Chinese and international scholars have examined the economic impacts of environmental violations, most focus on pre-COVID cases. By analyzing the BYD's Changsha Factory Pollution Incident (May 2022), this study investigates the multi-dimensional economic consequences and long-term strategic influence on corporate environmental violations in the post-COVID era, thereby enriching the current research. Secondly, providing case support for theoretical research. There is no existing research that analyzes the BYD's Changsha Factory Pollution Incident. This study analyzes the economic consequences of BYD's Changsha Factory pollution incident by the event analysis method, filling the gap in the existing academic case analysis.

2. Case summary

BYD Auto Co., Ltd. (Changsha) was established in August 2009 and is located in Yuhua District, Changsha, Hunan Province. Its main business includes automobile complete vehicles and automobile body manufacturing. According to BYD Co., Ltd.'s 2024 annual report, the group's total revenues for that year were approximately RMB 777.102 billion, of which the revenue from the automobile and related products business was approximately RMB 617.382 billion, accounting for 79.4% of the operating income for that year. BYD's Changsha factory was first put into production in 2012. The factory mainly produces new energy passenger vehicles and commercial vehicles and is one of BYD's key strategic manufacturing hubs.

According to Tencent News, the BYD Changsha plant became embroiled in an environmental controversy. Some residents and children around the factory said that they often smelled pungent odors, and had frequent nosebleeds, long-term coughs, dizziness, and nausea. On the evening of May 6, residents gathered around the factory for a collective protest to protect their rights, strongly demanding that BYD solve the pollution problem. Residents expressed strong dissatisfaction in the form of slogans and demanded that the company immediately rectify. The incident had a great

influence and attracted attention and discussion from multiple media outlets and the public. On May 7th evening, the official Weibo account of BYD stated that the factory in Yuhua District, Changsha, started its operation in 2012. The emissions of the factory comply with national environmental laws, regulations, and standards. The occurrence of unpleasant odors is a normal phenomenon in some residential areas around the factory. Relevant measures have been taken by the company, and the company is continuing to make improvements. Regarding the situation where nosebleeds occurred due to excessive emissions, BYD claimed that it was a malicious fabrication. The company reported the matter to the police and announced its intention to hold the responsible parties legally accountable. Afterwards, BYD Changsha Yuhua District Factory carried out subsequent rectification and announced that some production lines would be suspended for rectification.

3. Economic consequences and long-term impacts of the BYD's Changsha factory pollution incident

3.1. Short-term market reactions

The event study method quantifies the stock market's reaction to specific events and serves as a key empirical tool. This method sets a window period before and after the event, uses the clean period to estimate normal returns, calculates abnormal returns, and cumulative abnormal returns to determine whether an event has a significant impact on stock prices. Stock prices usually begin to adjust before the announcement and quickly complete the reaction on the day of the event. After that, there is no significant abnormal fluctuation, indicating that the market can quickly and effectively absorb public information, supporting the semi-strong efficient market hypothesis [5].

The revelation of BYD's Changsha factory pollution incident is expected to trigger stock-price volatility. After the media exposed the BYD pollution incident, it quickly attracted public attention and remained a hot topic for a long time, with a wide social influence. In the current era of the developed Internet, information is transmitted quickly and has a strong guiding nature. Investors' emotions and judgments on the incident will affect investment decisions, which are directly reflected in stock price fluctuations [6]. Meanwhile, reputation damage to the company stemming from the environmental incident will influence investors' decisions and induce stock price fluctuations.

This study employs cumulative abnormal return analysis to quantify the short-term market reaction as follows [7]: Firstly, event date identification $T(0)$. The event date $T(0)$ is set as May 6, 2022, corresponding to the news reports of resident protests against BYD's Changsha factory. Secondly, determining the event window. The event window is set to one day before and after the event date, that is, $T(-1, 1)$. Thirdly, calculate the normal return to determine the clean-up period (estimate period). After confirming the event date and window period, it is necessary to estimate the normal return. Take the 90th trading day before the event date to the 30th trading day before the event date, that is, $T(-90, -30)$, as the period for calculating the normal return. Fourthly, Normal Return Modeling. Using the model below to calculate the normal return.

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

Where $R_{i,t}$ means Normal Return, $R_{m,t}$ means Market Return, $\epsilon_{i,t}$ means Regression Residual. Figure 1 plots the fitted market-model regression used to estimate BYD's normal returns over the estimation window $(-90, -30)$. $y = 1.6254x + 0.005$ [3].

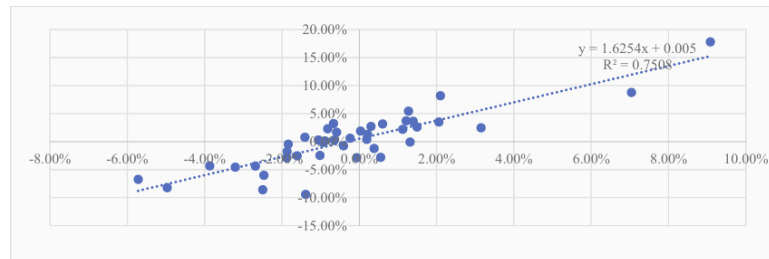


Figure 1. Fitted curve of the effect of $R_{m,t}$ on $R_{i,t}$.

Cumulative Abnormal Return Calculation. The daily Abnormal Returns are computed using:

$$AR_t = R_{it} - E(R) \quad (2)$$

AR_t (abnormal return) measures daily excess return as the difference between the actual daily return and the normal return, where $E(R)$ represents the expected return.

The Cumulative Abnormal Returns is then obtained by:

$$CAR = \sum AR_t \quad (3)$$

It is shown by Table 1 and Figure 2 that both abnormal returns and Cumulative Abnormal Returns exhibit pronounced fluctuations during the event window. On May 5, AR rose briefly and reached a high point, indicating that the market was optimistic about BYD at the beginning of the event. However, starting from May 6, AR quickly turned negative and continued to decline, falling to -1.03% on May 10, indicating that the market sentiment towards BYD had deteriorated significantly and investors had pessimistic expectations.

Table 1. AR and CAR calculation process

T	$R_{m,t}$	$E(R)$	R_{it}	AR_t	CAR
-1	-0.36%	-0.09%	0.76%	0.85%	0.85%
0	-3.81%	-5.69%	-4.11%	1.58%	2.43%
1	-1.84%	-2.49%	-5.95%	-3.46%	-1.03%

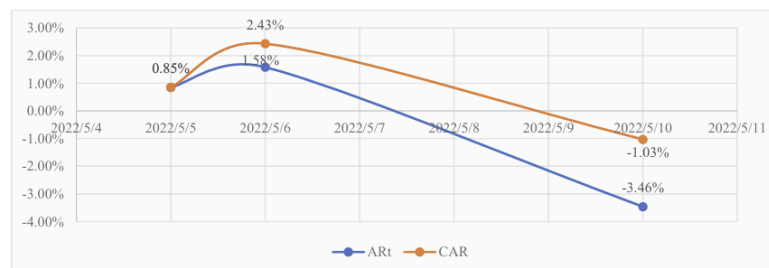


Figure 2. AR and CAR chart

Similar to the excess return, the cumulative excess return also rose briefly on May 5, reaching a cumulative return of 1.58%, but then continued to decline as AR declined, turning from positive to negative on May 10. Although the market had a short-term positive reaction at the beginning of the incident, from the overall trend, the market concerns caused by BYD's Changsha factory pollution

incident gradually increased, resulting in weakened investor confidence, a decline in stock price performance, and ultimately a negative cumulative return.

Collectively, the AR and CAR patterns demonstrate that the BYD Changsha pollution incident exerted a significant short-term negative impact on the firm, corroborating the adverse stock-price consequences revealed by the event study. In addition to the short-term stock price impact, the long-term impact of environmental violations on enterprises is more reflected in strategic adjustments and sustainable development capabilities, specifically in the optimization of ESG performance and the reshaping of long-term performance.

3.2. Long-term impact analysis

Enterprises' ESG performance is influenced by multiple factors, including institutional pressures, CEO attributes, and local government debt. Investors are more concerned with listed businesses that report ESG-related information in compliance with legal standards. Stock returns can be tremendously and favorably impacted by ESG performance and its constituents, environment "E" and social responsibility "S" [8]. Normative isomorphic pressure inhibits ESG performance, while coercive and mimetic pressures play a positive role. Dominant CEOs contribute a lot to the impact of isomorphic institutional pressure on the ESG performance of listed companies. Enterprises fulfilling their responsibilities in the areas of environment, society, and governance not only contribute to the establishment of the organization's legitimacy, but also enhance financial performance and market valuation [9]. Local government debt significantly inhibits the ESG performance of enterprises. This effect is more obvious in non-state-owned enterprises, enterprises with low profits, large scale, short establishment years, and enterprises in regions with high marketization levels, low financial levels, and high fiscal transparency [10]. Robust ESG performance can also have a series of effects. Enterprises fulfilling their ESG responsibilities not only help them gain organizational legitimacy but also improve their financial and market performance. Robust ESG performance can also enhance corporate value, sustainable investment decisions, and improve financial performance [11-13].

The BYD's Changsha factory Pollution incident occurred in May 2022. After the incident, BYD took some measures in ESG management. On environmental governance, according to BYD's Sustainability Report (as presented in Table 2), its CO₂ emission reductions increased from 13,370 tons to 21,445 tons in 2022 and will continue to increase emissions reduction in 2023. In exhaust gas management, BYD implemented significant upgrades to its organic waste gas treatment facilities in 2022. VOCs emissions will be further reduced, and the waste gas treatment process will be upgraded to reduce VOCs emissions further. The motor factory has improved the process by transforming the original dipping process into a dripping process, effectively reducing energy use, reducing the amount of insulating paint used in a single product by 20-50%, and significantly reducing VOCs emissions. This vehicle coating factory has invested nearly 600 million yuan in technological transformation and equipment upgrading. To reduce the emissions of solid waste and exhaust pollutants, the 3C2B coating process has been transformed into the B1B2 coating process.

At the same time, BYD added the integration of artificial intelligence technology into energy-saving technology reform in its ESG performance in 2022. Through real-time monitoring, calculation, and processing, it adjusted the equipment operating parameters to avoid ineffective power consumption of the equipment. For example, in the EMS intelligent management system project of the ice water station, based on the requirements of environmental parameter indicators and the actual operation of the central air conditioning system, an energy management platform and an energy-saving control system were designed. According to the characteristics of building load

changes, the system was dynamically adjusted to reduce system operation energy consumption and improve energy utilization efficiency. This demonstrates that BYD's Changsha factory pollution incident has prompted BYD to enhance its focus on energy conservation and emissions reduction while improving its ESG performance [14].

Table 2. BYD's energy management initiatives

Year	Number of Technological Upgrade Projects	Energy-Saving Benefits (in tons of standard coal equivalent)	Emission Reduction Benefits (in metric tons of CO ₂)
2021	43	3,332	13,370
2022	48	8,248	21,445
2023	93	17,160	132,491

4. Conclusion

Using an event-study design anchored in the efficient-market hypothesis and the resource-based view, this study investigates the impact and underlying mechanisms of BYD's Changsha factory pollution incident and reaches the following conclusions. The incident caused a short-term impact on BYD's stock price: the disclosure of information about the pollution incident triggered negative market sentiment, causing stock price fluctuations and negative cumulative excess returns, reflecting the damage to investor confidence. In terms of long-term impact, the incident promoted BYD's ESG performance. After the incident, BYD increased its investment in energy conservation, emission reduction, and technological transformation, showing BYD's active response to environmental governance. These changes not only alleviated public pressure but also facilitated corporate image restoration and enhanced sustainable development capacity.

The BYD's Changsha factory pollution incident shows that environmental pollution not only impacts companies but also harms public health. In the short term, it will cause market concerns and stock price declines, but in the long term, it will force companies to increase environmental protection investment, strengthen ESG performance, and make strategic adjustments. Therefore, relevant manufacturing companies should take this as a warning, strengthen ESG performance, and prevent pollution risks in advance; strengthen environmental monitoring in daily operations, maintain good communication with surrounding communities, and avoid intensified conflicts. At the same time, they should actively respond to crises. Promptly accepting responsibility and announcing corrective actions is more effective in restoring reputation and investor confidence than evasive responses.

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