

Investor Herding and Stock Price Volatility in the Electric Vehicle Industry: An Empirical Study on Tesla and BYD

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Abstract. It is common for investors' irrational decisions, driven by their "herd behavior," to influence the stock prices of companies in the electric vehicle (EV) industry. However, investors are usually regarded as rational decision makers, and few scholars have considered this kind of irrational behavior. Thus, the effect of "herd behavior" remains unknown. This study, using two representative companies, Tesla and BYD, as case studies, aims to determine the impact of the "herd behavior" of investors on EV companies' stock prices. The Cross-Sectional Absolute Deviation (CSAD) model and descriptive analysis are applied in order to sort out events that lead to the "herd behavior" of investors and figure out the trend of changes in stock prices following these significant events. The research findings indicate that although the emergence of herd behavior among investors does not directly cause greater volatility in stock prices over a longer period, it does lead to significant fluctuations in stock prices two days after major events of the EV company. This research fills the gap in the existing research concerning the impact of investor "herd behavior" on the stock prices of electric vehicle companies by using a more systematic method.

Keywords: Herd behavior, Tesla, BYD, Stock prices, Cross-Sectional Absolute Deviation (CSAD) model

1. Introduction

In 2023, the EV industry saw a 27% growth with \$769.3 billion in revenue [1]. Tesla and BYD are representative companies with Tesla earning \$78.509 billion and a 10.21% market share, and BYD earning \$82.41 billion and a 10.97% market share [2, 3]. It is universally acknowledged that when researchers estimate a company's share price, investors are generally considered rational decision-makers. However, investors inevitably make several irrational choices, as they find it hard to be immune to the "herd effect" when big events happen in the market, especially in some emerging industries like the electric vehicle (EV) industry. This effect might change investors' decisions and exert a profound but unknown influence on the stock prices of companies in such an industry. Despite this, limited research focuses on the impact of "herd behavior" on the stock prices of electric vehicle companies. In this case, this study aims to fill this gap by examining the effect of investor "herd behavior" on the stock prices of Tesla and BYD, two leading companies in the industry. The study hypothesizes that the "herd behavior" of investors leads to dramatic and irrational fluctuations of stock prices of companies in the electric vehicle industry.

2. Literature review

To understand the relationship between investor behavior and stock price volatility, it is important to clarify key concepts, particularly motivation and “herd behavior.” Motivation refers to what drives, or moves, an individual to take a certain action [4]. Different individuals can have different motivations for the same action, driven by differing goals and attitudes [5]. “Herd behavior,” on the other hand, describes a situation in which agents’ actions are motivated by not only their private information but also by the actions of others. Banerjee defines it as a phenomenon where “everyone is doing what everyone else is doing, even when their private information suggests doing something quite different” [6]. Bikhchandani et al. further elaborate that the “herd effect” occurs because individuals often encounter similar problems, similar knowledge, similar alternatives, and even similar payoffs, prompting them to follow others’ decisions [7].

With technological advancement creating more investment avenues, investor herding has become an influential factor in the stock market. Researchers have explored the existence of herding behavior and developed methods to measure this form of irrationality. Christie and Huang investigated herding during market stress using the Cross-Sectional Standard Deviation of Returns (CSSD), finding that low return dispersion between the stock and the market indicates investor “herd behavior” [8]. After that, a new measure of return dispersion called Cross-Sectional Absolute Deviation of Returns (CSAD) and a non-linear regression specification are proposed by Chang et al. to detect the “herd behavior” in the stock market, revealing that there is a partial presence of herding in Japan and a significant presence in emerging markets such as Korea and Taiwan, where investors pay more attention to macroeconomic information [9]. Further studies have expanded the scope to international markets. Evidence shows herding exists in advanced economies outside the U.S., and return dispersion in the U.S. can influence non-U.S. markets [10]. In Taiwan, both institutional and individual investors exhibit “herd behavior,” while in mainland China, Yao et al. Found significant herding in the B-share market, but not in the A-share market [11, 12]. Javaira and Hassanali mention that though the Pakistani stock market generally lacks herding, it emerges during crises due to information asymmetry and market uncertainty [13]. Although extensive research exists on herding in general equity markets, limited attention has been given to its effects on EV companies like Tesla and BYD. Studies have noted the divergence between Tesla’s stock price and its fundamentals [14]. And Yang observed that both Tesla and BYD experienced relatively stable stock performance until 2020, after which BYD showed more pronounced volatility and cyclical trends [15].

Given the limited focus on herding behavior in the EV industry, this study aims to explore the impact of investor herding on the stock prices of Tesla and BYD using systematic and comparative methods, thereby contributing new insights to behavioral finance research within sector-specific contexts.

3. Methodology

3.1. Research design

This study adopts a combination of qualitative research and quantitative research methods in the case study of Tesla and BYD. It begins with a literature review to identify gaps in existing studies, guiding the direction of the investigation. After that, using the CSAD model, this study sorts out two significant events of each company (e.g., the release of new products, the government intervention) that spark the “herd effect” by comparing the CSAD values ten workdays before and after these events. Calculating the variance and standard deviation of daily individual stock return rate, the

study assesses changes in stock price volatility after these events. Ultimately, this research draws a conclusion on the effect of investor “herd behavior.”

3.2. Data source and analysis techniques

Significant events of each company are identified through global news and public articles. Historical stock price data and market return indexes are obtained from Yahoo Finance. This study collects stock prices ten workdays before and after each essential event to analyze potential investor “herd behavior.”

The daily individual return for each company is computed by the formula:

$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1} + D_{i,t}}{P_{i,t-1}} \quad (1)$$

where $P_{i,t}$ represents the closing price of the stock at time t , $P_{i,t-1}$ is the closing price at time $t-1$ (the closing price on the previous trading day in this study), and $D_{i,t}$ is the dividend at time t . By adding daily individual return rates of the selected period together and dividing that sum by the number of days N ($N=10$ in this study), the average individual rate of return of a company can be found:

$$R_{i,average} = \frac{1}{N} \sum_{t=1}^N R_{i,t} \quad (2)$$

Similarly, the daily market rate of return is given by:

$$R_{m,t} = \frac{P_{m,t} - P_{m,t-1}}{P_{m,t-1}} \quad (3)$$

where $P_{m,t}$ represents the closing price of the S&P 500 Index or the SSE composite index at time t , while $P_{m,t-1}$ denotes the closing price of the S&P 500 Index or SSE composite index at time $t-1$ (the closing price on the previous workday in this study). To evaluate the degree of investor “herd behavior,” this study applies the CSAD model. The CSAD at time t is calculated using:

$$CSAD_t = \frac{1}{N} \sum_{t=1}^N |R_{i,t} - R_{m,t}| \quad (4)$$

where $R_{i,t}$ is daily stock return data for Tesla or BYD, and $R_{m,t}$ is the market return indexes in markets in the United States and China. For the U.S. market, this research uses the S&P 500 index return. For the Chinese market, this study uses a relevant index called the SSE Composite Index.

This research focuses on daily stock return data in the period of ten days before and after each significant event, so N equals to ten. A lower CSAD value indicates higher “herd behavior,” as it suggests that the company’s returns are closely aligned with the market index returns, highlighting that investors are following the market trend. A higher CSAD value suggests less “herd behavior,” indicating more independent decision-making among investors. In this case, if CSAD decreases after the event, it shows that the event triggers “herd behavior” among investors. By calculating the difference between each day's return and the average return of this ten-day period, squaring these differences, adding them up, and then dividing by the number of workdays minus 1 (degrees of freedom), the variance of the daily individual stock return rate can be found. The formula for variance is:

$$\text{Variance} = \frac{\sum_{t=1}^N (R_{i,t} - R_{i,\text{average}})^2}{N-1} \quad (5)$$

where N is the number of days ($N=10$ in this study). The square root of the variance is the standard deviation, which is the volatility of the stock. The formula for standard deviation is:

$$\text{Standard Deviation} = \sqrt{\text{Variance}} \quad (6)$$

Finally, descriptive analysis is used to analyze the trend of stock price volatility of two companies after big events that trigger investor “herd behavior.”

4. Empirical analysis

4.1. Essential events that trigger investor “herd behavior”

Event 1: The Tesla Model Y, a mid-sized SUV electric vehicle developed by Tesla, was released in Los Angeles on March 15, 2019. By collecting daily stock prices of Tesla and the daily value of the S&P 500 Index in the ten-day period before this release and comparing the stock return and the market return rate (Table 1) in the same selected period, the study figures out that the CSAD value before the release of Model Y is 2.42%.

Table 1: Daily stock return of Tesla and market return before the release of Tesla Model Y

Date	2.28	3.1	3.4	3.5	3.6	3.7	3.8	3.11	3.12	3.13	3.14
SP	21.33	19.65	19.02	18.44	18.42	18.44	18.94	19.39	18.89	19.26	19.33
SR (%)	/	-7.88	-3.21	-3.05	-0.11	0.11	2.71	2.38	-2.58	1.96	0.36
S & P	2784.49	2803.69	2792.81	2789.65	2771.45	2748.93	2743.07	2783.30	2791.52	2810.92	2808.48
MR (%)	/	0.69	-0.39	-0.11	-0.65	-0.81	-0.21	1.47	0.30	0.70	-0.09

Note: SP (Stock Price); (SR) Stock Return; S&P (S&P 500 Index); MR (Market Return)

Based on data in Table 2, the absolute deviation (CSAD value) after the launch of Model Y is 2.16%, which is lower than the value (2.42%) before the event. Thus, it is evident that investor “herd behavior” is present after the release of Model Y.

Table 2: Daily stock return of Tesla and market return after the release of Tesla Model Y

Date	3.15	3.18	3.19	3.20	3.21	3.22	3.25	3.26	3.27	3.28
SP	18.36	17.97	17.83	18.24	18.27	17.64	17.36	17.85	18.32	18.57
SR (%)	-5.02	-2.12	-0.78	2.30	0.16	-3.45	-1.59	2.82	2.63	1.37
S & P	2822.48	2832.94	2832.57	2824.23	2854.88	2800.71	2798.36	2818.46	2805.37	2815.44
MR (%)	0.50	0.37	-0.01	-0.29	1.09	-1.90	-0.08	0.72	-0.46	0.36

Table 3: Daily stock return of Tesla and market return before the "We, Robot" Press Conference

Date	9.25	9.26	9.27	9.30	10.1	10.2	10.3	10.4	10.7	10.8	10.9
SP	257.02	254.22	260.46	261.63	258.02	249.02	240.66	250.08	240.83	244.50	241.05
SR (%)	/	-1.09	2.46	0.45	-1.38	-3.49	-3.36	3.91	-3.70	1.52	-1.41
S & P	5722.26	5745.37	5738.17	5762.48	5708.75	5709.54	5699.94	5751.07	5695.94	5751.13	5792.04
MR (%)	/	0.40	-0.13	0.42	-0.93	0.01	-0.17	0.90	-0.96	0.97	0.71

Event 2: On October 10, 2024, in the Hollywood studio of Warner Bros., Tesla held the "We, Robot" press conference. By finding the daily stock prices of Tesla and the S&P 500 Index in the ten-day period before this press conference and comparing the stock return and the market return (Table 3), the study figures out that the CSAD value before the press conference is 1.97%.

According to Table 4, the absolute deviation (CSAD value) of the stock return rate and the market return rate in the ten-day period after the "We, Robot" press conference is 1.43%, which is lower than the value before the event (1.97%). Therefore, this press conference indeed triggers investor "herd effect" among investors.

Table 4: Daily stock return of Tesla and market return after the "We, Robot" Press Conference

Date	10.10	10.11	10.14	10.15	10.16	10.17	10.18	10.21	10.22	10.23
SP	238.77	217.8	219.16	219.57	221.33	220.89	220.7	218.85	217.97	213.65
SR (%)	-0.946	-8.783	0.624	0.187	0.802	-0.199	-0.086	-0.838	-0.402	-1.982
S & P	5780.05	5815.26	5859.85	5815.26	5842.27	5841.47	5864.67	5853.98	5851.2	5797.42
MR(%)	-0.207	0.609	0.767	-0.761	0.464	-0.014	0.397	-0.182	-0.047	-0.919

Event 3: BYD Song Pro was officially launched on July 11, 2019, and won the Best New Car Award at the 2019 Shanghai Auto Show Organizing Committee. Using the CSAD model to figure out the absolute deviation of the daily stock return rate of BYD and the market return rate ten days before this release, this study finds that the CSAD value before this event is 1.37%. All the data involved in the calculation is shown in Table 5.

Table 5: Daily stock return of BYD and market return before the release of BYD Song Pro

Date	6.25	6.26	6.27	6.28	7.1	7.2	7.3	7.5	7.8	7.9	7.10
SR	11.89	11.84	11.87	12.05	12.18	12.44	12.51	12.18	11.91	12.12	12.22
SR (%)	/	-0.42	0.25	1.52	1.08	2.14	0.56	-2.64	-2.22	1.76	0.83
SSE CI	2982.07	2976.28	2996.79	2978.88	3044.9	3043.94	3015.26	3011.06	2933.36	2928.23	2915.3
MR (%)	/	-0.19	0.69	-0.60	2.22	-0.03	-0.94	-0.14	-2.58	-0.18	-0.44

Note: CI means Composite Index. Based on the data listed in the following tables, the new CSAD value after the launch of the BYD Song Pro is 1.03%. Since the value becomes lower after the release, investor "herd behavior" does appear after this event of BYD.

Table 6: Daily stock return of BYD and market return after the release of BYD Song Pro

Date	7.11	7.12	7.15	7.16	7.17	7.18	7.19	7.22	7.23	7.24	7.25
SP	12.09	12.1	12.24	12.18	12.37	12.19	12.22	12.3	12.61	12.7	12.52
SR (%)	-1.064	0.083	1.157	-0.490	1.560	-1.455	0.246	0.655	2.520	0.714	-1.417
SSE CI	2917.76	2930.55	2942.19	2937.62	2931.69	2901.18	2924.2	2886.97	2899.94	2923.28	2937.36
MR (%)	0.084	0.438	0.397	-0.155	-0.202	-1.041	0.793	-1.273	0.449	0.805	0.482

Event 4: On the evening of February 10th, 2025, BYD held an intelligent strategy press conference at its headquarters in Shenzhen and unveiled the "Heavenly Eye" high-level intelligent driving system. Using data in Table 7, the CSAD value before BYD's press conference is 3.61%.

Table 7: Daily stock return of BYD and market return before the press conference of BYD

Date	1.24	1.27	1.28	1.29	1.3	1.31	2.3	2.4	2.5	2.6	2.7
SP	70.52	70.3	70.35	70.35	71.6	70.08	70.92	73.31	72.76	79.55	84.53
SR (%)	/	-0.31	0.071	0.00	1.78	-2.12	1.199	3.37	-0.75	9.332	6.26
SSE CI	3230.16	3252.63	3250.6	/	/	/	/	/	3229.49	3270.66	3303.67
MR(%)	/	0.696	-0.06	/	/	/	/	/	/	1.275	1.009

*Some data is not available due to the Chinese Spring Festival.

In the ten-day period after BYD's press conference (Table 8), the CSAD value falls to 2.84%, which suggests that there is investor "herd behavior" after this event.

Table 8: Daily stock return of BYD and market return after the press conference of BYD

Date	2.10	2.11	2.12	2.13	2.14	2.18	2.19	2.20	2.21	2.24	2.25
SP	86.62	84.87	91.57	88.35	93.38	93.20	93.88	98.63	100.9	98.37	100.2
SR	2.47	-2.02	7.89	-3.52	5.69	-0.19	0.73	5.06	2.30	-2.51	1.83
SSE CI	3322.17	3318.06	3346.39	3332.48	3346.72	3324.49	3351.54	3350.78	3379.11	3373.03	3346.04
MR	0.56	-0.12	0.85	-0.42	0.43	-0.66	0.81	-0.02	0.85	-0.18	-0.8

4.2. Volatility of company stock prices before and after the presence of investor "herd behavior"

Applying the formulas of variance and standard deviation (volatility) mentioned before, the research determines changes in stock price volatility after each crucial event that leads to investor "herd behavior." The results are listed in Table 9.

Table 9: Pre- and post-event stock price variance and volatility

Event	Pre-Variance	Post-Variance	Pre-Volatility	Post-Volatility
1	0.11%	0.08%	3.28%	2.70%
2	0.07%	0.08%	2.63%	2.80%
3	0.03%	0.02%	1.61%	1.34%
4	0.12%	0.14%	3.53%	3.80%

For Tesla, although the "herding effect" does not directly increase its stock price volatility, it does bring about a dramatic fluctuation in stock prices on the day on which the significant event happens or the day immediately after the event. For instance, the difference between the average stock return rate of Tesla and its return rate on March 15th, 2019, rises to 4.65%, and the difference on October 11th, 2024, which is the day after Tesla's "We, Robot" press conference, increases to 7.62%. Similarly, in terms of BYD's stock price volatility after each event, it does not increase dramatically in every ten-day period after these events. However, investor "herd behavior" truly causes a remarkable and irrational fluctuation in stock prices in the two days following the release of Song Pro and the press conference in Shenzhen.

5. Conclusion

While the results reveal that the volatility of stock prices of two EV companies does not increase significantly after the "herding effect" among investors occurred, the findings from this research

confirm that investors' "herd behavior" increases stock price volatility in the two days following the occurrence of such major events that trigger this kind of behavior, corresponding to the hypothesis.

However, the study does have certain limitations. Firstly, it is sometimes confronted with difficulties in gaining access to accurate data of stock prices from reliable sources. Furthermore, the CSAD model is a measure used in financial research to assess the dispersion of individual stock returns relative to the market return. This measure helps identify the "herd behavior" among investors, where investors tend to follow the market trend rather than making independent decisions. However, if there is both investor "herd behavior" and local divergence in the market, the CSAD value may also rise. Future research still needs to consider the overall market conditions during the period to determine whether the event actually triggers the "herd behavior" of investors, as broader market trends can also influence "herd behavior."

In conclusion, the study supports the hypothesis that the "herd behavior" of investors leads to dramatic and irrational fluctuations of stock prices of companies in the electric vehicle industry, especially in the two days immediately after these events. Future research may expand on this study by incorporating more events that lead to the "herd effect" among investors, conducting research on other EV companies' cases, and tracking the long-term effects of the "herd behavior" as the market grows.

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