Reaction mechanism of investors of new energy vehicle enterprises to China's program of retrogressive subsidies in the context of COVID-19 pandemic: Based on the event study method
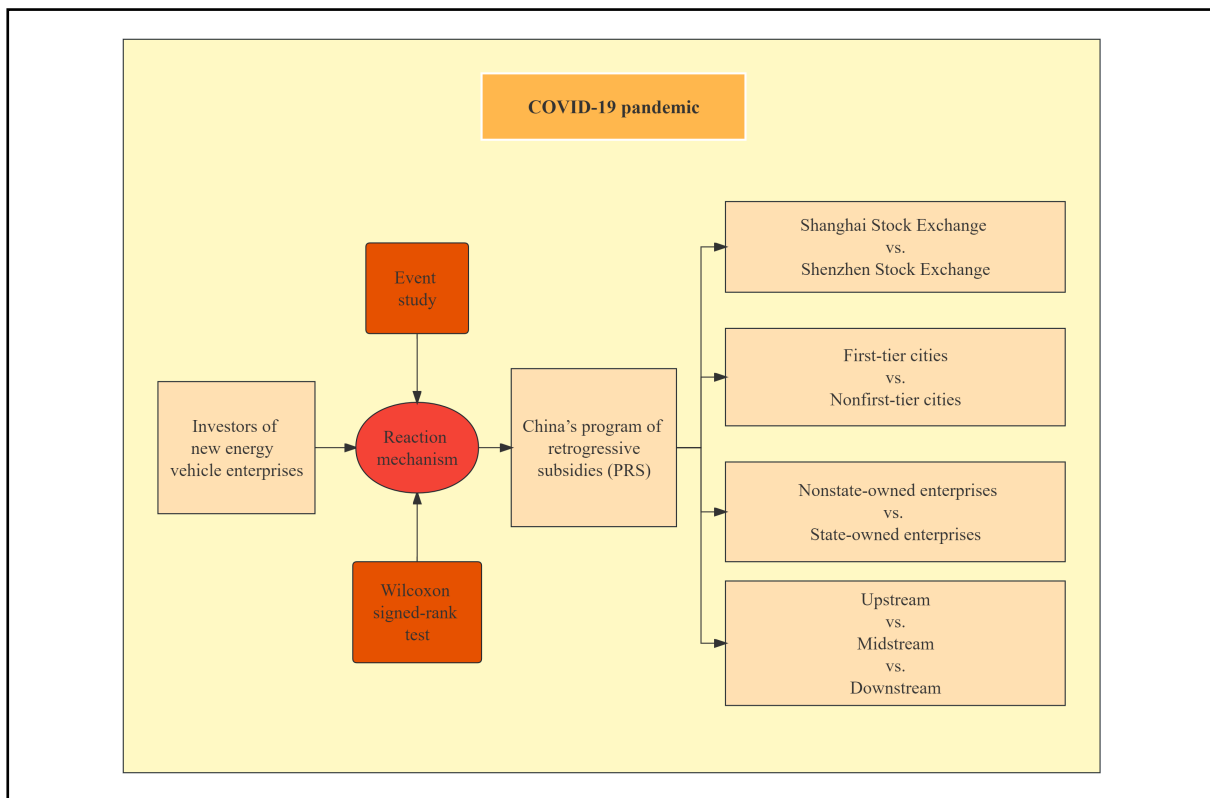
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Graphical abstract

The reaction of investors in new energy vehicle enterprises to China's program of retrogressive subsidies in the context of COVID-19 pandemic.

Public summary

■ The investors of NEV enterprises have a negative reaction to the China's program of retrogressive subsidies.

■ The negative reaction of investors of NEV enterprises listed on the Shanghai Stock Exchange (vs. the Shenzhen Stock Exchange) or located in first-tier cities (vs. nonfirst-tier cities) is weaker.

■ The negative reaction of investors of NEV enterprises that are nonstate-owned (vs. state-owned) or located in the upstream (vs. midstream and downstream) is stronger.

Reaction mechanism of investors of new energy vehicle enterprises to China's program of retrogressive subsidies in the context of COVID-19 pandemic: Based on the event study method

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Abstract: In recent years, the subsidy policy of new energy vehicles (NEVs) has promoted the vigorous development of China's NEV industry. In the past, scholars tended to focus on consumers' reactions to subsidy policies for NEVs, while attention to the reaction of investors is relatively scarce, especially in the context of major public emergencies. Based on the event study method, this study empirically tested the reaction mode of investors of NEV enterprises to China's program of retrogressive subsidies (PRS) in the context of COVID-19 pandemic and discussed the differences in investors' reactions under different enterprise attributes (i.e., whether listed on the Shanghai Stock Exchange, whether located in a first-tier city, whether belonging to state-owned enterprises, and whether belonging to the upstream NEV industry). Our research results provide a reference for the strategic management practices of NEV enterprises and their investors.

Keywords: retrogressive subsidy; new energy vehicle enterprise; investors; market value; event study method

CLC number: F272.3   **Document code:** A

1 Introduction

China has firmly set the goal of peak carbon emissions before 2030 and full carbon neutrality before 2060[1−3]. Against this background, the new energy vehicle (NEV) industry presents a new space for rapid growth. To promote the development of the NEV industry, China has successively issued a series of subsidies since 2009[4, 5]. In 2013, as the development of the NEV industry entered a new stage, China began to implement its program of retrogressive subsidies (PRS)①. The purpose of this policy is to reduce the impact of government intervention in the NEV industry by reducing the amount of subsidies year by year and to give full play to the decisive role of the market in resource allocation. Prior studies have shown that subsidies have promoted the development of China's NEV industry[6, 7].

The COVID-19 pandemic, a major public emergency, has a significantly negative impact on human society. To cope with the negative influence of the COVID-19 pandemic on China's NEV enterprises, the Chinese government issued the latest PRS on April 23, 2020, stating that China has decided to extend it until 2022, after which it may be completely cancelled②. Although previous scholars have conducted in-depth studies on the reaction of NEV enterprises' stakeholders to the subsidy policy and the resulting change in enterprises' performance, most of them tend to focus only on the reaction of corporate consumers to the subsidy policy and the resulting change in enterprises' financial or innovation perform-

ance[8, 9]. As a result, they have ignored the reaction of corporate investors to the subsidy policy and the resulting change in the corporate market value. On the other hand, prior scholars have always tended to investigate the reaction of stakeholders to subsidy policies in the context of corporate daily operations[10−12]. However, few scholars have paid attention to it in the context of major public emergencies, such as COVID-19 pandemic. Based on this, this research aims to explore the reaction mechanism of NEV enterprise investors to the PRS in the context of COVID-19 pandemic.

Overall, based on the event study method, this study empirically tested the reaction mechanism of investors of NEV enterprises to China's PRS in the context of COVID-19 pandemic and discussed the differences in investors' reactions under different enterprise attributes (i.e., whether listed on the Shanghai Stock Exchange, whether located in a first-tier city, whether belonging to state-owned enterprises, and whether belonging to the upstream NEV industry).

The rest of the paper is organized as follows. Section 2 introduces the theoretical background and develops our hypotheses. Section 3 introduces the research design, and Section 4 analyzes the empirical results. The last section is the conclusions.

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2   Theoretical background and hypothesis development

2.1   The reaction of NEV enterprise investors to the PRS in the context of COVID-19 pandemic

Prospect theory was first proposed in 1979, which points out that people are different in their sensitivity to loss and gain, and the pain in the face of loss is much greater than the pleasure in the face of gain[13−16]. Therefore, when choosing between a certain profit and a risky gamble, people often choose a certain profit to avoid the risk of loss[17−19]. From an investor's point of view, investors are generally reluctant to take risks[20]. For different investment projects with the same rate of return, investors will always choose the investment projects with the lowest risk[21, 22]. Based on this, investors' perception of the future risks and benefits of the NEV industry will affect their behavioral feedback to NEV enterprises, which in turn affects the market value of NEV enterprises.

The NEV subsidy policy is crucial to the survival and development of the NEV industry in China[23, 24]. During the past ten years, the subsidy policy for NEVs has greatly stimulated consumers' enthusiasm for purchasing NEVs and investors' desire to invest in the enterprises that produce them, which has effectively promoted the development of the NEV industry in China[25, 26]. However, the sudden outbreak of COVID-19 in 2019 disrupted the orderly development of China's NEV industry. To cope with its negative influence on China's NEV enterprises, the Chinese government issued the latest PRS on April 23, 2020. However, due to information asymmetry, stakeholders may misunderstand this subsidy policy; that is, they may hold that the government will not have other subsidy policies after the implementation of the PRS. Therefore, investors may be concerned about the future development of NEV enterprises. In this case, based on the perspective of prospect theory, investors may be more inclined to place their funds in lower-risk industries. Based on the above logic, we assume the following hypothesis:

Hypothesis 1. The reaction of NEV enterprise investors to the PRS in the context of COVID-19 pandemic is likely to be negative.

2.2   The heterogeneous reaction of NEV enterprise investors: Shanghai vs. Shenzhen Stock Exchanges

Generally, the Shanghai Stock Exchange is dominated by large enterprises with stable performance, while the Shenzhen Stock Exchange is dominated by small- and medium-sized enterprises that are in their developmental stages[27, 28]. Therefore, on the whole, compared with enterprises listed on the Shenzhen Stock Exchange, enterprises listed on the Shanghai Stock Exchange are generally more equipped to manage uncertainties and risks. In this case, investors of NEV enterprises listed on the Shanghai Stock Exchange (vs. the Shenzhen Stock Exchange) should have a lower risk perception when facing the PRS in the context of COVID-19 pandemic. Based on the above logic, we assume the following hypothesis:

Hypothesis 2. The negative reaction of investors is weaker when NEV enterprises are listed on the Shanghai Stock Exchange (vs. the Shenzhen Stock Exchange).

2.3   The heterogeneous reaction of NEV enterprise investors: state-owned vs. nonstate-owned enterprises

State-owned enterprises, which act in an agency capacity on behalf of the government in the market economy[29, 30], are granted sufficient resources[31, 32], such as policy and industry information[33], subsidies[34] and tax breaks[35], by the state. These political resources can help such enterprises effectively cope with risks and unforeseen challenges[36−38]. Therefore, even after the issuance of the PRS in response to COVID-19 pandemic, state-owned enterprises still enjoy more resources than nonstate-owned enterprises in the post-subsidy era. As such, investors in nonstate-owned NEV enterprises should have a higher risk perception given the anticipated effects of the PRS. Based on the above logic, we assume the following hypothesis:

Hypothesis 3. The negative reaction of investors is stronger when NEV enterprises belong to nonstate-owned enterprises (vs. state-owned enterprises).

2.4   The heterogeneous reaction of NEV enterprise investors: first-tier cities vs. nonfirst-tier cities

Generally, first-tier cities have a higher level of economic development than nonfirst-tier cities. Therefore, the local governments in first-tier cities usually have a stronger ability to support local enterprises in the postsubsidy era. In addition, enterprises that can survive in first-tier cities usually have more resistance to uncertainties and risks than those in nonfirst-tier cities. In this case, investors in NEV enterprises in first-tier cities (vs. nonfirst-tier cities) should have a lower risk perception in response to the PRS in the context of COVID-19 pandemic. Based on the above logic, we assume the following hypothesis:

Hypothesis 4. The negative reaction of investors is weaker when NEV enterprises are located in first-tier cities (vs. nonfirst-tier cities).

2.5   The heterogeneous reaction of NEV enterprise investors in the supply chain

At present, the number of upstream enterprises is much higher than that of midstream and downstream enterprises in China's NEV industry, which means that upstream enterprises will face greater competitive pressure when dealing with the uncertainties associated with future industry development. In other words, investors in upstream enterprises (vs. midstream and downstream enterprises) are more risk-aware when facing uncertainties. In this case, investors in upstream enterprises (vs. midstream and downstream enterprises) should have a higher risk perception in response to the PRS in the context of COVID-19 pandemic. Based on the above logic, we assume the following hypothesis:

Hypothesis 5. The negative reaction of investors is stronger for upstream (vs. midstream and downstream) NEV enterprises.

3   Research design

3.1   Sample selection and data source

A total of 171 automobile enterprises listed on the Shenzhen

Table 1. Descriptive statistics (dependent variable).

Dependent variable		Day −1	Day 0	Day 1	Day −1 to 0	Day 0 to 1	Day −1 to 1
	n	109	109	109	109	109	109
NEV enterprises	Mean	0.0035	−0.0035	−0.0116	0	−0.0151	−0.0116
	Variance	0.0007	0.0008	0.0007	0.0015	0.0016	0.0021
	n	62	62	62	62	62	62
NNEV enterprises	Mean	0.0064	0.0004	−0.0033	0.0069	−0.0029	0.0036
	Variance	0.0006	0.0011	0.0012	0.0022	0.0029	0.0037

and Shanghai Stock Exchanges were selected as samples in this study. Specifically, the sample source is Choice①, which is among the top financial databases in China. Based on the industry classification of listed enterprises by Choice, we obtained a sample of 209 listed enterprises whose main line of business is in the automobile industry. Considering that this study focuses on the PRS issued on April 23, 2020, we excluded 31 samples with market dates after April 23, 2020. Additionally, to prevent confounding events that fall within seven days of the issuance of the PRS and to avoid using an insufficient return prediction period, we also removed 7 unqualified samples[39, 40]. After accounting for these considerations, we obtained a sample of 171 listed auto enterprises, of which 109 are considered NEV enterprises and 62 are considered nonnew energy vehicle (NNEV) enterprises based on the classification set forth by Choice.

3.2 Variable definitions

3.2.1 Explained variable: cumulative abnormal return

Cumulative abnormal return (CAR) is the explanatory variable we use to probe the effect of the PRS on corporate market value. Following prior studies, CAR related to the critical event is calculated within a 3-day time window (i.e., −1, 0, and + 1 days) [41]. Concretely:

Abnormal return (AR) refers to the unexpected percentage difference between the expected normal and actual returns. The market model is used to calculate the normal return, AR and CAR[40], namely:

$$R_{it} = I_i + S_i R_{mt} + \mathrm{ET}_{it},$$

where R_{it} is the normal return of security i on day t, I_i is the intercept, S_i is the systematic risk related to security i, R_{mt} is the return on the market portfolio of stocks on day t, and ET_{it} is the error term of security i on day t.

Next, AR is calculated as:

$$\mathrm{AR}_{it} = R_{it} - (X_i + Z_i R_{mt}),$$

where AR_{it} is the AR of security i on day t and X_i and Z_i belong to the ordinary least squares (OLS) parameter estimates of security i. CAR for the 3-day time window for each security i is thus calculated as

$$\mathrm{CAR}_{(-1,0,+1)} = \sum_{t=n}^{n=(-1,0,+1)} \mathrm{AR}_{it}.$$

The expected normal returns are estimated using a trailing period of 128 to 8 trading days before the critical event[40]. We

regard the PRS issued on April 23, 2020, as the critical event. Since the policy promulgation time (17:08) is the closing time of the stock market on that day (13:00–15:00), we choose April 24, 2020, as the event date. The daily market return volatility is calculated using the equal weight average of the Shanghai Stock Exchange Composite Index and the Shenzhen Stock Exchange Component Index[40−42]. All data were collected from the CSMAR②.

3.2.2 Explanatory variable

Whether it is an NEV enterprise: If the firm is classified as a new energy concept by Choice, it is considered to be an NEV enterprise and given the value of "1"; otherwise, it is given the value of "0".

Listed on the Shanghai Stock Exchange: If the firm is listed on the Shanghai Stock Exchange, it is given the value of "1"; otherwise, it is given the value of "0".

Whether it is a state-owned enterprise: If the firm is ultimately controlled by the State-Owned Assets Committee of China, it is given the value of "1"; otherwise, it is given the value of "0".

Is it located in the first-tier city: If the firm was headquartered in a first-tier city (i.e., Beijing, Shanghai, Guangzhou and Shenzhen) in 2020, it is given the value of "1"; otherwise, it is given the value of "0".

Supply chain position: If the firm is mainly engaged in supplying raw materials and accessories/automobile manufacturing/vehicle sales, it is considered to be in the upstream/midstream/downstream of the supply chain and given the value of "1"; otherwise, it is given the value of "0".

3.2.3 Descriptive statistics

Tables 1 and 2 show the statistical data of the variables.

3.2.4 Kolmogorov–Smirnov (KS) test and Wilcoxon signed-rank test

To explore the effect of the PRS on the market value of NEV enterprises, we decided to follow Lo et al.[43] by applying the methods of an independent sample t-test or a Wilcoxon signed-rank test. Through the KS test, we found that all explained variables did not conform to the normal distribution (see Table 3); thus, the Wilcoxon signed-rank test was adopted (compared to the default median "0").

① http://choice.eastmoney.com/.
② https://www.gtarsc.com/.

Table 2. Descriptive statistics (explanatory variable).

Explanatory variable		NEV enterprises	NNEV enterprises
Whether it is a NEV enterprise	*N*	109	62
	Mean	0.6374	
	Variance	0.2325	
Listed on the Shanghai Stock Exchange	*N* (assignment 1)	50	33
	Mean	0.4854	
	Variance	0.2513	
Whether it is a state-owned enterprise	*N* (assignment 1)	25	18
	Mean	0.2515	
	Variance	0.1893	
Is it located in the first-tier city	*N* (assignment 1)	17	9
	Mean	0.152	
	Variance	0.1297	
Upstream of the supply chain	*N* (assignment 1)	84	54
	Mean	0.807	
	Variance	0.1567	
Midstream of the supply chain	*N* (assignment 1)	20	1
	Mean	0.1228	
	Variance	0.1084	
Downstream of the supply chain	*N* (assignment 1)	5	7
	Mean	0.0702	
	Variance	0.0656	

Table 3. Kolmogorov–Smirnov test.

		Time window					
		Day −1	Day 0	Day 1	Day −1 to 0	Day 0 to 1	Day −1 to 1
All the Samples (N=171)	Test statistics	0.152***	0.121***	0.089**	0.172***	0.103***	0.112***
	Sig.	0.000	0.000	0.002	0.000	0.000	0.000
NEV enterprises (N=109)	Test statistics	0.193***	0.149***	0.102**	0.179***	0.111**	0.101**
	Sig.	0.000	0.000	0.007	0.000	0.002	0.009
NNEV enterprises (N=62)	Test statistics	0.115*	0.152**	0.091	0.168***	0.105+	0.114*
	Sig.	0.040	0.001	0.200	0.000	0.089	0.045

$^+p < 0.10$; $^*p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$ (all tests are two-tailed).

4 Empirical results

4.1 Basic estimation results

It can be seen from Table 4 that the negative reaction of NEV enterprise investors is significant (Day − 1 to 1, z = 3.048, p = 0.002), while the negative reaction of NNEV enterprise investors is not significant (Day −1 to 1, z = 0.007, p = 0.994). Hypothesis 1 is thus proven. Additionally, Day −1 is not significant, thus indicating that no information is leaked before the event.

We further analyze charts of the stock market to identify the reaction of investors (see Fig. 1). Fig. 1 shows that the AAR is significantly negative from the first day (Day 0) and reaches the negative pole on the third day (Day 2). This reveals a coupling relationship between the dissemination period of policy information and the negative reaction of investors.

4.2 Further analysis

4.2.1 Comparison between stock exchanges

Table 5 reveals the difference in the reaction of investors of NEV enterprises listed on the Shanghai and Shenzhen Stock Exchanges. Table 5 shows that the market value of NEV enterprises listed on the Shenzhen Stock Exchange suffers a greater negative impact (Day −1 to 1, z = 4.022, p=0.000). Hypothesis 2 is therefore tested. The results show that investors have more confidence in NEV enterprises on the Shanghai Stock Exchange (vs. the Shenzhen Stock Exchange) in the postsubsidy era.

Table 4. Wilcoxon signed-rank test between NEV and NNEV enterprises.

		Time window					
		Day −1	Day 0	Day 1	Day −1 to 0	Day 0 to 1	Day −1 to 1
All the samples(*N*=171)	Wilcoxon signed-rank Z-statistic	0.848	−2.370*	−4.144***	−1.377	−3.681***	−2.334*
	Sig.	0.397	0.018	0.000	0.169	0.000	0.020
NEV enterprises (*N*=109)	Wilcoxon signed-rank Z-statistic	−0.208	−2.313*	−4.743***	−1.672+	−4.196***	−3.048**
	Sig.	0.835	0.021	0.000	0.095	0.000	0.002
NNEV enterprises (*N*=62)	Wilcoxon signed-rank Z-statistic	1.562	−1.006	−0.761	−0.067	−0.729	0.007
	Sig.	0.118	0.314	0.447	0.947	0.466	0.994

+$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (all tests are two-tailed).
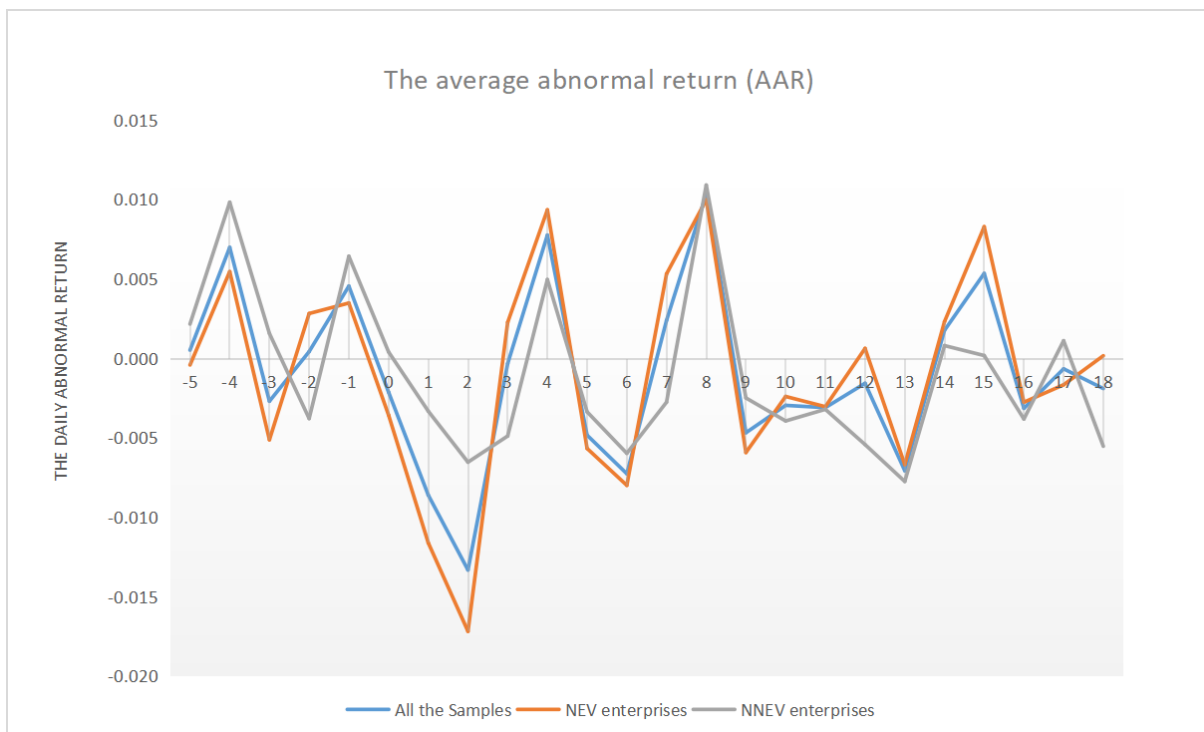
Fig. 1. NEV enterprise investors' reaction to the PRS.

4.2.2 Comparison of different types of ownership

Table 6 shows the difference in the reaction of investors of state-owned and nonstate-owned firms. From Table 6, it can be seen that the market value of nonstate-owned enterprises suffers a greater negative impact (Day −1 to 1, $z = 3.115$, $p = 0.002$). Hypothesis 3 is thus proven. Our results echo those of Wang et al.[8] and support our view that state-owned

NEV enterprises have more political resources to ensure their survival and development, and their investors will thus have higher confidence in their development prospects in the post-subsidy era.

4.2.3 Comparison between geographical locations

Table 7 shows the difference in the reaction of investors of

Table 5. Wilcoxon signed-rank test between the Shanghai and Shenzhen Stock Exchanges.

			Time window					
			Day −1	Day 0	Day 1	Day −1 to 0	Day 0 to 1	Day −1 to 1
NEV enterprises (*N*=109)	Shanghai Stock Exchange (*N*=50)	Wilcoxon signed-rank Z-statistic	−0.333	2.396*	−3.387**	1.462	−0.652	−0.140
		Sig.	0.739	0.017	0.001	0.144	0.515	0.889
	Shenzhen Stock Exchange (*N*=59)	Wilcoxon signed-rank Z-statistic	0.070	−5.022***	−3.453**	−3.687***	−4.770***	−4.022***
		Sig.	0.944	0.000	0.001	0.000	0.000	0.000

+$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (all tests are two-tailed).

NEV enterprises in different geographical locations. Table 7 shows that the market value of NEV enterprises located in first-tier cities suffers a less negative impact (Day −1 to 1, $z = 1.704$, $p = 0.088$). Hypothesis 4 is thus proven. Our results confirm our view that investors will have more confidence in NEV enterprises located in first-tier cities (vs. nonfirst-tier cities) in the postsubsidy era.

4.2.4 Comparison between supply chain locations

Table 8 shows the difference in the reaction of investors of NEV enterprises with different supply chain locations. It can be seen from Table 8 that the market value of NEV enterprises located in the upstream market segment suffers a greater negative impact (Day −1 to 1, $z = 2.792$, $p = 0.005$). Hypothesis 5 is thus proven. Our results confirm our view that investors may have less confidence in upstream (vs. midstream and downstream) NEV enterprises in the postsubsidy era.

4.3 Robustness test

First, the results of Day 0, Day 1, and Day 0 to 1 in Tables 4 to 8 are consistent with Day −1 to 1, thus indicating the robustness of our results. Second, to verify the validity of the Wilcoxon signed-rank test, the binomial sign test was selected as an alternative method (see Tables S1−S5 in Supporting Information). Our key results remain unchanged. Finally, we regard the new first-tier cities determined in 2020 as first-tier cities and empirically retest the first-tier cities variable. The results remain robust (see Tables S6 and S7 in Supporting Information).

5 Conclusions

COVID-19 pandemic has a serious negative impact on China's economy, especially in the NEV industry, which is in its early developmental stages. To address the negative impact of COVID-19 pandemic on China's NEV industry, the Chinese government issued the latest PRS on April 23, 2020. To explore the reaction mechanism of NEV enterprise investors to the PRS in the context of COVID-19 pandemic, 171 Chinese listed auto enterprises were selected as samples. Based on the event study method, this study discussed the differences in investors' reactions under different enterprise attributes (i.e., whether listed on the Shanghai Stock Exchange, whether located in a first-tier city, whether belonging to state-owned enterprises, and whether belonging to the upstream NEV enterprises). Overall, we obtained five results. First, due to information asymmetry, the reaction of NEV enterprise investors to the PRS in the context of COVID-19 pandemic is

Table 6. Wilcoxon signed-rank test between state-owned and nonstate-owned firms.

			Time window					
			Day −1	Day 0	Day 1	Day −1 to 0	Day 0 to 1	Day −1 to 1
NEV enterprises (N=109)	State-owned (N=25)	Wilcoxon signed-rank Z-statistic	1.063	−0.800	−0.821	−0.013	−1.413	−0.538
		Sig.	0.288	0.423	0.412	0.989	0.158	0.590
	Nonstate-owned (N=84)	Wilcoxon signed-rank Z-statistic	−0.736	−2.094*	−4.477***	−1.824+	−3.884***	−3.115**
		Sig.	0.462	0.036	0.000	0.068	0.000	0.002

$^+p < 0.10$; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$ (all tests are two-tailed).

Table 7. Wilcoxon signed-rank test between first-tier cities and nonfirst-tier cities.

			Time window					
			Day −1	Day 0	Day 1	Day −1 to 0	Day 0 to 1	Day −1 to 1
NEV enterprises (N=109)	First-tier (N=17)	Wilcoxon signed-rank Z-statistic	−1.491	−0.052	−1.917+	−1.538	−1.349	−1.704+
		Sig.	0.136	0.959	0.055	0.124	0.177	0.088
	Nonfirst-tier (N=92)	Wilcoxon signed-rank Z-statistic	0.321	−2.366*	−4.328***	−1.244	−4.001***	−2.553*
		Sig.	0.749	0.018	0.000	0.213	0.000	0.011

$^+p < 0.10$; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$ (all tests are two-tailed).

Table 8. Wilcoxon signed-rank test in the supply chain.

			Time window					
			Day −1	Day 0	Day 1	Day −1 to 0	Day 0 to 1	Day −1 to 1
NEV enterprises (N=109)	Upstream (N=84)	Wilcoxon signed-rank Z-statistic	0.025	−2.305*	−4.388***	−1.628	−4.014***	−2.792**
		Sig.	0.980	0.021	0.000	0.104	0.000	0.005
	Midstream (N=20)	Wilcoxon signed-rank Z-statistic	0.336	0.201	−1.979*	0.373	−1.213	−0.485
		Sig.	0.737	0.840	0.048	0.709	0.225	0.627
	Downstream(N=5)	Wilcoxon signed-rank Z-statistic	−1.483	−1.753+	1.826+	−2.023	−0.944	−1.214
		Sig.	0.138	0.080	0.068	0.043	0.345	0.225

$^+p < 0.10$; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$ (all tests are two-tailed).

negative. Second, the negative reaction of investors is weaker when NEV enterprises are listed on the Shanghai Stock Exchange (vs. the Shenzhen Stock Exchange). Third, the negative reaction of investors is stronger when NEV enterprises belong to nonstate-owned enterprises (vs. state-owned enterprises). Fourth, the negative reaction of investors is weaker when NEV enterprises are located in first-tier cities (vs. nonfirst-tier cities). Finally, the negative reaction of investors is stronger for upstream (vs. midstream and downstream) NEV enterprises. Overall, the results of this study provide empirical evidence for the effectiveness of risk aversion in prospect theory in practice and enrich the application scenario of prospect theory.

This study's contribution to the literature is threefold. First, our study provides empirical evidence for analyzing the reaction of NEV enterprise investors to the government subsidy policy, which enriches the literature focusing on the reaction of stakeholders to the government subsidy policy. Second, this study analyzes the reaction of NEV enterprise investors to the PRS in the context of COVID-19 pandemic from multiple perspectives, thus providing practical insight for NEV enterprises to make decisions on stakeholder management strategies in the context of major public emergencies. Finally, by comparing and analyzing the degree of change in the market value of NEV enterprises with different attributes when the PRS is issued, our study provides practical recommendations on how to formulate government policy response strategies according to the unique needs of each situation.

Our study also makes several practical recommendations for NEV enterprises and their investors. First, when the state announces subsidy policies similar to PRS, enterprises should communicate information with external investors in a timely manner to prevent losses caused by stakeholders' misunderstanding, especially in the context of major public emergencies, such as COVID-19 pandemic. Second, NEV enterprises should convey reliable signals to investors in the daily operation process to prevent them from suffering market value loss in the context of information asymmetry, especially for nonstate-owned enterprises, enterprises in the Shenzhen Stock Exchange and nonfirst-tier cities, as well as upstream enterprises with greater pressure of competition. Finally, investors of NEV enterprises should believe in the scientific nature and effectiveness of national policies to avoid causing their own losses due to misunderstanding.

Our research also presents several limitations. On the one hand, this study only focuses on NEV enterprises in the automobile industry. There are other firms in other industries related to NEV, which can be included in the sample for further exploration in future research. On the other hand, this study only focuses on the key subsidy policy made by the government in response to COVID-19 pandemic. As the situation of the epidemic changes, the government may introduce other follow-up policies. Therefore, future research can continue to explore the reaction mechanism of NEV enterprise investors to other policies on the basis of this study.

Supporting information

The supporting information for this article can be found online at http://doi.org/10.52396/JUSTC-2022-0042. It includes seven tables.

Acknowledgements

Conflict of interest

The authors declare that they have no conflict of interest.

Biographies

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References

[1] Dong L, Miao G, Wen W. China's carbon neutrality policy: Objectives, impacts and paths. *East Asian Policy,* **2021**, *13* (1): 5–18.

[2] Mallapaty S. How China could be carbon neutral by mid-century. *Nature,* **2020**, *586* (7830): 482–484.

[3] Xu J, Wei J, Lu L. Strategic stakeholder management, environmental corporate social responsibility engagement, and financial performance of stigmatized firms derived from Chinese special environmental policy. *Business Strategy and the Environment,* **2019**, *28* (6): 1027–1044.

[4] Liu C, Liu Y, Zhang D, et al. The capital market responses to new energy vehicle (NEV) subsidies: An event study on China. *Energy Economics,* **2022**, *105*: 105677.

[5] Zhang L, Wang L, Chai J. Influence of new energy vehicle subsidy policy on emission reduction of atmospheric pollutants: A case study of Beijing, China. *Journal of Cleaner Production,* **2020**, *275*: 124069.

[6] Jiang C, Zhang Y, Zhao Q, et al. The impact of purchase subsidy on enterprises' R&D efforts: Evidence from China's new energy vehicle industry. *Sustainability,* **2020**, *12* (3): 1105.

[7] Li W, Long R, Chen H. Consumers' evaluation of national new energy vehicle policy in China: An analysis based on a four paradigm model. *Energy Policy,* **2016**, *99*: 33–41.

[8] Wang J, Guthrie D, Xiao Z. The rise of SASAC: Asset management, ownership concentration, and firm performance in China's capital markets. *Management and Organization Review,* **2012**, *8*: 253–281.

[9] Yu F, Wang L, Li X. The effects of government subsidies on new energy vehicle enterprises: The moderating role of intelligent transformation. *Energy Policy,* **2020**, *141*: 111463.

[10] Austmann L M. Drivers of the electric vehicle market: A systematic literature review of empirical studies. *Finance Research Letters,* **2020**, *41*: 101846.

[11] Jiang C, Zhang Y, Bu M, et al. The effectiveness of government subsidies on manufacturing innovation: Evidence from the new

energy vehicle industry in China. *Sustainability,* **2018**, *10* (6): 1692.

[12] Wan D, Xue R, Linnenluecke M, et al. The impact of investor attention during COVID-19 on investment in clean energy versus fossil fuel firms. *Finance Research Letters,* **2021**, *43*: 101955.

[13] Barberis N C. Thirty years of prospect theory in economics: A review and assessment. *Journal of Economic Perspectives,* **2013**, *27* (1): 173–196.

[14] Holmes Jr R M, Bromiley P, Devers C E, et al. Management theory applications of prospect theory: Accomplishments, challenges, and opportunities. *Journal of Management,* **2011**, *37* (4): 1069–1107.

[15] Kaustia M. Prospect theory and the disposition effect. *Journal of Financial and Quantitative Analysis,* **2010**, *45* (3): 791–812.

[16] Kahneman D, Tversky A. Prospect theory: An analysis of decision under risk. *Econometrica,* **1979**, *47* (2): 263–292.

[17] Abdellaoui M, Bleichrodt H, Paraschiv C. Loss aversion under prospect theory: A parameter-free measurement. *Management Science,* **2007**, *53* (10): 1659–1674.

[18] Hens T, Vlcek M. Does prospect theory explain the disposition effect? *Journal of Behavioral Finance,* **2011**, *12* (3): 141–157.

[19] Olsen R A. Prospect theory as an explanation of risky choice by professional investors: Some evidence. *Review of Financial Economics,* **1997**, *6* (2): 225–232.

[20] Barberis N, Jin L J, Wang, B. Prospect theory and stock market anomalies. *The Journal of Finance,* **2021**, *76* (5): 2639–2687.

[21] Bromiley P. Looking at prospect theory. *Strategic Management Journal,* **2010**, *31* (12): 1357–1370.

[22] Edwards K D. Prospect theory: A literature review. *International Review of Financial Analysis,* **1996**, *5* (1): 19–38.

[23] Liu M, Liu L, Xu S, et al. The influences of government subsidies on performance of new energy firms: A firm heterogeneity perspective. *Sustainability,* **2019**, *11* (17): 4518.

[24] Sun C, Zhan Y, Du G. Can value-added tax incentives of new energy industry increase firm's profitability? Evidence from financial data of China's listed enterprises. *Energy Economics,* **2020**, *86*: 104654.

[25] Jin Z, Shang Y, Xu J. The impact of government subsidies on private R&D and firm performance: Does ownership matter in China's manufacturing industry? *Sustainability,* **2018**, *10* (7): 2205.

[26] Li Y, Zeng B, Wu T, et al. Effects of urban environmental policies on improving firm efficiency: Evidence from Chinese new energy vehicle firms. *Journal of Cleaner Production,* **2019**, *215*: 600–610.

[27] Cui L, Kent P, Kim S, et al. Accounting conservatism and firm performance during the COVID-19 pandemic. *Accounting & Finance,* **2021**, *61* (4): 5543–5579.

[28] Kato T, Long C. Executive compensation, firm performance, and corporate governance in China: Evidence from firms listed in the Shanghai and Shenzhen Stock Exchanges. *Economic Development and Cultural Change,* **2006**, *54* (4): 945–983.

[29] Boddewyn J J, Brewer T L. International-business political behavior: New theoretical directions. *Academy of Management Review,* **1994**, *19* (1): 119–143.

[30] Mohr A, Wang C, Fastoso F. The contingent effect of state participation on the dissolution of international joint ventures: A resource dependence approach. *Journal of International Business Studies,* **2016**, *47* (4): 408–426.

[31] Bradley S W, Aldrich H, Shepherd D A, et al. Resources, environmental change, and survival: Asymmetric paths of young independent and subsidiary organizations. *Strategic Management Journal,* **2011**, *32* (5): 486–509.

[32] Zheng W, Singh K, Mitchell W. Buffering and enabling: The impact of interlocking political ties on firm survival and sales growth. *Strategic Management Journal,* **2015**, *36* (11): 1615–1636.

[33] Hillman A J, Zardkoohi A, Bierman L. Corporate political strategies and firm performance: Indications of firm-specific benefits from personal service in the US government. *Strategic Management Journal,* **1999**, *20* (1): 67–81.

[34] Oliver C, Holzinger I. The effectiveness of strategic political management: A dynamic capabilities framework. *Academy of Management Review,* **2008**, *33* (2): 496–520.

[35] Hillman A J, Withers M C, Collins B J. Resource dependence theory: A review. *Journal of Management,* **2009**, *35* (6): 1404–1427.

[36] Ding S, Jia C, Wu Z, et al. Executive political connections and firm performance: Comparative evidence from privately controlled and state-owned enterprises. *International Review of Financial Analysis,* **2014**, *36*: 153–167.

[37] Li H, Zhang, Y. The role of managers' political networking and functional experience in new venture performance: Evidence from China's transition economy. *Strategic Management Journal,* **2007**, *28* (8): 791–804.

[38] Hu F, Leung S C. Top management turnover, firm performance and government control: Evidence from China's listed state-owned enterprises. *The International Journal of Accounting,* **2012**, *47* (2): 235–262.

[39] Godfrey P C, Merrill C B, Hansen J M. The relationship between corporate social responsibility and shareholder value: An empirical test of the risk management hypothesis. *Strategic Management Journal,* **2009**, *30* (4): 425–445.

[40] Li Z, Wei J, Marinova D V, et al. Benefits or costs? The effects of diversification with cross-industry knowledge on corporate value under crisis situation. *Journal of Knowledge Management,* **2021**, *25* (1): 175–226.

[41] Wei J, Ouyang Z, Chen H. Well known or well liked? The effects of corporate reputation on firm value at the onset of a corporate crisis. *Strategic Management Journal,* **2017**, *38* (10): 2103–2120.

[42] Xu J, Wei J, Chen H. Pollution stigma and manufacturing firms' disengagement effort: Interactive effects of pressures from external stakeholders. *Organization & Environment,* **2021**, *34* (2): 243–266.

[43] Lo C K, Tang C S, Zhou Y, et al. Environmental incidents and the market value of firms: An empirical investigation in the Chinese context. *Manufacturing & Service Operations Management,* **2018**, *20* (3): 422–439.