Analysis of the Impact of Foreign Restriction Policies on the Development of New Energy Vehicles in China Based on DID Algorithm

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Abstract. The world is facing an energy and environmental crisis, and is therefore actively promoting energy conservation, emission reduction and green development, and new energy vehicles have thus become the focus of attention. These vehicles, which use electricity instead of oil, are crucial to achieving carbon neutrality and have gained global consensus. In recent years, new energy vehicles have led the transformation of the global automotive industry and contributed to the sustained growth of the world economy. China has achieved leapfrog development in this field, leading the world in terms of industry scale and technology, and its complete industrial chain has enhanced its leading position in the global transformation of automotive electrification. However, despite the fact that China's new energy vehicle industry chain is the most complete and has competitive advantages, it still faces challenges in exporting, such as high tariffs and restrictions in the US and Europe. In order to explore the impact of these boycott policies on China's new energy vehicle industry, this study constructs a double-difference model (DID) to analyze the impact of these policies with tariff rates of each country as the control variable, which is expected to provide valuable reference for China's new energy vehicle export strategy.

Keywords: New Energy Vehicles, Carbon Neutral, Export Challenges, Double-Difference Model, Tariff Rates.

1. Introduction

In response to the energy and environmental crises, the world is actively promoting energy conservation, emission reduction and green development, and new energy vehicles have thus come into focus [1]. This type of vehicle, in which electricity replaces traditional fuel, is critical to achieving carbon neutrality and has gained global consensus [2-3]. In recent years, new energy vehicles have led the transformation of the global automotive industry and contributed to the sustained growth of the world economy [4]. China has achieved leapfrog development in this field, with the industry scale and technology leading the world, and the complete industrial chain has enhanced China's leading position in the global automotive electrification transformation.

Although China's new energy vehicle industry chain is the most complete, and has competitive advantages in new energy vehicles and lithium batteries, it still faces challenges in export [5]. For example, the United States has set high tariffs and restrictions on Chinese brands, and the European Union has made similar moves [6].

In order to explore the impact of these boycott policies on China's new energy automobile industry, we choose the tariff rate of each country as the control variable and construct a double-difference model (DID) for analysis. It is expected that this study will provide valuable reference for the export strategy of China's new energy vehicles.

2. DID model construction

The Double Difference Method (DID) is a method commonly used in regression analysis to control for the effects of potential confounders on observations [7]. Specifically, it assesses the actual effect of an intervention or policy on the treatment group (the group that received the effects of that intervention or policy) by comparing the difference between the treatment group (the group that

received the effects of that intervention or policy) and the control group (the group that did not receive the effects of that intervention or policy) at different points in time [8].

The central idea of double differencing is to use differencing to eliminate fixed effects (individual differences that do not vary over time) and common trends (factors that vary over time for all individuals). Fixed effects can be eliminated through the first differencing, i.e., calculating the amount of change in each individual at different points in time; then a second differencing is performed on the treatment and control groups, i.e., calculating the difference in the average amount of change between the two groups at different points in time to eliminate common trends. In this way, the double differencing method is able to estimate more accurately the actual impact of the intervention or policy on the treatment group [9-10].

In addition, the double differencing method is also widely used in research in economics, finance, political science and other fields to assess the impact of policies, market changes and other factors on economic indicators, company performance, and election results and so on.

Double differencing is a method that attempts to analyze causal effects by using the change in the actual untreated outcome in the control group as a counterfactual to the change in the outcome in the treatment group if it had been untreated, and usually includes the four elements of the shock event, the treatment group, the control group, and the period, whose classical construction can be expressed in the following form:

$$Yit = c + \delta Di + \lambda Tt + \beta(Di \times Tt) + \varepsilon it \quad (1)$$

Where Yitis the outcome variable, Diis the policy group dummy, Ttis the policy time dummy, Di× Tt is the interaction term, δ, λ and β are the coefficients before each term, andεitis the random error term. Taking the conditional expectation of the above equation yields the estimated effects shown in the table below.

In the DID approach, the control group provides a counterfactual that can be examined by approximating the "change" in the untreated control group over the observation period to the change in the treated group that would have occurred if the shock had not occurred. The causal effect is obtained by subtracting the change in the control group from the change in the treatment group before and after the period. The mathematical expression is shown in the following equation:

$$Y_{it} = c + \beta(D_i \times T_t) + \mu_t + Y_t + \varepsilon_{it} \quad (2)$$

In this question, we select the import and export data of new energy vehicles before and after 2018 for analysis, and the data group after 2018 is the group affected by the policy, i.e., the experimental group, and the data group before 2018 is the group not affected by the policy, i.e., the control group. First, we calculate the amount of change in tariff rates of each country before and after the policy for the experimental group, and then we calculate the amount of change in tariff rates of each country before and after the policy for the control group, and then we calculate the difference between the two variables mentioned above, so as to reflect the net impact of the international boycott policy.

3. Results

The U.S. government has tried to limit the development of China's new energy vehicles in the U.S. market by raising tariffs on Chinese electric vehicle parts. In addition, the U.S. has asked companies such as Tesla to stop producing key components such as batteries and motors in China and to ship these products to the U.S. for assembly before exporting them to other countries. And the U.S. government has issued a "Proposed New Regulations for Electric Vehicle Tax Credits" in order to support the country's electric vehicle industry. The new rules address issues such as "which electric vehicle manufacturers are eligible for the tax credit" and "sourcing of battery materials from China will be restricted". Although the rules have yet to be formally implemented, their intent is clear: to restrict the development of Chinese new energy vehicle companies in the US market. If the policy is formally implemented, it will be a major obstacle to the sales and promotion of Chinese new energy

vehicles in the U.S. market. The EU has implemented some trade protectionist measures against Chinese new energy vehicles, such as setting up technical barriers and banning the sale of non-compliant electric vehicles to the EU market. Bangladesh is worried that Chinese EVs will take over the local market and affect employment, so the government has adopted some restrictive policies. For example, it requires all Chinese EVs sold in Bangladesh to meet specific safety standards; it bans the import of EV batteries and other key components from China. The Indian government has also introduced a series of policies targeting Chinese new energy vehicles, including the requirement that all Chinese electric vehicles sold in India must meet Indian safety standards and certification requirements; and the ban on imports of electric vehicle batteries and other key components from China.

The above cases show that some countries are protecting the development of their automobile industries by formulating and implementing restrictive policies against Chinese new energy vehicles. These policies not only increase the competitive pressure on Chinese new energy vehicles in the international market, but also create substantial obstacles to their export and promotion. Therefore, this paper collects data on the tariff rates of the United States, the European Union, Bangladesh, and India on China, the changes in China's new energy vehicle exports, and tariff policies from 2017 to 2022, as shown in table 1 below, and tries to establish a DID model to analyze the impact of foreign restrictive policies on the development of China's new energy vehicles. The data in this article comes from http://www.apmcm.org/.

Table 1. Data source.

region	year	new energy vehicle export changes	customs tariff policy	customs tariffs
USA	2022	50.8	2	27.5
USA	2021	41.2	2	27.5
USA	2020	32.9	2	27.5
USA	2019	48.9	2	27.5
USA	2018	54.3	2	27.5
USA	2017	79.1	1	2.5
USA	2016	64.2	1	2.5
USA	2015	48.3	1	2.5
EU	2022	17	1	2
EU	2021	21.3	0	2
EU	2020	4.08	0	2
EU	2019	3.06	0	2
EU	2018	2.78	0	2
EU	2017	0.91	0	2
EU	2016	0.48	0	2
EU	2015	0.027	0	2
India	2022	27.89	1	15
India	2021	34.91	1	15
India	2020	11.34	2	30
India	2019	9.28	2	30
India	2018	7.34	2	30
India	2017	1.36	2	30
India	2016	1.06	2	30
India	2015	0.78	2	30
Bangladesh	2022	104.3	0	0.3
Bangladesh	2021	78.65	0	0.3
Bangladesh	2020	60.65	0	0.3
Bangladesh	2019	48.63	0	0.3
Bangladesh	2018	33.72	0	0.3
Bangladesh	2017	7.85	0	0.3
Bangladesh	2016	5.67	0	0.3
Bangladesh	2015	1.24	0	0.3

3.1. Empirical analysis

The table 2 above demonstrates the distribution of the data by subgroups. Before the event (After) then time=0, after the event (Before) - time=1; control group (Control) represents not subject to policy intervention - treat=0, experimental group (Treated) represents subject to policy intervention - treat=1.

Table 2. Cross-cutting summary table.

	pre-event	post-event	aggregate
Control group (Control)	9	15	24
Experimental group (Treated)	3	5	8
aggregate	12	20	32

The DID results are shown in Table 2 with a significance P-value of 0.054*, which is not horizontally significant and does not reject the original hypothesis, and a coefficient of -38.013, which can be considered as ineffective for increasing tariffs policy interventions, which is negative.

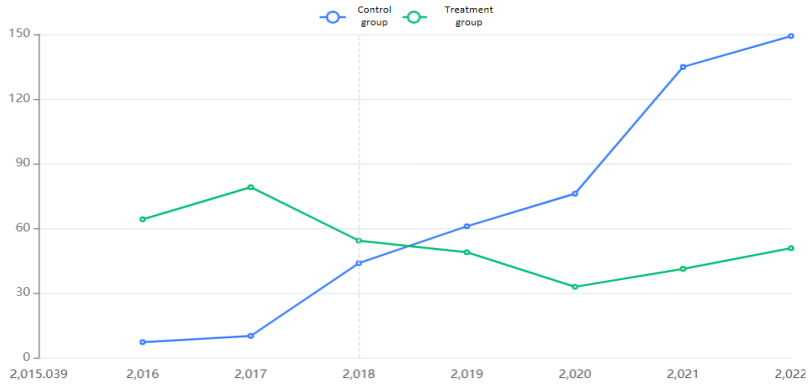

Figure 1. Time Trend Plots.

The above figure 1 shows the time trend graphs for the experimental and control groups, with the control group in blue, the experimental group in green, and the dotted line showing the point in time when the event occurred. From the graph, before the time occurrence (2018) of, the control group and the control group have a similar trend, which approximates to satisfy the parallel trend hypothesis, which needs to be further investigated using the event study method.

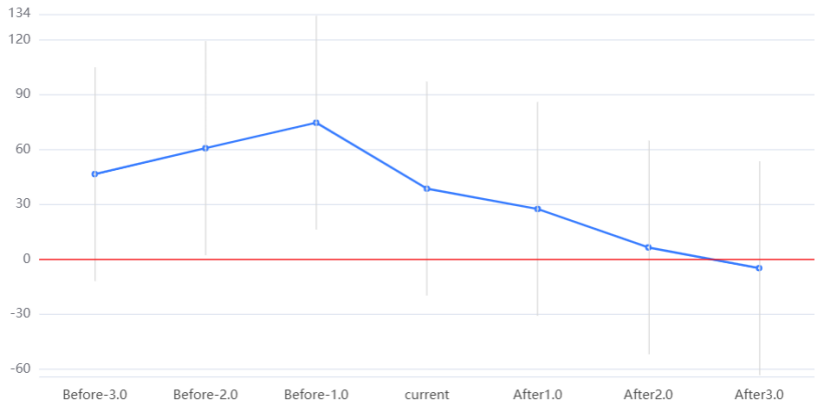

Figure 2. The results of the event study method.

As shown in Figure 2 above, the dotted line is contained at 0 after the event, indicating that the difference between the treatment group and the control group is not significant, in line with the parallel trend test. After the event, the dotted line exceeds the 95% confidence interval (dashed line) and is less than 0. It can be assumed that there is a significant negative effect of the policy, and that the boycott policy of various countries does not have a significant impact on the export volume of new energy vehicles in China.

4. Conclusions

China has achieved leapfrog development in the field of new energy vehicles, leading the world, but exports still face challenges, such as high tariffs and restrictions in the U.S. and Europe. This study constructs a double-difference DID model to analyze the impact of the boycott policy on China's new energy vehicle industry by taking the tariff rates of the U.S., the EU, Bangladesh, and India on China, the changes in China's new energy vehicle exports, and the data on tariff policy as control variables from 2017-2022, and sets the data into experimental and control groups, where the pre-event (After) and the event (After) are the experimental groups, and the control group (Control) represents no policy intervention. Before) are the experimental group, and the control group (Control) represents no policy intervention. The final DID result shows a p-value of 0.054* which is not significant and therefore the original hypothesis cannot be rejected. The coefficient of -38.013 indicates that the policy intervention of increasing tariffs is ineffective and negative. The time trend graph shows that the experimental and control groups have similar trends before the event and the parallel trend hypothesis is satisfied. After the event, the difference between the treatment and control groups is not significant and there is a significant negative policy effect. Therefore, the boycott policy of each country has little effect on the export volume of China's new energy vehicles.

The challenges that China's new energy vehicles face in the export sector go far beyond the high tariff barriers imposed by the United States and European countries. In fact, the complexity and diversity of restrictive policies cover many other factors, such as technical standards, market access conditions and environmental regulations. Therefore, in order to explore the actual impact of foreign restrictive policies on the development of China's new energy vehicle industry, it is necessary to further broaden the scope of data collection and comprehensively introduce more dimensions of restrictive policy data. This will help to build a more accurate and comprehensive impact analysis model, thus providing a more targeted and valuable reference basis for China's new energy vehicle export strategy.

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