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Analysis of the effect of China's new energy vehicle industry policies on a typical enterprise

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ABSTRACT

The promotion of new energy vehicles (NEVs) is in line with China's eco-civilization strategy and can help China realize the transformation from a big automobile country to a powerful automobile country. For the support policies of the NEV industry, the means of policy suggestions by which previous studies put forward lack pertinence to different time stages and effective objects. In this study, we present a two-dimensional framework of "policy instruments and value chain", that divides policies instruments into three types of supply, demand and environment and characterizes the industrial value chain as technology research, enterprise development and sales volume of enterprises, and apply the framework to analyze the effect of NEV industrial policies on a typical NEV enterprise in China. Some conclusions are drawn as follows: (1) although the support policies are criticized, the core aim of them is to build a healthy market; (2) policies have a great role in promoting the development of the enterprise, which is indicated by the consistency of the turning point of data between the enterprise and policies; and (3) the correlation between enterprise data and policy data is not obvious as there are many stakeholders, which makes policies have both direct and indirect effects on enterprises.

Keywords: policy analysis, policy effect, value chain, new energy vehicles, China

1. INTRODUCTION

The promulgation of China's new energy vehicle (NEV) industry policies is under the multiple backgrounds of economy, politics, and environment. First, the NEV industry can become one of the driving forces for the continued development of China's economy through the industrial linkage effect [1]. Second, by developing the NEV industry, China can gradually mitigate the dependence on imported oil and increase its energy security [2]. Third, the development of the NEV industry will bring huge environmental benefits [3].

With the development of the industry, the goals of China's NEV industry policies also focus on different directions. By observing the migration of goals in different development stages, we can summarize the characteristics of previous development stages to put forward effective suggestions for current development, make the policy goals more focused, and promote the standardized development of the industry. Meanwhile, selecting typical NEV enterprises to conduct case studies can help analyze the fit of the policies to the individuals involved, thereby opening up the microscopic perspective of the analysis and evaluation of policy effects.

Current practice of policy effect analysis in the NEV industry in China has been mainly qualitative studies. For instance, Gong et al. (2013) [4] summarized the efforts made by the Chinese government since 1995 in various

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levels of maturity of the NEV technology. Zhang and Qin (2018) [5] compared NEV policies that were launched by China's national, provincial, and municipal authorities in terms of their similarities and differences and their successes and failures. The focus has been on fiscal subsidies and tax incentives [6]. Several policy analysis frameworks have been designed to study the direction of NEV policies (e.g., [7] and [8]). Few studies so far have investigated the NEV policy effect quantitatively, e.g., evaluating the transformation of policy implementation effects at different development stages using a quantile regression model [9] and measuring NEV patents using a social network analysis [10]. No study has quantitively analyzed the NEV policy effect on the development of typical individual enterprises.

The objective of this study is to enrich and improve the analysis of NEV policies in China. We thus present a method that combines macro and micro perspectives by collecting relevant information about NEV policies, particularly their objectives and effects on the market and enterprise development, and by introducing a typical enterprise in China as the case study object.

2. MATERIALS AND METHODS

2.1 Policy selection and compilation

Policy documents have been collected from Beida Fabao (www.pkulaw.cn/) and divided into two categories: one is the documents promulgated by the State Council and some ministries and commissions under the State Council (hereafter referred to as the central policies); the other is the documents issued by various provinces and cities (hereafter referred to as the local policies). Two criteria are adopted for the compilation and classification of policies: (1) being accurate to the sentence to avoid omission and (2) counting by point to avoid repetition.

2.2 Enterprise choice

BYD Co., Ltd. (hereafter referred to as BYD), founded in 1995 and listed in Hong Kong in 2002, has three major industrial clusters: IT, automobile, and new energy. In the field of electric vehicles, BYD got involved earlier and launched its first electric vehicle in December 2008. Its NEV series are relatively mature, have a wide group of consumers. The sales data ranks first in the Chinese market all year-round, and also ranks among the best in the world's NEV market. In addition, in the development of NEV technology, the number of related patents held by BYD is also highly competitive in China and even in the world.

BYD is chosen as the research object for three reasons: (1) we can get conclusions related to enterprise management and operation, thus providing a basis for the policy formulation of China's NEV enterprises; (2) BYD, as the current leading enterprise of NEV sales in China, its data reflects its problems and can be used as a typical example to help get a glimpse of the China's NEV industry; and (3) as a listed company, BYD's data is more convenient to acquire.

2.3 Analysis framework

A two dimensional framework is established to analyze the effect of NEV polices (Fig 1).

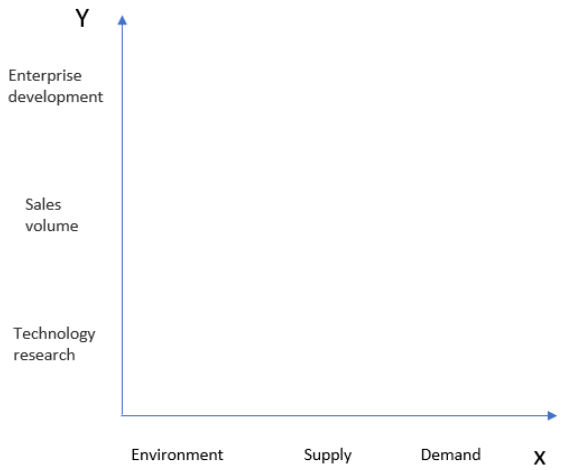


Fig 1 Two-dimensional analysis framework of policy instruments and value chain

In the X dimension, the three types of policy instruments, viz. environmental, supply-side, and demand-side [11], have been adopted. Environmental policies are environmental factors that influence technological development through policies; they include regulation control, target planning, financial and taxation support, intellectual property, etc. Supply-side policies represent the impetus of those policies towards the emerging technology; they include talents and training, information and technical support, capital investment, infrastructure, etc. Demand-side policies refer to the government's efforts to reduce market uncertainty; they include government procurement, trade control, market subsidies, price guidance, etc..

In the Y dimension, the policy effect is represented by the industrial value chain that consists of technology research, enterprise development, and sales volume. For technology research, the number of invention patents of enterprises is selected as an indicator for the measurement the innovative technology level and

willingness of enterprises. For enterprise development, the clauses in the policies that promote the long-term development of the NEV industry is included in the classification. For sales volume, the NEV industry has been developed with the governmental support; the increase in profits brought by the increase in sales volume can support enterprises to break away from support policies and move towards a normal development path.

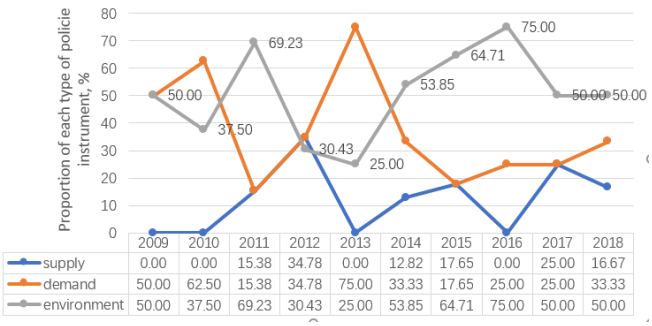
It is worth mentioning that the two dimensions were defined based on two key stakeholders of NEV policies: governments (or government policies, in X-axis) and enterprises (in Y-axis). Their perspectives constitute two levels of our analysis. The detailed classification of the two dimensions is to see how enterprises respond to different policy types, not from nine stakeholders or nine perspectives.

3. RESULTS AND DISCUSSION

3.1 The main policy purpose for a healthy NEV market

Policy classification showed that the policies had no preference for a specific enterprise and their main purpose was to promote the sound development of the whole NEV market. This purpose can be analyzed from three points.

(1) The environmental policies accounted for a high proportion of the three types of policy instruments in most years (Fig 2), which indicated that the policy focus did not absolutely support either of the consumers or suppliers in the current market, but regulated the market order, guided the direction of enterprises, and promoted their sound development. The clauses contained in this type of policy mainly emphasized five aspects of policy goals: industry permission, safety supervision, market competition, consumer right, and purchase discount.

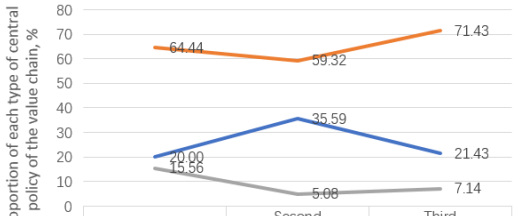


	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
supply	0.00	0.00	15.38	34.78	0.00	12.82	17.65	0.00	25.00	16.67
demand	50.00	62.50	15.38	34.78	75.00	33.33	17.65	25.00	25.00	33.33
environment	50.00	37.50	69.23	30.43	25.00	53.85	64.71	75.00	50.00	50.00

Fig 2 The proportion of three types of policy instruments (2009-2018)

(2) The proportion of demand-side policies were declining after 2013. The original intention of purchasing guidance in the early stage was not just for consumers, but to expand the market and improve consumers' acceptance of NEVs. As the market scale gradually expanded, the financial subsidies had been declining, and the subsidy means had been relatively fixed. Such an example can be seen in the *Notice on Continued Promotion and Application of NEVs* (hereafter referred to as the 2013 Notice) that has been issued for many years.

(3) In all the three stages, the number of enterprise development policies accounted for the largest proportion among the three types of value-chain components (Fig 3) and focused on the long-term benign development of the whole industry, not only emphasizing the sales volume and innovation of current enterprises but also emphasizing the benign guidance for fast-developing enterprises.



	First Stage(2009-2012)	Second Stage(2013-2015)	Third Stage(2016-2018)
Sales Volume	20.00	35.59	21.43
Enterprise Development	64.44	59.32	71.43
Technology Research	15.56	5.08	7.14

Fig 3 The proportion of central policies of the value-chain classification in the three time stages

3.2 Synchronization of policy data and enterprise data in time

The sales of BYD's NEVs began with its first NEV F3DM in 2009 (Fig 4); and 2009 was the first year when the central government began to vigorously assist the NEV industry. In addition, the turning point of sales was 2014, in which BYD's sales increased by 580.3% year-on-year. In September 2013, four ministries and commissions under the State Council promulgated the 2013 Notice that, while did not propose any new method to promote sales, extended the private subsidies for NEVs in five pilot cities selected in 2010 to all provinces and. Therefore, BYD's NEV sales were more obviously affected by the sales volume policies.

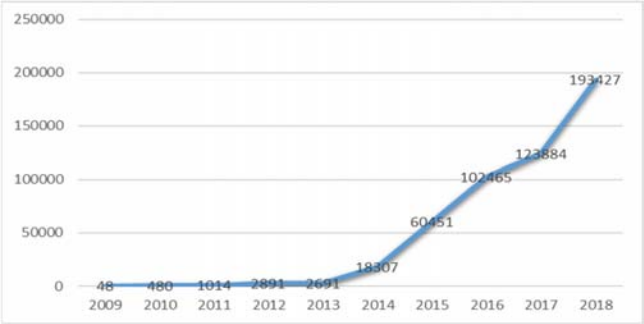


Fig 4 Annual sales volume of NEVs from BYD (2009-2018) (data complied from China Automobile Industry Yearbook)

There were also three obvious stages in the data changes of BYD's NEV invention patents (Fig 5), and the timing was roughly similar to the above-mentioned three-stage classification. The change node of patent data had a certain relationship with the time of policy issuance. For example, from 2012 to 2013, the number of BYD's invention patents showed a leaping increase. Coincidentally, in September 2012, the central government issued the "Notice on Organizing and Carrying out Technological Innovation Projects in the NEV Industry". BYD's innovation decision might have been affected by this document, which had accelerated BYD's research and development process.

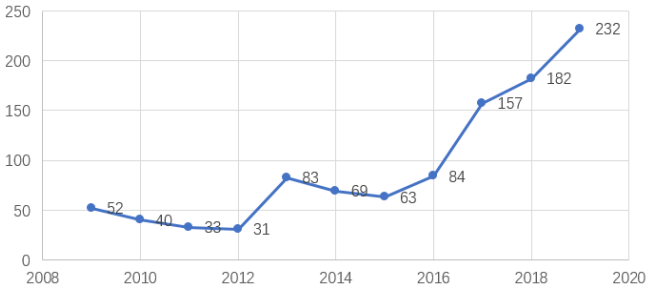


Fig 5 Annual invention patents of NEVs From BYD (2009-2018) (data compiled from the "Paten Star" website (www.patentstar.cn))

3.3 The influence of policy stakeholders on enterprise development

The relationship between policy data and corporate data cannot be observed straightforwardly. The NEV industry policies involved many stakeholders such as government functional departments, commercial banks, and consumers. Various parties had taken different actions for their own interests according to the current market environment, directly or indirectly affecting the process by which policy functioned, thereby increasing the complexity of the relationship between enterprise data and policy data.

4. CONCLUSIONS

This study uses the two-dimensional framework of "policy instruments and value chain" and case analysis and adopts BYD as a typical enterprise to make a more detailed analysis of the effect of China's NEV industry policies. The main conclusions can be drawn as follows:

- The NEV industry has a healthy policy goal and can create a virtuous circle.
- Policies should increase the means to encourage enterprise innovation and promote industrial development.
- The policy clauses that encourage the construction of supporting facilities are gradually increasing and the means are more concrete.
- The role of policy is the consistency of the turning point of data between the enterprise and the policy.
- The policy's promotion of enterprise development has both direct and indirect effects.

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