

Comparative Analysis of Policy Effect Evaluation of New-energy Vehicle Industry in China and the U.S.

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Abstract. Against fluctuations in the global automotive market, the electric vehicle (EV) industry has demonstrated a positive development trend overall. China has become a leader in battery production and related infrastructure construction, while the United States, though ranking third, also holds an important position. This paper analyzes the effects of government-led policies and market-driven policies on the electric vehicle policies of China and the United States. It explains how the industries and policies of the two countries interact. By analyzing the current state of the industries in both countries and their different policy preferences in terms of fiscal policy, infrastructure allocation, and other dimensions, the following conclusions can be drawn. Firstly, compared to the incoherent central policies and decentralized local policies lacking central authority in the U.S. electric vehicle industry, China's top-down long-term policies lead to a more consistent and efficient development of its electric vehicle industry. This article concludes that China's strong authoritative and consistent policies in the electric vehicle industry play an important role in maintaining its leading position in the global electric vehicle industry.

Keywords: New-energy vehicle industry, policy evolution, policy effect.

1. Introduction

In 2022, more than half of the world's electric vehicles were used in China, making it the third-largest electric vehicle market globally, with the highest growth rate in sales. Although both countries are major developers of electric vehicles, China's sales and production far exceed those of the United States. However, until 2015, the United States was the largest electric vehicle market, followed by China. Under the global goal of net-zero emissions by 2050, both China and the United States emphasize the important role of the electric vehicle industry in reducing carbon emissions and achieving sustainable development, as well as in competing in the global market and climate politics [1, 2]. By 2030, nearly one-third of cars on the road in China will be electric vehicles, compared to nearly one-fifth in the United States [3]. The rapid proliferation of various types of electric vehicles will reduce oil demand by 6 million barrels per day by 2030 and by over 10 million barrels per day by 2035, equivalent to the current oil use of road transportation in the United States [4].

How to further cultivate the development of the electric vehicle industry is a key issue for energy security, energy saving, emission reduction, and industrial transformation in China and the United States, the world's two largest economies. By comparing the different policy orientations of these two major economies toward the electric vehicle industry, this paper may provide insights into the development of the electric vehicle industry in other countries and their policy-making processes. Furthermore, this article may offer an ideal model for achieving zero emissions, helping the international community to achieve harmonious and sustainable coexistence and prosperity.

Under the shared concern for climate change and global sustainable development, the global electric vehicle industry has been booming in recent decades. As a major component of transportation, electric vehicles play an important role in achieving energy transmission and emission reduction for various countries, and in realizing the global net-zero emissions goal by 2050. This report focuses primarily on studying the status of the electric vehicle industry in China and the United States to understand the current development of the industry in both countries. Additionally, it analyzes from

a comparative perspective the current policies for the electric vehicle industry in both countries and examines how these two different policy guidance models impact the industry. At the end of the article, it discusses the challenges and competitiveness faced by the U.S. and Chinese electric vehicle industries in the context of globalization and sustainable development.

2. Concept Overview

If a vehicle contains a battery or is classified as a plug-in hybrid vehicle, it can be defined as an electric vehicle. Electric vehicles are seen as a promising alternative to internal combustion engine vehicles that emit harmful gases. According to the 2024 annual report by the International Energy Agency, as major markets develop and emerging economies rise, electric vehicle sales continue to maintain strong growth. Total electric vehicle sales may reach about 17 million units, a 25% increase from the first quarter of 2023 to the first quarter of 2024. By 2024, the market share for electric vehicles could reach 45% in China, 25% in Europe, and over 11% in the United States [4], thanks to competition among manufacturers, declining prices for batteries and vehicles, and ongoing policy support. The continuous growth in electric vehicle sales continues to drive global battery demand, with the fastest growth in 2023 seen in the United States and Europe, both up by over 40%, followed closely by China, with an increase of about 35%. Given existing policies supporting the widespread adoption of electric vehicles, significant development is expected in the coming decades, impacting the future of transportation [3]. As for industry pioneers, BYD and Tesla remain far ahead, accounting for 35% of all electric vehicle sales combined in 2023 [4].

However, due to global events in recent years, the growth of electric vehicles (EVs) has been directly impacted. The COVID-19 pandemic severely disrupted the electric vehicle and automotive industries. Lockdowns and travel restrictions hindered the workforce, forcing many people to work from home. Global affairs, including the Russia-Ukraine war, led to a sharp increase in global gasoline prices [5]. Such events disrupted supply chains, resulting in price hikes for key EV materials such as nickel and lithium [1,6]. The sustainable development of the electric vehicle industry is critical to achieving the global net-zero emissions goal by 2050. Therefore, there are challenges and potential in the EV industries of both China and the United States.

2.1. China's Electric Vehicle Industry

Over the past few decades, China has maintained a leading position in the electric vehicle industry, possessing the largest electric vehicle market and achieving strong growth driven by national strategic policies. In China, new electric vehicle registrations reached 8.1 million units in 2023, a 35% increase from 2022. In 2023, China exported over 4 million vehicles, becoming the world's largest automobile exporter, with 1.2 million of these being electric vehicles [4]. From January to March 2024, nearly 1.9 million electric vehicles were sold in China, representing a nearly 35% increase compared to the first quarter of 2023. The year 2023 marked the first time that China's new energy vehicle industry operated without national subsidies for electric vehicle purchases, which facilitated a 35% market expansion from 2023 to 2024. Additionally, China leads in the deployment of EV charging infrastructure, with over 85% of the world's fast chargers and about 60% of slow chargers. China is also the world's largest exporter of EV batteries, exporting approximately 12% of electric vehicle batteries.

BYD, a leading Chinese electric vehicle company, holds an 80% market share in the electric vehicle segment, having developed primarily as a battery production company, thus enjoying a natural advantage in EV manufacturing and sales [7]. In 2022, BYD surpassed Tesla to become the global sales leader in plug-in hybrid vehicles. In the second half of 2023, BYD became the world's best-selling pure electric vehicle company. When considering both BEV (Battery Electric Vehicles) and PHEV (Plug-in Hybrid Electric Vehicles) models, BYD's market share in the global electric vehicle market is slightly over 20%. BYD also became the top-selling automotive company with over 2.4

million new registrations, capturing 11% of the domestic market. BYD's global sales exceeded 3 million units, making it one of the top ten automotive sellers worldwide.

2.2. The United States Electric Vehicle Industry

The development of the electric vehicle industry in the United States has been driven by government support and technological advancements, with a steady increase in the number of electric vehicles since 2010. In the U.S., new electric vehicle registrations totaled 1.4 million in 2023, marking an increase of over 40% compared to 2022. Sales in the first quarter reached approximately 350,000 units, nearly a 15% increase from the same period the previous year [4]. By 2024, U.S. electric vehicle sales are expected to grow by 20% compared to the previous year, with nearly 500,000 additional units sold compared to 2023. The U.S. is the fastest-growing major EV market, with an increase of over 40%. Nevertheless, the U.S. market remains smaller than China's, with about 100 gigawatt-hours in 2023 compared to China's 415 gigawatt-hours. The U.S. import share remains relatively large, meeting over 30% of the demand for electric vehicle batteries. In 2023, U.S. production of EV batteries reached 70 gigawatt-hours, and total production of electric vehicles reached 1.2 million units. As of 2023, Tesla accounted for over 45% of total U.S.

3. Comparative Analysis of China and USA Policies in the NEV Industry

3.1. Analysis Framework of Content, Outlook, Power, and Authorities (COPA)

According to Lindblom and his incrementalism model of policymaking analysis, decision-making and efficiency of specific policy is an incremental process of dynamic interplay between different power groups of different [8], or even opposed interests. Furthermore, this process exemplifies the allocation of limited social resources, impediments of government bureaucracy, and the human nature of avoiding the risky pitfalls of policy amendments [9]. This incremental policy analysis framework allows examination of the interplays between the government and capital market regarding NEV industry policymaking and implementation. The COPA framework (i.e., analysis from four dimensions of content, outlook, power, and authorities) is utilized to analyse policy evolution in respect of the new-energy vehicle industry (NEVI), which corresponds with the incrementalism of policy evaluation. The following paragraph discusses how these policies take effect under powerful government authority (which is the case in China) or under highly autonomous markets (which is the case in the USA).

According to previous research, public policy is a “sociopolitical space constructed as much through techniques and instruments as through aims or content” [10]. Therefore, a public policy instrument, which constitutes a technical and social device to coordinate power relations between the state and those it is addressed to, significantly impacts the outputs of a specific public policy. In this part, the framework of interest analysis is applied to evaluate the efficiencies of the two different types of public policy introduced in former parts, from the perspective of incrementalism of policy analysis. Outputs of the policies will be analyzed from the perspectives of policy making and implementation, specific impacts on the new energy vehicle market and its supply chain, and the overall impact on the industrial development. Theoretically, this comparative analysis assumes that the contrast between the strength of state government and that of the public & society leads to a dynamic process of interaction and bargaining between state and society in terms of a specific policy, from its formation, implementation, and revision. This assumption can be testified by examination of policy outputs on industrial development [11].

3.2. Comparison of Different Policies of New Energy Vehicle Industry (NEVI) in China vs. USA

3.2.1. Policy Priority & Implementation Instruments

Promoting the utility of new energy and optimizing energy consumption structure is a crucial part of China's national strategy to alleviate its domestic environmental problems and energy shortage. As an important part of China's energy revolution, the development of NEVI has been controlled or supported by governments in all sectors [11]). NEVI policy in China exhibits a high extent of government authority and strategic deployment. This also corresponds with the "Made in China 2025" planning, which expects to stimulate technological innovation in NEVI and therefore reinforce China's competence in the global NEV market and supply chain. This strategic requirement is deeply rooted in China's national planning of sustainable development and its dual carbon targets of carbon peaking by 2030 and carbon neutrality by 2060. Therefore, this urgent requirement of NEVI development calls for powerful governmental control to achieve high efficiency and a low level of negative externality. Chinese government applies powerful policy implementation instruments such as direct financial subsidy, quotas, and mandatory standards to monitor the overall industry and NEV market. For example, since 2017, China has implemented the Dual-Credit Policy (DCP), which requires traditional car companies to produce a certain percentage of new energy vehicles to offset the carbon emission credits of their combustion engine vehicles. If the enterprise cannot meet the standard, it must purchase new energy vehicle credits from other car companies, forming a strong policy pressure. As Peng and Li illustrate, the DCP has a significant impact on extending the NEV market penetration. Furthermore, the DCP is rather effective in energy saving and emission reduction [12].

The case in the U.S., however, is distinctively different. Its NEVI development has been propelled mainly by autonomous technological innovation and free market competition. Its NEVI policy focuses on stimulating technological innovation and the improvement of market competitiveness. The government supports R&D and infrastructure construction, especially encouraging private enterprises to independently develop R&D capability for new energy vehicle production. United States' new energy vehicle policy is more market-driven, with big companies' success stimulating others to innovate and catch up. While the U.S. is also concerned about environmental issues, policy guidance is not as explicit as China's for energy security or as part of a national strategy. White House pays more attention to diversified energy solutions, such as renewable energy, natural gas, hydrogen energy, etc., with NEV only part of the solution. The U.S. government applies policy instruments such as tax breaks and market incentives which highly rely on market mechanisms and have a limit on the total amount of subsidies for different enterprises. In the United States, the promotion of new energy vehicles is relatively fragmented, with some states (such as California) actively promoting zero-emission vehicle (ZEV) policies, requiring automakers to sell a certain percentage of new energy vehicles and some less active. Unlike China, the United States' policy on new energy vehicles relies on market incentives rather than mandatory requirements and standards. Enterprises can flexibly adjust their production and sales strategies according to market demand and competition, and the government is more likely to provide infrastructure support (such as charging network construction) and R&D investment.

3.2.2. Market & Supply Chain

China's NEVI policies issued so far have been focused mainly on government encouragement, technical support, and equipment specification. First, the government carries out active publicity and offers clear guidance to influence consumers' vehicle-purchasing preferences. Second, the government supports core technology development of NEV production and innovation. Third, the government formulates authorized standards on links and products in the NEVI chain [11, 12]. According to Dong and Liu, the Chinese government insists on clear consumer-behavior guidance, with 75 guiding policies issued by various authorities. Furthermore, the Chinese government also introduces fiscal and tax support, such as purchase-tax exemption and the provision of car purchase

subsidies [11]. China has started to speed up the process of NEVI development of subsidy policy (mainly toward producers) [13], which primarily propelled NEV innovation and manufacturing in the starting stage. These policies shape the NEV market and supply chain by directly affecting consumer preferences and behaviors and setting mandatory standards for enterprises. China's NEV export in the global market is also driven by government configuration.

China's current NEV promotion policy plays a significant role in promoting its industrial development. Among its contributions, technological innovation policies, energy environmental policies, and tax subsidy policies play the most significant role. However, the existing policy system still has weaknesses. The current NEVI policy involves relatively narrow fields, insufficient incentives for infrastructure construction, and a lack of agency. These deficiencies restrict NEV companies from conducting technological research. Instead of building a balanced and comprehended NEVI system, policymakers currently focus on massive manufacturing and purchasing promotion, which is less time-consuming and more achievable. According to Zhang and Liu, China's new energy vehicles industry is in the commercialization and marketing stage; therefore, current policies in China mainly encourage business promotion, instead of public R&D stimulation [14]. Although the Chinese government issued the National Plan for the Eleventh Five-year Science and Technology Development in 2006 which proposes a substantial increase in funding for NEV research, technical support, local policies relating to technical support or public R&D are still lacking [14]. Furthermore, cities that highlight technical support are mainly more developed cities such as Beijing and Shanghai, which leads to the imbalanced development of NEVI in different regions.

Compared to China, the U.S. has formed a free market of NEVI with intense competition and a high level of agency. Its NEV industrial structure exhibits distinct market-oriented competition, which is also the driving force for innovation and overall industrial development. The U.S. NEVI depend highly on market demand and the state government plays a standby role in this process. This high autonomy for NEV companies comes with pros and cons. On the one hand, it allows flexible manufacturing and market strategy, which significantly promotes innovation and upgrading. This has helped the U.S. develop high-end NEVs and stay competitive in the global market [15]. On the other hand, compared to China, the adoption process of NEV in the United States is slower, due to less powerful guidance and weaker effect on consumer behavior. Besides, this enterprise agency has been causing a distinct lag between the construction of charging infrastructure and market demand. After-sale services and basic charging appliances are still in shortage. This fragmented supply chain is a side-effect of the free market, because intense competition highly focuses on NEV innovation and mass production, with thorny fields such as battery and charging systems untouched [16].

The U.S. policy focuses highly on technological innovation, especially aiming at promoting competitive NEV companies to conduct R&D programs. The U.S. government primarily provides innovation funds to set up scientific research projects to provide support for enterprises. Department of Energy started to fund car companies for their R&D project of battery innovation and so on. In 2009 the U.S. government set up \$2 billion for R&D funding projects to support the innovation of core technologies and key components. Subsequently, the Ministry of Energy established a \$25 billion R&D funding, providing low-interest loans to companies engaged in technical innovation. The U.S. government has accelerated the all-around development of the high-tech field of NEV and has also directly invested in 48 new energy vehicle research and development projects [16].

4. Conclusion

Based on a comparative analysis of NEVI policies in China and the U.S., it can be concluded that both government-guided policy and market-oriented policy exhibit advantages in promoting industrial development. While the former provides overall configuration and powerful guidance to directly shape the NEV manufacturing and domestic market, the latter enables enterprises agency and autonomy for innovation and free competition.

In China's case, the conclusions are as follows. (1) The Chinese NEVI policy attaches persistent importance to government-guided consumption and government-led industrial development, with high authority and relatively low extent of the market agency. Although "moderate" industrial policies are gradually being adopted as well, the issuance strength has been maintaining a steady rise of consistency. The competent authority is one of the key factors that continuously affect the development of the NEVI in China. (2) The effect of industrial policy differs greatly at different development stages. Along with the gradual formation of market orientation of the NEVI, the effect of industrial policies has been weakening gradually. Appropriate reduction of subsidy is expected to achieve optimal allocation of government resources.

It can be concluded in the U.S. NEVI case that although capital market and free competition propel technical advancement, it also tends to overlook social welfare and infrastructure construction for NEV buyers who require an after-sale guarantee, which is crucial in NEV replacing traditional vehicles. A high level of local autonomy has also led to inconsistent provincial policies for NEVI, with the domestic supply chain remaining fragmented and requiring the import of batteries and other materials. The role of the U.S. government is less powerful in promoting NEV purchasing and mainly focuses on stimulation for technical innovation. However, this policy preference has been changing moderately after the Biden administration launched the Inflation Reduction Act which exhibits stronger state control over NEV supply chain and after-sale system.

Theoretically, both government-guided policy and market-oriented policy evolve throughout the dynamic interplay between society and state. According to incrementalism, this process includes changing of strength of government and market, which may lead to a gradual shift from one to another. Therefore, China and the U.S. need to utilize each other's experience for better policy revision to achieve sustainable development in NEVI.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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