MDPI

Article

Measuring the Policy Effectiveness of China's New-Energy Vehicle Industry and Its Differential Impact on Supply and Demand Markets

Di Wang [1,2,*] and Yuman Li [1]

1   School of Economics and Management, China University of Mining and Technology, Xuzhou 221116, China; liyuman@cumt.edu.cn
2   Carbon Neutrality and Energy Strategy Think Tank, China University of Mining and Technology, Xuzhou 221116, China
*   Correspondence: wangdi.js@cumt.edu.cn

Abstract: To promote the precise governance of China's new-energy vehicle (NEV) industry, this paper quantitatively analyzes 204 policy texts on the NEV industry in China since 2007 and constructs an evaluation system of policy effectiveness from three dimensions of policy attributes, policy objectives, and policy measures to reveal the effectiveness and evolutionary trends of China's NEV industry policies. In addition, this paper explores the two-way effects of different types of policy measures on the NEV supply and demand markets through an econometric model to reveal the differential impact effectiveness of various policy instruments in China's NEV industry. The results indicate that China's NEV industry has changed from "government-driven" to "government-driven + market-driven", and the multi-sectoral policy coordination needs to be further improved; the dynamic evolution over the years reveals a similar pattern of change in the total effectiveness of policy issuance as influenced by the number of policies; the quantity of patents in China is large but the quality of patents is insufficient, and an overall problem of low level of core technology is being faced; taxation and subsidy measure, technical innovation measures, social guidance measures, and environmental support measures all effectively promote the development of the supply-side market, while taxation and subsidy measures, social guidance measures and legal regulation measures can better promote the development of the demand-side market; the impact of financial support measures on both supply and demand-side markets is not significant.

Keywords: new-energy vehicle; industrial policy; policy evaluation; effectiveness evaluation

1. Introduction

With the acceleration of China's economy and urbanization, the greenhouse gas emissions caused by the consumption of fossil energy have grown rapidly [1,2]. As an important sector affecting urban greenhouse gas emissions, the issue of carbon reduction in the automotive industry has received widespread attention from all sectors of society [3–5]. The International Energy Agency (IEA, 2016 [6]) pointed out that the carbon emissions of the global automobile industry account for 25% of the total greenhouse gas emissions, gradually having a trend of enhancement, which will have an increasing impact on regional energy demand, environmental pollution, and public health in the future. As a decisive starting point for realizing regional green transformation, the new-energy vehicles (NEV) are not only the leading direction of the long-term development of the global automobile industry but also the key means for the Chinese government to reduce air pollution and carbon emissions [3,7]. According to the China Association of Automobile Manufacturer data, it is shown that the sales of NEV in 2011 were only 8159 units, and by 2021 sales of 3,521,000 units, accompanied by the retention of the position of being top in the world. The speeding development of China's NEV industry, as an emerging economic industry, cannot

be separated from the huge market demand and the support and orientation of national and local policies [8].

As early as 2012, the *Energy-saving and New-Energy Vehicle Industry Development Plan (2012–2020)* issued by the State Council proposed that the new-energy vehicle industry is supposed to take as an important task the acceleration of the transformation of the economic development mode, the intensity of supporting policies should be strengthened and a nice development environment ought to be created. Moreover, to promote the transformation of the automobile industry, the State Council further emphasized the request that "combining market leadership and government support, we should establish a long-term and stable development policy system of NEV, create a good development environment and accelerate the cultivation of the market, to promote the steady and rapid growth of the NEV industry". In addition, the government also stated clearly that the promotion and application of NEV should be accelerated in terms of infrastructure construction, fiscal and tax subsidies, and business model innovation. Therefore, the Chinese government has successively issued a series of related policies to promote the development of the NEV industry. However, up to now, the existing problems include a lack of innovation in core technology, an insufficient quality assurance system, lagging infrastructure construction, unsound industrial ecology, and increasing market competition. Therefore, there is an urgent need to examine the issued policies corresponding to the NEV industry. The policy evolution characteristics should be clarified, and the policy effectiveness needs to be quantified, and then the effective policy tools for industry policies can be screened.

Vigorously developing the NEV industry is an important strategic measure to effectively alleviate the environmental pressures and promote the transformation and upgrading of the automobile industry. Currently, the relevant studies on the NEV policies mainly focus on the supporting policies of industry and market promotion, such as tax incentives, R&D subsidy, financial support, infrastructure construction, road sign priority, and public acceptance [9–13], which is described as follows. Using analysis of the influencing factors of China's NEV market demand, Liu et al. believed that it is more effective for the policies of dynamic taxation and static subsidy in promoting the NEV market [14]. Wang et al. evaluated the heterogeneous impact of government subsidies on the financial performance of NEV companies [15]. Jenn et al. found that for every $1000 provided by the U.S. government as a rebate or tax credit, the average electric vehicle ambulance sales increased by 2.6% by evaluating the impact of policy measures on electric vehicle adoption [16]. Moreover, Wang et al. proposed the key to promoting NEV is the density of charging piles, the preferential level of license fees, the existence of driving restrictions, and the priority of infrastructure land [17]. After investigating the issue of the impacts of subsidy policy and dual credit policy on NEV and fuel vehicle production decisions, Li et al. believed that the battery recycling rate is the most crucial element influencing the NEV manufacturer's competitive status under both policies [18]. In addition, Chi et al. used the synthetic control method to verify that the license plate quota policy for internal combustion engine vehicles had a positive impact on the adoption of NEV [19]. Xiong and Wang endorsed that policy announcements could enhance the policy cognition of potential consumers and their purchase intentions. Meanwhile, increasing infrastructure construction and optimizing incentive policies were some of the necessary measures [20].

The evolution of NEV industry policy has been explored in existing related studies. Someone pointed out that the main body of regulation was gradually changing from the government to the market and the focus of policies transitions from producer orientation to consumer orientation [21–24]. Zhang et al. discovered that an overall trend of the mutual promotion between the central government and local government was presented with the evolution path of industry policies from 2006 to 2016 [25]. The existing industrial policies cover industrial planning, financial subsidies, and policy pilots, but the policy synergy and communication mechanism between the central government and local governments have yet to be strengthened, especially in terms of industrial technology R&D and infrastructure layout. Zhang and Qin concluded that the implementation of the policies consisted of a

"plan-pilot-promotion-subsidy-development" process, supporting that the promulgation of industrial policies should focus on infrastructure construction, R&D, recycling of batteries, and private purchase regulations [26]. Hartley et al. used data from semi-structured interviews with EU circular economy experts to identify policies to accelerate the transition to a circular economy, including more robust production standards, tax breaks for recycled products, and support for awareness campaigns, which could also be applied to the transition of the automotive industry [27]. Put another way round, many scholars were aware of the importance of the purchase intention and acceptance of NEV. Many scholars have introduced the social and cultural elements into the cognitive behavior model, exploring the impact of supportive policies and customer perceived value on the purchase intention of NEV customers [28,29]. Overall, despite the obvious diversity in political systems and economic structures among various countries, technology R&D and market promotion are regarded as prominent means for the sustainable development of the NEV industry [30,31]. The consensus view is that government subsidies and other consumption stimulus factors are the main driving force in the initial stage of the development of the NEV, while along with the gradual weakening of policy orientation, the sustainable development of the NEV industry cannot be separated from the convenience and cost advantages brought by technological progress and infrastructure improvements [32].

Throughout the domestic and foreign academic research on NEV policies, the majority investigate the intervention effect of various industrial policies based on the causal inference paradigm [11,13,33]. This kind of "looking back" policy research helps review the effect of policy implementation and summarizing experience, but it will interfere with the implementation effect of relevant industrial policies through man-made factors like large subsidy defrauded and administrative barriers, directly leading to the neglect of the fundamental issue of the validity of the policy text itself in the process of judging its validity by the effect of policy implementation [34,35]. Policy effectiveness is often affected by multiple factors and subjects in the process of policy implementation. The traditional policy evaluation methods (such as regression discontinuity, multiple difference method, instrumental variable method, etc.) tend to measure the effectiveness of policy by the results of policy implementation, but pay little attention to the policy itself, resulting in the subjectivity and uncertainty of policy evaluation [15,36].

In contrast, the text analysis method can directly reflect the policy makers' policy intentions, policy goals, and focus of attention by extracting policy text information and the characteristic items, which can noticeably avoid the subjectivity and uncertainty of effectiveness evaluation and the ambiguity of qualitative research, widely applying to the evaluation of policy effectiveness in various fields as mining, transportation, wind energy and NEV [37–40]. For example, Dong and Liu utilized the COPA framework to analyze the policy evolution in respect of the NEV industry [8]. Yang et al. used the text mining technology and PMC model to evaluate quantificationally 11 policies in China's NEV industry, proposing that more specific and feasible subsidies policies should be issued by the government, and the focus of industry ought to be shifted gradually from norm-oriented to market-oriented [41]. Zhang and Qin classified and compared the industry policies by using qualitative analysis methods, revealing there were differences in the focus of policy concerns in different periods and regions [26]. Li et al. explored the latent topics of numerous NEV policy documents and their impact on promoting NEVs at the city level by combining the Latent Dirichlet Allocation (LDA) topic model and the econometric method [42]. In general, the existing studies on the policy evolution of the NEV industry mainly focus on policy routes and policy effectiveness evaluation, using a qualitative analysis method to investigate the impact, but lacking an integrated classification system and evaluation method, especially for the analysis of the heterogeneous policy effectiveness of different types of policy tools.

Based on the above literature analysis, first, by combing China's new-energy vehicle industry policies from 2007 to 2022, this paper quantifies and analyzes the content of policy texts, establishes a policy evaluation index system, and reveals policy effectiveness

and evolutionary trends in three dimensions: policy attributes, policy goals, and policy measures. Second, since different types of policy measures have different impacts on the NEV market and the same type of policy measures have different impacts on the dual-side market of supply and demand, we construct regression model 1 with policy effectiveness as the main explanatory variable and the dual-side market development level of the NEV industry as the explanatory variable, and model 2 with the effectiveness of six types of policy measures as the main explanatory variable and the same dual-side market development level of the NEV industry as the explanatory variable.

The main contributions of this paper are the following. First, this paper coded the policy data obtained through retrieval to construct a database of NEV industry policies in China. Second, we constructed an index system for evaluating the effectiveness of China's NEV industry policy in three dimensions: policy attributes, policy objectives, and policy measures. We used this index system to quantitatively analyze the NEV industry policies, avoiding the problem of information distortion when policy variables are measured by dummy variables. Third, the effectiveness values of the policy measures obtained from the indicator evaluation are incorporated into the regression models to explore the operational effects of heterogeneous policy measures on both the supply and demand side of the market, respectively.

The rest of the article in this paper is organized as follows. The second part deals with data sources and model design. The third part is the analysis of policy evolution, evaluation of policy effectiveness, and assessment of policy measures' effects on both the supply and demand side of the market. Finally, we present the conclusions and policy recommendations of this paper.

2. Methodology and Data

2.1. Data Foundation

To collect and analyze the NEV industry policies from both the textual content and external structure of the policies is the basic work to quantify the policy impact effects. This article mainly uses the *China Law Search System*, and *Peking University Laws & Regulations* Database as data sources to collect NEV industry policies. First, the search term was "new-energy vehicles" and "electric vehicles", and we filtered the retrieved texts one by one. Then, the official website of the relevant department was used to obtain the original text to ensure its integrity and accuracy. Referring to Yang et al. [41], this paper screened the policy texts according to the following principles: (1) the policy texts should be published by ministries and commissions that are closely related to the NEV industry; (2) the policy texts should directly reflect the policy orientation of government departments, excluding the forwarding of higher-level policy documents by lower departments; (3) the policy texts should include laws, regulations, and similar normative documents; (4) the policy levels we selected are the NEV industry policies issued by departments either at or above the level of ministry and commission; and (5) the inspection period of the sample selection is from 1 January 2007, to 1 June 2022.

According to the above principles, this article reviewed all relevant policy texts during the inspection period, letters, and notices without any substantive content. Subsequently, we developed a coding list of analysis units in terms of policy title, effectiveness level, issuing department, issuing time, policy attributes, policy objectives, and policy measures, and conducted an in-depth study of the retrieved policies. Eventually, we established a database of industrial policies in the field of NEV. This database contains 204 policies in the field of NEV industry, formulated independently or jointly by the General Office of the State Council (SC), the National Development and Reform Commission (NDRC), the Ministry of Finance (MF), the Ministry of Commerce (MC), the Ministry of Industry and Information Technology (MIIT), the Ministry of Science and Technology (MST), and many other departments. Especially, the NEV analyzed in this paper mainly refers to the use of non-conventional vehicle fuels as the power source, including pure electric vehicles, hybrid electric vehicles, and fuel cell electric vehicles.

2.2. Policy Effectiveness Evaluation System

Based on the different roles of the government in the development of the NEV industry, this paper develops quantitative criteria for the strength of the NEV industry policy in dimensions of policy attributes (PA), policy objective (PO), and policy measures (PM), drawing on the research ideas of Wang and Liu [36]. The strength of policy attributes is an indicator reflecting the size of the legally binding force of the policy, which is judged according to the level and type of the department that promulgates the NEV industry policy [43]. The intensity of the policy objectives is mainly the degree of toughness and detail of the attitude shown by the industrial policy to achieve the objectives related to the development of the NEV industry. The stronger the policy objective means the stronger and more detailed the policy is implemented. The strength of a policy measure reflects the degree of the binding force of the instrument or tool adopted to achieve the current purpose. This paper divides the measures of policies into six categories which are named the taxation and subsidy measures, financial support measures, technical innovation measures, social guidance measures, environmental support measures, and legal supervision measures, respectively. In this regard, we assign a score of 1 to 5 to each policy attribute indicator, with a score of "5" indicating the more legally binding the policy is. At the same time, considering that the scorers' understanding and grasp of the quantitative criteria of the policy text are not accurate enough, the indicators of the strength of policy objectives and policy measures are given three scores of 1, 3, and 5. Higher scores indicate stronger policy objectives and stronger policy measures. A higher score means stronger policy objectives and policy measures. The specific indicator assignment method and scoring criteria are shown in Table 1.

Table 1. The NEV industry policy intensity evaluation index.

Dimension	Score	Detailed Evaluation Criteria
Policy Attributes (PA)	5	Laws promulgated by the National People's Congress and its Standing Committee.
	4	Regulations, regulations, and instructions issued by the State Council; Ministerial orders of various ministries and commissions.
	3	Interim regulations, provisions, plans, decisions, opinions, methods, and standards promulgated by the State Council; Regulations, regulations, and decisions of various ministries.
	2	Opinions, methods, plans, guidelines, standards, rules, conditions, and interim regulations of various departments.
	1	Notices, announcements, and plans.
Policy Objective (PO)	5	There are detailed and specific promotion and application goals which involve multiple aspects, such as a detailed action plan, and clear safeguards and supervision units are provided.
	3	There are no separate policy objectives and task terms listed, only simple promotion and application objectives and simple action plans are given.
	1	The content of the policy does not clearly express the above purpose, only highlighting the need to accelerate the promotion and application of NEV.

Table 1. *Cont.*

Dimension		Score	Detailed Evaluation Criteria
Policy Measures (PM)	Taxation and subsidy measure (tsm)	5	The content involves financial subsidies, tax incentives, purchase tax exemptions, consumption tax exemptions, and other aspects, and there are clear and detailed implementation plans, specific fiscal and tax standards, and clear supervision plans.
		3	The content gives support from several aspects and is more specific, or from one aspect of the content and is very detailed and specific.
		1	Only the keywords such as finance or implementation of consumption tax and vehicle purchase tax are mentioned without a detailed description.
	Financial support measure (fsm)	5	There is support for the government or social capital to provide low-interest loans, senior loans, financing services, and many other aspects of the NEV-related industries, with clear, detailed implementation plans and clear regulatory plans.
		3	The content gives support through several aspects and is more specific, or is from one aspect of the content, being very detailed and specific.
		1	The content only mentions keywords such as low-interest loans or innovative and optimized financing channels and does not elaborate on them.
	Technical Innovation measure (tim)	5	The content includes support for NEV to carry out independent innovation in technology, build technology R&D platform, improve the NEV industry norms and technical standards, and other aspects, with a detailed implementation plan and a clear regulatory plan.
		3	The content gives support through several aspects and is more specific, or is from one aspect of the content, being very detailed and specific.
		1	The content only mentions that the NEV industry should strengthen technological innovation and increase investment in research and development, without a detailed description.
	Social guidance measure (sgm)	5	The content contains guiding measures to support NEV enterprises to carry out green development, energy saving, and emission reduction, with clear and detailed implementation plans and clear regulatory plans.
		3	The content gives support through several aspects and is more specific, or is from one aspect of the content, being very detailed and specific.
		1	The content only mentions that the industry needs to be promoted to guide green development, energy conservation, and emission reduction, etc., without details.
	Environmental Support measure (sem)	5	The policy includes the development of access standards for all aspects of the NEV industry, operational requirements for NEV enterprises, power battery safety requirements, and model catalogs, with clear and detailed implementation plans and clear regulatory schemes.
		3	The content gives support through several aspects and is more specific, or is from one aspect of the content, being very detailed and specific.
		1	The content only mentions the wording of the designation criteria and requirements and does not elaborate.
	Legal supervision measure (lsm)	5	For safety management and supervision measures, battery recycling supervision, reward and punishment mechanisms, work assessment, safety hazard investigation, and other related regulations and rules, the policy content has a clear and detailed implementation plan and a clear supervision plan.
		3	The content gives support through several aspects and is more specific, or is from one aspect of the content, being very detailed and specific.
		1	The content only mentions laws and regulations and other related terms, without details.

2.3. Policy Effectiveness Measurement Model

After determining the policy quantitative standards, we invited nine experts in the field of NEV industrial policy to form an evaluation team. To ensure that the evaluators reach an agreement on the quantitative rules, we fully discussed each of the quantitative standards in Table 1. Then, we scored the texts of 204 NEV industry policies between 2007 and 2022 in three dimensions: policy attributes, policy objectives, and policy measures, so we obtained preliminary quantitative data. The effectiveness of the policy measures (PM) of the NEV industry policy is not only related to the strength of the measures but also

influenced by the superimposed cumulative multiplier effect brought about by the strength of the policy attributes and the strength of the policy objectives [44]. We can explain that the stronger the policy attributes of the NEV industry, the clearer the goals to be achieved, and the more specific the measures that are adopted, the more effective will be the measures of this policy. Therefore, we use Equations (1) and (2) to calculate the total and average effectiveness of China's NEV industry policies and use Equation (3) to further obtain the effectiveness of policy measures.

$$NEVE_t = \sum_{i=1}^{N}\left(PA_i \times PO_i \times \sum_{j=1}^{M} PM_{ij}\right) \quad t \in [2007, 2022] \tag{1}$$

$$ANEVE_t = NEVE_t / N \qquad t \in [2007, 2022] \tag{2}$$

$$PM_t = \sum_{i=1}^{N}\left(PA_i \times PO_i \times PM_{ij}\right) \qquad t \in [2007, 2022] \tag{3}$$

where N represents the number of NEV industry policies in the t-th year; M indicates six policy measures such as taxation and subsidy measure (*tsm*), financial support measure (*fsm*), technical innovation measure (*tim*), social guidance measure (*sgm*), environmental support measure (*esm*), and legal supervision measure (*lsm*). $NEVE_t$ and $ANEVE_t$ denote the total effectiveness and average effectiveness of China's NEV policies in the t-th year, respectively; PA_i and PO_i denote in turn the score of policy attributes and policy objectives of the i-th policy; PM_{ij} means the score of the j-th policy measures the strength of the i-th policy.

2.4. Evaluation Model of Heterogeneous Policy Tools

According to the *Energy Conservation and New-Energy Vehicle Statistical Yearbook*, China's NEV industry has developed rapidly in recent years and reached 3.545 million units and 3.521 million units in production and sales respectively in 2021. The result could not have been achieved without the support of NEV industrial policy. To study the impact of different policy measures on NEV production and sales, this paper quantitatively analyzes the impact of six policy measures on the supply and demand of the NEV market for NEV during the inspection period from 2008 to 2021. Although the policy measures of the NEV industry are one of the main factors affecting its market development, non-policy factors such as the technological progress of the industry and the resident income level can also affect the development of the industry. Therefore, we include the two factors of annual patent applications for NEV and the disposable income of residents in the regression model.

It should be noted that the NEV production and sales data are obtained from the *China Association of Automobile Manufacturers* [45]; the data underlying the effectiveness of the cumulative policy measures were obtained from the *Legal Information Center of Peking University* [46] and are then cumulated using Equation (3); the number of patents from *Jiangsu Baiteng Technology Co Ltd.* (Changzhou city, China) [47]. To eliminate the effects of data fluctuations and heteroskedasticity on the regression results, each variable was calculated by taking the logarithm. Meanwhile, we need to consider the reality that most policy measures have a certain lag on the impact of market supply and demand, so we first determine the lags of each indicator and then substitute their lag terms into the model to be tested.

The empirical analysis is divided into two stages. Considering that the impact of policy effectiveness has a certain cumulative effect [44], this paper first puts the total cumulative effectiveness of NEV industry policies into Equations (4) and (5) to explore the impact of industrial policies on the NEV industry development, and then puts the cumulative effectiveness of different policy measures into Equations (6) and (7) to examine the heterogeneous impact of different policy measures on industrial development. The equations involved in the specific model are shown below.

$$\ln supply_t = c + \alpha_1 \ln NEVCE_t + \alpha_2 \ln pat_t + \alpha_3 \ln cdi + \varepsilon_t \tag{4}$$

$$\ln demand_t = c + \alpha_4 \ln NEVCE_t + \alpha_5 \ln pat_t + \alpha_6 \ln cdi + \varepsilon_t \tag{5}$$

$$\ln supply_t = c + \beta_1 \ln tsm + \beta_2 \ln fsm + \beta_3 \ln tim + \beta_4 \ln sgm + \beta_5 \ln esm \\ + \beta_6 \ln lsm + \beta_7 \ln pat_t + \beta_8 \ln cdi + \varepsilon_t \tag{6}$$

$$\ln demand_t = c + \gamma_1 \ln tsm + \gamma_2 \ln fsm + \gamma_3 \ln tim + \gamma_4 \ln sgm + \gamma_5 \ln esm \\ + \gamma_6 \ln lsm + \gamma_7 \ln pat_t + \gamma_8 \ln cdi + \varepsilon_t \tag{7}$$

where $supply_t$ and $demand_t$ denote the production and sales of NEV in China in year t, respectively; $NEVCE_t$ is the cumulative effectiveness value of NEV in year t; pat_t is the cumulative number of patents in year t; cdi is the disposable income of residents in that year; tsm, fsm, tim, sgm, esm, and lsm denote the cumulative effectiveness values of the taxation and subsidy measures, financial support measures, technical innovation measures, social guidance measures, environmental support measures, and legal supervision measures in that year, respectively.

3. Empirical Results and Discussion

3.1. Policy Evolution of China's NEV Industry

Straightening out the development history of China's NEV industry can reveal the dynamic evolution process of relevant policies. In the observation period, by sorting out 204 policies concerning NEV issued by the Chinese government, we divided the evolutionary process into four stages: the macro-strategy stage, the industry standardization stage, the demonstration and promotion stage, and the industrial adjustment stage. In the following, we elaborate on the development history of China's new-energy vehicle industry, including landmark events and key features at different stages of development, and represent them in Figure 1.
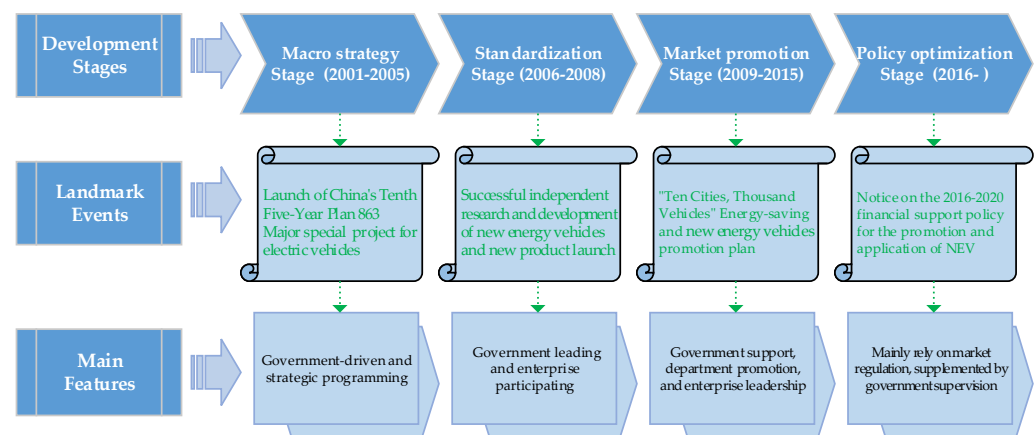

Figure 1. Policy evolution of China's NEV industry.

- The macro-strategic stage, namely from 2001 to 2005, did not start until the implementation of the major electric vehicle project of the "863" plan. At the early stage of the development of the NEV industry, relevant industry standards had not yet taken shape, resulting in industry progress relying entirely on government promotion. Moreover, the focus of policies implemented was on the top-level design link and the R&D link. The volume of policies was low of which the documents were almost macro-strategic policies.
- The industry standardization stage was marked by the emergence of NEV industry-related products such as pure electric vehicles, hybrid vehicles, charging stations, and charging piles independently developed in China in 2006. In the observation period from 2006 to 2008, the embryonic form of the NEV industry technology system gradually came into being. Although the government still occupied a dominant position in development, the concentration of policy had begun to incline to the production link. At this stage, an industrial standard system and industrial order was

produced. The number of relevant policy documents showed sound momentum of gradual growth, while the most were industry normative policies.

- In 2009, the Ministry of Science and Technology, the Ministry of Finance, the Development and Reform Commission, and the Ministry of Industry and Information Technology jointly launched the "Ten Cities, One Thousand New-Energy Vehicles Project", choosing to conduct pilot projects in large and medium-sized cities to implement financial subsidy policy measures, and then gradually expand to other cities based on the summary of the pilot cities. From then on, the NEV industry was gradually promoted, accompanied by hot topics. Along with the slow development of the NEV industry from government-oriented to "market + government" double-led, the industrial support policies in this period achieved remarkable results. However, there was still a severe situation of high cost, insufficient technology and reliability, and oversupply in the demand market for the NEV industry.

- Since 2015, China's NEV sales have surged, and the promulgation of "*the Notice on the Promotion and Application of New-Energy Vehicles from 2016 to 2020 of Financial Support Policies*" has brought the NEV industry into an optimization phase. China's new-energy vehicle industry has a certain market base with more perfect standards and production scale accumulating year by year. Meanwhile, the development of various types of financial subsidies to retreat programs makes the NEV by the government-led to market-led change the industry support government focus on the two aspects of consumption link and use link. Though there were still a series of practical problems, such as lack of core technology, insufficient supporting infrastructure, and excessive reliance on financial subsidies.

Since the NEV industry began to develop, the number of departments involved in the formulation of policies for the industry has gradually increased, and the cooperative relationship between departments has been strengthened, presenting a situation in which a single department is dominant and a multi-departmental coalition is complementary, as shown in Figure 2. In the process of formulating policies, the Ministry of Industry and Information Technology (MIIT), the National Development and Reform Commission (NDRC), and the Ministry of Finance are the main participating departments, and the major issuing form of these industrial policies is the "announcement" and the "notice". The overall policy management and control pattern has formed a collaborative model of "planning by the State Council-coordinated operation by the MIIT-review by the NDRC-participation of multiple ministries and commissions". However, given the game between various departments and their power functions corresponding to coincidence and conflict [42], some problems like low strength and short timeliness have emerged in the policies co-issuance. Therefore, the cooperation between various departments needs to be strengthened, comprehensively.
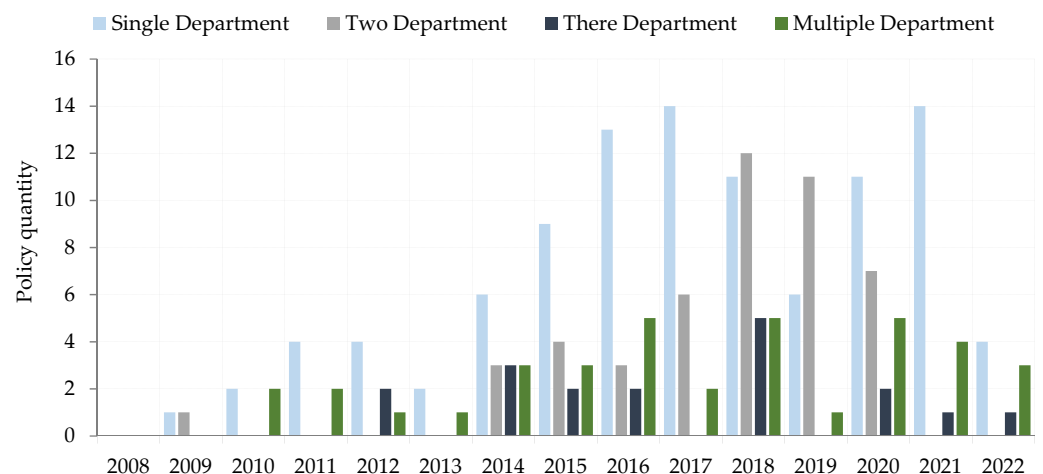

Figure 2. Policy quantity jointly issued by various departments.

3.2. Policy Effectiveness of NEV Industry Policy Texts in China

Due to the low volume and poor representativeness of the policies promulgated before 2007, this paper selects the NEV industrial policies promulgated since 2007 as the research object. To better observe the annual number of policies, the total annual effectiveness of policies, and the trend of annual effectiveness of different policy measures, we use the policy effectiveness measurement model for calculation, and the results are shown in Figure 3.
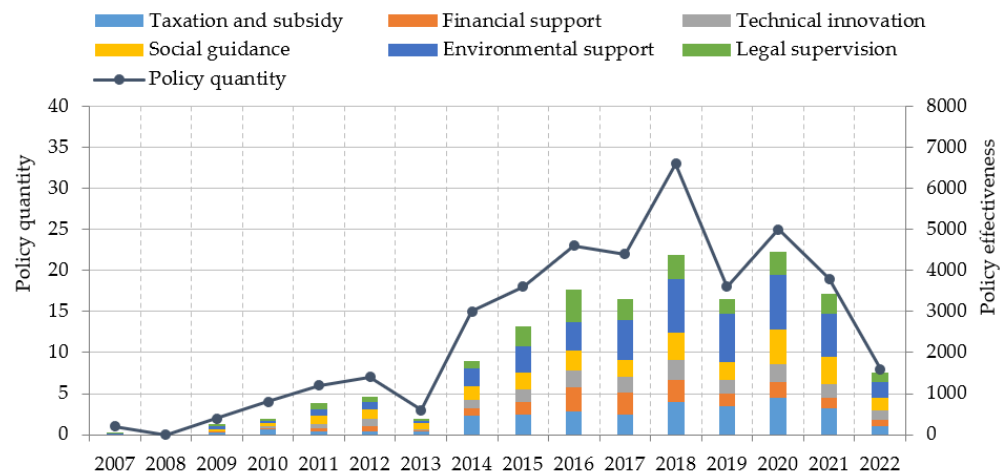

Figure 3. Trends in policy number and the policy effectiveness of different measures.

The dynamic evolution over the years shows a similar pattern of change in the total effectiveness and number of policies enacted. Before 2013, the number of policies issued, and the annual policy effectiveness were at a low level. The reason is that the relevant policies introduced before this period focused on the top-level design and strategic planning of the development of the NEV industry, even though in 2009 the Ministry of Finance pointed out in the "Notice on the Pilot Project for the Demonstration and Promotion of Energy-saving and New-Energy Vehicles" that subsidies were given to consumers of NEV, but the scope of subsidies was only for the pilot cities and did not spread across the board. After 2013, Beijing took the lead in granting preferential license plates for NEV and exempting them from traffic restrictions, which then spread to other medium and large cities. At the same time, a series of supportive policies such as high subsidies and exemption from purchase tax has greatly increased consumers' willingness to purchase new-energy vehicles. In 2013, the sales of NEV were only 17,600 units, in 2014 it exceeded 70,000 units, while in 2015 it exceeded 300,000 units, with remarkable results.

Considering the continuity of the policy, it is more realistic to use the cumulative policy approach to measure the effectiveness of NEV industrial policies. We added up the annual policy measure effectiveness year by year, added up the total effectiveness year by year and used Formula (2) to obtain the average cumulative policy effectiveness, thus obtaining the evolution of the cumulative policy measure effectiveness and the cumulative average policy effectiveness of China's NEV industry over time as shown in Figure 4. The results show that there are significant differences in their policy effectiveness scores. The effectiveness values of environmental support measures and taxation and subsidy measures are relatively high, which is related to the government's higher attention in terms of NEV device standard requirements, project access standards, tax relief, etc. While the effectiveness scores of the financial support measures and technical innovation measures are less effective, which requires further attention from the government.
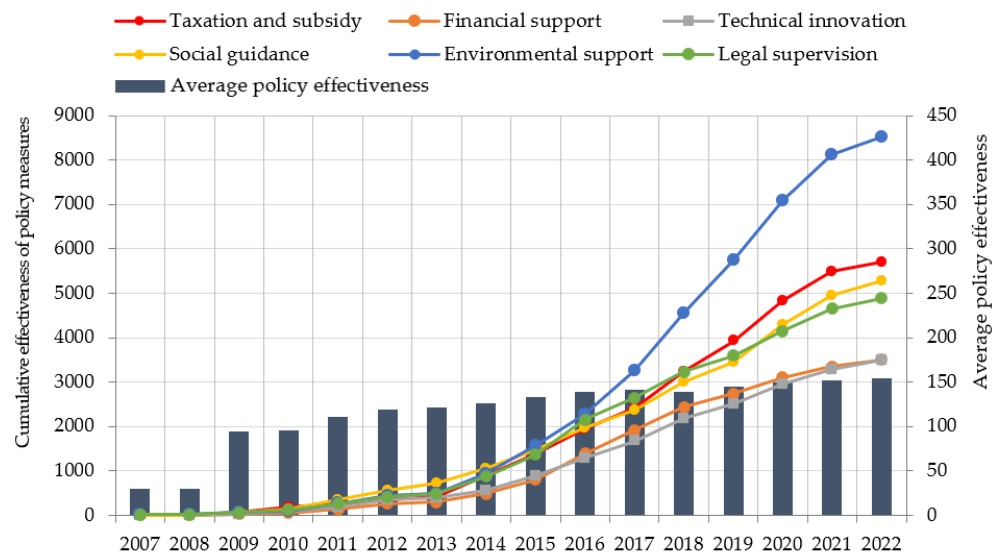
Figure 4. Cumulative effectiveness of different policy measures in the NEV industry.

As shown in Figure 4, the effectiveness value of each policy measure is generally at a low level until 2013, after which it begins to grow steadily and reaches a high level from 2018 to 2020. In the six types of NEV industry policy measures, the score of the policy effectiveness of environmental support measures was relatively small until 2014, while it grew rapidly and leapt to become the most effective policy measure thereafter. The policy effectiveness of taxation and subsidy measures remains in the top position, with its effectiveness level ranking second in 2018; since then, the subsidy policy has started to retreat, and along with the impact of the epidemic, such subsidies continue until 2022 and have been giving a good impact effectiveness. The score of the policy effectiveness of social guidance measures remained in the second position until 2018, after which such measures still played a positive role but were less effective. The reason for this result is that the development of the NEV industry mainly relies on policy guidance in the early stage, while in the later stage it mainly relies on market promotion to drive industrial progress. The policy effectiveness of financial support measures and legal supervision measures are relatively low, but show an increasing trend year by year, indicating that the Chinese government is gradually improving the policy measures in these two areas.

In addition, the cumulative annual average effectiveness of NEV industry policies has not increased significantly with the cumulative number of policies, reflecting the need to strengthen the attributes of existing policies and to further clarify the objectives of the policy text before adopting practical policy measures.

3.3. Evaluation of the Effect of the NEV Industry Policy in China

To prevent the phenomenon of "pseudo-regression", all the variables involved in the model were tested for smoothness, and the results of the ADF test showed smoothness. Given the possible lagged effects of the respective variables on the market, this paper determined the lags of the independent variables based on the AIC and SC criteria, resulting in a one-period lag for policy effectiveness and proprietary technology in Model 1 and a one-period lag for fiscal, technical, guidance and legal regulatory measures in Model 2. From the test results in Tables 2 and 3, it can be seen that the adjusted R^2 is close to 1, which indicates that the explanatory variables have strong explanatory power for the explained variables; the F-value also meets the test criteria, which fully indicates that the overall fit of the model is good.

Table 2. Results of industrial policy on NEV market supply and demand.

Variable	Supply			Demand		
	Lag	Coefficient	t-Statistic	Lag	Coefficient	t-Statistic
c	0	−130.840 ***	−5.513	0	−203.236 ***	−7.622
NEVECE	1	1.112 ***	3.461	1	0.792 **	3.170
cdi	0	14.960 ***	5.748	0	23.137 ***	7.875
pat	1	−1.682 **	−3.057	1	−2.389 ***	−4.854

Note: *** $p < 0.01$, ** $p < 0.05$.

Table 3. Differential impact of policy measures on NEV market supply and demand.

Variable	Supply			Demand		
	Lag	Coefficient	t-Statistic	Lag	Coefficient	t-Statistic
c	0	−133.078 ***	−7.969	0	−159.836 ***	−9.308
tsm	1	0.767 ***	5.143	1	0.390 *	2.536
fsm	0	−0.096	−0.165	0	−0.107	−0.812
tim	1	0.361 *	2.420	1	−1.716 ***	−5.848
sgm	1	0.454 **	4.254	0	2.464 ***	6.164
esm	0	1.392 *	2.565	1	−0.886 **	−4.453
lsm	1	−0.759	−1.528	1	1.736 **	4.316
cdi	0	15.240 ***	7.862	0	17.547 ***	8.568
pat	1	−2.421 ***	−15.182	1	−1.897 ***	−8.489

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

The results in Table 2 show that the coefficient of the effect of the NEV industry policy effectiveness on the supply-side market is 1.112 and is significant at the 1% level, while the coefficient of the effect on the demand-side market is 0.792 and is significant at the 5% level. It means that the industrial policy has played a significant positive role in the development of the NEV industry, both in the supply and demand markets. In addition, the impact of disposable income on both the supply and demand side of the market is equally positive and significant, indicating that there will be greater public demand for NEV due to the increase in resident income level. However, the impact of patented technology on both the supply and demand side of the market is significantly negative, which is a result different from expectations. As we all know, patented technology has become an important reflection of the progress and development of society and the world. But patent quantity realization is not only a change in quantity but also in quality. It does not mean that the larger the number of applications means the higher the innovation ability, as there may be junk patents among them. Along with the development boom of the NEV industry, when the number of such inferior patents is higher, instead, the quality of patents will decline, resulting in the overall patent level remaining low, thus not promoting the NEV industry technology to achieve a qualitative breakthrough. This also reflects that the development of NEV industry in China is facing a problem of weak core technology capability.

The foregoing has confirmed that the NEV industrial policy can effectively promote the development of the industry. However, whether there are differences in the impact of different policy measures on the NEV industry remains to be studied further. Therefore, this paper empirically analyzed the effects of different policy measures on both the supply and demand sides of the NEV market. The results in Table 3 appreciate that different policy measures have different impacts on the NEV market, and there are differences in the impacts of the same policy measures on both the supply and demand side of the market. The specific analysis is as follows.

- The impact of tax and subsidy measures on the NEV market is positive. Compared with the traditional fuel vehicle market, this policy measure can significantly reduce the production cost of new energy vehicle companies and the purchase cost of consumers, thereby improving the competitiveness of the NEV market [11].

- Policy measures of financial support do not have a significant impact on the NEV market. This result is consistent with the inefficiency of the financial support policy measures. In fact, the financial support measures promote NEV market progress indirectly by supporting the government or social capital to provide low-interest loans and financing services to relevant enterprises [9]. Therefore, the Chinese government needs to refine the policy measures in terms of financial support and strengthen the policy implementation.
- The technical innovation measures have a significantly positive impact on the supply-side market of NEVs and a negative impact on the demand-side market, indicating that technical innovation measures can drive the production side of the NEV industry. However, technical innovation measures have no direct impact on the consumer-side, resulting in no direct positive impact on the sales volume of NEVs.
- The social guidance measures have created a sound market environment not only for enterprises but also for consumers. The test results show that the social guidance measures promote both the supply and demand sides of the NEV market. The guidance, promotion efforts, and industrial planning have played a positive role in promoting the NEV market.
- Environmental support measures mainly involve general standards for NEV devices, industry access rules, and technical safety standards. Since the main implementation body of such measures is the production side such as enterprises, it only has a positive effect on the supply-side market.
- Legal supervision measures mainly restrain unreasonable behavior in the market through safety management and supervision, reward and punishment mechanisms. Such measures do not have a significant impact on the supply-side market of NEVs, which may be related to the lack of implementation of legal supervision measures, even resulting in the phenomenon of vehicle enterprises cheating on subsidies in the early stage. However, such measures are a form of protection for consumers and therefore have a clear beneficial contribution to the development of the demand-side market.

4. Conclusions and Policy Implications

4.1. Conclusions

According to the analysis of the policy evolution process, the NEV industry in China has changed from "government-driven" to "government-driven + market-driven", and the overall policy control pattern has formed a synergistic pattern of "planning by the State Council-coordinated operation by the Ministry of Industry and Information Technology, review by the Development and Reform Commission, and participation by multiple ministries".

The total effectiveness of China's NEV industrial policies is influenced by the number of policies issued, which shows a trend of increasing and then decreasing during the examination period, but its cumulative policy effectiveness increases year by year. In terms of the effectiveness scores of various policy measures, the policy effectiveness values of taxation and subsidy measures, environmental support measures, and social guidance measures are relatively high, while the policy effectiveness values of financial support measures, technological innovation measures, and legal supervision measures are relatively small and need to be further improved in the future.

From the evaluation of the effect of policy measures on the supply and demand side of the market department, although the quantity of patents in China is large the quality of patents is not high, the overall face of the problem is of an insufficient core technology level; the improvement of the income level of the people can effectively improve the development of the supply and demand side of the market of NEV. For the supply side of the NEV market, taxation and subsidy measures, technological innovation measures, social guidance measures, and environmental support measures can effectively promote the development of the supply side of NEV; for the demand side of the NEV market, taxation and subsidy measures, social guidance measures, and legal supervision measures can better

promote the market promotion of NEV; the impact of financial support measures on both the supply and demand sides of the NEV market is not obvious.

4.2. Policy Implications

According to the conclusion, we put forward the following policy suggestions.

(1) With the increasing number of NEV industrial policies, the Chinese government should pay more attention to the effectiveness of relevant policy documents. Given the phenomenon of inconsistent opinions caused by functional conflicts between related departments [48], it is recommended to attach great importance to the overall planning, strengthen coordination and communication between the central governments, local governments, and enterprises in terms of promulgation and implementation, and increase the participation of local governments and enterprises in the policy-making process.

(2) Considering the heterogeneous effects of different policy tools, it is suggested that the government should optimize the NEV industrial policies to engage in the combined effect of different policy tools. Specifically, the government should optimize the content and form of the support policies on both sides of supply and demand of NEV, gradually establish a technological innovation system with enterprises as the main body, market-oriented, industry-university-research-cooperation, and strengthen the policy support of R&D investment and business model innovation in NEV enterprises.

(3) The complementarity between long-term policy tools and short-term policy tools should be emphasized. It is suggested that the government should focus on the application of market-oriented policy tools such as fiscal and tax preferences, purchase subsidies, financial support, and public opinion publicity in the short term. In the long term, it should increase investment in infrastructure construction and R&D of the NEV industry and accelerate the construction of the common technology innovation platform, to improve its industrial technology level and basic capabilities.

(4) It is recommended to give full play to the decisive role of the market in resource allocation and to strengthen the dominant position of enterprises in technology route selection, production, and service system construction. Specifically, the government should play a leading role in industrial strategies planning, formulating standards and regulations, quality and safety supervision, and guiding green consumption to create a good market environment for industrial development.

(5) The policy text is effective, but the policy measures may not be able to be effectively implemented, which leads to differences in the impact of various policy measures on the NEV market. More importantly, different policy measures are implemented differently in supply-side and demand-side markets. Therefore, the Chinese government needs to implement policies into action and strengthen the overall execution on both the supply and demand sides of the NEV market. The specific suggestions are as follows. First, the government should strengthen the implementation of legal and regulatory measures in the supply side of the market, for instance, the government should increase the safety hazard inspection of enterprises, and the reward and punishment process for enterprises should be supervised. Second, the government should further enhance the application of technological innovation and environmental support measures on the market demand side; for example, the government should guide consumers to recycle batteries and promote the "double points" management scheme to consumers. Finally, there is a need for the government to improve the effectiveness of the implementation of financial measures in both supply-side and demand-side markets, such as the provision of R&D capital lending services to enterprises and the establishment of a new energy vehicle venture capital fund by the government but on the other hand, to lower the loan criteria for consumers to purchase new energy vehicles.

References

1. Wang, D.; He, W.; Shi, R. How to achieve the dual-control targets of China's CO_2 emission reduction in 2030? Future trends and prospective decomposition. *J. Clean. Prod.* **2019**, *213*, 1251–1263. [CrossRef]
2. Wang, D.; Liu, X.; Yang, X.D.; Zhang, Z.Y.; Wen, X.C.; Zhao, Y.Y. China's energy transition policy expectation and its CO_2 emission reduction effect assessment. *Front. Energy Res.* **2021**, *8*, 627096. [CrossRef]
3. Su, C.; Yuan, X.; Ran, T.; Umar, M. Can new energy vehicles help to achieve carbon neutrality targets? *J. Environ. Manag.* **2021**, *297*, 113348. [CrossRef]
4. Umar, M.; Ji, X.; Kirikkaleli, D.; Alola, A.A. The imperativeness of environmental quality in the United States transportation sector amidst biomass-fossil energy consumption and growth. *J. Clean. Prod.* **2021**, *285*, 124863. [CrossRef]
5. Tor, O.B.; Teimourzadeh, S.; Koc, M.; Cebeci, M.E.; Akınc, H.; Gemici, O.; Bahar, C.; Hildermeier, J.; Saygin, D. Transport sector transformation: Integrating electric vehicles in Turkey's distribution grids. *Energy Sources Part B* **2021**, *16*, 1026–1047. [CrossRef]
6. Internatioanl Engery Agency (IEA). World Energy Outlook. 2016. Available online: https://www.iea.org/reports/world-energy-outlook-2016 (accessed on 1 October 2021).
7. Yang, X.; Lin, W.; Gong, R.; Zhu, M.; Springer, C. Transport decarbonization in big cities: An integrated environmental co-benefit analysis of vehicles purchases quota-limit and new energy vehicles promotion policy in Beijing. *Sustain. Cities Soc.* **2021**, *71*, 102976. [CrossRef]
8. Dong, F.; Liu, Y. Policy evolution and effect evaluation of new-energy vehicle industry in China. *Resour. Policy* **2020**, *67*, 101655. [CrossRef]
9. Zhang, X.; Liang, Y.; Yu, E.; Rao, R.; Xie, J. Review of electric vehicle policies in China: Content summary and effect analysis. *Renew. Sustain. Energy Rev.* **2016**, *70*, 698–714. [CrossRef]
10. Du, J.; Ouyang, D. Progress of Chinese electric vehicles industrialization in 2015: A review. *Appl. Energy* **2017**, *188*, 529–546. [CrossRef]
11. 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. [CrossRef]
12. Tian, X.; Zhang, Q.; Chi, Y.; Cheng, Y. Purchase willingness of new energy vehicles: A case study in Jinan City of China. *Reg. Sustain.* **2021**, *2*, 12–22. [CrossRef]
13. Wang, R.; Zhao, X.; Wang, W.; Jiang, L. What factors affect the public acceptance of new energy vehicles in underdeveloped regions? A case study of Gansu Province, China. *J. Clean. Prod.* **2021**, *318*, 128432. [CrossRef]
14. Liu, C.; Huang, W.; Yang, C. The evolutionary dynamics of China's electric vehicle industry-Taxes vs. subsidies. *Comput. Ind. Eng.* **2017**, *113*, 103–122. [CrossRef]
15. Wang, X.; Li, Z.; Shaikh, R.; Ranjha, A.R.; Batala, L.K. Do government subsidies promote financial performance? Fresh evidence from China's new energy vehicle industry. *Sustain. Prod. Consum.* **2021**, *28*, 142–153. [CrossRef]
16. Jenn, A.; Springel, K.; Gopal, A.R. Effectiveness of electric vehicle incentives in the United States. *Energy Policy* **2018**, *119*, 349–356. [CrossRef]
17. Wang, N.; Pan, H.; Zheng, W. Assessment of the incentives on electric vehicle promotion in China. *Transp. Res. Part A Policy Pract.* **2017**, *101*, 177–189. [CrossRef]
18. Li, J.; Ku, Y.; Liu, C.; Zhou, Y. Dual credit policy: Promoting new energy vehicles with battery recycling in a competitive environment? *J. Clean. Prod.* **2020**, *243*, 118456. [CrossRef]
19. Chi, Y.; Wang, Y.; Xu, J. Estimating the impact of the license plate quota policy for ICEVs on new energy vehicle adoption by using synthetic control method. *Energy Policy* **2021**, *149*, 112022. [CrossRef]
20. Xiong, Y.; Wang, L. Policy cognition of potential consumers of new energy vehicles and its sensitivity to purchase willingness. *J. Clean. Prod.* **2020**, *261*, 121032. [CrossRef]
21. Xu, L.; Su, J. From government to market and from producer to consumer: Transition of policy mix towards clean mobility in China. *Energy Policy* **2016**, *96*, 328–340. [CrossRef]

22. Ma, S.; Fan, Y.; Feng, L. An evaluation of government incentives for new energy vehicles in China focusing on vehicle purchasing restrictions. *Energy Policy* **2017**, *110*, 609–618. [CrossRef]

23. Contestabile, M.; Alajaji, M.; Almubarak, B. Will current electric vehicle policy lead to cost-effective electrification of passenger car transport? *Energy Policy* **2017**, *110*, 20–30. [CrossRef]

24. Du, H.; Liu, D.; Sovacool, B.K.; Wang, Y.; Ma, S.; Li, R.Y.M. Who buys New Energy Vehicles in China? Assessing social-psychological predictors of purchasing awareness, intention, and policy. *Transp. Res. Part F-Traffic Psychol. Behav.* **2018**, *58*, 56–69. [CrossRef]

25. Zhang, X.; Bai, X. Incentive Policies from 2006 to 2016 and New Energy Vehicle Adoption in 2010–2020 in China. *Renew. Sustain. Energy Rev.* **2017**, *70*, 24–43. [CrossRef]

26. Zhang, L.; Qin, Q. China's new energy vehicle policies: Evolution, comparison and recommendation. *Transp. Res. Part A-Policy Pract.* **2018**, *110*, 57–72. [CrossRef]

27. Hartley, K.; Santen, R.V.; Kirchherr, J. Policies for transitioning towards a circular economy: Expectations from the European Union (EU). *Resour. Conserv. Recycl.* **2020**, *155*, 104634. [CrossRef]

28. Wang, L.; Fu, Z.; Guo, W.; Liang, R.; Shao, H. What influences sales market of new energy vehicles in China? Empirical study based on survey of consumers' purchase reasons. *Energy Policy* **2020**, *142*, 111484. [CrossRef]

29. Chen, K.; Ren, C.; Gu, R.; Zhang, P. Exploring purchase intentions of new energy vehicles: From the perspective of frugality and the concept of "mianzi". *J. Clean. Prod.* **2019**, *230*, 700–708. [CrossRef]

30. Ren, J. New energy vehicle in China for sustainable development: Analysis of success factors and strategic implications. *Transp. Res. Part D-Transp. Environ.* **2018**, *59*, 268–288. [CrossRef]

31. Styczynski, A.B.; Hughes, L. Public policy strategies for next-generation vehicle technologies: An overview of leading markets. *Environ. Innov. Soc. Trans.* **2019**, *31*, 262–272. [CrossRef]

32. Sun, S.; Wang, W. Analysis on the market evolution of new energy vehicle based on population competition model. *Transp. Res. Part D-Transp. Environ.* **2018**, *65*, 36–50. [CrossRef]

33. Xie, Y.; Wu, D.; Zhu, S. Can new energy vehicles subsidy curb the urban air pollution? Empirical evidence from pilot cities in China. *Sci. Total Environ.* **2021**, *754*, 142232. [CrossRef] [PubMed]

34. Rosenbaum, P.R. *Observation and Experiment: An Introduction to Causal Inference*; Harvard University Press: Cambridge, MA, USA, 2017.

35. Xiong, Y.; Wang, X. Policy options for NEV technology innovation incentives: 'Supportive' or 'threshold' policies? *China Popul. Resour. Environ.* **2020**, *30*, 98–108. (In Chinese)

36. Wang, D.; Liu, X. Deconstruction of ecological civilization policy effectiveness and evaluation of heterogeneous policy tools in Jiangsu Province. *J. China Univ. Min. Technol. (Soc. Sci.)* **2020**, *22*, 44–53. (In Chinese)

37. Estrada, M.A.R. Policy modelling: Definition, classification, and evaluation. *J. Policy Model.* **2011**, *33*, 523–536. [CrossRef]

38. Cools, M.; Brijs, K.; Tormans, H.; Laender, J.D.; Wets, G. Optimizing the implementation of policy measures through social acceptance segmentation. *Transp. Policy* **2012**, *22*, 80–87. [CrossRef]

39. Liao, Z. The evolution of wind energy policies in China (1995–2014): An analysis based on policy instruments. *Renew. Sustain. Energy Rev.* **2016**, *56*, 464–472. [CrossRef]

40. Liu, L.; Zhang, T.; Avrin, A.P.; Wang, X. Is China's industrial policy effective? An empirical study of the new energy vehicles industry. *Technol. Soc.* **2020**, *63*, 101356. [CrossRef]

41. Yang, T.; Xing, C.; Li, X. Evaluation and analysis of new-energy vehicle industry policies in the context of technical innovation in China. *J. Clean. Prod.* **2021**, *281*, 125126. [CrossRef]

42. Ji, S.; Zhao, D.; Luo, R. Evolutionary game analysis on local governments and manufacturers' behavioral strategies: Impact of phasing out subsidies for new energy vehicles. *Energy* **2019**, *89*, 116064. [CrossRef]

43. Zhang, G.; Zhang, Z.; Gao, X.; Yu, L.; Wang, S.; Wang, Y. Impact of energy conservation and emissions reduction policy means coordination on economic growth: Quantitative evidence from China. *Sustainability* **2017**, *9*, 686. [CrossRef]

44. Zhang, G.; Zhang, Z.; Gao, Y.; Chen, Z.; Li, B.; Du, Y. Environmental regulation policies and public health: Based on the mediating effect test of environmental pollution. *Syst. Eng.-Theory Pract.* **2018**, *38*, 361–373. (In Chinese)

45. China Association of Automotive Manufacturers, 2022. Retrieved statistical data. from. Available online: http://www.caam.org.cn (accessed on 1 June 2022).

46. LICPU (Legal Information Center of Peking University). 2022. Available online: https://www.pkulaw.com (accessed on 22 May 2022).

47. Jiangsu Baiteng Technology Co. Ltd. Retrieved Big Data Service. 2022. Available online: http://www.baiten.cn (accessed on 1 June 2022).

48. Du, H.; Guo, Y.; Lin, Z.; Qiu, Y.; Xiao, X. Effects of the joint prevention and control of atmospheric pollution policy on air pollutants—A quantitative analysis of Chinese policy texts. *J. Environ. Manag.* **2021**, *300*, 113721. [CrossRef] [PubMed]