

The Impact of the Phase-Out of National Purchase Subsidies on China's New Energy Vehicle Industry: A Difference-in-Differences Research Design

Tianyu Zhao

*Law College, East China University of Politics and Law, Shanghai, China
2983436589@qq.com*

Abstract. China has implemented a series of policies to boost the new energy vehicle (NEV) sector, such as purchase subsidies, technical standards, charging infrastructure, industrial planning, and tax incentives. In 2022 the national purchase subsidy programme was phased out, but policy supports continue, which suggests a shift in policy support rather than its withdrawal. Based on the results of this study, the authors propose a Difference-in-Differences (DiD) research design to examine the effects of subsidy withdrawal on market performance and technological innovation across Chinese provinces with varying levels of subsidy exposure. Market performance will be measured using NEV registrations and market share, and innovation will be evaluated by the number of new models introduced and the number of invention patent applications. The study analyzes whether government support fostered sustainable industrial capacity or market dependency. NEV is not the same as all industries, but is seen as a good example of an industry that is a policy intensive strategic emerging industry and will offer insights into the longer-term impacts of industrial policy.

Keywords: New energy vehicles, Purchase subsidy, Difference-in-Differences, Industrial policy, Technological innovation

1. Introduction

China has adopted a suite of measures including purchase subsidies, tax rebates, technical standards, charging-infrastructure deployment, and industrial planning to support the development of new energy vehicle (NEV) industry. The national purchase-subsidy programme closed its doors on 31 December 2022 and cars sold afterward could no longer benefit from a subsidy [1]. Other policy supports, such as vehicle-purchase tax exemptions for NEVs purchased in 2024 and 2025 and reduced benefits in 2026 and 2027, however, have remained. This policy adjustment should thus be interpreted as the end of national purchase subsidies, and not the end of NEV support [2].

This paper investigates the impact of withdrawal of the national purchase subsidy on the NEV market performance and technological innovation for Chinese provinces that have different exposure to the subsidy. It measures the differences in the changes in the two groups of provinces before and after the end of the policy in 2022.

Data for this study are sourced from provincial monthly statistics for the period 2018-2025 and applied a Difference-in-Differences (DiD) design. It examines the impact on the difference in changes after January 2023 between high and low subsidy exposure provinces prior to policy withdrawal.

This study is important because expansion in the market is not always a measure of sustainable competitiveness. Technological ability, production efficiency, competitive capabilities and supply chain are also critical for the long-term development of industry. For this reason, both market and innovation indicators are analyzed to evaluate the policy support's effects—whether it is producing lasting industrial capacity or temporary dependence.

2. Literature review

2.1. Policy support and market development

New technologies often face consumer resistance, inadequate infrastructure, and high costs. The barriers can be overcome with government incentives that lower adoption costs and aid in market development. Liu et al. discovered that purchase subsidies, tax exemptions, administrative privileges, and charging policies had positive impacts on EV adoption in China, but in differing ways in the short and long-term [3]. Financial incentives primarily drove short-term market responses, whereas infrastructure- and management-related measures fostered longer-term development.

Zhao et al. analysed policy packages in Chinese cities and concluded that the effectiveness of incentive packages would vary based on the mixture of financial and non-financial support measures [4]. Likewise, Shang et al. found that financial subsidies led to higher EV market share uptake but were less effective in the presence of non-financial incentives [5] using a quasi-natural experiment.

To conclude, previous research has shown that subsidies did have a positive effect on market development for NEVs. However, these studies provide limited evidence regarding whether the industry maintained sufficient competitiveness following the phase-out of national purchase subsidies.

2.2. Government support and technological innovation

Government support can impact not only consumer demand, but also technological innovation. Jiang and Xu found that policy incentives and government subsidies alleviated financial constraints and stimulated research activities, thereby enhancing technological innovation among Chinese NEV firms [6]. However, they also noted that government support may shape innovation trajectories and that such support needs to be well-designed.

The effect of withdrawal of subsidy is still debated. Qin and Xiong discovered that the impact of subsidy changes varied across the stages of the innovation process [7]. According to Wang and Han [8], subsidy withdrawal exerted negative impacts on some NEV firms' innovation and economic performance, and the specific withdrawal modality shaped firms' responses [8].

On the other hand, Wang, Lu and Qiao reported that withdrawing subsidies led to an increase in substantive research and development activities, but to a decrease in symbolic innovation [9]. This indicates that cut-backs in subsidies could lead to greater competition and higher quality innovations. Zhang et al. demonstrated that enterprise-level support can partially offset government support to sustain market demand; however, it cannot fully replace government-led support [10].

These findings suggest that subsidy withdrawal may enable subsidy-dependent firms to reduce their reliance on state support while strengthening the competitiveness of more efficient firms.

2.3. Regional industrial capability

The industrial cluster, infrastructure, suppliers and manufacturing capability vary among different regions, resulting in uneven development of China's NEV industry. Patchell et al. demonstrated that the development of the NEVs in China was driven by competition as well as coordination between central and provincial governments [11]. This means that the impact on the provinces due to withdrawal of subsidies will vary depending on the robustness of their industrial base.

Zhang et al. found the difference in technological innovation efficiency between listed NEV companies in China [12]. The regional differences indicate that the impacts of subsidy withdrawal should be assessed taking into account regional factors such as the level of economic development, industrial structure, charging infrastructure and previous market performance.

2.4. Research gap, contribution and hypotheses

The previous studies largely have focused on either government incentives and EV adoption or government incentives and firm level technological innovation. Previous research indicates that financial subsidies, tax benefits, and policy packages have contributed to the development of the NEV markets and innovation [3, 10]. There is limited scholarly discussion on regional markets and technological innovation in the context of the complete phase-out of subsidies, and particularly scarce is the analysis that incorporates varying subsidy intensities across provinces.

This study seeks to fill this research gap. Rather than examining the overall impacts of subsidy policies, it focuses specifically on the phase-out of national purchase subsidies. It contributes by accounting for the regional variation in pre-policy exposures, as well as analysing market and innovation outcomes under a single analytical framework. One limitation of this study is that its conclusions apply only to policy-driven strategic emerging industries, rather than to industries in general.

The following hypotheses are drawn from the literature reviewed:

More NEV registrations and market share will be lost in provinces that had higher subsidy exposure prior to subsidy withdrawal.

The negative market impacts of subsidy removal will be less pronounced in provinces with higher charging infrastructure, more developed industrial clusters, and higher capacities of innovation.

Substantive technological innovation (measured by invention patent applications) can be maintained or even boosted after the withdrawal of subsidies due to the fact that more intense competition will lead to more high-quality innovation, while less valuable or strategic patenting could reduce [13].

3. Research design

3.1. Data sources and acquisition

Observations will be the province-month units of analysis. A provincial level panel dataset for the period 2018-2025 will be developed based on the monthly data.

The proposed data sources are:

1. Vehicle registrations: The NEV registrations of the vehicle models in each province will be taken from the vehicle-registration or compulsory motor-vehicle insurance system of China Automotive Technology and Research Center on a monthly basis by institutional access [14].

2. Subsidy eligibility and rates: Ministry of Industry and Information Technology model catalogues and subsidy schedules of the country will be used to collect subsidy eligibility information and maximum subsidy amounts [1].

3. Patent outcomes: NEV-related invention patent applications will be retrieved from the China Patent Research Database (CNRDS) [15].

4. Charging Infrastructure: The statistics of charging piles at the provincial level will be retrieved from the monthly report by China Electric Vehicle Charging Infrastructure Promotion Alliance [16].

5. Economic controls: GDP per capita, population, urbanization, industrial structure and vehicle ownership data will be collected from the National Bureau of Statistics, China and provincial statistical yearbooks [17].

6. New model introductions: Details of new models approved for NEVs will be gathered from vehicle announcements and model recommended catalogues provided by the Ministry of Industry and Information Technology [18].

All datasets are merged using provincial administrative codes and calendar months. Registration records are matched against subsidy-eligibility information, while patent applications are assigned to the applicant's registered province. A data dictionary will be compiled to document data sources, variable definitions, and data-cleaning procedures to facilitate replication.

3.2. Operational definitions

The main treatment variable is pre-policy subsidy exposure. It will be calculated as:

Total model-weighted statutory subsidy of NEV vehicles registered between 2019 and 2022 divided by all new vehicle registrations between 2019 and 2022.

The firm level subsidy income is not used to measure the amount of subsidy received, as this would not be uniform across the provinces. Only information before 2023 will be used to prevent that treatment outcomes will be influenced by post-policy outcomes.

For the baseline binary specification:

High-exposure provinces are those in the top third of provinces exposed to the highest levels of subsidy.

Low exposure provinces: provinces with the lowest third.

Middle-exposure provinces will not be included in the baseline comparison but will be included in the robustness tests with continuous exposure measures.

The post-policy period is after January 2023.

The primary market results are:

Logarithm of monthly NEV registrations.

NEV registration rate (percentage of new vehicle registrations).

The key innovation result is:

Patent application count for the inventions related to NEV.

Utility-model patents will be looked at separately as they could be lower forms of innovation. Secondary outcomes are production volume and number of newly approved NEV models.

3.3. Difference-in-differences model

The baseline model is:

$$Y_{it} = \alpha + \beta (\text{HighExposure}_i \times \text{Post}_t) + \gamma X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Here, Y_{it} is the outcome in province i during period t . X_{it} includes time-varying regional controls. Province fixed effects, μ_i , and control for permanent differences between provinces. Month fixed effects, λ_t , and control for national shocks, seasonality, and macroeconomic changes.

The coefficient β indicates whether outcomes increased or decreased in the more heavily exposed provinces relative to the less exposed provinces once the subsidy was phased out.

The national withdrawal was felt in all provinces. Hence, the coefficient does not measure the overall national impact of subsidy elimination. Instead, it estimates the differential effect stemming from pre-policy subsidy exposure. This interpretation will be clearly expressed and will not exceed the scope of causal inferences.

To test the feasibility of using the policy exposure and sales data at the provincial level in the present design, Hao et al. used a difference-in-differences approach at the provincial level to assess the effect of differentiated subsidy adjustments on new energy vehicles sales [19].

3.4. Case selection and external validity

This study focuses on China's NEV sector, a strategic emerging industry tightly linked to policy implementation, technological progress, and infrastructure investment. The 2022 subsidy phase-out represents a distinct policy shift suitable for examining the long-term effects of industrial-policy support.

The NEV sector is not a typical case of the Chinese economy, however. NEVs are not like the traditional industries, and they need the advanced manufacturing capability, battery technology, charging infrastructure, and coordinated supply chains. Thus, it is not possible to draw direct inferences for all industries.

Despite these limitations, the NEV sector serves as an illustrative case: it features high R&D intensity, technological uncertainty, infrastructure reliance, and strong state involvement, making it well-suited for studying industrial policy.

China's New Energy Vehicle Industry Development Plan (2021-2035) [13] defines NEVs as "an integrated industrial system covering vehicle manufacturing, energy systems, information technology, battery production, and supporting infrastructure." Thus, the industry can offer important information about the effect of government policies on technological capabilities and industrial development.

Analytical generalization, not statistical generalization, is used in this study. Results could be relevant to other sectors that are subject to policy-driven technologies and infrastructure, such as advanced batteries, renewable energy equipment and green manufacturing.

4. Feasibility and limitations

This research is possible because it is based on secondary data from official government agencies, institutional databases and public statistical sources. Since the study will not use human subjects, survey studies, or interviews, ethical concerns are absent, and the research can be completed within the project's time frame. The 2022 roll-back of China's NEV purchase-subsidy programme represents a well-suited policy shock for a Difference-in-Differences (DiD) empirical setup.

All the data needed are available from existing resources, such as: China Automotive Technology and Research Center (CATRC) vehicle registration data, CNRDS (The National Information System of Research Data) patent data, China Electric Vehicle Charging Infrastructure Promotion Alliance

(CEVCI) charging infrastructure data, and China National Bureau of Statistics (NBS) statistics and statistical yearbooks of provinces. Subscription information and information on new car models is available in the publications of the Ministry of Industry and Information Technology. The proposed methodology is also feasible, since DiD is widely used for policy evaluation, and is suitable when all provinces undergo the same policy change, but vary in their level of previous exposure. Findings will be more reliable by using robustness checks such as the parallel-trend test, placebo test, alternative treatment measures and sensitivity analyses [19, 20].

But there are a few drawbacks. First, provincial-level outcomes may be driven by fluctuations in consumer demand, industrial development, or other regional heterogeneity, rather than solely by differences in subsidy dependence. While fixed effects and control variables minimize this concern, omitted-variable bias is still possible. Second, if incentives for local action remain or other policies are continued after 2022, it will be harder to distinguish the impact of the national withdrawal of subsidies. Third, the implementation period (2023-2025) could not fully reflect long-term innovation effects as it takes time to develop technologies. Last but not least, given the strategic emerging nature of NEVs, the conclusions should not be extrapolated from one industry to the other because NEVs are a highly policy-supported strategic emerging industry.

5. Conclusion

This paper proposes a feasible research design for evaluating the impacts of China's national NEV purchase-subsidy phase-out. Using a provincial Difference-in-Differences approach, it explores the potential difference in the impact of the measure on the performance of the market and technological innovation for the provinces with higher exposure to subsidies in the past compared to the provinces with lower exposure. This study does not treat the NEV sector as representative of industries in general. Instead, it examines this technology-driven, policy-supported emerging sector and investigates whether state support builds durable industrial capacity or generates short-term market dependence.

In cases where the impact of high exposure is greater on registration, market share or innovation results in highly exposed provinces which indicates that reliance on subsidies remains. A stable market and innovation performance, on the other hand, would suggest that market preconditions were set earlier in industrial development, as a result of policy support. Mixed results could indicate that the subsidies provided established long term benefits in certain areas but not others that require ongoing support. These interpretations are not necessarily the facts, but rather expectations. The general significance of this study is to provide an understanding of the positive or negative effects of government intervention on a temporary expansion and/or long-term industrial development.

References

- [1] Ministry of Finance, Ministry of Industry and Information Technology, Ministry of Science and Technology, and National Development and Reform Commission. (2021). Notice on the fiscal subsidy policy for the promotion and application of new energy vehicles in 2022 (Cai Jian [2021] No. 466). Government of the People's Republic of China. [Policy document in Chinese]. Available at: https://www.gov.cn/zhengce/zhengceku/2021-12/31/content_5665857.htm (Accessed: 3 August 2026).
- [2] Ministry of Finance, State Taxation Administration, and Ministry of Industry and Information Technology. (2023). Announcement on the continuation and optimization of vehicle purchase tax reduction and exemption policies for new energy vehicles (Announcement No. 10 of 2023). State Taxation Administration of the People's Republic of China. [Policy document in Chinese]. Available at: <https://fgk.chinatax.gov.cn/zcfgk/c102416/c5207352/content.html> (Accessed: 3 August 2026).

- [3] Liu, Y., Zhao, X., Lu, D., & Li, X. (2023). Impact of policy incentives on the adoption of electric vehicle in China. *Transportation Research Part A: Policy and Practice*, 176, Article 103801. doi: 10.1016/j.tra.2023.103801.
- [4] Zhao, X., Li, X., Jiao, D., Mao, Y., Sun, J., & Liu, G. (2024). Policy incentives and electric vehicle adoption in China: From a perspective of policy mixes. *Transportation Research Part A: Policy and Practice*, 190, Article 104235. doi: 10.1016/j.tra.2024.104235.
- [5] Shang, W.-L., Zhang, J., Wang, K., Yang, H., & Ochieng, W. (2024). Can financial subsidy increase electric vehicle penetration? Evidence from a quasi-natural experiment. *Renewable and Sustainable Energy Reviews*, 190, Article 114021. doi: 10.1016/j.rser.2023.114021.
- [6] Jiang, Z., & Xu, C. (2023). Policy incentives, government subsidies, and technological innovation in new energy vehicle enterprises: Evidence from China. *Energy Policy*, 177, Article 113527. <https://doi.org/10.1016/j.enpol.2023.113527>
- [7] Qin, S., & Xiong, Y. (2024). Differences in the innovation effectiveness of China's new energy vehicle industry policies: A comparison of subsidized and non-subsidized policies. *Energy*, 304, Article 132151. <https://doi.org/10.1016/j.energy.2024.132151>
- [8] Wang, F., & Han, H. (2024). How does progressive subsidy reduction affect the innovation and economic performance of new energy vehicle firms? *Economic Analysis and Policy*, 84, 1621–1635. <https://doi.org/10.1016/j.eap.2024.10.050>
- [9] Wang, Y., Lu, T., & Qiao, Y. (2025). Visible hands: The impact of subsidy withdrawal on new energy vehicle enterprises' innovation behaviors. *Energy Policy*, 198, Article 114466. <https://doi.org/10.1016/j.enpol.2024.114466>
- [10] Zhang, L., Li, S., Cheng, X., & Geng, J. (2025). Can subsidies promote electric vehicles' sustainable development? A general equilibrium perspective on substituting enterprises for government. *Annals of Operations Research*, 355(1), 123–146. <https://doi.org/10.1007/s10479-024-06402-w>
- [11] Patchell, J., Tsai, K. S., Wang, H., & Cheung, B. (2024). Competition and coordination: Regional dynamics in the rise of China's new energy vehicle industry. *Sustainability*, 16(5), Article 1907. <https://doi.org/10.3390/su16051907>
- [12] Zhang, T., Li, S., Li, Y., & Wang, W. (2023). Evaluation of technology innovation efficiency for the listed NEV enterprises in China. *Economic Analysis and Policy*, 80, 1445–1458. <https://doi.org/10.1016/j.eap.2023.10.006>
- [13] General Office of the State Council of the People's Republic of China. (2020). New energy vehicle industry development plan, 2021–2035 (Guo Ban Fa [2020] No. 39). Government of the People's Republic of China. [Policy document in Chinese]. Available at: https://www.gov.cn/zhengce/content/2020-11/02/content_5556716.htm (Accessed: 3 August 2026).
- [14] China Automotive Technology and Research Center Co., Ltd. (2018–2025). Vehicle registration and compulsory motor-vehicle insurance database [Proprietary database in Chinese]. Access proposed through an institutional subscription. Available at: <https://www.cataarc.ac.cn/> (Accessed: 3 August 2026).
- [15] Chinese Research Data Services Platform. (2018–2025). China Patent Research Database [Database in Chinese]. Access proposed through an institutional subscription. Available at: <https://www.cnrds.com/> (Accessed: 3 August 2026).
- [16] China Electric Vehicle Charging Infrastructure Promotion Alliance. (2018–2025). Monthly reports on electric vehicle charging infrastructure in China [Data set in Chinese]. Available at: <https://www.evcipa.org.cn/> (Accessed: 3 August 2026).
- [17] National Bureau of Statistics of China. (2018–2025). China statistical yearbook and national data [Data set in Chinese]. China Statistics Press. Beijing. Available at: <https://www.stats.gov.cn/sj/ndsj/> (Accessed: 3 August 2026).
- [18] Ministry of Industry and Information Technology of the People's Republic of China. (2018–2025). Road motor vehicle manufacturers and products announcements and new energy vehicle model catalogues [Official catalogues and data set in Chinese]. Available at: <https://ythzxfw.miit.gov.cn/gxbcyjszq/dljdczq/index.html> (Accessed: 3 August 2026).
- [19] Hao, Y. A., Peng, B., Zou, H., Zhu, N., & Du, H. (2025). How does differentiated subsidy adjustment influence new energy vehicle sales? *Transportation Research Part A: Policy and Practice*, 195, Article 104432. doi: 10.1016/j.tra.2025.104432.
- [20] Roth, J., Sant'Anna, P. H. C., Bilinski, A., & Poe, J. (2023). What's trending in difference-in-differences? A synthesis of the recent econometrics literature. *Journal of Econometrics*, 235(2), 2218–2244. doi: 10.1016/j.jeconom.2023.03.008.