The Distributional Effects of Electric Vehicle Subsidies in China

Jing Liang, MA[1]; Junji Xiao, PhD[1]
[1]Lingnan University

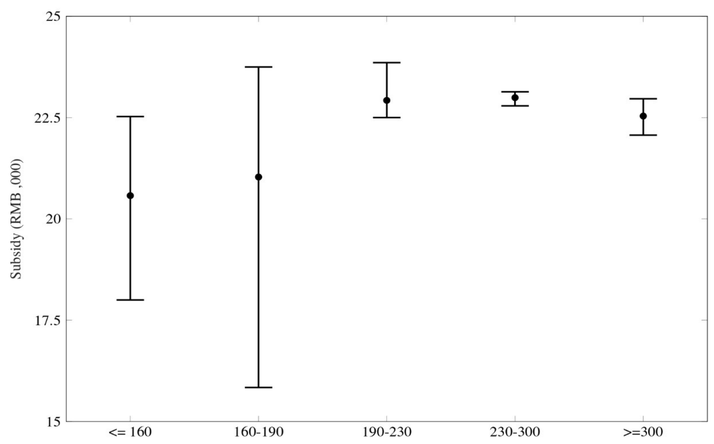
Abstract

This study investigates the pass-through and distributional effects of electric vehicle (EV) subsidies in China. It evaluates how these effects affect market equilibrium and welfare.
Empirical results indicate that EV subsidy pass-through to consumers is more-than-complete, disproportionately favoring high-income individuals. Additionally, we introduce an equitable subsidy model that prioritizes innovation while being progressive in the sense that it redistributes resources toward low-income households. A surprising finding is that this alternative scheme reduces consumer surplus, as producers exploit its progressive structure, transferring gains. Despite enhancing EV adoption and welfare (excluding externalities), the progressive design of subsidies transfers consumer surplus to producers.

Introduction

Subsidies have been widely adopted by many countries to incentivize the substitution of internal combustion engine vehicles (ICEVs) with electric vehicles (EVs), owing to the latter's clean-technology nature. In particular, Li et al. (2022) document that more than half of EV sales can be attributed to consumer subsidies in China.
This paper highlights the importance of tax incidence and distributional effects in determining the effectiveness of the EV subsidies. Firstly, the pass-through of subsidies to consumers affects how much benefit consumers actually receive. Manufacturers may strategically respond and share only a portion of the subsidies, undermining the impact of the subsidies on EV diffusion. Secondly, the distribution of subsidies across income groups plays a role in determining who benefits more from the policy. Current subsidy systems often favor high-end EVs, which are typically chosen by high-income consumers, resulting in a regressive distribution that favors higher-income households (Figure 1). This undermines the effectiveness of subsidies further, as high-income consumers are less sensitive to subsidies. The pass-through and progressivity of subsidies depend on factors such as income and the competition structure of the EV market.
The paper conducts simulations to compare the current attribute-based subsidies with alternative subsidies that are both attribute-based and progressive in terms of income. The progressive scheme aims to reallocate subsidies from high-income consumers to low-income consumers, with the expectation that it will be more effective in promoting EV sales.
The paper contributes to the existing literature in several ways. Firstly, it is the first study to examine subsidy pass-through and its impact on EV adoption in China. Secondly, it extends previous research on the progressivity of subsidies and its implications for policy efficiency. Thirdly, it adds to the limited empirical studies on the relationship between progressivity and the incidence of subsidies. Lastly, it contributes to the emerging literature on the Chinese EV market.

Figure 1: Subsidy Distribution Based on Income



Note: The figure shows subsidies from the central government and the annual income of car consumers in 2020. The subsidies are aggregated to consumers with similar incomes. The top and bottom borders of the line are the minimum and maximum subsidies. The black dot in each box is the mean.

Methods and Materials

The research employs a structural model that considers both demand and supply sides of the passenger vehicle market in China. It utilizes micro-moments BLP identification methods and city-level sales and buyer survey data from 2016 to 2019. Through counterfactual analysis, the study compares the current attribute-based subsidies with alternative subsidies that are both attribute-based and progressive in terms of income.

Contact

Junji Xiao
Lingnan University
Email: junjixiao@ln.edu.hk

Results

The study finds that EV subsidies in China are disproportionately benefiting high-income individuals, resulting in a regressive subsidy scheme. The pass-through of subsidies from manufacturers to consumers is found to be more-than-complete, with manufacturers passing on 121.32% of the subsidies on average to consumers.

The counterfactual analysis reveals that this progressive subsidy scheme, despite enhancing EV adoption and welfare, leads to a reduction in consumer surplus as producers exploit its structure and transfer gains to themselves (Table 1). This highlights the complex dynamics between subsidy design, pass-through behavior, and welfare outcomes.

Table 1: Cost-Benefit Analysis of EV Subsidies

Scenarios [a]		Null	(1)	(2)	(3)	(4)
Compensating variation[b]			2.0532	-0.2873	-0.0233	-0.0040
Profits						
Domestic	EV manufacturers	6.3308	6.8948	6.2084	6.3223	6.3453
	ICEV manufacturers	2.8460	2.5154	2.9076	2.8510	2.8595
Imported	EV manufacturers	0.1548	0.1361	0.1585	0.1551	0.1557
	ICEV manufacturers	1.2584	1.1080	1.2881	1.2608	1.2661
Subsidy		0.4085	5.2583	0.0000	0.3804	0.4085
Subtotal for sales		10.1815	7.4492	10.2753	10.1855	10.2141
Externalities[c]						
EVs	(Coal-fired electricity)	89.1917	484.5169	37.4508	84.978	92.8927
EVs	(Natural-gas-powered electricity)	19.0276	103.3636	7.9895	18.1286	19.8171
ICEVs		364.7407	327.1915	371.2565	365.2693	365.8749
Subtotal	(Coal-fired electricity)	453.9324	811.7084	408.7073	450.2473	458.7676
Subtotal	(Natural-gas-powered electricity)	383.7683	430.5551	379.2460	383.3979	385.6920
Total	(Coal-fired electricity)	-443.7509	-804.2592	-398.4320	-440.0618	-448.5535
Total	(Natural-gas-powered electricity)	-373.5868	-423.1059	-368.9707	-373.2124	-375.4779

[a] Scenario null: the subsidy scheme is the same as that for 2019. Scenario (1): the subsidy scheme is the same as that for 2015. Scenario (2): subsidy is zero for all EVs. Scenario (3): the base of this subsidy scheme is designed for the lowest income group (with annual income less than RMB 60,000) and it is the same as the scheme for 2019. The effective subsidies of high-income groups are the product of subsidies in the null scenario and the multipliers shown in equation **??**. Scenario (4): the subsidies depend on both income and vehicle ranges. The subsidy is given by $sb_{ij} = 8.1227 - 1.445 \times y_i + R_j \times 0.004$, where R_j is the range of vehicle j. The subsidy is in RMB 10,000.
[b] All values are in RMB billions. The estimates are for Shanghai in the second half of 2019.

Discussion

Weyl and Fabinger (2013) prove that pass-through depends on both demand and supply elasticities in imperfect competition. Given that consumers are heterogeneous in their price sensitivity, the aggregate demand elasticity should depend on individual price sensitivity and demographic distribution. Therefore, given the income distribution, progressivity could be the exogenous reason behind the high pass-through of subsidies: When more subsidies are designed for high-income and low-elasticity consumers, the subsidized consumers' overall price sensitivity is low; consequently, the manufacturers will pass a large portion of the subsidies through to consumers to gain market shares from ICEVs. Our empirical findings support such a relationship between progressivity and pass-through: When the subsidy scheme is redesigned into a system progressive on incomes, the subsidies passed through to consumers become less (Table 2). Intuitively, manufacturers can better exploit their market power with the progressive scheme, which generates a greater distortion, leading to higher welfare loss, compared with the regressive subsidy scheme. This finding also suggests that subsidy pass-through depends on the policy nature of income distribution.

Table 2: Subsidy Pass-through to Consumers

Scenarios [a]	Null	(1)	(3)	(4)
EV manufacturers[b]	121.32%	121.08%	120.35%	114.01%
Hybrid manufacturers [c]	120.92%	120.74%	120.00%	114.88%
All manufacturers[d]	120.99%	120.80%	120.06%	114.73%

[a] The equilibrium prices in scenario (2) are used as the benchmark for the pass-through calculation since scenario (2) simulates the zero-subsidy policy. In the other scenarios, the pass-through is defined as the ratio of the price decrease, relative to the no-subsidy price, to the subsidies.
[b] This row presents the average pass-through of EVs made by firms only producing EVs, including Beijing Electric Vehicle, Nio, WM Motor, and Xpeng.
[c] This row presents the average pass-through of EVs made by firms producing both EVs and ICEVs, including Beijing Benz, Beijing Borgward, Beijing Hyundai, BAIC Motor, BYD, Chery, Chongqing Changan, Dongfeng Honda, Dongfeng Motor, FAW-Volkswagen, GAC Honda, GAC Mitsubishi, GAC Motor, Geely, JAC Motor, SAIC-GM, SAIC Motor, and SAIC-Volkswagen.
[d] This row presents the average pass-through of EVs produced by all firms.

Conclusions

This paper analyzes the incidence (or pass-through)—the subsidy distribution between manufacturers and consumers, and progressivity—the subsidy distribution over consumers of different incomes. Our findings suggest that the subsidy pass-through to the consumers is more than complete: The manufacturers not only pass through the subsidies to the EV buyers but also further lower their prices in response to ICEV manufacturers' strategic response to the EV decline caused by subsidies.

References

1. Li, S., Zhu, X., Ma, Y., Zhang, F., Zhou, H., 2022. The role of government in the market for electric vehicles: Evidence from China. Journal of Policy Analysis and Management 41, 450–485.
2. Weyl, E.G., Fabinger, M., 2013. Pass-through as an economic tool: Principles of incidence under imperfect competition. Journal of Political Economy 121, 528–583.