Can the subsidy program change the customer base of next-generation vehicles?

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1. Background and research objective

Since the promotion of hybrid electric vehicles (HEVs) is efficient to reduce energy consumption and greenhouse gas emissions from the transportation sector, various countries have introduced preferential tax treatments and rebate programs for HEVs. The impacts of such subsidies on HEV sales have been examined in Canada (Chandra et al. 2010) and the United States (Gallagher and Muehlegger 2011). Further, a similar subsidy program called the "Eco-car program" was introduced in Japan; Iwata and Matsumoto (2016) confirm that the program rapidly expanded the sales of HEVs. Although it is important to know the types of households that are likely to be attracted by a specific subsidy program, no literature has yet identified the households that switched from conventional gasoline vehicles to HEVs. In this study, we compare the vehicle choice between three sampling periods (before/during/after the Eco-car program) and examine whether the rebate program changed the customer base of HEVs.

2. Data and research method

For the empirical analysis, we use micro-level data from the Japanese National Survey of Family Income and Expenditure (NSFE), which was collected in 2009 and 2014. NSFE collects data on households' socioeconomic characteristics, information related to houses, etc. In addition, NSFE also collects vehicle-related information such as the number of vehicles owned, the year of purchase of each vehicle, and the type of vehicle.

We focus on the households that purchased only one new vehicle between 2004 and 2014. We conduct empirical analyses based on the Multinomial Logit Model. We estimate the probability of selecting one of the following three types of vehicles: HEV, compact gasoline vehicle (CGV), and regular gasoline vehicle (RGV). To examine whether new types of households began purchasing HEV with the Eco-car program, we divide the data into three sampling periods: before, during, and after the Eco-car program. We then estimate the following equation for three sampling periods separately,

$$\Pr(y_i^t = j) = \frac{\exp(\boldsymbol{B}_j^s \boldsymbol{X}_i - \gamma_j^s p_j^t + \theta_j^s g^t)}{\sum_{j=1}^{3} \exp(\boldsymbol{B}_j^s \boldsymbol{X}_i - \gamma_j^s p_j^t + \theta_j^s g^t)}$$

where $\boldsymbol{B}_j^s$, γ_j^s, and θ_j^s are period-specific coefficients; $\boldsymbol{X}_i$ is the vector of socioeconomics characteristics of household i; p_j^t is the weighted average price of type j's vehicle at time of purchase t; g^t is the gasoline price at time of purchase t. We choose HEV as the base outcome.

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Table 1. Changes (RRRs) in the marginal impact of household characteristics on vehicle selection.

Variables	Before Eco-Car program				During Eco-Car program				After Eco-Car program			
	Vehicle = CGV		Vehicle = RGV		Vehicle = CGV		Vehicle = RGV		Vehicle = CGV		Vehicle = RGV	
Gasoline Price	0.959	***	0.968	**	1.020		0.988		0.979		0.954	
Household income	0.749	**	1.109		0.583	***	0.898		0.804	*	1.002	
Gender of household head dummy	0.602	***	0.940		0.565	***	0.823		0.646	***	0.896	
Net wealth	0.971		0.971		0.930	***	0.952	***	0.963	**	0.947	***
Age of household head	0.982	***	0.978	***	0.997		0.977	***	1.014	***	0.990	**
Household size	1.117		1.348	***	1.244	***	1.368	***	1.156	**	1.312	***
Detached house dummy	1.078		0.823		1.412	**	1.035		0.844		0.974	
Home owner dummy	0.741		0.923		0.524	***	0.765	*	0.802		0.705	**
Electricity bills per capita	0.882	***	1.026		1.001		1.069	***	0.932	***	1.006	
Constant	3.88E+11	*	5870071		0.000		0.004		922.143		4E+37	
N	10158				4149				3004			
Log likelood	-7368.137				-4046.655				-3093.565			

Notes: 1) ***, **, * indicate significance at 1, 5, and 10% level, respectively; 2) RRRs capture the relative risks, which are the ratios of the vehicle choice probabilities; 3) dummies of 47 prefectures and average weighted price of each type of vehicles are concluded in the model.

3. Main findings

The results presented in Table 1 suggest that the impact of household characteristics on HEV selection has changed during three purchase periods. We find that the impact of gasoline price has become smaller after the Eco-car program. We also find that higher income households who used CGVs before the Eco-car program switched to HEVs during the Eco-car program. In contrast, household income does not play an important role on the choice between HEV and RGV. In addition, we find that households with large net wealth tend to choose HEVs over both CGVs and RGVs. Households who own a house tend to choose HEVs over CGVs or RGVs during and after the Eco-car program, while households living in a detached house tend not to choose HEVs over CGVs during the Eco-car program. Finally, we find that RGV households consume more electricity than remaining two households.

4. Conclusion

In this study, we analyzed the micro-level data of vehicle selection from NSFE and found how the Eco-car program affected the vehicle selection of households. These findings shall give policy implications to the further promotion of next-generation vehicles.

References

Chandra, A; Gulati, S; Kandlikar, M 2010. “Green drivers or free riders? An analysis of tax rebates for hybrid vehicles.” *Journal of Environmental Economics and Management* 60: 78-93.

Iwata, K and Matsumoto, S 2016. “Use of hybrid vehicle in Japan: An analysis of used car market data.” *Transportation Research Part D* 46: 200-206.

Gallagher, K and Muehlegger, E 2011. “Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology.” *Journal of Environmental Economics and Management* 61(1): 1-15.