How much greenhouse gas did hybrid-vehicle drivers save? : Analysis of Japanese Used Market Data

Arimura, Toshi H. (Waseda University)

Iwata, Kazuyuki (Takasaki City University of Economics)

Matsumoto, Shigeru (Aoyama Gakuin University)

[Long Abstract]

1. Background and Research Motivation

Reduction of greenhouse gas (GHG) emissions from transportation sector has been an important policy agenda. For the last several years, countries have significantly tightened fuel economy standards for motor vehicles. For example, on August 28, 2012, the Obama administration set the new standard that required automakers to nearly double the average fuel economy of new cars and trucks by 2025 (Vlasic 2012). On April 23, 2009, the European Parliament and the Council approved regulations setting a target of 130 g/km for the average emissions of new cars to be phased-in by 2015 (Global Fuel Economy Initiative (2013)).

To further accelerate the reduction of GHG emissions, several countries have implemented policies to stimulate the sales of hybrid vehicles (HVs) in more recent years. For instance, federal, state, and local governments in Canada and the United States have implemented sales-tax or cash rebate programs for HVs. Japanese government implemented similar rebate programs since 2009. Recent empirical studies confirmed that the rebate programs led to a large increase in the market share of HVs (Chandra, Gulati, and Kandlikar (2010), Gallagher and Muehlegger (2011)).

Despite the rapid market penetration of HVs, the driving behavior of hybrid vehicle owners has not yet been examined carefully. In fact, the majority of previous studies assumed that the driving behavior of HVs owners was the same as that of conventional vehicle owners and then estimated the potential reduction of GHG emissions.

In this study, we analyzed vehicle usage based on Japanese used car market data and evaluated the effectiveness of the rebate program for HVs. Specifically, we examined (1) whether there was a difference in the mileage between HVs and their competitive cars, (2) how much GHG hybrid-vehicle drivers saved, and (3) whether the rebate program for HVs is a cost-effective GHG reduction measure.

2. Data and Empirical Methodology

We obtained our primary data from Proto Corporation. Proto Corporation is the market research firm that publishes one of the most popular used car magazines, Goo. It also provides up-to-date information on its Web site called “Goo-net.” The data

obtained from Proto Corporation includes a variety of information such as price, mileage, and detailed specifications of the used cars. Using this data, we conducted three types of analyses.

In the first-stage analysis, we compared the mileages across vehicle models and then identified the vehicle characteristics that were associated with the mileages. Parry, Walls, and Harrington (2007) estimated the monetary values of externalities associated with vehicle use in the US. Koyama and Kishimoto (2001) and Kanemoto (2007) followed similar empirical analytical approaches and estimated the monetary values of externalities in Japan. In the second stage analysis, we combined these external costs with the mileage data and compared the magnitudes of externalities across vehicle models. We include vehicle taxes and rebates in the final stage analysis and evaluated the cost-effectiveness of the rebate program for HVs.

3. Main Findings

Table 1. Monetary Values of Externalities（First three years average）

Model	Mileage	CO_2 Emission	Costs of GHG Warming [a]	Mileage-related costs	Total External Cost
(Unit)	(km)	(kg/car)	(yen)	(Yen)	(Yen)
Prius	35,770	2325.0	23,250	382,734	405,984
Competitors					
Mazda Axela Sports	22,756	3433.1	34,331	243,494	277,824
Peugeot 207	17,280	3464.8	34,648	184,896	219,544
Nissan Note	29,826	3626.9	36,269	319,137	355,405
Honda Fit	27,000	2768.7	27,687	288,900	316,587
Toyota Wish	30,894	5066.1	50,661	330,568	381,230
Toyota Vitz	25,493	2715.2	27,152	272,778	299,930
Volkswagen Golf	28,080	5024.8	50,248	300,451	350,699
Toyota Auris	24,014	3252.9	32,529	256,952	289,481

Note a: The cost of CO_2 is assumed to be 10,000 yen per ton.

Table 1 summarizes the external costs of each vehicle model. The average mileage of HV (Prius) owners for the first three years is 35,770 km while those of the competitive cars range from 17,280 km to 30,894 km. Therefore, HV (Prius) owners drive their cars more than conventional car owners. Despite longer mileage, HV owners emitted lower amount of CO_2 owing to the low fuel economy of HV. If the cost of CO_2 was 10,000 yen per ton, then HV owners saved 11,000-27,000 yen of GHG costs for the first three years. Since the amount of the rebate for HVs is larger by 31,250 yen than that for competitive cars, HV owners received a larger rebate than their contribution to GHG

reduction. If other mileage-related external costs such as local air pollution, congestion, and accident are included in the analysis, then the economic benefit of hybrid vehicles with respect to conventional vehicles disappear.

4. Conclusion

Although GHG emissions will be reduced by the market penetration of HVs, other externality problems will not be resolved. HV owners drive their cars more than conventional car owners and the mileage-related external cost is much larger than the cost of GHG warming. Although the governments have tightened fuel economy standards and have introduced rebate programs, those policies are not enough. We need a mileage charge to resolve externality problems associated with vehicle use.

Acknowledgements

This work was supported by Grand for Environmental Research Projects from the Sumitomo Foundation.

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