



Evaluation of incentive policies for electric vehicles: An experimental study on Jeju Island

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ABSTRACT

In Korea, electric vehicles (EVs) are considered as a potential solution for counteracting environmental issues that have arisen due to vehicles with internal combustion engine. Therefore, a multitude of incentives have been offered to the consumers but the effectiveness of those incentives varied due to diverse consumer perceptions on various incentives. To evaluate consumer behavior toward the incentives for EVs, this study performed stated preference experiments of actual EV owners. The experiments showed that, compared with the potential consumers, actual EV owners exhibited a greater inconvenience to charging time. For the incentives, EV owners showed different preferences to the different incentive measures. Especially, they have far greater preference for subsidies during their ownership period, such as discounts to the electricity charging rate and operation subsidies, than for those at the time of purchase, such as purchase subsidies and charger installation. These findings suggest that it would be more effective to formulate an incentive policy that reflects diverse consumer behavior toward EV incentive measures.

1. Introduction

The transportation sector is responsible for 14% of the world's greenhouse gas emissions; this is projected to increase up to 50% by 2030 (IEA, 2007). As the need for reducing greenhouse gases has emerged as a global task, the automobile market starts to expand the production of environmentally-friendly vehicles. Electric vehicles (EVs), which can gradually replace internal combustion engine vehicles (ICEVs) in the current transportation system, are considered as a potential solution to environmental issues. Hence, many countries have taken actions to promote EVs (Zhang et al., 2014). These actions include various incentive policies such as purchase subsidy, operation subsidy, free parking, and access to high occupancy vehicle lanes. However, EV sales have been sluggish, representing only 0.9% of automobile sales worldwide in 2015 (IEA, 2016) due to various disadvantages such as high purchase price, short driving distance, and insufficient charging infrastructure. Like governments of other countries, the Korean government announced a “Green Car Roadmap” in 2010 with the vision of Korea becoming one of the four leaders worldwide in global green car power. This plan aimed to promote the green car industry and to increase rapidly the diffusion of EVs. Furthermore, a law, the “act on the promotion of development and diffusion of environmentally-friendly vehicles,” was legislated in Korea to expedite EV market penetration. As a part of this act, various incentives were offered to EV buyers to make these vehicles more attractive and competitive with ICEVs. Despite these efforts, only 11.7 thousand EVs had been sold by the end of 2016; this number was slightly over 13% of the government target.

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Table 1
Incentives for EV owners (On Jeju Island as of 2015).

Division	Description	Incentive for EV	Incentive Provider	
Tax incentives	Individual consumption tax (a)	• 5% of vehicle factory price	Max. 2 million KRW ^a reduction	National government
	Education tax (b)	• 30% of (a)	Max. 0.6 million KRW reduction	National government
	Acquisition tax	• 7% of [vehicle factory price + (a) + (b)]	Max. 1.4 million KRW reduction	National government
	Public bond	• 9–20% of [vehicle factory price + (a) + (b)]	Max. 0.2 million KRW reduction	National government
	Annual vehicle tax (c)	• 80–200 KRW/cc	Credit of 10 million KRW ^b	National government
	Annual education tax	• 30% of (c)	Charged 3 million KRW ^b	National government
Other incentives	Public parking lot fee	• 5 thousand ~ 10 thousand KRW per day	Exempt	Local government
	In-home charger installation fee	• Supports for EV wall charger installation cost	Max. 6 million KRW reduction	National and Local government
	EV purchase subsidy	• Supports up to 50% of the price difference between EVs and ICEVs	Max. 22 million KRW reduction	National and Local government
	Battery warranty	• Battery warranty period varies by automobile company	Max. 14 million km	Automobile company
	Refueling/Charge cost	• A different rate is charged depending on the charging time and season of the year (e.g., light load in summer: 57.6 KRW/Kwh, maximum load in winter: 190.8 KRW/kWh)	EV rate system	National government

^a 1.1 thousand Korean won (KRW) is equivalent for 1 US dollar in 2017.

^b The same amount of tax is charged regardless of the vehicle type.

Compared with the sluggish EV market in other regions in South Korea, EV sales in Jeju Island have grown successfully over the past 4 years. Since the incentive policy went into effect in 2013, more than 5890 EVs – over 55.2% of all EV sales in South Korea, and 2.8% of all passenger car sales on Jeju Island – have been sold and registered on Jeju Island as of 2016 (MOLIT Statistics System). A major reason for this success is that the Jeju Self-governing Province has actively expanded its public charging infrastructure and offered various incentives to Jeju residents in addition to the ones provided by the Korean government. For the subsidy, the applicants should be residents of Jeju island who have not received the EV subsidy previously. Once they are selected for the subsidy, the upfront subsidy is given for the purchase if they retain the ownership for at least two years. Otherwise, the owner (i.e., subsidy recipient) should fully return the upfront subsidy. Meanwhile, the operation incentives such as discounts of annual vehicle tax and charging electricity rate are provided as long as the EVs are in operation (even after the ownership is transferred). These incentives on Jeju Island are summarized in Table 1.

Despite the successful promotion of EVs that the various incentives have collectively achieved on Jeju Island, the satisfaction level of each policy varies. A consumer satisfaction survey which was previously conducted in Jeju Island showed that EV owners were more satisfied with the subsidies during operation period than at the purchase, and less satisfied with non-monetary benefits such as battery warranty (Son, 2014). In this study, however, the satisfaction levels were measured qualitatively based on consumers' anecdotal responses. Therefore, it is necessary to evaluate people's perceptions of the different incentives so that more effective policy measures can be formulated to ease budget constraints. In view of this, this study collected survey responses from actual EV owners who had already scrutinized and experienced the various incentives, and evaluated the effects of those measures on the purchases of EVs. To this end, the following section reviews survey methods and the literature on policy measures that affect EV consumer behavior. Section 3 provides descriptions of the design of the stated preference survey and the data collected in this study. In Section 4, the statistical analysis used to evaluate the data is explained; the outcomes from this analysis are documented in Section 5. The final section summarizes findings and suggests directions for formulating policy measures and alternative policies that may enhance the effects of the incentive policy.

2. Literature review

The high price of EVs is considered one of the major obstacle to the diffusion of EVs in the automobile market (Larson et al., 2014). Thus, various types of incentives have been offered to EV consumers with the intention of encouraging the EV market penetration (Yang et al., 2016). The effectiveness of these incentives were evaluated by previous studies, which can be categorized into two groups. One type of study analyzed the changes in market share of EVs with respect to the time of initiation of the incentive policy. The other type of study evaluated consumer behavior toward EVs based on survey data.

The market analysis showed that the incentive policy had a positive effect on promoting the purchase of EVs (Bjerkkan et al., 2016; Mersky et al., 2016; Leurent and Windisch, 2011; Jin et al., 2014). Meanwhile, the outcome varied in accordance with the form of incentive provision. The policy was more effective when provided in the form of subsidy (e.g., subsidy for EV purchase and tax exemption) than in the form of non-financial benefits (e.g., free public parking and access to high-occupancy vehicle lanes).

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