Exploring Consumer Adoption of Electric Vehicles in Japan: an Empirical Study

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1 ABSTRACT

In line with the Green Growth Strategy, Japan has actively pushed for the increased adoption of electric vehicles (EVs, PHVs, FCVs) aiming for their exclusive presence in new passenger car sales by 2035. However, Japan's progress in electric vehicle uptake lags behind other developed nations. Despite robust marketing efforts by both local and global automakers, Japanese consumers remain hesitant to embrace electric vehicles. This study conducts a pilot survey to gauge the demand for electric vehicles in Japan. Results indicate that respondents prioritize the country of manufacturer as the most crucial factor in their next passenger car purchase, followed by the car's drive type and cruising range. Price is considered the least influential factor. Notably, respondents place significant importance on domestic manufacturer and plug-in hybrid drive type. These findings offer valuable insights for academic research and policymaking to encourage broader electric vehicle adoption in Japan.

Keywords: Green Growth Strategy, Electric Vehicles, Carbon Neutral Society, Consumer Behaviour, Japan

2 INTRODUCTION

Recent advancements in Japan's automotive sector have been significantly influenced by the Green Growth Strategy initiated by the Japanese government. This strategy views the response to global climate change as an opportunity for industrial and socioeconomic transformation rather than a hindrance to economic growth (Cabinet Secretariat, et.al., 2021). Specifically, the Green Growth Strategy aims to reduce greenhouse gas emissions by 46% by 2021, relative to 2013 levels, in alignment with the country's carbon neutrality goals for 2020 and 2030 (Ministry of the Environment, 2021). Key measures include promoting renewable energy and accelerating the adoption of electric vehicles (EVs), plug-in hybrid vehicles (PHVs), and fuel cell vehicles (FCVs), aiming to achieve 100% penetration of these electrified vehicles in the new passenger car market by the year 2035 (Yamaguchi, 2022).

Despite these efforts, Japan lags behind other industrialized nations in EV adoption, with consumers exhibiting reluctance to purchase electric vehicles despite extensive marketing efforts. In contrast, countries like China, South Korea, and Vietnam are experiencing a surge in EV popularity, while others such as Thailand, Malaysia, and Indonesia are embracing EV production technologies to stimulate economic growth (Purtanto, 2023).

Given that Japan heavily relies on automobile manufacturing, which accounts for nearly one-fifth of its exports, the nation faces the prospect of economic stagnation should it fail to transition towards electric vehicle production (Electrek, 2022). This pilot study aims to investigate EV demand in Japan through a nationwide survey targeting individuals aged 20 to 70 who own cars. Alongside geographic and demographic data, the study will employ conjoint analysis to identify attributes prioritized by respondents in their prospective car purchases.

3 METHODS

3.1 Plan Cards

We conducted a full-profile-rating conjoint analysis to explore the factors influencing the purchase of private cars, drawing upon previous research on the demand for environmentally friendly vehicles. Initial factors were identified through previous literatures(Jung, et al.,2022; Khan,et al.,2020; Kowalska-Pyzalska,et.al., 2022; Kajiwara & Muromachi, 2023; Ito & Managi, 2015) and interviews with five randomly selected car owners nationwide. Ultimately, four factors were chosen for the empirical study: 1. the nationality of the manufacturer, 2. the cruising range of the vehicle, 3. the vehicle type, and 4. the price.Table 1 outlines the characteristics of the products examined in this study.

To assess consumer preferences, we created various product profiles, or "plan cards," based on different attribute levels. Respondents evaluated these profiles, resulting in a total of 36 potential combinations ($3 \times 2 \times 3 \times 2$). To streamline the selection process and minimize bias, we employed Fisher's factorial design to

reduce the combinations to 11 plan cards using IBM SPSS conjoint software (version 19). Respondents were then presented with these 11 plan cards and asked to imagine purchasing a new car, rating each card based on its characteristics. Ratings were provided on a five-point scale ranging from 'strongly considering purchasing' to 'not considering purchasing.'

Attribute	Level 1	Level 2	Level 3
Country	Germany	Japan	China
Car's range	500km	200km	-
Type	EV	PHV	Gasoline car
Price	3,000,000JPY	1,500,000JPY	-

Table 1: Levels and Atrributes

Equation (1) presents the consumer behavior model utilized in our analysis:

$$\text{Estimated consumer's utility} = \beta_0 + \beta_C \times \text{Country} + \beta_R \text{ Range} + \beta_T \times \text{Type} + \beta_P \text{ Price} \quad (1)$$

When selecting a car, consumers aim to maximize their utility by considering various features. In this model, utility serves as the dependent variable, representing the customer's utility function. It encompasses different attributes, with the utility of each attribute assumed to be quantifiable. Thus, the total utility is calculated as the sum of individual attribute utilities.

Equation (2) outlines the model for determining the average importance of each attribute:

$$\text{i attribute's importance} = R_i / (R_C + R_R + R_T + R_P) \times 100 \quad (2)$$

Here, importance i represents the average importance of attribute i, and Ri denotes the value range of the utility factors associated with attribute i. The subscripts C, R, T, and P correspond to the attributes of country, range, type of vehicle, and price, respectively. The calculation yields each attribute's relative influence, expressed as a percentage summing to 100%. This computation is conducted for each respondent, and the average importance across all respondents is derived.

3.2 Descriptive data

A nationwide consumer survey was conducted from March 8 to March 9, 2024, utilizing a web-based survey platform. The questionnaire encompassed several sections. Initially, respondents provided demographic information, including gender, age, household income, marital status, presence of children, and residential area. Subsequently, they were presented a list combining the attributes of cars. Table 2 summarises the statistical data.

Variable		N	%
Gender	Male	476	72.2
	Female	183	27.8
Age	Young adults (ages 20-39)	83	12.6
	Middle-aged (ages 40-59)	326	49.5
	Old age (60 above)	250	37.9
Household Income	Low income group (below 500 million JPY)	214	32.5
	Middle income group (500-below1000)	272	41.3
	High income group (1000 above)	101	15.3
	Pefer not to answer	72	10.9
Education	High School	168	25.5
	Jonior Colledge	123	18.7
	Undergraduate	324	49.2
	Graduate School	44	6.7
Marital status	Married	468	71.0
	Unmarried	191	29.0
Children Status	Present	419	63.6
	Absent	240	36.4
Region	Greater Tokyo Area	292	44.3
	Nothern	66	10.0
	Middle and Hokuriku	94	14.3
	Kinki	108	16.4
	Chugoku	56	8.5
	Kyushu and Okinawa	43	6.5

Table 2: Demographics

3.3 Empirical results

The model outcomes were computed utilizing IBM SPSS conjoint (version 26). Table 3 presents the empirical findings encompassing all respondents. Notably, the Pearson's R values were notably high (0.998), indicating a strong correlation coefficient between the values predicted by the model and the evaluation scores provided by the respondents. Higher values approaching 1 suggest a robust correlation coefficient. Additionally, Kendall's tau exhibited high values (0.778), affirming the reliability of the partial utility value calculations. Hence, the conjoint analysis model aligns well with the response tendencies of the respondents. Both Pearson's R and Kendall's tau are statistically significant (sig. < 0.000), indicating a well-fitting model.

Next, we examined the country's impact on consumer utility. The results revealed that Japan has the most positive effect on consumer utility values (+0.899), while Germany has the second highest effect (-0.127). China has the worst impact on consumer utility (-0.772). This attribute was the most important of all, with an average importance of 57.0%.

Then, we examined the effect of range on consumer utility. The high range (500km) positively impacts customer utility (+0.039). The low range (200km) has a negative effect (-0.039). This attribute had the 3rd degree of importance, with an average importance of 12.6%.

Regarding the type of car, PHV has a positive effect (-0.067), and the other two have a negative effect(EV: -0.018, Gasoline: -0.048). This attribute had the 2nd degree of importance, with an average importance of 18.7%.

Lastly, we examined the effect of price on consumer utility. When the price is reasonable (¥1,500,000), the effect on utility is positive (+0.051). High prices (¥3,000,000) have a negative impact (-0.051). The average importance of this factor is 11.4%, making it the least important factor.

Attribute	Estimation			
	Level	Utility	SD	Importance (%)
Country	Germany	-0.127	0.041	57.0
	Japan	0.899	0.041	
	China	-0.772	0.041	
Range	500km	0.039	0.031	12.6
	200km	-0.039	0.031	
Type	EV	-0.018	0.041	18.7
	PHV	0.067	0.041	
	Gasoline	-0.048	0.041	
Price	150	0.051	0.031	11.4
	300	-0.051	0.031	
Constants		2.218	0.033	
Pearson's R	0.998	Significance	0.000	
Kendall's tau	0.778	Significance	0.002	

Table 3: Empirical Results (All respondents)

3.4 Discussion

The results of our study shed light on what Japanese consumers prioritize when choosing eco-friendly vehicles and how these factors affect their decision-making process. Firstly, where the car is made, or its country of origin, emerged as the most influential factor. Japanese cars were preferred, followed by German ones, indicating that consumers pay close attention to where a car is manufactured. This factor held significant importance, with 57.0% of respondents considering it when making their choice. Secondly, the type of vehicle played a crucial role. Plug-in hybrid vehicles (PHVs) were favored, while electric vehicles (EVs) and gasoline-powered ones were less preferred. This suggests a preference for hybrid technology, possibly due to its perceived environmental benefits and fuel efficiency. Japanese automakers offer a wide range of hybrid models, which may contribute to consumers' confidence in this technology. Although less crucial, the range of the car also influenced consumer decisions. A longer range of 500 km had a positive effect, while a shorter range of 200 km had a negative impact. Lastly, while price remains a consideration,

it's not as significant as other factors like country of origin, car type, and range. This suggests that consumers prioritize these attributes over price when purchasing a car. These results can explain the current state of green vehicles in the Japanese market. For example, Nissan's Sakura was the top-selling EV in 2023, accounting for 40 percent of all sales with 37,140 units. The company's Leaf and Aria followed. China's BYD, on the other hand, sold 1,446 units, despite its vigorous marketing efforts and the introduction of low-cost, high-performance Evs (36Kr Japan, 2024).Our findings highlight the complexity of consumer preferences for car attributes and emphasize the importance for automakers to consider various factors when designing and marketing their vehicles.

4 CONCLUSION

Our research examines Japanese consumer preferences for eco-friendly vehicles, highlighting the significant influence of country of origin, vehicle type, cruising range, and price on car purchasing decisions. We find that Japanese consumers strongly favor domestically manufactured cars over foreign ones, with over 57.0% considering this factor crucial. Additionally, plug-in hybrid vehicles (PHVs) are preferred over electric vehicles (EVs) and gasoline-powered cars, reflecting a preference for hybrid technology. While price is a consideration, it is less important compared to country of origin, vehicle type, and cruising range. Overall, our findings underscore the complexity of consumer preferences and emphasize the importance for automakers to address these factors in vehicle design and marketing strategies to meet the demands of the Japanese market for eco-friendly vehicles. Future research endeavors should aim to explore the nuances in preferences among various segments of consumers, incorporating a comprehensive analysis of demographic variables alongside psychographic and behavioral variables. Additionally, further investigation could delve into the influence of cultural and societal factors on consumer preferences for eco-friendly vehicles.

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