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Article

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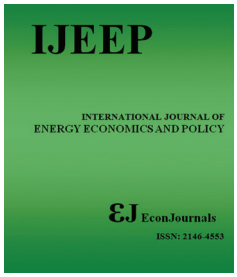

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The Determination of Willingness to Pay for Electrical Vehicles: A Literature Review

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ABSTRACT

With growing concerns about climate change and an unreliable fuel market, the world is shifting toward an electric-based transportation system, which requires a country to overhaul major infrastructures, establish highly funded research, change government regulations, and adapt available resources in order to transition from a gasoline-based transportation system to an electric one. The study is focused on consumers' determination of willingness to pay for electrical vehicles. By examining consumers' intentions to buy or not buy electric vehicles, researchers are attempting to determine what factors are motivating them to do so which may be range factor, demographic factors, marketing, charging station, government policy. The review studies show the various factors for determination of willingness to pay for electric vehicle.

Keywords: Electric Vehicle, Consumers' Determination, Willingness to Pay, Motivational Factor
JEL Classifications: 03, M2

1. INTRODUCTION

In the last period, it has been a surge in enthusiasm for the usage of electric vehicles and associated cars using green technology. (Nunes and Bennett, 2010). Electric vehicles (EVs) are among the most popular prominent vehicles that run on alternative fuels gained popularity in recent years. (Zhuge et al., 2019). From the consumer's viewpoint, willingness to pay is assessed and connected to EV pricing or services. The term "willingness" itself has a tendency to change depending on experience and a consumer's expectations versus reality. (Skippon et al., 2016). Both academic circles and the policy community have shown a significant interest in the willingness-to-pay (WTP) for electric vehicle (EVs). As a result of displacement of air pollution, EVs have the ability to lower carbon emissions, improve public health, and reap other benefits including greater energy and national security and noise reduction (Archsmith et al., 2015; Sovacool and Hirsh, 2009).

Electric vehicles (EVs), as the name implies, run entirely or partially on electricity supplied by the power grid. EVs are made up mostly of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). BEVs run on electricity, which is charged by plugging the vehicle into a power source or the electric grid. Batteries are used to store the energy. They do not use any petroleum-derived fuels. PHEVs, on the other hand, employ batteries to store grid-supplied electricity and petroleum-based fuels to power their combustion engines. EVs can be viewed as an alternative to the widespread use of internal combustion engine vehicles (ICEVs), which use a combustion engine and consume petroleum-based fuels, emitting greenhouse emissions (Egbue and Long, 2012).

Battery electric vehicles (BEVs) and plug-in electric cars make up the majority of EVs (PHEVs) in Nepal (Adhikari et al., 2020). As the market for electric vehicles (EVs) expands, it is critical to establish how much people are ready to pay for them. This includes

looking at things like EV costs, environmental advantages, and financial incentives. Researchers and governments can design ways to encourage increased adoption of EVs and reduce carbon emissions by calculating willingness to pay.

Although the comparatively substantial empirical evidence on the numerous EV criteria for willingness to pay and advantages has been widely acknowledged, the topic of why determination of willingness to pay for EV is so challenging still lingers. What are some additional important, largely undiscovered factors? This paper aims to study the factors affecting willingness to pay for EV.

The remainder of the paper is organized as follows. The section 2 presents the study method and section 3 outlines the literature review concerning willingness to pay, knowledge about EV and determining factors for EV. While Section 4 outlines the findings and discussion. Section 5 summarizes the conclusion.

2. METHODS

This review paper is based on the literature review and secondary data such as the journal articles, reports, paper. These are extracted from web searches using keywords: Willingness to pay, electric vehicle, determination, consumer preference. The data base searched on, Elsevier, Springer, MDPI, and Google scholar. The study covers the period from 2011 to 2023 and identified 9341 articles using keywords like electric vehicle, willingness to pay, purchasing intents, factors for motivation, battery electric vehicles (BEV), plug-in electric vehicles (PHEVs), or consumer preference. After eliminating book chapters, editorials, discussions, mini-reviews, and conference abstracts from 6234 papers, we preserved only research articles that were topic-related, leaving us with 3264 articles. Eventually, 109 research articles were found to be suitable for this study after 3155 research articles were rejected because of incorrect titles. Just 32 were chosen to review this article due to a lack of empirical facts and extraneous texts. Biblometric analysis is advised for perusing and examining sizable amounts of data. The method of biblometric analysis falls within the areas of performance analysis (e.g., the quantity of publications and citations) and science mapping (e.g., identification of the most important publication) (Donthu et al. 2021).

3. REVIEW

3.1. Willingness to Pay (WTP)

The amount of money a consumer is willing to pay (WTP) on a single unit of goods or services (Raje et al., 2002). Based on actual data gathered from in-person surveys, WTP is calculated (Ramos-Real et al., 2018). WTP was also utilized to create incentives to improve the consumer appeal of items (Dimatulac et al., 2018).

Positive feelings about a product, intuitively, should be associated with an increased tendency to make a purchase. (Peter and Olsson, 2008). (Hini et al., 1995) Given the numerous positional and character factors that may influence a buying behavior, such as differences in attitudes toward threat, the influences of advertising and marketing alternative costs, and variation in the levels of significance that people associate to particular factors, it was noted that the attitude-willingness to acquire affiliation is complex and, as a result, there are many measurement issues associated with its estimation. The intensity of the supposed link will therefore obviously differ based on a variety of variables. For instance, (Johnstone and Hooper, 2016) identified (dearth of) peer influence, a lack of knowledge about the performance of the product, and a constrained supply of the product as possible confounding factors. When conducting a customer survey on the topic, accessibility of a product must be taken into account as it is a key predictor of desire to purchase the commodity (Dodds et al., 1991). Consumer attitude plays a significant role in consumer acceptance of the product. Several factors must be examined before an electric vehicle may be accepted. A customer's WTP expresses the personal value they assign to a particular amount by being the highest price they would be ready to pay to obtain a specific quantity of a product or services (Wertenbroch and Skiera, 2002). Clearly, understanding consumers' WTP is important for estimating demand and creating optimal pricing in marketing (Wertenbroch and Skiera, 2002).

3.2. Knowledge about Electric Vehicles

The policy on emission requirements has been enhanced as a result of the increased emphasis on environmental contamination. This puts greater strain on the automobile industry, which is supposed to concentrate on creating more ecologically friendly vehicles (Kim and Park, 2017). By 2020, there will be 10 million electric vehicles in use worldwide. The COVID-19 pandemic caused a 16% decrease in the total number of newly registered vehicles, but a 41% rise in the number of licensed electric vehicles as contrasted to 2019. (Global EV Outlook 2021) However, when the total number of officially registered electric vehicles is considered, the registered number of electric vehicles in 2020 remains high, showing that electric vehicle registrations are increasing internationally. In fact, the growth in the number of licensed units in 2017 was bigger. Additionally, KAMA (Korean Automobile Manufacturers Association) reported that worldwide electric vehicle sales grew 46.1% over previous years, amid the automobile market slowdown brought on by COVID-19 in 2020. (Deloitte Insights 2021, 3, 1-22).

According to the literature, prospective electric vehicle owners are at least somewhat aware of the essential features of electric vehicles and similar technologies, including the absence of gas, absence of carbon dioxide emissions, lack of substantial driving range, recharge time, and accessibility of supercharger stations. (Egbue and Long, 2012; Policarpo and Aguiar, 2020). Also, according to academic research, environmentally concerned consumers often choose driving or using low-emission automobiles and sometimes even show their willingness to spend extra for them in order to benefit the ecology, community, and financial savings (Ziegler, 2012). Considering this, customers' particular expertise of EVs is not as thorough or sophisticated, which may have an impact on their decision to purchase this vehicle intellectually and contribute to the persistence of the myths. (Barton and Schutte, 2017). According to earlier research, a person's unique interest in and awareness of the symbols, qualities, and effects on the overall ecology of environmentally friendly products and services are a crucial cognitive indication. (D'Souza et al., 2006; Laroche et al., 2001; Jaiswal et al., 2021;Uddin and Khan, 2018).

3.3. Determining Factors for EV

3.3.1. Charging station

According to (Liang et al., 2021), there is a significant correlation between the total number of EVs and the number of EVCS (EV charging stations). The number of EVs is the most important factor that impacts the financial aspects of EVCS operation and other issues. Giving development subsidies for charging stations is a common strategy, as demonstrated in studies by (Kongklaew et al., 2021; Huang et al., 2021; Zolfagharian et al., 2021). Even in certain nations, the government constructed charging stations in the beginning to encourage the development of EVs, resulting in a ratio of one charging station for every ten EVs, which is the optimal Figure 1 (IEA, 2021). An incentive to lower the operating expenses of EVs is the policy of offering discounts on power rates for home charging and charging stations (Wang, 2019; Novizayanti et al., 2021). The majority of authors, including (Zolfagharian et al., 2021; Lonan and Ardi, 2020; Yu et al., 2018; Hu et al., 2020; Tarei et al., 2021), are constantly researching the factors that affect the availability and number of charging stations for EVs. Every EV comes with a home charging station, so it won't be a problem if the vehicle is driven just a short distance and relies on home charging.

3.3.2. Marketing

The promotional impacts of EVs have an impact on EV willingness to pay as well (Tarei et al., 2021; Huang et al., 2021; Abbasi et al., 2021). Promotion is a legitimate way for vehicle salespeople, especially those of EVs, to persuade customers to purchase the goods they are selling. Governmental or non-governmental organizations may also engage in promotion by emphasizing the value of EV use in the media and on social media.

A element that cannot be disregarded in the adoption of EVs, in addition to government promotion, is the word of mouth (WoM impact) of EV excellence (Deuten et al. 2019; Yu et al., 2018). In actuality, the WoM impact happens in every social institution, including the job, housing, neighborhoods, public transit, etc. (According to Tarei et al., 2021; Kim et al., 2018; Kumar and Alok, 2020; Jung et al., 2020), environmental awareness is another aspect that affects a person's decision to purchase an emission-free vehicle like an electric vehicle (EV). Consumer opinions toward EVs are considered to still be greatly influenced by product information, independent of its source. (Egbue and Long, 2012; Rezvani et al., 2015a) It can impact what users expect from the product in terms of performance, features, and degree of satisfaction (Soderlund and Gunnarsson, 2000). Awareness to commercials in TV programs, magazine or newspaper columns, talks with the others, or "mere exposure" may result in consumer knowledge of EVs. (Le Hebel et al., 2014).

3.3.3. Government policy

Tax and fee reductions or exemptions for EV owners are all examples of fiscal policy for users. Subsidies and incentives are also included. The most frequently used policy to promote the adoption of EVs, according to almost all nations (Ali and Naushad, 2022; Kumar and Alok, 2020; Secinaro et al., 2020), is purchase price subsidies/incentives. A vehicle registration charge (registration cost) and a title transfer incentive are both part of the subsidy or incentive for buying electric vehicles. The annual tax incentive is another financial measure frequently provided to EV customers (Deuten et al., 2019; Llopis-Albert et al., 2021). The articles and authors depicting the factors affecting willingness to pay for electric vehicle Table 1.

3.4. Range Anxiety

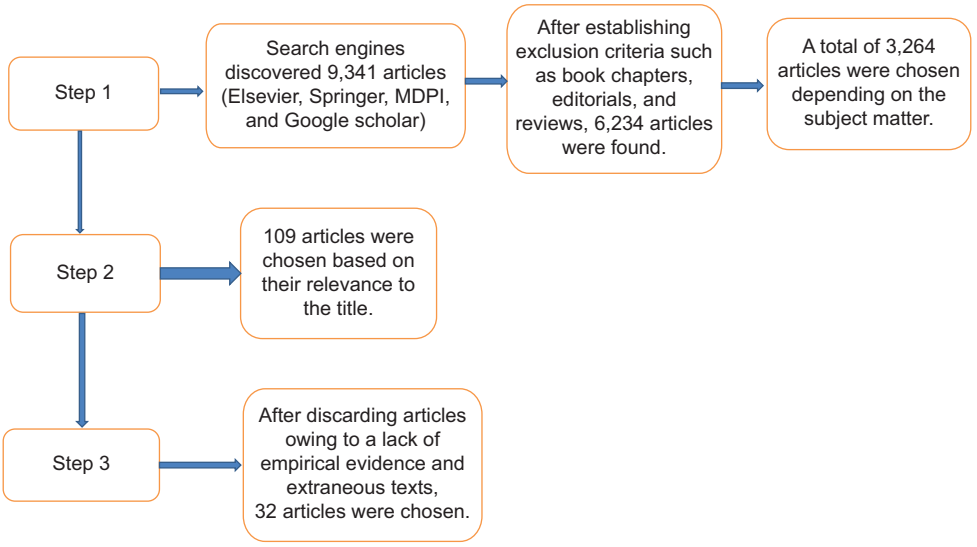
One of the main barriers to purchasing BEVs is perceived to be their limited range (Bonges and Lusk, 2016). Range anxiety is the driver's worry that there won't be enough battery life to get them where they're going and that they might get stuck (Salah and Kama, 2017; Neubauer and Wood, 2014). Battery technology advancements can help BEVs with their range anxiety (Cherry et al., 2016; Dill and Rose, 2012). Through improved energy density and technology, the latest models from Tesla and other manufacturers are making every effort to extend the range of electric vehicles. (Cao and Emadi, 2011; Thackeray et al., 2012).

Table 1: The articles and authors depicting the factors affecting willingness to pay for electric vehicle

Articles and authors	Factors affecting willingness to pay for electric vehicle
Prospects of Electric Vehicles in the Developing Countries: A Literature Review (Rajper and Albrecht 2020)	Energy Savings Range Anxiety
Willingness to pay for electric vehicles and their attributes (Hidrue *et al*. 2011)	Fuel economy, performance, and pollution reduction
From Intention to Actual Behavior to Adopt Battery Electric Vehicles: A Systematic Literature Review (Hoang *et al*. 2022)	Psychological, behavioral, contextual, and demographic factors.
Determinants of EVs adoption: a study on green behavior of consumers (Dash 2020)	Environmental concern, knowledge of EV, subjective norms, attitude towards EV , willingness to adopt
Challenges in the penetration of electric vehicles in developing countries with a focus on Nepal (Mali *et al*. 2022)	Cost, policy and finance, power availability , charging station, target group
Are residents more willing to buy and pay for electric vehicles under the ''carbon neutrality''? (Zhang *et al*. 2022)	Age, gender, monthly income, education, family size.
Willingness to Pay and Attitudinal Preferences of Indian Consumers for Electric Vehicles (Bansal *et al*. 2021)	Demographic factors, product attributes, service attributes, policy attributes.
Willingness to pay for fast charging station for electric vehicles with limited market penetration making (Ardeshiri and Rashidi 2020)	Age, gender, household structure, employment status, education level, income, consumers' perception.
Willingness to Pay for Electric Vehicles and Vehicle-to-Grid Applications: A Nordic Choice Experiment(Noel *et al*. 2019)	Fuels, driving range, recharging time, purchasing price

Source: Compiled by the authors

Figure 1: This review's article selection procedure



Source: Compiled by authors

When there is a charging infrastructure that communicates inside the network, anxiety regarding range is decreased (Carley et al., 2013). Range anxiety can also be reduced by having accurate information about vehicle performance, journey timing, distance, and the availability of charging infrastructure. Such data, however, is infrequently accessible in the real world (Neubauer and Wood, 2014). With enough BEV driving experience, the driver learns the vehicle's capabilities, suitable driving methods, and travel planning, which also helps to lessen range anxiety (Dill and Rose, 2012).

3.4.1. Energy savings

Compared to their gasoline-powered counterparts, EVs perform better in terms of energy efficiency. If one uses electric power instead of fuel to get around, one may be saving energy. Due to the electrification of mobility, India currently saves 44,000 L of gasoline and 109,884 kg of CO_2 daily (International Energy Agency, 2017; Fame India, 2018).

3.4.2. Fuel economy, performance, and pollution reduction

The majority of the characteristics are self-explanatory and reflect the factors that we predicted vehicle purchasers would consider important when comparing EVs with GVs (gasoline vehicles): driving range, charging time, fuel efficiency, decrease in pollution, performance, and price difference. Price was defined as the sum that the responder was willing to spend over the cost of their favorite GV. This emphasizes the trade-off between the additional money spent on an EV and the benefits one would obtain in return. The amount of time required to charge a battery for 50 km was referred to as the charging time. Pollution reduction was used as a measure of consumers' desire to purchase more ecologically friendly products. The final component was performance, which served as a stand-in for the performance variations between EVs and GVs (Hidrue et al., 2011).

Developing nations could emulate developed nations like Norway, China, Canada by implementing rapid charging on important routes. This will guarantee that EVs can do long trips (Wagner, 2020). However, due to financial limitations, nations should first carry out in-depth study on important demographics, regions, residents' financial capabilities, etc. before deciding on important locations where infrastructure development should be carried out (Mali et al., 2022). It was observed that when buying EVs, the majority of respondents will prioritize the ease of charging and the actual cost of an EV, including sales price, maintenance cost, tax incentives, battery life and cost, and battery endurance, while paying less attention to the performance of EVs, such as speed capability and load capacity (Zhang et al., 2022).

3.4.3. Demographic factors

The desire to adopt declines with age (Lu et al., 2020). In South Korea, adults over the age of 65 are more likely to embrace BEVs (battery electric vehicles) (Kim et al., 2019). As a result, the influence of age may differ among countries, and persons with a graduate degree are more interested in BEVs than others (Lu et al., 2020). People in China who have previously owned a car are more likely to purchase BEVs (Lu et al., 2020).

In conclusion, there are many different and complex elements that can influence someone's desire to pay for an electric vehicle. The decision-making process can be significantly influenced by a number of additional considerations in addition to price, including operating costs, range anxiety, government incentives, environmental concerns, and brand loyalty. It seems possible that more individuals will be prepared to pay for an EV as the technology behind them advances and becomes more generally accessible, especially given how much less expensive they are becoming.

4. FINDINGS AND DISCUSSION

Understanding demand and future adoption of electric cars (EVs) requires determining willingness to pay (WTP). WTP

is influenced by price, consumer awareness/attitudes, and charging infrastructure. First, governments must support the factors of EVs by granting exemptions from tolls on roads, easy access to charging infrastructures (Mersky et al., 2016), and tax and financial incentives (Falbo et al., 2022) while taking into account energy trading and vehicle sharing (Meisel and Merfeld, 2018). Second, it's crucial to spread extensive awareness about the EV market, whether it be through the establishment of adequate infrastructure that takes into account the need for charging stations (Bailey et al., 2015) or by comprehending the policy recommendations made by governments with regard to available subsidies (Helveston et al., 2015; Dong, 2022). According to studies, consumers are generally willing to pay a premium for EVs, although the amount of the premium varies. Further research is needed to better understand electric vehicle purchasing decisions.

5. CONCLUSION

This study aims to examine the conditions and settings that influence people's willingness to pay for electric vehicles. According to this review, many elements such as range anxiety, demographic characteristics, fuel economy, charging station, and government policy all play a part in people's willingness to pay for electric vehicles. Future research could focus on the willingness to pay for electric vehicles in underdeveloped countries, where such vehicles are still in their infancy. Furthermore, recognizing and understanding consumer preferences will pave the road for the success of EV factors for willingness to pay.

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