

Intention of Consumers to Purchase Electric Vehicles in Developing Countries

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Abstract

Electric vehicles (EVs) have appeared as a strategic solution for minimizing vehicle emissions. For the successful integration of EVs into existing transportation frameworks, it's critical to know the reasons which influence consumer buying decisions towards EVs. This study is designed to delve into these factors, with a specific emphasis on consumer perceptions. A survey was administered in October 2023, targeting potential buyers in Qasimabad Taluka, Hyderabad City, yielding 400 valid responses. The analysis employing binary logistic regression, provided empirical insights. The outcomes revealed that gender, specifically being male, and falling within a certain income bracket were significant indicators of a propensity to acquire an EV. Conversely, individuals in their 20s and 30s were less inclined to consider purchasing EVs. These results offer actionable guidance for the formulation of marketing methodologies and act like a benchmark for stakeholders in the EV sector to enhance the effectiveness of policies aimed at promoting EV adoption.

Keywords: EVs, Binary Logistic Regression, Purchase Intention, Pakistan

Introduction

Pakistan is dealing with a wide range of complex challenges across multiple sectors, necessitating multi-faceted solutions that can bring about positive changes in several areas at once. The nation is severely threatened by worsening environmental complications, a reduction the electricity sector, and a weakening economy (LUMS Energy Institute, 2019). Ranked as the sixth country most susceptible to climate change impacts, Pakistan has seen significant alterations in its annual average temperature and precipitation levels (Carabine, 2014). The emission of carbon dioxide from burning fossil fuels not only harms human health but also plays part in the spread of diseases through polluted floodwaters. Without action on climate change, the average temperature in Pakistan is going to rise by 3°C. Despite commitments made at the SAARC summit to reduce greenhouse gas emissions by about 20% by 2030, progress towards the development and deployment of electric vehicles (EVs) in Pakistan has been minimal (Energy Centre and Dept, 2017).

The economic hurdles and environmental issues are escalating rapidly, presenting significant challenges for Pakistan. Without serious measures to tackle these escalating risks, the situation is likely to deteriorate further within the next year. Addressing these critical issues demands an urgent and comprehensive strategy. The transport sector in Pakistan is a big contributor in greenhouse gas emissions, leading to a steep reduction in the air quality index. Environmental adulterants are found at levels many times more than the World Health Organization's recommended thresholds, a situation that is expected to worsen with the passage of time. As a result, air pollution has been connected to an increase in mortality rate and diseases, with the mortality rate from environmental pollution surpassing that of diseases like malaria, tuberculosis, and HIV/AIDS (Rabi al-Thani, 2019).

Electric vehicles (EVs) offer a viable solution to these problems. Without intervention, emissions are projected to double by 2021 and increase more than twofold by 2030 (Rabi al-Thani, 2019). With rising air pollution limits and its association with road transport, governments are recognizing the importance of EVs as an eco-friendly alternative. Reports suggest that Pakistani officials aim to transform 90% of the country's vehicles to electric power by 2040, supported by

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policies from the China-Pakistan Economic Corridor to address e-mobility challenges. Despite recent financial incentives for EV buyers and manufacturers sparking public interest, there is little understanding of the factors influencing consumer decisions to purchase EVs. It is essential to examine a variety of factors to predict consumer intentions towards adopting EVs, thereby assisting policymakers and manufacturers (Ul-Haq et al., 2020).

Currently, Pakistan lacks a significant presence in the electric mobility market, with no electric two-wheelers or four-wheelers present for sale to the general public. Additionally, the infrastructure for charging these vehicles is inadequate. A study showed that only 1% of light-duty passenger vehicles in Pakistan are hybrids. In 2019, the country launched its first domestic EV Policy, aimed at benefiting Pakistani EV manufacturers and importers, projecting that EVs will represent 30% of new vehicle sales by 2030 (Haq, 2019). This research aims to analyze the reasons to influence the intention to purchase EVs, focusing on Pakistan's vehicle policy and user psychology to offer key policy recommendations.

Literature Review

The Federal Cabinet has endorsed a strategy proposed by the Pakistani Minister to boost the import and manufacturing of electric vehicles (EVs). The Ministry of Industries and Trade's 2016 report highlighted that Honda and Toyota were the main manufacturers of Hybrid Electric Vehicles (HEVs) in Pakistan, with Karakoram Motor being the country's and only producer of Battery Electric Vehicles (BEVs). Additionally, Pakistan has become a favored market for electric bicycles, with brands like Superpower and Neon offering electric bikes aimed at various economic segments (Electric bikes, 2018; Pakwheels, 2019). Notably, EV or Plug-in Hybrid Electric Vehicle (PHEV) charging stations have been formed at three prominent locations: the Lahore Metro buses, the Dolmen Shopping Centre in Karachi, and the Emporium Mall in Lahore are examples of private enterprise facilitated initiatives to promote the usage of electric vehicles. However, for some smaller businesses, scaling up EV charging might not be feasible, underscoring the need for affordable and efficient transition strategies to EVs.

The Economic Survey of Pakistan (2016) preliminarily estimated that HEVs accounted for less than 1 percent of all cars in Pakistan, indicating a nascent stage in the adoption of electric vehicles. The recent spike in inflation has adversely affected purchasing power, making gasoline-powered two-wheelers a more attractive option for low-income individuals due to their affordability and economy.

Reports have surfaced about international companies negotiating with Pakistani vehicle industry firms to import EVs into Pakistan. China, for example, has implemented policies to support the shift towards EV purchase to balance network efficiencies (Naseem et al., 2019).

Research by Bhutto et al. (2021) utilizing the idea of planned behavior investigated the determinants of Pakistani users' intentions to purchase EVs and their willingness to pay a premium, introducing environmental unease and minded to pay (WTP) as new variables. This study found that both the theory of planned behavior and environmental issues significantly influence the intention to buy EV technology. Suhail et al. (2021) explored the effect of cultural norms on the will to adopt hybrid electric vehicles in Pakistan, creating an expanded model based on Hofstede's cultural norms and the theory of planned behavior. Their findings supported seven out of eight hypotheses. Bilal et al. (2020) examined consumer attitudes, subjective norms, and personal moral norms regarding hybrid electric vehicles, concluding that environmental concerns positively affect these factors, thereby enhancing the willingness to adopt HEVs.

Comparative researches, like as Burgess et al. (2013)'s investigation into the UK's EV adoption models, have identified key factors influencing purchasing decisions. Lashari et al. (2021) highlighted the worth of environmental awareness, technical knowledge, and the perceived long-term viability of EVs in purchase decisions, stressing the need for EV affordability. Han et al. (2017) examined how consumers' perceptions of value influence their willingness to purchase EVs, finding that functional value directly and indirectly affects willingness, while non-functional value has a marginal impact. Khazaei (2019) proposed a conceptual framework to assess factors influencing the adoption of BEVs, revealing that performance expectations, price, innovation, and other factors positively influence the desire to use EVs, regardless of their availability.

Efforts to replace petrol with alternative fuels aim to mitigate climate change, with electric vehicles emerging as a promising solution. Although research on integrating EVs into the transport

sector is ongoing and still in early stages, urban areas are seen as primary adopters due to EVs' limited range and compact size. The economic viability and specific requirements of electric cars remain underexplored. However, consumer awareness and perceptions of EVs have significantly improved, leading to a decrease in perceived risk and an increased willingness to purchase these vehicles.

This assessment of the literature suggests that a sizable number of studies have examined the variables driving EV purchases. Particularly, prior research indicates that vehicle performance, individual traits, and user attitude and perception can all have significant effects. Nevertheless, there aren't many studies out there right now that specifically address user attitude and perception. We contend that the lack of adequate information might result in ineffective marketing tactics that don't reach more potential EV buyers.

This is accurate given that the EV market is still in its infancy and that customers often have limited knowledge and experience with EVs. Additionally, this study examined technical issues using a variety of questions pertaining to trust or fear of new technology as well as general annoyance from unforeseen problems. This study is anticipated to be significant in this way as it adds to the body of knowledge already available on the adoption of EVs, focusing on the influence of individual customers' attitudes and perceptions through a case study in Pakistan, a country with a developing EV industry.

Method and Materials

Survey and Study area.

This research employs data gathered from a survey aimed at understanding user intentions towards purchasing electric vehicles (EVs). The survey was carried out both online and in person, gathering responses from 390 participants in the Qasimabad Taluka of Hyderabad City, Pakistan. The sample encompassed a diverse range of age groups, income levels, genders, and occupations. To accurately capture pertinent data, a structured questionnaire was designed. This questionnaire focused on collecting detailed information regarding the respondents' socio-demographic and economic status, as well as specifics about the characteristics of their vehicles.

This research employed the Binary Logistic Regression analysis to know the determinants that affect the willingness of consumers to purchase electric vehicles (EVs). The purpose of utilizing this analytical technique was to understand the myriad reasons that influence the decision to purchase EVs. Binary Logistic Regression was specifically chosen for its precision in predicting the variables that shape consumers' intentions to buy EVs, as highlighted by Lashari et al. (2021). This statistical method is commonly used in research concerning EV purchasing decisions (referenced by Junquera et al., 2016; Axsen et al., 2015; Lashari et al., 2022). The investigation involved a binary logistic model to identify key factors that influence the intent to purchase EVs among consumers. It assessed the binary decision-making process, categorizing the potential outcomes into either the "intention to purchase an EV" or "no intention to purchase an EV." Thus, the dependent variable was binary-coded, receiving a value of 1 for respondents willing to buy an EV and a value of 0 for those not willing to make a purchase. The structure of the model was detailed and given below:

$$P = Prob (Y = 1) = \frac{(\beta_0 + \beta_1x_1 + \dots + \beta_nX_n)}{1 + exp(\beta_0 + \beta_1x_1 + \dots + \beta_1^nX_n)}$$

Here *P* represent the probability of adopting EVs

Y is the dependent variable

The symbols *X*₁ *X*_{*n*} are explanatory variables,

*B*₀ is a constant, and *B*₁*B*_{*n*} are regression coefficients that reflect the impact of explanatory variables on *Y*.

Results and Discussion

The findings from the binary logistic regression analysis are showcased, highlighting how consumers' perceptions play a crucial part in the decision-making process for purchasing electric vehicles (EVs).

Table 01. Binary Logistic Regression Model (n = 400)

Variables (Reference Variable)	Variable description	Coefficients
	Constant	1.028**
Gender (Ref. = Female)	Male	0.836***
Age (Ref. = 60 and Above)	20-29	-0.932**
	30-39	-0.004*

	40-49	0.513
	50-49	-0.658
House type (Ref. = multi-family house)	Apartment	0.335*
	Single-family	-0.256
Monthly Income (thousand PKR) (Ref. = 16-30)	Up-to 15	0.758
	31-45	0.238
	Above 45	0.896**
Occupation (Ref. = others)	Govt. employee	0.110
	Private employee	-0.008
	Self-employee	0.658
Education (Ref. = intermediate)	Matriculation	0.129
	Graduation	-0.052
	Post-Graduation	0.361
Family members (Ref. = one)	Member 2	-0.006
	Member 3-5	-0.391
	Member > 5	-0.217
Number of cars (Ref. = Zero)	1	-0.088
	2 and more	0.398*
Car type (Ref. = SUV)	Small	-0.265
	Medium	-0.610
	Full size	-0.659*
Vehicle Age (Ref. above 10 years)	1-5	0.007
	6-10	-0.015
Monthly Fuel expenditure Up to 5000 (PKR)	6000-10,000	0.368
	>10,000	-0.310
	McFadden Pseudo R ²	0.619

*p< 0.1; **p< 0.05; ***p< 0.001.

Table 1 displays the outcomes of the binary logistic regression, with a focus on only the variables that showed significant results for the sake of conciseness. The analysis revealed that gender plays a crucial part in influencing the decision to buy electric vehicles (EVs), with a notably higher likelihood among male participants to make a purchase. Age also emerged as a significant factor, particularly among younger individuals in their 20s and 30s, who showed a lower propensity towards buying EVs. This finding may seem surprising as younger populations are often more open to adopting new technologies. Nonetheless, considering the higher buying value of EVs as compare to other vehicles, the result is understandable. It suggests that the financial capabilities of younger individuals might not adequately meet the demands of purchasing EVs. It is important to note, however, that the influence of gender and age on the intention to purchase EVs is not universally consistent, as some studies, such as by Degirmenci and Breitner (2017), have indicated these factors to have a minimal impact.

The analysis also found that living in an apartment is clearly associated with the likelihood to purchase an EV, possibly due to the easier provision of parking spaces equipped with charging stations in such housing types. Additionally, a household income exceeding 45 thousand PKR is positively correlated with the intention to buy EVs, highlighting those individuals from lower-middle income brackets, who feel the financial strain of fuel, maintenance, and repairs more acutely, might be more inclined towards EVs.

Regarding vehicle characteristics, the data shows that owners of multiple cars are more predisposed to adding an EV to their collection, likely using it as a secondary vehicle due to its limited range. The preference for EVs decreases among owners of medium to large vehicles, as the current market is dominated by smaller EVs. This aligns with findings by Hahn et al. (2018), which also noted a reluctance among full-size vehicle owners to switch to EVs, despite a paradoxical interest in EVs among this group. This contradiction suggests a gap in the market for larger EVs and points to the potential for shifting purchase intentions as the variety of EVs available increases, warranting further research to understand these dynamics.

The intention to buy electric vehicles was shown to be highly correlated with sociodemographic factors. Those with lesser incomes in particular are more inclined to buy EVs. This implies that EV purchases might be encouraged for those with lower incomes who are unduly burdened by the fuel, upkeep, and repair expenses of conventional cars. Furthermore, individuals who identify as masculine are more inclined to embrace EVs. In terms of age, the younger age group—

especially those in their 20s and 30s—exhibited a notably unfavourable correlation with plans to buy. Specifically, in terms of automobile ownership, respondents with more than one vehicle are more inclined to buy electric vehicles. Compared to owners of smaller cars, the estimated parameters for the vehicle type variable revealed that owners of medium-to large vehicles have a negative reaction to the purchase of an electric vehicle.

Conclusion

This research was conducted to know the reasons that affect consumers' intentions to buy electric vehicles (EVs), with a special focus on how users perceive these vehicles, based on survey data. The study also investigated the socio-demographic, economic, and vehicle and travel characteristics of respondents. Binary logistic regression analysis was utilized, yielding meaningful results that highlight the important reasons influencing a consumer's decision to buy an EV. The study arrives at significant conclusions that are crucial for enhancing EV sales and their broader adoption in transportation systems. One critical finding is the importance of making consumers to know the economic advantages of EVs, like as reduced operating costs, which could foster a shift from conventional vehicles to EVs. Furthermore, the perception of government incentives aligned with environmental policies and efforts to decrease EV operating costs are pivotal in consumers' purchasing decisions.

This study acts as a platform for collaboration between city officials and automotive companies to increase EV ownership and the intention to buy. By delving into reasons that influence the intention to buy EVs, particularly from the perspective of users, this research underscores the necessity of understanding customer characteristics, intentions, and preferences towards EVs.

For a deeper insight into user attitudes and perceptions, future research could include longitudinal studies to observe how respondents' perceptions evolve over time and how these changes affect their intentions to purchase EVs. Gathering cross-sectional data from a broader spectrum of users', including those from various SSregions or with varying levels of experience with EVs, could provide a more comprehensive view of diverse purchase intentions. Additionally, employing alternative analytical techniques like machine learning and multi-criteria decision-making could offer novel insights into EV purchase intentions and facilitate comparative analyses to promote the introduction of EVs.

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