

Antecedents of Electric Vehicle Purchase Intention

Subjects: Business

Contributor: Gulnaz Ivanova, António Carrizo Moreira

Global sales of electric vehicles (EVs) have grown steadily; however, their worldwide market share is still less than 10%. The antecedents were classified into three main categories: consumer characteristics, EV characteristics, and EV-related policies. A summary model represents the impact information of each of the main antecedents.

Keywords: purchase intention ; electric vehicles ; antecedents of purchase intention

1. Introduction

The growing demand for conventional vehicles with internal combustion engines that use fossil fuels as an energy source has aggravated the current environmental and energy crises. In recent years, the massive use of gasoline and diesel has led to a sharp increase in greenhouse gases (carbon dioxide and nitrogen oxide), and has become a major cause of global warming and climate change ^{[1][2]}. Transportation is one of the major sectors of the economy contributing to air pollution ^[3]. Between 1990 and 2019, annual carbon dioxide (CO₂) emissions from the transportation sector increased by about 80% ^[4]. By 2020, passenger cars were the largest source of CO₂ emissions, presenting 41% of the emissions produced by the transportation sector worldwide ^[5]. Experts predict a doubling of global private car sales by 2050 ^[6], i.e., the number of private cars on the roads could reach 2–2.5 billion by 2050 ^[7]. In turn, an increase in the number of vehicles with internal combustion engines will increase dependence on oil, as the transport sector accounts for about 60% of the total oil demand ^[8]. These factors present major energy security and supply risks at the global level.

The diffusion of electric vehicles (EVs) represents a sustainable solution to mitigate the environmental and energy crises and helps meet the targets for achieving carbon neutrality under the Paris Agreement and Green Deal. Electric cars use electricity, a secondary energy source that replaces fossil fuels, and do not emit emissions while driving. The negative impact on the environment can be further mitigated, especially if the electricity comes from renewable sources such as wind, sun, biomass, etc. ^{[9][10]}. Thus, the transition to electric mobility contributes to the reduction of environmental pollution, which is also beneficial for public health and helps to reduce fossil energy consumption ^{[11][12][13][14]}, representing a new paradigm of sustainable energy ^[3]. Since 2010, the growth rate of EVs has been much higher than that of conventional vehicles ^[15].

For faster market penetration of EVs, it is crucial to understand consumer behavior regarding the purchase of this type of vehicle. Consumer behavior is directly predicted by intentions ^[16]. Consumers' purchase intentions largely determine the EV market trend and represents the main aspect of their demand ^[2]. Understanding the factors associated with EV purchase is a prerequisite for the popularization of sustainable mobility ^[17].

2. Antecedents of Electric Vehicle Purchase Intention

The dynamics of publications in the area of consumer behavior towards EV purchasing coincide with the dynamics of global electric car sales, i.e., the trend is positive with a peak in 2021. There was a drop in academic publications in 2020, which can be explained as a result of the onset of the COVID-19 pandemic and restrictions applied by governments.

Articles identified several antecedents of the purchase intention of EVs. Singh et al. ^[18] divided them into four types: demographic, situational, contextual and psychological. In turn, Sierzchula et al. ^[19] distinguished between three sets: technological aspects; consumer characteristics; and contextual factors.

The category "Consumer characteristics" is the most researched. Despite this fact, there is a clear need for further research in this area, since the results of the studies are contradictory, especially regarding sociodemographic factors. Regarding gender issues, researchers have not reached a consensus. For example, in Russia ^[20] and Norway ^[21], women show more interest in buying an EV than men, while in the Netherlands ^[22] and Germany ^[23], male respondents

are more likely to buy EVs. However, Habich-Sobiegalla et al. [24] and Zhang et al. [25] did not find a statistically significant relationship between gender and the purchase intention of EVs.

Regarding the age group of consumers, middle-aged individuals are more likely to buy an EV [23][24][26], while young individuals show a significantly negative association with EVs purchase intention [27]. Given the high price of electric cars and the low incomes of young consumers at the beginning of their working careers, these results are understandable. Several studies indicate that highly-educated individuals are more willing to buy an EV [20][22][24][28][29]. As a rule, workers with higher education earn more money, which means that their higher incomes allow them to pay the premium price of an EV. This view is indirectly supported by Habich-Sobiegalla et al. [20], Ling et al. [30], Shareeda et al. [31], Zhang et al. [25] and Xu et al. [28], who found that consumers with the highest incomes are associated with higher EV purchase intention. However, based on a study of 1500 potential consumers in South Korea [27] and a study of 360 Chinese respondents [32], it was concluded that individuals with lower incomes are more likely to buy EVs. This can be explained by the lower total cost of ownership (TCO) of an EV (less maintenance and repair, low cost per mile) compared to a conventional vehicle, which is something that individuals with low incomes may take into consideration. However, when analyzing the TCO of all-electric cars in Italy, Scorrano et al. [33] argued that high annual mileage (the annual distance travelled) is a decisive factor in achieving TCO savings.

The results of the factor impact of the consumers' geographical location show that people living in rural or suburban areas travelling a large number of kilometers per year [23] or with a higher daily travel distance [25] are more likely to buy an EV. This can be explained by the economic benefits, namely by low cost per kilometer, which Heyvaert et al. [34] considered the biggest advantage of EVs. Clearly, this only makes sense if electricity is much cheaper than gasoline or diesel. As far as psychological factors are concerned, the relationship between consumer attitude towards EVs and their purchase intention is one of the most studied in this SLR. All the researchers conclude that attitude has a significantly positive impact on the purchase intention of EVs. According to Yetano Roche et al. [35], attitudinal research is one of the conceptual frameworks and methodological approaches, which can be used in studies of preferences and demand for new technologies.

The results also point to a strong positive impact of subjective norm [21][28][36][37][38][39][40][41][42][43][44][45] and social influence [22][27][32][46][47][48] as antecedents on EVs consumers' purchase behavior. Comments from individuals close to the potential buyer (e.g., friends, family members and parents) create social pressure and influence the potential buyer's behavior towards purchasing an EV. Therefore, the higher the social pressure, the higher the intention to buy an EV. This knowledge can be used most successfully in crafting strategies for countries with a strong tendency towards collectivism, where people place the highest value on the opinions of others. The third variable of TPB, perceived behavior control, was found to be a significant positive predictor of EVs purchase intention [21][28][36][37][38][39][40][41][42][45][49][50], implying its strong influence on consumer behavior. Perceived behavioral control refers to an individual's perception of their ability to engage in a particular behavior [51]. Therefore, EV-related policies need to be geared towards increasing the consumer's willingness to purchase an EV.

With regard to environmental concern, many researchers from different countries studied its relationship with the purchase intention of EVs. This is not surprising, as EVs are seen as a means of sustainable mobility that can mitigate the environmental crisis. The analysis shows that consumers' environmental concerns have a strong positive effect on their willingness to buy EVs [12][16][20][24][27][28][40][46][47][52][53][54][55][56][57][58]. Government awareness and public education programs on the need to protect the environment can directly contribute to the market penetration of EVs. Regarding consumers' personal characteristics, the results indicate that there is a consensus among researchers regarding the positive influence of the openness to experience/personal innovativeness variables [12][27][47][59]. Openness to experience is related to the degree of curiosity, creativity and preference for variety and novelty [47]. Personal innovativeness is a widely examined factor in innovation adoption research. Consumers with a high level of innovation are more willing to try new things and adopt new ideas [12]. Thus, electric cars, which are seen by many people as a new transportation technology, can easily attract the attention of innovative individuals who are open to experimentation.

The analysis shows that previous experience in driving EVs influences the most willingness to buy EVs [17][29][30][42][60][61]. This result is in agreement with Schulte et al. [62], who noted that a positive experience with high-tech products makes them attractive to consumers, creating a positive perception, which in turn increases the likelihood of purchase. Most studies confirm a positive influence of consumers' knowledge/awareness of EVs on their intention to buy EVs [17][25][29][31], although few studies found no relationship between the two variables [21][36][61]. Following Simsekoglu and Nayum [21], due to the relative newness of EVs, consumers know little about their history and features compared to their knowledge of internal combustion engine vehicles. In turn, Ghadikolaie et al. [7] conclude that knowledge about alternative fuel vehicles is a critical point to increase the number of this type of car in the global transportation sector. Therefore, the authors

believe that educating the population about the characteristics of alternative fuel vehicles and their use is a permanent solution for a sustainable demand in the future. Shareeda et al. [31] stated that the success of EV adoption depends on consumers' high awareness and understanding of why they should switch to this type of vehicle. Several studies have shown that the antecedent personal norm relative to EV purchase is a positive influencing factor [37][63][64]. Thus, a high level of moral responsibility on the part of consumers leads to a higher intention to purchase EVs. This is mainly valid for developed countries and China, as studies in developing countries [65][66] found no statistically significant relationship between these two variables. Thus, activating personal norms may promote EV ownership.

Regarding the impact of "financial/cost factors" as an antecedent, the results are contradictory: some studies on this issue found a significant effect on EV purchase intention [61][67], while other studies found no statistically significant relationship between the two variables [37][56]. There are a set of indicators, such as acquisition cost, fuel cost, maintenance cost, EV depreciation and resale price, among others, that are important. Following Sovacool et al. [61], the adoption of new technologies is associated with tradeoffs between high initial capital costs versus long-term efficiency. The authors conclude that cost considerations are important in Chinese consumers' willingness to purchase EVs. In turn, Montian and Suthikarnnarunai [67] reached the same conclusion in their research in Bangkok. A positive effect of cost factors on consumers' purchase intentions may be related to the symbolic significance of the electric car itself, i.e., its role in defining consumer status. The higher the costs associated with an EV, the higher the status that should be expressed. However, Thananusak et al. [56] did not find a positive relationship between the financial factors and EV purchase intention, which may be due to a lack of information about operating costs, maintenance costs and the resale market in Thailand. In turn, Dong et al. [37] stated that, in the context of subsidies that the Chinese government has implemented in its EV-related policies, the cost factors do not significantly influence EVs purchase intentions.

Most studies state that the purchase price level of EVs is a determining factor and has a significant impact on consumer behavior regarding EV purchase intention. Consumers consider the price of an EV to be higher than the price of an internal combustion engine car [26][48][56]. A decrease in the initial purchase price is positively associated with EV purchase intention, i.e., the willingness to buy an EV increases when the EV price is lower [20][26][55].

Regarding the technical characteristics of EVs, the results of the influence of the antecedents of this subcategory on the purchase intention of EVs vary from one study to another, presenting contradictory results. However, most studies state a statistically significant influence of the antecedents performance [16][25][48][53][56][67], (re)charging time [26][68][69][70] and driving range [26][32][68][71][72][73] on the purchase intention of EVs. According to Ghadikolaei et al. [7] and Heyvaert et al. [34], one of the major disadvantages of EVs is their limited driving range i.e., the distance a vehicle can travel without recharging. This can be explained by the fact that cars powered exclusively by electricity cannot currently provide an equal range as fuel-powered cars. Therefore, to achieve a greater diffusion of EVs, consumer concerns about limited range need to be alleviated. OEMs need to develop technology to achieve the same range as conventional vehicles, while governments and other stakeholders need to install more charging stations. It is important to note that around 43% of the studies focused on driving range did not consider this variable as a significant predictor of EV purchase intention. This may be due to the fact that consumers attach more importance to other factors, such as individual factors, EV purchase price, charging infrastructure factors [31][69], or, as in the case of Shareeda et al. [31], the reason for the lack of significant influence may be the small size of the Kingdom of Bahrain. Another disadvantage of EVs is the (re)charging time, which is considerably longer than in conventional vehicles [7].

The significantly positive impact of the antecedent performance on the purchase intention of EVs was confirmed in the vast majority of studies [16][25][48][53][56][67]. In the EV context, EV performance refers to acceleration, safety, reliability, driving comfort, range, etc. Thus, it is important to develop advertising and marketing plans with emphasis on these characteristics of EVs, presenting them as strengths in order to stimulate the demand for EVs. This will also educate consumers, increasing their knowledge about EVs. As mentioned above, consumers' knowledge/awareness of EVs can contribute to a sustainable demand for EVs in the future.

With regard to the risk and benefit factors, the antecedents perceived usefulness and/or ease of use, perceived risk and perceived benefit were highly cited, although the results of their influence are contradictory. The significantly positive relationship between the perceived benefit and intention to purchase EVs showed greater agreement among the researchers. Perceived benefit is the perceived possibility of the positive outcome of a purchase. Following Yang et al. [74], the perceived benefits towards EVs consist of financial (e.g., low cost of electricity, maintenance and repair, government subsidies) and non-financial (possibility of charging at home, being environmentally friendly, use of a high-tech product, enjoyment of non-monetary government policies) benefits. Krishnan and Koshy [48] found that the perceived benefit has the greatest direct effect on Indian consumers' intention to purchase EVs. Other studies in the sample also state that this variable is a key factor for the diffusion of electric cars [60][74]. One more positive relation was noticed between the

antecedent perceived usefulness and/or ease of use and intention to purchase EV [46][53][60][63]. This variable is widely used in research related to new technologies. Perceived usefulness indicates the extent to which an individual believes that using EVs will increase their performance [48], while perceived ease of use represents the degree to which an individual feels that they will not have complications and additional effort to learn to use the EV [46][48]. The statistically significant influence of these variables indicates that consumers are concerned about the issue of the ease of use of EVs and their usefulness. Thus, marketing strategies should be developed to spread public awareness that EV use is easy and requires no additional effort.

Given the positive impact of the perceived benefit on purchase intention, it is important to underline the financial and non-financial advantages in EV advertising for a faster diffusion of this type of car. In turn, the insignificance of the perceived benefit [44] and perceived usefulness and/or ease of use [48] in some sample studies can be explained by other factors (e.g., price, range, lack of infrastructure, etc.) or by the fact that individuals do not have a clear awareness of EV ease of use or usefulness. Regarding the antecedent perceived risk, as expected, most studies state its significantly negative influence on the willingness to buy EVs, i.e., the more risk a person perceives regarding EVs, the lower their intention to buy them. Perceived risk was originally a research topic in the field of psychology, and referred to the negative effects predicted by the consumer regarding the purchase of a specific product [74]. Since an EV is considered a technological innovation, it is often associated with safety, operational, functional and temporal risks [60][75].

Regarding government-based policy factors, the relationship between the antecedent government support policy and the purchase intention of EVs was the most studied in this subcategory, showing a significantly positive correlation in three-quarters of the studies on this issue [17][25][29][32][61][67][76][77]. EVs government support policies consist of financial (e.g., purchase subsidies for EVs, purchase tax/some toll exemption, etc.) and non-financial (e.g., charging and free parking in public areas, provision of the electronic platforms, etc.) incentives [6][34][78][79]. Given the importance of government support policies for consumers, governments should start/continue to implement a range of incentives for faster EV market penetration.

The influence of pre- and after-sales service factors on EV purchase intention is still little studied when compared to other factors. It was possible to highlight the following antecedents: test drive, marketing, distribution and after-sales service, poor professional pre-sales consulting and experience services and the perceived importance of pre- and post-sale services. Regarding the test drive, the researchers used the concept of a sensory marketing approach. According to Krishna [80], sensory marketing engages consumers' senses and affects their perception, judgment and behavior by creating subconscious triggers that characterize consumers' perceptions of abstract notions of the product.

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