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PURCHASE INTENTION FOR ELECTRIC VEHICLES IN CHINA FROM A CUSTOMER-VALUE PERSPECTIVE

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Vehicle exhaust emissions are a major contributor to the creation of smog in big cities in China. Hence, the manufacture of electric vehicles (EVs) has become an emerging industry, and receives special attention from the Chinese government for its great advantages of lack of pollution and energy efficiency. However, Chinese people have been very reluctant to purchase EVs. In this study, I recruited a sample of 454 participants and explored which factors affect customers' purchase intention for EVs. Results revealed that customers pay more attention to the environmental value of EVs but have fears related to electricity leakage, explosions, or radiation exposure from batteries. These findings indicate that the Chinese government's support for EVs is still not sufficient, and that government promotion of a low-carbon lifestyle must be enhanced.

Keywords: electric vehicle, purchase intention, perceived value, perceived risk, green lifestyle, China.

Rapid rise of the air pollution index (PM2.5) in China has challenged the level of human endurance, especially for sensitive individuals. Tailpipe emissions from conventional combustion engines constitute a major source of air pollution (Bao, 2014). Environment preservation is of paramount importance and efficient measures are required to reduce pollution levels. Logically, the production of EVs is becoming an emerging industry, and is receiving increased attention from

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the Chinese government because of its potential to contribute toward cleaner air and energy efficiency.

However, judging from the modest sales and current state of industry development, many Chinese consumers are still reluctant to buy EVs. Statistics show that 74,800 EVs were sold in China in 2014, representing an increase of 323.8% compared to 2013 reported sales; however, this figure constitutes only 0.32% of total vehicle sales in 2014 (Tencent, 2015). At the end of 2014, there were 119,000 electric cars in China and 80% of those were used for public transportation, meaning that very few were private cars (Liu, 2015). It is shown in the reports above that the EV market is developing slowly because of the low purchase intention level of consumers. Therefore, it is essential to investigate the main factors that influence Chinese consumers' intention to purchase EVs, in order to accelerate and improve sales.

Many scholars have studied consumer acceptance of EVs. Calfee (1985) used a random-choice model to analyze the potential market demand. The results showed that price, operating costs, and popularity were the important factors influencing consumer behavior. Diamond (2009) and Zhang (2011) studied consumer behavior by means of cross-sectional analyses and logistic regression analysis models; these authors both found that consumer acceptance of EVs had a strong correlation with oil prices. A survey conducted by Lieven, Mühlmeier, Henkel, and Waller (2011) in Germany revealed that only 5% of potential users of automobiles are EV buyers. It is these three studies that inspired the current one. To date, the focus in empirical research about purchase intention has been mainly on influencing factors. However, in China, consumer perception regarding EVs has some particularities. For instance, it is necessary to evaluate the impact of some stimulative measures taken by the government to assess the various characteristics of purchase intention in China. No researchers up until now have undertaken a comprehensive analysis of the advantages and disadvantages of EVs in the context of the Chinese market environment, or of factors that influence Chinese consumers' intention to purchase EVs.

Theoretical Foundation and Hypotheses Development

Purchase Intention and Perceived Value Maximization

Perceived value maximization refers to the fact that, when making purchase decisions, consumers choose products or programs that they believe will yield the maximum value under certain constraints (Zeithaml, 1988). Holbrook and Schindler (1994) argued that customers purchase primarily to obtain value. Chen and Dubinsky (2003) studied customers' choices of specific online retailers based on perceived value and associated the concept of consumer choice with purchase intention. From the studies above, I drew the conclusion that the academic world

shares the perception of a positive correlation between perceived value and purchase intention.

Dimensions of perceived value. Sheth, Newman, and Gross (1991) outlined a model for customers' perceived value with five dimensions: social value, emotional value, functional value, conditional value, and epistemic value. Furthermore, in their research on durable goods, Sweeney and Soutar (2001) found that conditional and epistemic values had nonsignificant impacts on purchase of these products.

In the current study, I have regarded perceived value consistently according to three dimensions: *inclusive functional value* (the features or utilities of a product or service that would meet the consumer's needs in terms of functionality or usefulness), *emotional value* (the pleasure that a consumer feels when purchasing a product or a service and the abilities or utilities of a product or service to affect a consumer's mood), and *social value* (the link between products or services and certain social groups; it indicates people's views on specific commodities or services). In this research I proposed the following hypotheses:

Hypothesis 1: Perceived functional value will have a significant positive impact on customers' purchase intention for electric vehicles.

Hypothesis 2: Perceived emotional value will have a significant positive impact on customers' purchase intention for electric vehicles.

Hypothesis 3: Perceived social value will have a significant positive impact on customers' purchase intention for electric vehicles.

Purchase Intention and Minimization of Perceived Risk

Perceived risk refers to the uncertainty regarding the potential for an adverse outcome from an individual activity (Jacoby & Kaplan, 1972). Bauer (1960) was the first scholar to introduce the theory of perceived risk in consumer behavior research. Featherman and Pavlou (2003) studied the behaviors of consumers in an e-commerce system and found that there was a negative relationship between perceived risk and accepted risk.

Dimensions of perceived risk. Roselius (1971) pointed out that perceived risk includes four losses: time loss, hazard loss (which refers to goods that may present a hazard, such as decayed food), ego loss (goods that may damage a person's reputation in the eyes of their friends), and monetary loss. However, the overall perceived risk framework outlined by Jacoby and Kaplan (1972) includes five dimensions: financial risk, performance risk (when a new technology product may not meet consumers' expectations), physical risk, psychological risk (when a product may not meet consumers' personal satisfaction and the approval their friends and relatives), and social risk. According to the researchers, these five types of risk explain 74% of the overall perceived risk. The remaining 26% can be explained by other, less significant, risks, such as time loss.

In this research I used a four-dimensional model of perceived risk (i.e., performance risk, financial risk, physical risk, and psychological risk), because not every product is associated with every type of risk. For example, the social risk associated with EVs is nonsignificant. Therefore, I developed the following hypotheses:

Hypothesis 4: Perceived performance risk will have a significant negative impact on customers' purchase intention for electric vehicles.

Hypothesis 5: Perceived financial risk will have a significant negative impact on customers' purchase intention for electric vehicles.

Hypothesis 6: Perceived physical risk will have a significant negative impact on customers' purchase intention for electric vehicles.

Hypothesis 7: Perceived psychological risk will have a significant negative impact on customers' purchase intention for electric vehicles.

Government Policy

Public policy is the principled guide to action taken by the administrative executive branches of the state with regard to a class of issues in a manner consistent with law and institutional customs (Xia, 2009). The Chinese government has adopted an economic policy by which financial subsidies support EV manufacturers and consumers. Before 2010, the focus of national development was more on public transportation. Since 2010, the government has introduced fiscal subsidies for the private purchase of EVs; further, restrictions have been imposed on the number of traditional (i.e., powered by fossil fuels) automobiles that can be registered (Wang, 2013). Therefore, I proposed the following hypothesis:

Hypothesis 8: The policies of the Chinese government will have regulating effects on the relationships among consumers' perceived value, perceived risk, and purchase intentions in regard to electric vehicles.

Research Model

On the basis of the above analyses, I developed the research model depicted in Figure 1.

Method

Data and Sample

I designed a survey based on the findings reported in previous studies, combined with the characteristics of the EV. I sent out 500 forms through http://www.sojump.com/ and received back 164 completed surveys. I also received completed surveys from 86 people who were contacted by friends and classmates through instant messaging tools. I received completed survey forms

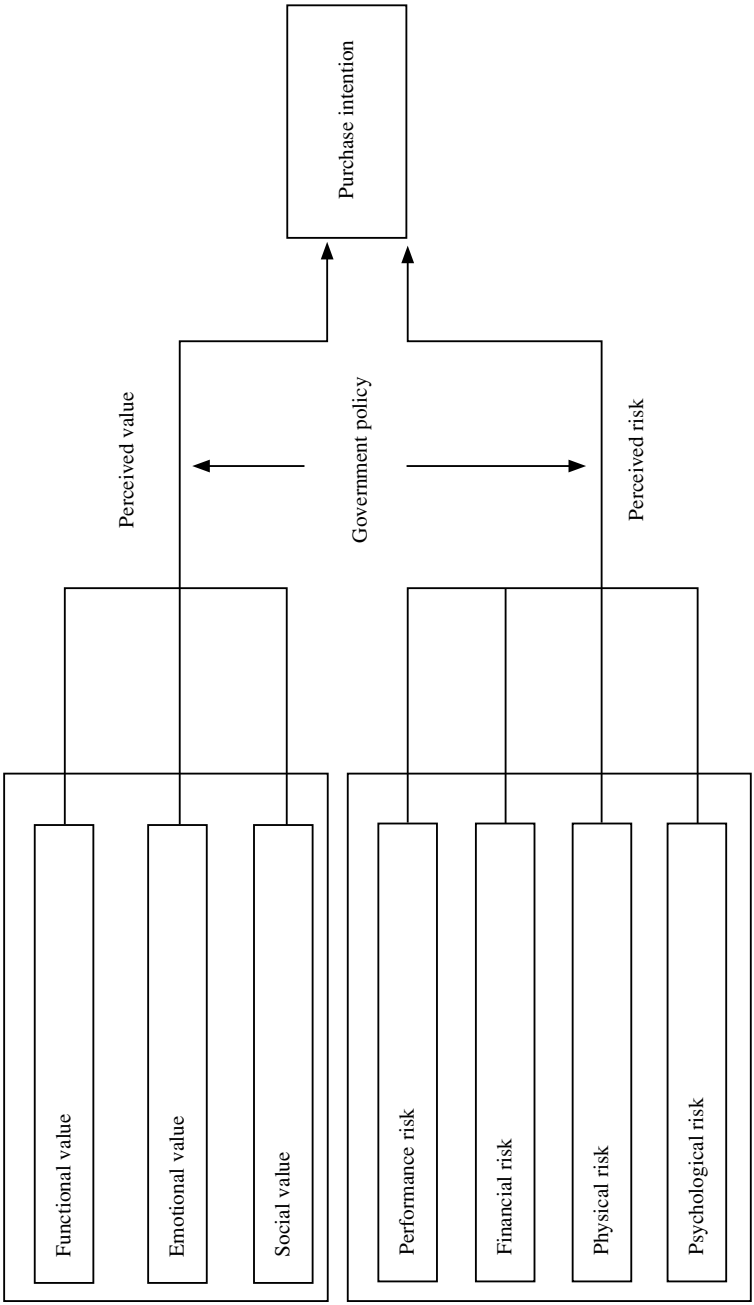

Figure 1. *Research model.*

Table 1. *Descriptive Statistics of Study Sample*

Variables	Response category	*n*	%	Variables	Response category	*n*	%
Gender	Men	295	65%	Family income	Less than RMB 50,000	98	21.6%
	Women	159	35%		RMB 50,000–90,000	176	38.8%
Age (years)	18–25	21	4.6%		RMB 100,000–150,000	101	22.2%
	26–40	235	51.8%		More than RMB 150,000	79	17.4%
	41–50	178	39.2%	Family-owned	0	162	35.7%
	55+	20	4.4%	cars (*n*)	1	261	57.5%
Education	Junior high school and below	7	1.5%		2	27	6.0%
background	High school or polytechnic school	42	9.2%		3	2	0.4%
	Junior college	102	22.5%		4	2	0.4%
	University graduate	240	52.9%	Understanding	Very familiar	11	2.4%
	University postgraduate and above	63	13.9%	electric vehicles	Familiar	94	20.7%
					General	182	40.1%
					Little	158	34.8%
					Never heard of it	9	2.0%

from 230 more people through interviewing employees of BYD, Huawei, and other companies. Of the 480 received responses, 454 (95%) were valid. Survey respondents were mainly adults with driving experience, with the rest being nondrivers.

Respondents rated the items in the survey on a 5-point Likert scale ranging from 1 = *strongly agree* to 5 = *strongly disagree*. The descriptive statistics for the study sample are set out in Table 1.

Measurement Development

Dependent measures. According to Dodds, Monroe, and Grewal (1991) and Grewal, Monroe, and Krishnan (1998), customers' purchase intention can be evaluated in three dimensions: a) I will consider buying an EV (Y1); b) I am willing to buy an EV (Y2); and c) I would be willing to recommend an EV to someone else (Y3).

Independent measures.

Variables associated with consumers' perceived value of electric vehicles. Heffner, Kurani, and Turrentine (2007) suggested that the lower operating costs of EVs may be considered by potential consumers. Furthermore, the maintenance costs related to the purchase of an EV may also influence the decision to purchase (Adamson, 2005). According to the definition of *functional value*, which refers to the features or utilities of a product or service that would meet the consumer's needs in terms of functionality or usefulness, I included two items in the survey representing two variables: Compared with a petrol-powered vehicle, an EV has lower operating costs because the cost of electricity is cheaper than that of fossil fuels (X1); Compared with a petrol-powered vehicle, an EV has lower maintenance costs because the EV has no engine and no gearbox (X2).

Consumers with high environmental awareness and considerations are more willing than others are to purchase EVs to express an explicit commitment to protecting the environment (Erdem, Şentürk, & Şimşek, 2010). Huijts, Molin, and Steg (2012) also pointed out that the adoption of EVs involves the use of new technologies. When Graham-Rowe et al. (2012) performed a qualitative analysis of responses about electric cars, based on semistructured interviews conducted with 40 noncommercial drivers in the UK, they found that the drivers felt less guilt associated with polluting the air when they drove EVs. Therefore, we composed items for three variables of emotional value: The EV's contributions to the environment are important, as it emits no exhaust fumes and produces only low levels of noise (X3); The EV features exciting new technology that is reminiscent of the introduction of the light bulb (X4); Driving an EV will reduce guilt about contributing to unhealthy smog levels through air pollution (X5).

Furthermore, Kurani, Turrentine, and Heffner (2007) found that people who owned EVs were seen by other people to express their maturity, intelligence, and

awareness. EV ownership is a signal to show the tendency to embrace something new or better (Kang & Park, 2011). On the other hand, Skippon and Garwood (2011) pointed out that EVs signaled that their users were high in agreeableness, conscientiousness, and openness to experience. Ownership of an EV is a reflection of sharing community values (Kahn, 2007). Hence, in my survey I included two items to represent variables associated with the perception of others, as follows: EV drivers are perceived by others to be fashionable, mature, and intelligent (X6); Driving an EV inspires others to feel that the driver is noble and reliable (X7).

Variables associated with EV consumers' perceived risk. A participant driving an EV was found to be embarrassed when he was getting overtaken by many vehicles powered by diesel or petrol (Schuitema, Anable, Skippon, & Kinnear, 2013). The long recharging time has been found to be an important factor influencing the adoption of EVs (Skippon & Garwood, 2011). On the basis of these findings, I composed items on performance risk that would assess two variables: When compared with a traditional vehicle, an EV operates within a slower speed range of between 80 and 200 km per hour (the maximum speed that an EV can reach; X8); An EV takes 8 hours to charge at home and between 15 and 30 minutes at a quick-charge station (X9).

Lane and Potter (2007) suggested that the higher purchase price of EVs was a major barrier to customers' buying them. Mourato, Saynor, and Hart (2004) reported that running costs and high costs associated with battery replacements were concerns for consumers. The potential adoption of EVs depends on availability of charging stations or recharging points (Skippon & Garwood, 2011). Thus, I composed three items to assess variables associated with financial risk: Compared to the price of a traditional vehicle powered by diesel or petrol, the price of an EV is between 50% and 100% dearer (X10); Batteries are expensive to replace and the average lifetime of a battery is 5–6 years; the price of a battery accounts for 50% of the total EV purchase price (X11); There is an inadequate number of charging stations or recharging points; thus, it takes time to search for a recharging station or wait in line at a station to recharge the battery (X12).

In a study on China's EVs, Xu and Xu (2010) found that vehicle safety received much attention from buyers. Liu and Cheng (2014) concluded that one of the risks of EVs is low safety performance, such as electricity leakage, explosions, and radiation exposure. I, therefore, composed one item for the variable of physical risk: The technology for the battery used in an EV is immature, creating consumer concerns about electricity leakage, explosions, and radiation exposure (X13).

Some drivers are often influenced by other people's opinions about cars (Schuitema et al., 2013); therefore, we composed one item for the variable of psychological risk: People worry about negative opinions of friends and/or relatives after purchasing an EV (X14).

Moderating variable. Since June 1, 2010, consumers in China have been eligible to receive RMB 60,000 (US$9,375) in central government subsidies when they buy pure EVs. Additionally, they can obtain RMB 50,000 (US$7,812) in central government subsidies for buying plug-in hybrid EVs. For the period from 2011 to 2020, consumers are exempted from the vehicle purchase tax when purchasing EVs or plug-in hybrid EVs. In addition, in Beijing, Shanghai, Guiyang, Guangzhou, Tianjin, Hangzhou, and other cities in China, the authorities have imposed restrictions on registration of petrol and diesel-powered vehicles (Wang, 2013). Therefore, I proposed the following two items for the variable relating to subsidies: Government subsidies and tax exemptions were my primary motivations for purchasing an EV (F1); Restrictions on purchasing and licensing a vehicle powered by diesel or petrol influenced my decision to purchase an EV (the Chinese government sometimes restricts registration; F2).

Results

Factor Analysis

Before performing the OLS (ordinary least square) regression analysis, I performed factor analysis. Data are suitable for factor analysis when the Kaiser–Meyer–Olkin measure of sampling adequacy is close to 1 (Kline, 1994). According to the KMO and Bartlett's test, the KMO was greater than 0.7 and the significance of the Bartlett test was .001. These results show the data had high validity.

Table 2. *The Results of Factor Analysis*

	Component								
	1	2	3	4	5	6	7	8	9
Y2	**.855**	-.040	.178	.176	.191	.140	.007	.037	-.037
Y1	**.823**	-.002	.122	.156	.279	.135	-.018	-.056	-.076
Y3	**.794**	-.063	.182	.160	.120	.147	.043	-.018	-.048
X10	-.049	**.862**	-.086	.072	.065	.012	.125	-.027	.036
X11	-.010	**.789**	.033	-.117	-.141	-.038	-.028	.092	.114
X12	-.044	**.748**	.225	.041	.080	.013	.130	.029	.140
X3	.125	.170	**.794**	-.059	.085	.242	-.023	.072	-.019
X5	.200	-.014	**.667**	.404	.137	.060	.106	-.133	.057
X4	.277	.023	**.605**	.330	.105	.076	.126	-.071	-.041
X7	.198	-.001	.145	**.851**	.115	.073	.062	.015	-.031
X6	.202	-.007	.132	**.792**	.117	.180	.065	.178	-.035
F2	.273	-.024	.029	.132	**.798**	.154	.105	-.021	.060
F1	.318	.016	.281	.138	**.730**	.025	-.034	.089	-.047
X2	.204	.003	.036	.242	.124	**.814**	.083	-.076	-.016
X1	.182	-.026	.384	.024	.056	**.746**	.069	.060	-.019

Table 2 continued

	Component								
	1	2	3	4	5	6	7	8	9
X8	-.080	.000	.026	.148	.193	.140	**.849**	.126	.003
X9	.157	.410	.133	-.015	-.174	-.008	**.730**	.005	.110
X14	-.025	.079	-.046	.126	.039	-.021	.114	**.954**	.056
X13	-.128	.301	-.012	-.055	.020	-.029	.075	**.063**	.930

Note. Numbers in **bold** indicate factor loadings greater than 0.5.

Following the results shown in the Table 2, I classified the independent variables into seven dimensions. The analysis of the moderating variable and the dependent variable resulted in the extraction of one factor for each, in line with my research expectations.

The Cronbach's alpha scores of the constructs were greater than .70, showing that the reliability is very good (Nunnally, 1978).

Regression Analysis

After confirming the fit of the data of the dependent and independent variables, I determined the model's parameters and obtained the regression equation.

Table 3. *Regression Coefficients of Perceived Value and Perceived Risk Variables*

Model	Unstandardized coefficients		Standardized coefficients	*t*	Sig.	Collinearity statistics	
	β	*SE*	β			Tolerance	VIF
Constant	1.170	.272		4.303	.001		
Functional value	.218*	.045	.214	4.878	.001	.735	1.360
Emotional value	.362*	.057	.294	6.290	.001	.651	1.536
Social value	.209*	.040	.233	5.206	.001	.709	1.410
Performance risk	-.033	.045	-.031	-0.734	.464	.806	1.240
Financial risk	-.038	.049	-.034	-0.782	.434	.749	1.334
Physical risk	-.105*	.038	-.116	-2.755	.006	.798	1.253
Psychological Risk	-.025	.031	-.031	-0.797	.426	.910	1.099

Note. SE = standard error, VIF = variance inflation factor. * $p < .01$

The regression equation for a consumer's intention to purchase an EV was as follows:

$$\text{Purchase intention} = 0.214 \times \text{functional value} + 0.294 \times \text{emotional value} + 0.233 \times \text{social value} - 0.031 \times \text{performance risk} - 0.034 \times \text{financial risk} - 0.116 \times \text{physical risk} - 0.031 \times \text{psychological risk}.$$

The estimated regression coefficients of the perceived-value factors were all positive. There were positive correlations ($p < .01$) between factors influencing

perceived value and purchase intention. Thus, Hypotheses 1–3 were all supported. Conversely, estimated regression coefficients of perceived risk factors were all negative, so there were negative correlations between factors of perceived risk and purchase intention. Physical risk was negatively correlated ($p < .05$), supporting Hypothesis 6. The impact of performance risk, financial risk, and psychological risk on purchase intention was not significant; therefore, Hypotheses 4, 5, and 7 were not supported. These results may indicate that Chinese consumers generally believe that the current EV technology is not yet mature; thus, because they are concerned mostly about risks, they are, generally, unwilling to purchase EVs.

Among perceived value factors, Chinese customers pay more attention to emotional value, which reflects that Chinese customers have accepted the environmental value of EVs. Among perceived risk factors, the customers focused predominantly on physical risks from electricity leakage, explosions, or radiation exposure.

All the calculations of variance inflation factors were below 10, indicating that there was no multicollinearity (Wu, 2001).

Government Regulation

The impact of performance risk, financial risk, and psychological risk on purchase intention was not significant. Thus, I verified the effects of government regulations on the relationships among functional value, emotional value, social value, physical risk, and purchase intention. From the regression analysis, I found that the significance of the relationship between social value and government regulations was less than .05, indicating that restrictions on purchasing and licensing a petrol- or diesel-powered vehicle can influence more people to consider buying an EV; further, the significance of the relationship between functional value and government regulations was .068, and the difference between the R^2 and the adjusted R^2 was considerable, indicating that the government policies can reduce the cost of EVs. However, government regulations did not have a significant effect on the relationships among physical risk, emotional value, and purchase intention, indicating that government support to enhance technology innovation for EVs is still not sufficient, and that government promotion of a low-carbon lifestyle must be enhanced.

Discussion

Relationships Among Customers' Perceived Value, Perceived Risks, and Purchase Intention

Each dimension of the customers' perceived value had a significant impact on their purchase intention. The positive correlation of perceived value with

purchase intention indicates that the greater the consumer's perception of value, the greater the purchase intention will be. This confirms the findings of Holbrook and Schindler (1994) and Chen and Dubinsky (2003). Negative coefficients for the perceived risk factors are indicators of greater perceived risk and a lower likelihood to purchase. This finding is consistent with that of Featherman and Pavlou (2003).

The mean value of consumers' purchase intentions was low. In other words, consumers' intention to purchase EVs was indicative of a wait-and-see attitude. From the survey conducted as part of this study, I found that there were a number of reasons for this attitude. First, there was a general perception that EV costs are much higher than the costs of petrol- or diesel-powered vehicles; respondents expressed the view, in addition to the Likert scale options, that the extra savings associated with purchase of petrol- or diesel-powered vehicles could be used to buy fuel. Although EVs have no engine and low maintenance costs, there are issues regarding the battery, including possible explosions and the need for periodic replacement. These aspects of maintaining an EV do not back up the bargain price touted in regard to its maintenance. Respondents also expressed a fear that widespread use of EVs may cause a supply shortage that will result in a sharp rise in the price of electricity. Even though there are no exhaust emissions from EVs, plants producing electric power will emit air pollutants as most use coal in China. Generally speaking, the respondents' overall perception of the value EVs was low; therefore, the intention to purchase was low.

As well as the respondents' concerns about the potential for electricity leakage, explosions, and radiation exposure from the EV battery, our results showed that there were worries about driving EVs when the majority of people are not driving them.

Regulations and Government Policy Guidance

The Chinese government's policy guidance influenced the relationship between consumers' perceived value and purchase intention, but the absolute values of the coefficients were relatively small. These results indicate that the Chinese government's current level of support for EVs is insufficient. This is a new finding in EV research.

Although there are financial subsidies available, they are very small. For example, if the original price of a BYD E6 (a model of EV in China) is RMB 360,000, the government subsidy of RMB 120,000 would offset only a small portion of the cost; in other words, the consumer would still need RMB 240,000 to purchase the EV. This price is still twice that of a similar vehicle powered by petrol or diesel (Zhang, 2013). Further, the Chinese government's publicity promoting the EV's contribution to low-carbon living is not sufficiently attractive to consumers.

Conclusion and Policy Implications

Manufacturer perspective. My findings provide three important directives for managers of EV manufacturing plants. First, technology innovation and quality must be enhanced and the cost of the vehicles to consumers must be reduced. Improvement of EV battery and charger performance is a key in promoting sales. Second, publicity about EVs should be increased, to familiarize consumers with its features and benefits. Companies manufacturing EVs should make use of news media, television, magazines, and Internet plug-in advertising to encourage consumers to purchase EVs. Third, manufacturing companies should establish an excellent after-sales service system. Assuring excellence in this area is an important measure toward improving customer loyalty to, and confidence in, a company.

Government perspective. EV purchases in China by individuals can be enhanced if some important measures are taken by the government. First, government support should be increased through incentives such as increased subsidies and tax cuts for consumers and companies that manufacture EVs. Second, the necessary infrastructure needs to be improved. The government should modernize the existing infrastructure to make sure that the operating of an EV would be convenient for a consumer. Finally, both EV trial operations and the low-carbon lifestyle should be promoted by the government, through emphasizing the vehicle's environmental contribution and by placing the EV as a mainstream item for consumption.

Study Limitations and Future Research Directions

A limitation in this study is the demographically imbalanced dataset. Although respondents represented a geographically wide area of China that included Wuhan, Shanghai, Changchun, Beijing, Shenzhen, and other provinces and municipalities, 75% of the respondents were from Hubei Province. In addition, as well as the factors that I included in my research, there are many other direct and indirect factors that impact the purchase intention of consumers in relation to EVs, such as individual characteristics of consumers, consumption perspectives, and consumption habits and lifestyle. All of these aspects require further research in relation to the purchase and operation of an EV.

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