



Why people want to buy electric vehicle: An empirical study in first-tier cities of China



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ABSTRACT

Electric vehicles are considered to be one of the most important ways for China to solve a series of energy problems such as urban smog, energy supply security and turning to green development. With the powerful support provided by the government, China has become the world's largest electric vehicle market and continues to maintain a high-speed growth. This paper examines the factors that may affect the public's purchasing intention of electric vehicles via a survey. An electric vehicle purchasing intention model is proposed based on the literature review and the reality in China. The model takes into consideration a number of demographic characteristic factors and attitude factors. A survey was conducted in China's four largest cities which include: Beijing, Shanghai, Guangzhou and Shenzhen. Based on the survey data, the paper examines the public's cognition of each influencing factor and analyses the impacts of these factors. The results reveal that attitude factors such as network externality, price acceptability, government subsidies, vehicle performance, environmental concerns, and demographic characteristics such as gender, age and marital status have significant impact on respondents' willingness to purchase electric vehicles. The finding of this paper provides constructive advices to diverse stakeholders.

1. Introduction

Air pollution has become a serious problem in urban areas of China. Especially in the large cities, highly concentrated contaminants, including airborne particulate matter, SO₂ and NO_x, have caused millions of people to die every year (Rohde and Muller, 2015). Smog is the most familiar form of air pollution, which is now one of the most important public concerns in China. In the Hazardous smog days, the government often issues “red alert” and impose regulatory measures such as traffic restrictions based on even and odd numbered license plates. Emissions generated by driving vehicles are considered to be a critical factor causing the smog pollution (Zhang et al., 2014; Huang et al., 2016). Vehicle ownership of China has grown rapidly in recent years (Lin and Du, 2015). As shown in Fig. 1, the vehicle ownership in China has growth more than 100 times since 1980, while the population only increase 40% during the same period. Since 2009, China has overtaken the US in terms of total vehicle production and has become the largest automotive market in the world (Liu et al., 2010). In 2015, the total sales amount reached to 24.6 million vehicles in China. Meanwhile, motor vehicles consume nearly 40% of oil used in China (Lin and Xie,

2013). If the oil consumption rate of vehicle rises to the level of United State, which is as high as 70% (Davis et al., 2016), China may consume more than 1 billion ton oil per year. The rapid and sustained growth of vehicle energy consumption has raised concerns over local air pollution, carbon dioxide emissions, and national energy security (Yin et al., 2015; Du and Ouyang, 2017). If no restrictions are exerted to the use of vehicles in China, the support of such large energy consumption may be unsustainable in the future years (Wang et al., 2014).

The adoption of electric vehicles (EV), which is considered as the main trend in the future's development of China transportation sector, is now implemented as a long-term solution to the problems mentioned above. Benefiting from the powerful supports offered by the government, China is now the largest EV consumer and manufacturer in the world. Table 1 lists the sales number of new energy vehicle (NEV) and EV of China in recent years. The NEV market of China is often segmented into EV, plug-in hybrid vehicle (PHEV) and others like fuel cell vehicle (FCV) and capacitance vehicle (CV). Most of the market share is occupied by EV which is powered solely by electricity and the PHEV which having both electric motor and internal combustion engine. Presently, support policies in China are focused on the EV market and

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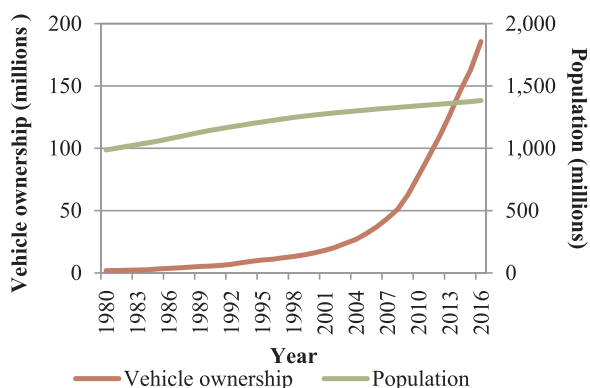


Fig. 1. Trend of vehicle ownership and population in China.

most of the NEV sales in China are pure EV now. The booms of NEV /EV market started in 2014, when the sales growth recorded a number higher than 200% at that year. The increasing momentum maintains in the following years and shows no signs to let up. Meanwhile, the proportion of EV sales has grown to 1.43% from a negligible level. An ambitious program proposed by central government plans that the ownership of EV may reach more than 5 million by 2020.

There are two reasons for the fast growth of EV. One is that, the China's government releases a new subsidies policy in 2013, which greatly enhance the subsidies for the EV. Another is that the price of battery, which is one of the major costs of EV, has declined to the range of economic feasibility (Lin and Wu, 2017). The subsidies are only for the EV, and other NEVs such as PHEV are excluded. As a result, most of the NEV market is occupied by EV.

China's consumers have shown a high willingness to adopt EVs (Helveston et al., 2015). If the present policy is maintained, the demand for EV may still maintain a rapid upward trend and begin to be an available alternative for gasoline vehicles. Therefore, to understand what factors may impact the purchasing intention of EVs is important for the government and industry. First of all, the government can release a more efficient policy to provide subsidies and promote the growth of EV. Secondly, the public may have cognitive bias about EVs, which may affect the purchase intention. A better understanding about these biases may help the industry to plan a more efficient market strategy. Thirdly, according to the public's attention, the manufacturers can centralize the resources in the points which may have stronger influence on the EV demands.

Though China is now the largest EV market in the world, previous studies on the topic of EV in China mainly focus on the influence of power grid (Gao and Zhang, 2011; He et al., 2016), the public infrastructure of charging system (Andrenacci et al., 2016; Moon and Kim, 2017), and the subsidy policy (Hao et al., 2014; Zhang et al., 2016; Diao et al., 2016). Few studies focus on what factors impact the purchasing intention of China's vehicle consumer.

This paper proposes an integrated model to evaluate the acceptance of EV. A survey is designed and conducted to collect empirical data about the factors that may influence the purchasing intention about EVs; quantitative analyses of these factors are also implemented.

The remainder of this paper is arranged as follows: Section 2 briefly

reviews the previous literature, followed by a theoretical framework and data sources in Section 3. Section 4 provides descriptive statistics of the samples, and Section 5 presents the main findings of the survey and the discussion about the result. The policy implication and conclusion are presented in Section 6 and Section 7.

2. Literature review

Literature on EV adoption has grown dramatically in recent years (Rezvani et al., 2015). This selective review focuses on the adoption behavior and attitude factors for the purchasing intention of EVs.

The theory of planned behavior (TPB) is frequently used to predict the intentions of consumers. The TPB assumes that the decision is made based on rational evaluation of stimuli; human action is guided by behavioral beliefs, normative beliefs and presence factors (Ajzen, 1991). Consumer's behavior is directly predicted by intentions, and the intentions can be predicted by the sum of possible consequences of behavior (Bamberg and Möser, 2007). Rezvani et al. (2015) review the literature about the adoption of EVs, and found that various models have been established based on TPB theory. The example including Moons and De Pelsmacker (2012) applied TPB to investigate the determining factors of the usage intention of an electric car and identified some correlated factors. Sang and Bekhet (2015) extended the framework of TPB to explore EVs acceptance in Malaysia, and found seven key predictors to be statistically significant towards electric vehicles usage intention.

The TPB proposed that the behavioral intention is formed by the attitude, subjective norm and perceived behavioral control. We can expand the intention by incorporating variables (Sang and Bekhet, 2015). According to the previous empirical study, we can categorize the factors as follows:

Some researchers proposed that the demographic variables, such as age, gender, education level and income, may impact the perceived behavioral control, and will influence the intentions of adoption (Liu et al., 2013; Axsen and Goldberg, 2016).

The charging infrastructure may also influence the perceived behavioral control. Egbue and Long (2012) pointed out that the charging infrastructure is now one of the major challenges faced by EVs. Neubauer and Wood (2014) found sufficient charging infrastructure will reduce the range anxiety, which may significantly affect the usage intention of EVs.

The TPB considers that individuals may relevant others' beliefs that he or she should or should not perform such behavior. The social influence occurs when individual's emotions, opinions, or behaviors are affected by others. Axsen et al. (2013) point out that the battery electric vehicle (BEV) perceptions of people were "highly influenced" by at least one social interaction. Kelman (1958) identified three broad varieties of social influence: Compliance, Identification, and Internalization. Sang and Bekhet (2015) figured out that the interpersonal influence may impact the social influence and affect the usage intention of EVs. Eppstein et al. (2011) applied the agent-based model to study market penetration, and modeled network externalities based on an agent's susceptibility to media campaigns and social influence when studying the adoption of EVs.

The attitude toward behavior may be affected by behavioral beliefs

Table 1
Sales of new energy vehicle in China.

Year	2011	2012	2013	2014	2015	2016
New energy vehicle ^a	8159	12,791	17,642	74,763	331,092	493,806
Electric vehicle	5579	11,375	14,604	45,048	247,482	400,916
Overall vehicle	18,505,114	19,306,435	21,984,079	23,491,893	24,597,583	28,028,175
EV proportion	0.03%	0.06%	0.07%	0.19%	1.01%	1.43%

^a The sales number of new energy vehicle include the electric vehicle and other type of vehicle such as PHEV, FCV and CV.

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