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Policy implications for promoting the adoption of electric vehicles: Do consumer's knowledge, perceived risk and financial incentive policy matter?

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ABSTRACT

Electric vehicles (EVs) have been regarded as one of the most promising green technologies to reduce carbon emissions and energy consumption from the transport sector. Understanding and exploring the factors that affect consumer's intention to adopt EVs is important. The main purpose of this research is to analyze the effects of consumer's knowledge about EVs, perceived risk, perceived usefulness and current financial incentive policies on consumer's intention to adopt EVs using an extended technology acceptance model. The model is empirically tested using questionnaire survey data collected from 320 consumers in China. The results shown that consumer's knowledge about EVs is positively and significantly related to perceived usefulness, attitude and intention to adopt EVs, but negatively and significantly related to perceived risk. Perceived risk negatively affects perceived usefulness, attitude and intention to adopt EVs. Meanwhile, perceived usefulness has a positive effect on adoption intention and attitude, and attitude is also positively related to the intention to adopt EVs. However, the results also indicate that the financial incentive policy has no significant effect on intention to adopt EVs. In addition, the results also find that consumers lacking of knowledge about EVs and perceiving high risk of EVs could be the psychological barriers to their acceptance of EVs. Based on the results, policy implications for increasing the adoption of EVs and suggestions for future research are discussed.

1. Introduction

With the rapid development of Chinese economy and the continuous improvement of living standards, the numbers of motor vehicles are increased dramatically in China in recent years (Lin and Du, 2015). By the end of 2016, there are about 290 million motor vehicles in China.[1] The increase in motor vehicle ownership has caused many negative effects such as traffic congestion, energy shortage, and especially carbon emissions (Larson et al., 2014; Zhang et al., 2018). According to a report issued by the International Energy Agency, the carbon emissions generated from motor vehicles accounts for about one-fourth of the total carbon emissions in China and this proportion is expected to reach 45% in 2030 (IEA, 2016). Reducing carbon emissions from motor vehicles is vital to achieve emission reduction targets in China and alleviate the serious environmental problems (Wang et al., 2017; Zhu et al., 2018). In this context, electric vehicles (EVs) have been regarded as one of the promising means to reduce carbon emissions substantially since

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[1] http://www.caam.org.cn.

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that the electricity is produced from renewable energy sources (Schuitema et al., 2013; Ferguson et al., 2018).

Compared with traditional gasoline vehicles, EVs have several societal and environmental benefits such as reduce carbon emissions, enhance energy security and promote the usage of renewable and clean energy (Egbue and Long, 2012; Lopes et al., 2014; Morganti and Browne, 2018). Considering these benefits, the governments of different countries in the world have initiated incentives and subsidy programs to encourage the uptakes of EVs. For example, the UK government has planned to invest more than 300 million dollars to develop EVs infrastructure and technology and subsidize consumers and manufacturers (Graham-Rowe et al., 2012). US government has implemented the monetary incentive polices, such as a federal income tax credit of up to 7500 dollars for the adoption of EVs, sales tax exemptions and lower licensing fees, to popularize the EV sales and minimize the higher selling price (Dumortier et al., 2015). The Japanese government has implemented the free charging policy to encourage consumers to adopt EVs (Rezvani et al., 2015).

The Chinese government has also taken measures to increase the market share of EVs and formulated a range of financial incentive polices to motivate consumers to adopt EVs. For example, the Chinese government has implemented the "Energy Saving and Electric Vehicle" strategy and carried out pilots to subsidize EV buyers directly (Wang et al., 2016). Other financial incentive policies such as purchase tax and value added tax exemption, and road tolling exemption have also been implemented (Wang et al., 2017). Though great efforts and supporting incentive polices have been exerted and provided, consumer's enthusiasm to adopt EVs still seems to be low and the market share of EVs is relatively small (Zhang et al., 2013; Li et al., 2016). According to the report issued by China Association of Automobile Manufactures (CAAM),[2] the number of whole vehicle sales was more than 28 million while the number of EV sales was only 409,000 by the end of 2016. The market share of EVs is merely 1.46% in China. EVs not only in China but also in other developed countries are facing a dilemma of "hot policy" but "cold market" (Li et al., 2016). For instance, in Norway and US, the market share of EVs only accounted for about 2% and 0.70% in 2015 (Li et al., 2016; White and Sintov, 2017). The low level of enthusiasm for consumers to adopt EVs highlights the necessity to explore the effect of financial incentive policy on consumer's intention to adopt EVs and further investigate what factors affect consumer's adoption behavior of EVs.

Previous research has investigated consumer's intention to adopt EVs, and much research has been undertaken in the technology field and regarded the limited cruising range, insufficient charging infrastructure, long charging time, uncertain performance, battery capacity and vehicle safety issues as the major barriers to impede the diffusion of EVs (Carley et al., 2013; Lim et al., 2014; Junquera et al., 2016; Wang et al., 2017). However, with the further development of EVs technology and the construction of charging facilities (e.g., charging stations and piles), these barriers may not be directly associated with consumers' acceptance of EVs. In fact, the mass acceptance of EVs to a large extent is reliant on consumers' psychological perceptions of EVs, such as their attitudes, concerns, values, beliefs, interests and understandings (Larson et al., 2014; Rezvani et al., 2015). Hence, it is significant and meaningful to explore consumer's intention to adopt EVs from the perspective of consumer psychology, highlight the importance of psychological factors and go deeper to investigate the specific psychological factors and their effects on consumer's intention to adopt EVs.

Several researches have explored the effects of psychological factors on consumer adoption of EVs. For example, Moons and De Pelsmacker (2012) explored the effects of attitude, subjective norm and emotions on consumer's intention to purchase EVs. They found that emotions and attitude are the strongest determinants of usage intention, followed by the subjective norm. Egbue and Long (2012) and Carley et al. (2013) noted that consumers' awareness of environmental issues and environmental beliefs, values and norms positively affect their intentions to purchase EVs. Schuitema et al. (2013) highlighted the role of perceived hedonic attributes, symbolic attributes and instrumental attributes in affecting consumer adoption of EVs. Noppers et al. (2014) found that consistency of EV's image with consumer's self-image influences the adoption intention positively. Wang et al. (2016) examined the role of personal moral norm and environmental concern in promoting the adoption of EVs and indicated that they are two important psychological determinants to influence consumer adoption of EVs. Han et al. (2017) noted the importance of perceived functional and non-functional values in influencing consumer adoption of EVs and found that non-functional values are more important than functional values. Degirmenci and Breitner (2017) pointed out that the perceived green environmental performance of EVs is a stronger predictor of purchase intention than perceived price value and range confidence.

Based on these researches, this paper aims to further extend the research on consumer's adoption behavior of EVs by examining the effects of consumer's knowledge about EVs and perceived risk. Consumers hesitate to purchase EVs, may be due to the fact that they are unfamiliar with EVs, own little knowledge about EVs and worry about the risk of using EVs. Consumers with greater knowledge about EVs and perceived lower risk of using EVs are more likely to adopt EVs. Hence, it is valuable and meaningful to consider these two psychological factors. Furthermore, some literature suggests that the perceived usefulness is an important psychological factor and has an impact on consumer's acceptance of new and innovative products (Egbue and Long, 2012; Schuitema et al., 2013). Hence, this research also attempts to explore the relationship between perceived usefulness and the adoption behavior of EVs. In addition, considering that perceived usefulness is an important factor of technology acceptance model (TAM) and TAM has been widely used to explain consumer's acceptance of technological innovation and new products, this research decides to select TAM as the basic theoretical model of this research (Davis, 1989).

Overall, this research aims to employ the TAM as the basic theoretical model and integrate two psychological factors (consumer's knowledge about EVs and perceived risk) and financial incentive policy into TAM as antecedents to explain consumer's intention to adopt EVs. The remainder of this paper is structured as follows. Section 2 briefly reviews the previous literature and proposes the hypotheses. Section 3 focuses on data and methodology issues. Data analysis and the results are presented in Section 4. Section 5 discusses the results and derives policy implications. The final Section concludes the research and points out the limitations.

[2] See detail at http://www.auto-stats.org.cn.