Factors Analysis on Chinese Consumers’ Attitude towards Electric Vehicles Based on Online Reviews

Ruiting Wang

Statistics and Mathematics, Inner Mongolia university of finance and economics, Hohhot, Inner Mongolia, 010070, China

Corresponding author’s e-mail: 15201613055@163.com

Abstract. Electric vehicles are more economic and environmentally friendly, but they are still not widely accepted by citizens in China. This paper makes a detail study on factors influencing consumers’ attitude of electric vehicles by analyzing 2769 online reviews, aiming to point out authentic assessment from the actual EV users. Firstly, we build the comment thermodynamic chart based on the review quantity and find the comment quantity reflects the sales to some extent, and the sales amount is positive relevant to regional policies quantity. Secondly, we calculate the correlation among space, manipulate, power-consumption, power, trim, comfort, appearance, cost-performance and mainly analyze how the first seven performance influences the cost-performance. Thirdly, we study the purchase purpose, finding that for EV users, they choose EVs mainly for daily short-distance running. These findings can not only help consumers for their consumption choice, but also guide EV manufacturers about their further technology focus in a certain degree.

1. Introduction

With huge vehicle ownership, China faces serious traffic problem, low air quality and potential energy crisis[1]. New Energy Vehicles (NEVs), often referred to electric vehicles (EVs), plug-in hybrid vehicles (PHEVs) and fuel cell vehicles (FCVs), are regarded as the most promising transportation trend to change this situation[2]. Compared with the internal combustion engine vehicles (ICEVs), NEVs are more economic and environmentally friendly[3]. Chinese government has initiated plenty of policies to promote the adoption of NEVs. From 2006 to 2016, there are nearly 180 policies was promulgated by all levels of Chinese government[4]. In 2009, “Ten cities, Ten thousand NEVs” demonstration and application project officially started the promotion stage[5]. The State Council issued “Energy saving and new energy vehicle industry development plan (2012 - 2020)” in 2012[6], which made a systematic planning for the technological path, industrial objectives, infrastructure, financial subsidies and financial support for the NEVs. In 2017, “Parallel Management Method of Average Fuel Consumption and New Energy Vehicle Integral in Passenger Vehicle Enterprises” was promulgated, turning the core of policies from fiscal subsidies to fuel consumption control[7].

With the growing maturity of electric vehicles and series of promotion policies, China became the biggest electric vehicles’ (EVs’) production and sales market in the world by the end of 2016[8]. Table 1 lists the sales volume of NEVs and EVs from 2011 to 2018, which shows NEVs have a rapid sales increasing and EVs cover more than 70% of this sales. This means the growing enthusiasm of consumers to buy EVs, however, they are still not widely recognized by citizens. They are worried about EVs’ higher production cost, questionable battery performance and safety, imperfect charging infrastructure[9][10][11]. Actual consuming feedback is a useful channel to get real experience of a
vehicle. However, existing research mostly focuses on EVs’ techniques, performance, policies, or consumers. So this paper makes a detail study on the feedbacks of electric vehicles by analysing the online reviews, aiming to point out authentic assessment from the actual EV users.

Table 1. The sales volume of EVs and NEVs in China from 2011 to 2018.

| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|------|------|------|------|------|------|------|------|------|
| EV   | 5579 | 11375| 14604| 45048| 247482| 400916| 646303| 981171|
| NEV  | 8159 | 12791| 17642| 74763| 331092| 493806| 768023| 1247514|
| EV proportion | 68.38% | 88.93% | 82.78% | 60.25% | 74.75% | 81.19% | 84.15% | 78.65% |

The remaining of the paper is laid out as follows. Section 2 gives out how the data is acquired and processing. Section 3 is the main analysis part. Then we draw the conclusion in the last section.

2. Data acquisition

Autohome is an automotive website which provide one-stop service for car selection, purchase, use and replacement. Table 2 lists customer satisfaction of new energy vehicles in 2018. We choose nearly 20 vehicle models from these auto manufacturers and collect customers’ feedback of these vehicles from Autohome’s word-of-mouth page. Finally we collected 2769 feedbacks from 2013 to 2019, getting their purchase models, purchase time, purchase price, purchase purpose, purchase city and the score of space, manipulate, power-consumption, power, trim, comfort, appearance, cost-performance.

Table 2. Customer satisfaction of new energy vehicles in 2018

| Model       | Auto Manufacturer | Market Segment                  | CSI |
|-------------|-------------------|---------------------------------|-----|
| iEV6E       | JAC               | Pure Electric A00 Class Vehicle | 76  |
| EC series   | BAIC NEW ENERGY VEHICLE | Pure Electric A00 Class Vehicle | 76  |
| eQ          | CHERY             | Pure Electric A00 Class Vehicle | 75  |
| Qin EV      | BYD               | Pure Electric A Class Vehicle   | 79  |
| E5          | BYD               | Pure Electric A Class Vehicle   | 77  |
| EU series   | BAIC NEW ENERGY VEHICLE | Pure Electric A Class Vehicle | 77  |
| EMGRAND EV  | GEELY             | Pure Electric A Class Vehicle   | 74  |
| EU series   | BAIC NEW ENERGY VEHICLE | Pure Electric A Class Vehicle | 77  |
| ROEWE ERX5  | SAIC              | Pure Electric SUV               | 76  |
| Song EV     | BYD               | Pure Electric SUV               | 76  |

*a organised by China Automobile Customer Satisfaction Index (CACSI) published by China Association for Quality.

b CSI is the abbreviations of customer satisfaction index

3. Data analysis

3.1. Purchase area analysis

In 2013, 28 cities or regions get the approval for the first batches to promote the new energy vehicles[21]. Then in 2014, another 12 cities also was determined as demonstration city. Apart from central policies, these demonstration cities also have their own local policies. Review quantity in each regions can reflect the sales to some extent. As Figure 1 shown, we draw the Thermodynamic chart of the review region. From the figure, we can find that Beijing and Guangdong two cities have more than 200 consuming reviews, Henan, Shandong, Anhui and Jiangsu each has more than 150 reviews and other province also has varying amounts of reviews except Xizang. Till now the NEV industry has not been fully marketized, so its purchase price is still high without subsidies. According to the review data, consumers need to pay extra 80 to 100 thousand without subsidies. Beijing, as the first batch
demonstration city, has published more than 50 promoting policies. With these powerful policies, Beijing’s private electric vehicles reached 124 thousand in 2017. It means that the promotion policies are of great importance for the EVs’ sales in current China.

3.2. Correlation analysis
According to data published by China Association for Quality, the customer satisfaction index is 75 out of 100[22]. Also, we calculate the average score of EVs’ performance and list in Table 3. In accordance with customer satisfaction index, the average score of each item in the table is more than 4.3(out of 5), indicating a higher evaluation from EV users.

Table 3. The average score of EVs’ performance$^a$.

| item      | space  | manipulate | power-consumption | power | trim | comfort | appearance | cost-performance |
|-----------|--------|------------|-------------------|-------|------|---------|------------|-----------------|
| score     | 4.51   | 4.59       | 4.65              | 4.74  | 4.34 | 4.37    | 4.68       | 4.72            |

$^a$ full mark is 5

Also, in order to clear up if there is any correlation between each item, we make the correlation analysis and the autocorrelation matrix is as Figure 2 shown. Cost-performance is quite an important index influencing consumers’ purchasing. It can be found out that the degree of correlation between the cost-performance and appearance, power-consumption, trim, comfort, manipulate, power, space decreases in turn. Nowadays, as consumers psychological needs keep increasing, they pay more attention to product’s appearance, that’s why appearance has the highest correlation with cost-performance. As for the power-consumption, it’s an important issue that consumers care. Figure 3 points out that most EV buyers are for short-distance run and the full-charged vehicle can help them complete the shuttle run. Also the purchase price in our data list is within subsidies, so the most vehicles purchase price is not very high. Above all explains that why appearance, trim, comfort have relatively high correlation with cost-performance.
3.3. Purchase intention analysis

Apart from the purchase price and vehicle performance, the purchase intention is another factor influencing the cost-performance evaluation. Consumers perceive that EVs have the limited driving range and inconvenient charging infrastructure, so they have range anxiety. From Figure 3, it can be found that the main three purposes of buying electric vehicles are commuting, shopping, picking-up children, all of which are short distance running. The long running covers a very small percentage. It means that even for EV users, they mainly choose EVs for daily homely use.
4. Conclusion
In this article, we collect 2769 online reviews of actual EV users from Autohome and analyze these review data, aiming to get the real attitude from these truly user experience. From our research, we draw three main conclusions. Firstly, we build the comment thermodynamic chart based on the review quantity and find the comment quantity can reflect the sales to some extent, and the sales amount is positive relevant to regional policies quantity. Secondly, we analyze the correlation among every EVs’ performance score and mainly analyze which performance influences the cost-performance. This findings not only can help consumers for their consumption choice, but also can guide EV manufacturers about their further technology focus in a certain degree. Thirdly, we study the purchase purpose in EV using, finding that for EV users, they choose EVs mainly from daily short-distance running instead of long-distance trip. In short, users have a relatively positive attitude towards electric vehicles.

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