

Price Elasticity of Demand in Electric Vehicle Industry

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Abstract. This study explores the price elasticity of demand (PED) in electric vehicle industry in China. As the new-energy vehicle industry becomes popular, it is important for people to learn consumers' purchasing behaviors. The data used to calculate PED is the sales and prices of new-energy vehicles in China from February 2023 to May 2025. Two methods are used in this study to find out the exact value of PED in each month. This study uses the definition formula, linear regression, and the combination of PED and derivatives to find out the exact value of PED. After calculating out the results, this study makes a conclusion that the PED of electric vehicle industry in China is relatively elastic. Based on the property of elasticity, the paper gives some suggestions to help increase the sales of electric cars. If there are more and more people are willing to buy the electric vehicles, it can help protect the environment. That is because the electric cars are environmental-friendly.

Keywords: PED, electric vehicles, Chinese industry.

1. Introduction

Electric Vehicles (EVs) develop rapidly all around the world due to environmental awareness, policy support, and technological advancements [1]. To address energy crises and environmental pollution, EVs have emerged as a key solution globally [2]. In fact, in recent years, new-energy vehicle industry does develop rapidly. There are more and more electric cars on the streets in China. At the same time, a lot of new electric vehicle brands emerge. Why electric vehicles become so popular? First, they are environmental-friendly. There are no carbon dioxide emissions when people drive the electric cars. It can reduce the air pollution. What's more, the electric power can derive from some renewable energy resources, like solar energy. In the past, the fuel vehicles rely on petroleum which is non-renewable resource. If people buy more electric vehicles instead of traditional fuel vehicles, it can help reduce the usage of the non-renewable resources. Second, the cost of driving electric cars is low, since the electricity is cheaper than fuel. Studying the PED in electric vehicle industry can help better understand people's purchase behaviors. Therefore, this study will try to propose some suggestions to help increase the sales of the electric cars. If the governments or car companies can take some actions to attract the consumers, according to the suggestions proposed in this paper, more people may drive electric cars instead of traditional fuel vehicles. As a result, the reduction of driving traditional fuel cars may help protect the environment. The methodology this study used is the definition formula of PED, linear regression, and the combination of PED and derivatives. The paper is constructed as follow: Section 3 is the methodology. It includes the specific data of the sales of electric cars in China from February 2023 to May 2025. What's more, it shows two methods which are used to calculate out the PED in electric cars industry. Section 4 presents the results this study got. It contains the exact value of PED in new-energy vehicle industry and the suggestions to help increase the sales. Section 5 is the conclusions of what this study did and the limitations of this study.

2. Literature Review

A researcher analyzed UK passenger transport demand from 1850 to 2010, indicating that income and price elasticities were extremely high in the mid-19th century which were 3.1 and -1.5, but they declined gradually [3]. This decline is consistent with the shift of transport from a "luxury" to a "necessity" as economics develop [4]. These two papers inspire that PED can change due to the

development of economics. It means that people's sensitivity to the price change of a product can change. Studying the PED of electric vehicle industry in China in recent years can help understand the sensitivity of people to the price change of electric vehicles.

Considering purchase price, government incentives, operating costs, and battery leasing fees, a survey tries to capture costumers' sensitivity to the price fluctuations. It proposes a hybrid choice model (HCM). At the same time, it combines stated preference (SP) surveys with structural equation models (SEM) [5]. Another study uses a nested logit model. According to the data that the new car transaction in Norway between 2002 and 2016, the authors estimate direct and cross price elasticity for different kinds of vehicles [6]. There are several methods to measure consumers' sensitivity towards price changes.

There are many factors that can influence consumers' decisions of car purchases, like prices, fuel costs and the acceleration of the vehicles [7]. What's more, a study of market performance of hybrid vehicles shows that consumers consider environmental attributes when they purchase the vehicles [8]. There is research which focuses on the market trends when the price of gasoline and electricity changes. The result reveals that battery electric vehicles (BEV) users are more sensitive to electricity prices [9]. These studies show that there are several factors which can affect people's choices to buy a car. In some cases, these factors can influence PED of electric vehicle industry.

Based on the Swiss market, EVs' price elasticity is -0.92, near unit elasticity, indicating that lowering the price can boost market penetration effectively [10]. According to the elasticity of certain type of industry, we can conceive some ways to help increase the sales. Research says that Norway has become a country which has high EV penetration rates because of strong fiscal incentives. The policy includes full exemptions from purchase tax, annual ownership tax, road tolls, and parking fees for EVs. These actions stimulate market structural transformation effectively [11]. There are three types of new-energy vehicle (NEV) policies in China: guiding policies (e.g. environmental protection advocacy and consumption encouragement), supporting policies (e.g. tax subsidies, financial support, and procurement mandates), and normative policies (e.g. technical and equipment standards) Different countries have different policies to encourage citizens to purchase electric vehicles [12]. In conclusion, most of these policies aim to decrease the costs of driving the electric cars.

This paragraph introduces some proper nouns which will mention in the following. PED is a measure of how sensitive the quantity demanded of a good is to a change in the price of that good. Relatively elastic refers to a situation where the quantity demanded of a good is significantly responsive to changes in price. Linear regression, in statistics, is a process for determining a line that best represents the general trend of a data set.

Compared with previous studies, this study focuses on the PED of electric industry in China in recent years. What's more, this study uses to two methods to calculate out the PED to make sure the accuracy of the results. The first method this study used is the definition formula of PED. Use it directly to calculate out the PED of new-energy vehicle industry in China from February 2023 to May 2025. The second one this study used is the combination of PED and derivatives. To be specific, this study uses linear regression to find out the function of demand, and then takes the exact value into the derivative formula and finds out the PED.

3. Methodology

3.1. The Definition Formula of PED

$$\text{Price Elasticity of Demand} = \frac{\% \text{Change in the Quantity Demanded}(\Delta Q)}{\% \text{Change in the Price}(\Delta P)} \quad (1)$$

As the formula shows above, PED equals to the change in the quantity demanded divided by the change in the price. This study collected the data which contains the sales and the prices of each month from February 2023 to May 2025 from China Passenger Car Association (CPCA). Then, the study takes the data collected before into the definition formula and then calculates out the PED of

each month from February 2023 to May 2025 in electric vehicle industry. The Table 1 below is the specific data this study uses to calculate the PED.

Table 1. The sales and prices of electric cars from February 2023 to May 2025 in China (Data from: China Passenger Car Association)

Month	Sales (ten thousand)	average exchange price (ten thousand)	the rate of change in sales (%)	the rate of change in price (%)
Feb-23	37.4	¥ 18.27	37.17%	-8.40%
Mar-23	51.3	¥ 19.10	-9.55%	4.50%
Apr-23	46.4	¥ 18.60	15.52%	-2.60%
May-23	53.6	¥ 17.76	16.04%	-4.50%
Jun-23	62.2	¥ 18.51	-6.27%	4.20%
Jul-23	58.3	¥ 17.74	12.52%	-4.10%
Aug-23	65.6	¥ 17.53	3.05%	-1.20%
Sep-23	67.6	¥ 17.26	2.37%	-1.50%
Oct-23	69.2	¥ 16.76	6.50%	-2.90%
Nov-23	73.7	¥ 17.55	14.65%	4.80%
Dec-23	84.5	¥ 17.80	-25.56%	1.40%
Jan-24	62.9	¥ 17.80	-25.60%	0.00%
Feb-24	35.3	¥ 17.37	-43.60%	-2.40%
Mar-24	66.7	¥ 17.23	88.95%	-0.80%
Apr-24	64.3	¥ 16.84	-3.60%	-2.30%
May-24	74.1	¥ 16.56	15.24%	-1.70%
Jun-24	79.1	¥ 17.38	6.75%	5.00%
Jul-24	85.9	¥ 16.65	8.60%	-4.20%
Aug-24	97.3	¥ 15.80	13.27%	-5.10%
Sep-24	106.2	¥ 16.07	9.15%	1.70%
Oct-24	114	¥ 15.42	7.34%	-4.10%
Nov-24	120	¥ 15.77	5.26%	2.30%
Dec-24	125.4	¥ 16.36	4.50%	3.70%
Jan-25	67.7	¥ 16.66	-46.01%	1.80%

The Fig.1 above shows the regression line this study finds. The function of the regression line is:

$$y = -14.91x + 328.05 \quad (6)$$

It means that if the price increases by 1 unit, the sales will decrease by 14.91 units. In other words, as the price increases, the sales will decrease. This study derives the demand function, and the first derivatives is $y'=-14.91$, so it takes $y'=-14.91$ and the data set (Table 2) shown below into the derivatives formula.

$$\text{Demand Elasticity}(P_0) = D(P_0) \times \frac{P_0}{D(P_0)} \quad (7)$$

Table 2. The sales and prices of electric cars from February 2023 to May 2025 in China (Data from: China Passenger Car Association)

Month	sales(ten thousand)	average exchange price (ten thousand)	the rate of change in sales (%)	the rate of change in price (%)
Feb-23	37.4	¥18.27	37.17%	-8.40%
Mar-23	51.3	¥19.10	-9.55%	4.50%
Apr-23	46.4	¥18.60	15.52%	-2.60%
May-23	53.6	¥17.76	16.04%	-4.50%
Jun-23	62.2	¥18.51	-6.27%	4.20%
Jul-23	58.3	¥17.74	12.52%	-4.10%
Aug-23	65.6	¥17.53	3.05%	-1.20%
Sep-23	67.6	¥17.26	2.37%	-1.50%
Oct-23	69.2	¥16.76	6.50%	-2.90%
Nov-23	73.7	¥17.55	14.65%	4.80%
Dec-23	84.5	¥17.80	-25.56%	1.40%
Jan-24	62.9	¥17.80	-25.60%	0.00%
Feb-24	35.3	¥17.37	-43.60%	-2.40%
Mar-24	66.7	¥17.23	88.95%	-0.80%
Apr-24	64.3	¥16.84	-3.60%	-2.30%
May-24	74.1	¥16.56	15.24%	-1.70%
Jun-24	79.1	¥17.38	6.75%	5.00%
Jul-24	85.9	¥16.65	8.60%	-4.20%
Aug-24	97.3	¥15.80	13.27%	-5.10%
Sep-24	106.2	¥16.07	9.15%	1.70%

Oct-24	114	¥15.42	7.34%	-4.10%
Nov-24	120	¥15.77	5.26%	2.30%
Dec-24	125.4	¥16.36	4.50%	3.70%
Jan-25	67.7	¥16.66	-46.01%	1.80%
Feb-25	64.4	¥14.96	-4.87%	-10.20%
Mar-25	95.3	¥15.64	47.98%	4.50%
Apr-25	84.6	¥15.55	-11.23%	-0.50%
May-25	92.9	¥15.94	9.81%	2.50%

4. Results

4.1. PED

4.1.1 By using definition formula to calculate PED

Table 3. The PED calculated by definition formula (Data from: China Passenger Car Association)

Month	Sales (ten thousand)	average exchange price (ten thousand)	the rate of change in sales (%)	the rate of change in price (%)	PED(definition formula)	PED (definition formula [keep two decimals])
Feb-23	37.4	¥18.27	37.17%	-8.40%	4.424497072	-4.42
Mar-23	51.3	¥19.10	-9.55%	4.50%	2.122590427	-2.12
Apr-23	46.4	¥18.60	15.52%	-2.60%	5.968169761	-5.97
May-23	53.6	¥17.76	16.04%	-4.50%	3.565505804	-3.57
Jun-23	62.2	¥18.51	-6.27%	4.20%	1.49288011	-1.49
Jul-23	58.3	¥17.74	12.52%	-4.10%	3.054009957	-3.05
Aug-23	65.6	¥17.53	3.05%	-1.20%	2.540650407	-2.54
Sep-23	67.6	¥17.26	2.37%	-1.50%	1.57790927	-1.58
Oct-23	69.2	¥16.76	6.50%	-2.90%	2.242375922	-2.24
Nov-23	73.7	¥17.55	14.65%	4.80%	3.0529172	3.05

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Dec-23	84.5	¥17.80	-25.56%	1.40%	18.25866441	-18.26
Jan-24	62.9	¥17.80	-25.60%	0.00%	infinity	infinity
Feb-24	35.3	¥17.37	-43.60%	-2.40%	18.16666667	18.17
Mar-24	66.7	¥17.23	88.95%	-0.80%	-111.1875	-111.19
Apr-24	64.3	¥16.84	-3.60%	-2.30%	1.565217391	1.57
May-24	74.1	¥16.56	15.24%	-1.70%	8.964705882	-8.96
Jun-24	79.1	¥17.38	6.75%	5.00%	1.35	1.35
Jul-24	85.9	¥16.65	8.60%	-4.20%	2.047619048	-2.05
Table 3 (continued)						
Aug-24	97.3	¥15.80	13.27%	-5.10%	2.601960784	-2.6
Sep-24	106.2	¥16.07	9.15%	1.70%	5.382352941	5.38
Oct-24	114	¥15.42	7.34%	-4.10%	1.790243902	-1.79
Nov-24	120	¥15.77	5.26%	2.30%	2.286956522	2.29
Dec-24	125.4	¥16.36	4.50%	3.70%	1.216216216	1.22
Jan-25	67.7	¥16.66	-46.01%	1.80%	25.56111111	-25.56
Feb-25	64.4	¥14.96	-4.87%	-10.20%	0.47745098	0.48
Mar-25	95.3	¥15.64	47.98%	4.50%	10.66222222	10.66
Apr-25	84.6	¥15.55	-11.23%	-0.50%	22.46	22.46
May-25	92.9	¥15.94	9.81%	2.50%	3.924	3.92

The Table 3 shown above is the PED that calculated by definition formula. Normally, the PED is negative, but some of the PED value this study calculates out is positive. This study analyzes and considers that there may be several reasons to explain why the PED is positive. For instance, when a electric car company upgrades its products, the costs to produce a single car increase. As a result, the company increases selling prices. At the same time, people may be attracted by the functionality of the new cars, so they may not mind the higher prices and don't change their purchase choices. In this case, as the prices increase, the sales may increase instead of decreasing. Therefore, the PED might be positive in some conditions. All in all, in most cases, the PED is negative, and the absolute value is greater than 1. Thus, the PED of new-energy vehicles in China from February 2023 to May 2025 is relatively elastic.

4.1.2 By using the derivatives formula to calculate the PED

Table 4. The PED calculated by derivatives formula (Data from: China Passenger Car Association)

Month	Sales (ten thousand)	average exchange price (ten thousand)	the rate of change in sales (%)	the rate of change in price (%)	PED (derivatives)	PED (derivatives [keep two decimals])
Feb-23	37.4	¥ 18.27	37.17%	-8.40%	- 7.28357 4866	-7.28
Mar-23	51.3	¥ 19.10	-9.55%	4.50%	- 5.55128 655	-5.55
Apr-23	46.4	¥ 18.60	15.52%	-2.60%	- 5.97685 3448	-5.98
May-23	53.6	¥ 17.76	16.04%	-4.50%	- 4.94032 8358	-4.94
Table 4 (continued)						
Jun-23	62.2	¥ 18.51	-6.27%	4.20%	- 4.43704 3408	-4.44
Jul-23	58.3	¥ 17.74	12.52%	-4.10%	- 4.53693 6535	-4.54
Aug-23	65.6	¥ 17.53	3.05%	-1.20%	- 3.98433 3841	-3.98
Sep-23	67.6	¥ 17.26	2.37%	-1.50%	- 3.80690 2367	-3.81
Oct-23	69.2	¥ 16.76	6.50%	-2.90%	- 3.61115 0289	-3.61
Nov-23	73.7	¥ 17.55	14.65%	4.80%	- 3.55048 1682	-3.55
Dec-23	84.5	¥ 17.80	-25.56%	1.40%	- 3.14080 4734	-3.14
Jan-24	62.9	¥ 17.80	-25.60%	0.00%	- 4.21936 407	-4.22

Feb-24	35.3	¥ 17.37	-43.60%	-2.40%	- 7.33673 3711	-7.34
Mar-24	66.7	¥ 17.23	88.95%	-0.80%	- 3.85156 3718	-3.85
Apr-24	64.3	¥ 16.84	-3.60%	-2.30%	- 3.90488 958	-3.9
May-24	74.1	¥ 16.56	15.24%	-1.70%	- 3.33211 336	-3.33
Jun-24	79.1	¥ 17.38	6.75%	5.00%	- 3.27605 3097	-3.28
Jul-24	85.9	¥ 16.65	8.60%	-4.20%	- 2.89000 5821	-2.89
Aug-24	97.3	¥ 15.80	13.27%	-5.10%	- 2.42115 1079	-2.42
Sep-24	106.2	¥ 16.07	9.15%	1.70%	- 2.25615 5367	-2.26
Oct-24	114	¥ 15.42	7.34%	-4.10%	- 2.01677 3684	-2.02
Nov-24	120	¥ 15.77	5.26%	2.30%	- 1.95942 25	-1.96
Table 4 (continued)						
Dec-24	125.4	¥ 16.36	4.50%	3.70%	- 1.94519 6172	-1.95
Jan-25	67.7	¥ 16.66	-46.01%	1.80%	- 3.66913 7371	-3.67
Feb-25	64.4	¥ 14.96	-4.87%	-10.20%	- 3.46356 5217	-3.46
Mar-25	95.3	¥ 15.64	47.98%	4.50%	- 2.44692 9696	-2.45
Apr-25	84.6	¥ 15.55	-11.23%	-0.50%	- 2.74054 9645	-2.74
May-25	92.9	¥ 15.94	9.81%	2.50%	- 2.55829 2788	-2.56

The Table 4 shown above is the PED that calculated by derivatives formula. All the results this study gets is negative and the absolute values are greater than 1. In conclusion, the PED of new-energy vehicles in China from February 2023 to May 2025 is relatively elastic.

The results calculated by two different methods both indicate that the PED of new-energy vehicle industry is relatively elastic. According to the property of elasticity in electric vehicle industry, this study gives some suggestions below to help increase the sales of electric vehicles.

4.2. Suggestions to Increase the Sales of Electric Cars

4.2.1 Suggestions for car companies

As the result shows that the PED of electric vehicle industry is relatively elastic, it means that the demands will increase if the prices become lower. To increase the sales, companies can take some actions to lower the selling prices of the cars at an appropriate degree. There are several ways to achieve it. Firstly, the company can directly lower the selling prices. For example, in 2023, Tesla decreased the selling price of Model 3 and Model Y globally, the data shows that after decreasing the selling prices, the exchange amounts of Tesla cars increase significantly. Secondly, the company can provide some gifts for the consumers, like the ¥10000 shopping card. In this way, the selling price decreases indirectly, so the consumers would be more willing to choose this brand.

4.2.2 Suggestions for the government

Research says that Norway has become a country which has high electric vehicle (EV) penetration rates because of strong fiscal incentives. The policy includes full exemptions from purchase tax, annual ownership tax, road tolls, and parking fees for EVs [14]. These policies help to lower the cost of driving electric cars indirectly, so they effectively influence consumers' purchase choices. For the governments, if they can come up some policies for citizens to help them lower the cost of driving new-energy cars, people will be more willing to buy the electric cars. For example, the government can give some subsidies to people who buy a electric car. To be specific, if a person buys a electric car, the government can compensate him ¥5000-¥10000 according to the price he pay. A study mentions that infrastructure development is critical for EV adoption. The governments of countries like China, Norway, and Germany fund public charging networks, with targets such as 1 charging point per 8 EVs in Chinese pilot cities [15]. To attract people to buy the electric cars, governments should help build more infrastructures to make sure the convenience of driving electric vehicles. For instance, governments can give some funds to build more charging stations in the cities to ensure that wherever a person is, he can find a place to charge his electric car.

5. Conclusion

This study explores the PED of electric car industry in China. Firstly, the study collected the data of the sales and prices in electric car industry from February 2023 to May 2025 in China. Secondly, the research lists a table to arrange the data set and uses the definition formula of PED to calculate out the PED of each month. After that, the study uses linear regression to find out a line that can represent the trend of sales. Later, the survey finds out the function of that regression line. Then, the study uses the derivatives formula and the data set collected before to calculate out the PED of each month. After that, this study analyzes the results and notices that in most cases, the PED is negative, and its absolute value is greater than 1. Since some PED values this study calculated out are positive, the researcher feels a little bit confused. After thinking deeply, the researcher realizes that there are several factors can affect people's purchase choices. For example, when a company upgrades its products and increases the selling prices of the car, people are attracted by the functionality of the new cars. Therefore, they may not mind the increased prices and still be willing to buy that kind of cars. In these cases, as the prices increase, the sales will increase, too.

There are some limitations in this research. Firstly, because the electric car industry is a relatively new industry for us, it is difficult to find enough data and calculate out the PED to support the conclusion in this study. Thus, the data used in this study is not enough to strongly support the conclusion. In the future, there will be someone who can find more data of sales and prices. If people can extend the time scale they study, the data can be more stationary and reliable. Secondly, there are

some factors that can affect PED are not considered in this study. Some PED values this study calculate out are positive, but in this study, researcher did not explore a lot why it will happen. In the future, people can use multiple models to calculate PED and explain the phenomenon why PED is positive sometimes.

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