# Research on the Forecast of NEV Credit Price Based on the Law of Value

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**Abstract.** The Passenger Cars Corporate Average Fuel Consumption and New Energy Vehicle Credit Regulation set up "CAFC" and "NEV" credit respectively for the assessment of energy saving of fuel-powered vehicles and development of new energy vehicles. The enterprises will have credit surplus if they meet the standards, or have credit deficit if they fail to do so. The industry has now completed five credit tradings, during which enterprises with credit surplus have gained considerable profits, while those with credit deficit have paid a lot of costs. It is worth noting that the credit prices fluctuated greatly since the beginning of the credit trading, with a difference of more than 30 times between the lowest and highest price of the credit tradings, causing many difficulties to the production plan and product planning of enterprises. This paper analyzes the key factors affecting the NEV credit price from the underlying logic of the formation of NEV credit, and builds a forecast model for the NEV credit price based on the law of value to provide the credit price forecast for the industry more reasonably and support the product planning and policy implementation evaluation of enterprises to a certain extent.

**Keywords:** CAFC credit; NEV credit; credit price forecast

## 1 Introduction

### 1.1 Necessity of Forecast of NEV Credit Price

In 2017, in order to promote the energy saving of the industry and the development of new energy vehicles, The Passenger Cars Corporate Average Fuel Consumption and New Energy Vehicle Credit Regulation (hereinafter referred to as "dual-credit policy") was released[1]. It proposed two assessment targets for passenger car enterprises, i.e., the energy saving of fuel-powered vehicles and development of new energy vehicles, against which "CAFC" and "NEV" credits were set up respectively. The enterprises will have credit surplus if they meet the standards, or have credit deficit if they fail to do so. Besides, enterprises with credit deficit are allowed to achieve compliance to offset their credit deficit by purchasing NEV credit surplus. Now, the industry has completed five credit tradings with a cumulative trading amount of over RMB20 billion. However, due to the lack of price forecasting, the NEV credit price has fluctuated significantly during the trading process[2], bringing greater risks and challenges to both policy management & implementation and product planning of enterprises. Stable price expectation has become a common voice for the entire industry. In this context, it

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is necessary to explore the formation principle of NEV credit price, analyze the underlying logic of credit trading, and open the "black box" of NEV credit price.

### 1.2 Analysis of Price Influencing Factors

According to the law of value, prices are based on value and fluctuate up and down depending on the interaction between supply and demand[3]. From this perspective, prices of commodities are mainly regulated by their value and the interaction between supply and demand.

Value is the most fundamental factor affecting price and is mostly characterized by cost. Generally speaking, the price of a commodity is based on cost as the minimum threshold. When the price of a commodity is lower than its cost, the seller of the commodity is not only unprofitable, but also make a loss because of its fixed costs.

The relationship between supply and demand is an important reason for price fluctuations. Market supply refers to the supply of commodities in the market, while market demand refers to the demand for commodities that consumers can afford to pay for. In the commodity trading market, when the supply is greater than the demand, it will make commodity prices fall; when the supply is less than the demand, it will bring commodity prices rise; when the market supply and demand tend to balance, commodity prices also stabilize.

In addition, the price of a commodity is highly correlated with the degree of information flow. In a perfectly competitive market, the symmetry of information forces the seller of the commodity to lower the price to the cost price; while in a market environment with asymmetric information, the buyer and seller are able to find out each other's bottom line through negotiation and eventually reach a consensus upon price.

## 2 The Logic of NEV Credit Formation and Its Influencing Factors

As an intangible commodity, NEV credit also follows the same rule of fluctuating with the interaction of supply and demand on the basis of its value. To find the underlying logic of the NEV credit price, we need to analyze it from the above two aspects.

### 2.1 Analysis of Characterization Index of Credit Value

The main characterization index of credit value is the compliance cost, i.e., the cost paid by the credit deficit enterprise to offset its credit deficit to zero. The NEV credit price is positively correlated with the compliance cost. The higher the compliance cost is, the higher the NEV credit price is. The credit deficit enterprises do not rely on external forces to achieve credit compliance, and the most convenient way is to increase the production of new energy vehicles. Since conventional energy vehicle models are generally more profitable than new energy vehicle models, the compliance cost of credit deficit enterprises is mainly contributed by the relative loss caused by increasing the production of new energy vehicles and reducing the launch of conventional energy vehicles in the context of limited production capacity[4]. The compliance cost for a credit deficit enterprise to produce one unit NEV credit is calculated as in Equation (1).

$$C_l = \frac{\sum c_i \times q_i}{neg\_Credit_l} \tag{1}$$

Where, $C_l$ is the unit credit compliance cost of the credit deficit enterprise $l$; $c_i$ is the relative loss of the $i$th new energy vehicle of enterprise $l$; $q_i$ is the production of the $i$th new energy vehicle that needs production increase, and $neg\_Credit_l$ is the total quantity of credit deficit of enterprise $l$.

$c_i$, i.e., the relative loss of the $i$th new energy vehicle, needs to take three factors into consideration[4]. The first is the increased manufacturing cost of new energy vehicles compared to the conventional energy vehicles, mainly for the cost of components such as batteries, motors, electronic controls, etc.; the second is the rising price amount of new energy vehicles compared to the conventional energy vehicles; the third is the part where the enterprise considers that the new energy vehicles are less mature than conventional energy vehicles with regard to market and technology, and the target profit per new energy vehicle is lower than that of conventional energy vehicle. The specific loss amount per NEV $c_i$ is calculated as in Equation (2).

$$c_i = material_i - price_i - profit_i \tag{2}$$

Where, $material_i$, $price_i$, $profit_i$ represent the increased manufacturing cost, the rising price amount and the target profit reduction of the $i$th new energy vehicle, respectively.

Credit compliance means that both CAFC and NEV credits are offset to zero. The dual-credit policy states that CAFC credit deficit can be offset by NEV credit surplus, but NEV credit deficit cannot be offset by CAFC credit surplus. In addition, the dual-credit policy also provides preferential support to new energy vehicles, as enterprises can reduce both CAFC credit deficit and NEV credit deficit by producing new energy vehicles. Therefore, the determination of the increased production $q_i$ of the $i$th new energy vehicles shall take into account the credit offset rules and the superimposed effect of new energy vehicles. The paper solves for the increased production of new energy vehicles by solving the credit compliance equation.

Specifically, the credit compliance equation is shown in Equation (3).

$$\begin{cases} Min(cafc, 0) + nev = 0, \\ cafc = [T \times avg\_Con(G) - avg\_Con(R)] \times \sum(q_i + Q_i + Q_{ti}), \\ nev = [\sum avg\_Cre_i \times (q_i + Q_i)] - [P \times \sum Q_{ti}], \\ avg\_Con(x) = \frac{\sum F_{txi} \times Q_{ti} + \sum F_{xi} \times (q_i + Q_i)}{\sum Q_{ti} + H_x \times \sum (q_i + Q_i)}, x = G \text{ or } R \end{cases} \tag{3}$$

Where, *cafc* represents CAFC credit of the enterprise, while *nev* represents NEV credit of the enterprise. The first equation in Equation (3) reflects the compliance requirements for enterprises under the credit offset rule.

The dual-credit policy has provided for the detailed regulations on the calculation of CAFC and NEV credits. The CAFC credit is defined as the product of the difference between compliant FC and average FC, and total passenger car production of the enterprise. Furthermore, the compliant FC is the product of target FC *avg_Con(G)* and compliance ratio

multiplier $T$; $avg\_Con(R)$ is the average FC of the enterprise; $q_i$, $Q_i$, and $Q_{ti}$ represent the production of additionally produced new energy vehicles, new energy vehicles that have been produced, and conventional energy vehicles, respectively, and the sum makes up the total production of passenger cars of the enterprise; the NEV credit is calculated as the difference between NEV credit surplus and NEV credit compliant target. Among them, the NEV credit surplus is the product of the NEV credit per vehicle $avg\_Cre_i$ of a NEV model and the production $(q_i+Q_i)$ of a NEV model. The NEV credit compliant target is the product of the production of conventional energy vehicle $Q_{ti}$ and compliance ratio requirement of NEV $P$.

Equation (2) and Equation (3) enable the calculation of relative loss $c_i$ and the increased production of NEVs $q_i$[5], which further enable the calculation of compliance cost with Equation (1).

### 2.2 Analysis of Characterization Index of Supply-Demand Relationship

#### 2.2.1 Supply-Demand Ratio

The supply-demand ratio is the ratio between the supply and demand of credits in a certain period. The price of NEV credits is inversely correlated with the supply-demand ratio; the greater the supply-demand ratio is, the lower the price is. The supply-demand ratio is calculated as shown in Equation (4).

$$\alpha = \frac{pos\_Credit}{neg\_Credit} \tag{4}$$

Where, $\alpha$ means the supply-demand ratio of the industry; $pos\_Credit$ is the total supply of NEV credit surplus available for trading; $neg\_Credit$ is the demand for NEV credit deficit offset.

It can be concluded that when $\alpha>1$, supply is greater than demand in the industry, and the credit price will be lowered; on the contrary, when $\alpha<1$, things turn around and supply falls short of demand, and the credit price is raised; when $\alpha=1$, the supply and demand is just balanced, and the price is relatively stable, which can reflect the credit value to the maximum extent.

#### 2.2.2 Relative Concentration

Industry concentration reflects the likeliness of monopolistic competition in the market and is measured as the total market share held by the top $N$ largest enterprises in the market. In the NEV credit market, there are both buyers and sellers of credits, so the concentration of credits in the buyer's and seller's market is formed respectively. Therefore, "relative concentration" is used to measure the degree of monopoly in both buyer's and seller's market. The calculation method is shown in Equation (5).

$$\beta = \frac{CR_{10\_seller}}{CR_{10\_buyer}} \tag{5}$$

Where, $\beta$ is the relative concentration of buyers and sellers of NEV credits; $CR_{10\_seller}$ is the total market share of the top 10 sellers in the NEV credit market; $CR_{10\_buyer}$ is the total market share of the top 10 buyers with the largest demand for credits.

The relative concentration reflects the voice of buyers and sellers of NEV credits in the trading process and is positively correlated with price. When $\beta>1$, the top 10 sellers with NEV credit surplus have a larger market share and have a greater say in the pricing process, and the sellers have a tendency to raise the credit price to gain more profit; when $\beta<1$, the top 10 buyers with NEV credit deficit have a larger market share and have higher bargaining power in the credit pricing process, and they are more inclined to lower the credit price.

## 3 Credit Price Forecast Model

The credit price forecast model is built based on the relationship between the credit price and each influencing factor, as shown in Equation (6).

$$PC = C \times e^{\eta_1 \times (\alpha - \alpha_{balance}) + \eta_2 \times (\beta - \beta_{balance})} \tag{6}$$

Where, $PC$ is the average credit trading price of the industry; $C$ is the credit compliance cost; $\alpha$ and $\beta$ are the supply-demand ratio and relative concentration of the credit market, respectively; $\alpha_{balance}$ and $\beta_{balance}$ are the credit supply-demand ratio and relative concentration respectively when supply and demand are in balance; $\eta_1$ and $\eta_2$ are used as weight parameters to adjust the positive and inverse relationship between credit price $PC$, supply-demand ratio $\alpha$ and relative concentration $\beta$, and to measure the influence of $\alpha$ and $\beta$ as influencing factors on the credit trading price.

In Equation (6), the exponential form ensures the non-negativity of the credit price; the existence of $\alpha_{balance}$ and $\beta_{balance}$ enables the credit price to reflect the credit value to the maximum extent when the supply and demand are in balance; $\eta_1$ shall be a negative number less than 0 to ensure the inverse relationship between NEV credit price and supply-demand ratio; $\eta_2$ shall be a positive number greater than 0 to reflect the positive relationship between NEV credit price and relative concentration.

## 4 Parameter Fitting and Accuracy Testing

Credit market trading data are used to validate and analyze the price forecast model. Through the collation of enterprise financial reports and enterprise research, we collected and organized the 2018-2022 credit trading data of mainstream passenger car enterprises, including key factors such as enterprise compliance cost, credit supply-demand ratio, relative concentration, trading quantity, and trading price, and qualitatively verified the forecast model built with Equation (6) to obtain the relationship between credit price and compliance cost, supply-demand ratio, and relative concentration as shown in **Figure 1**.

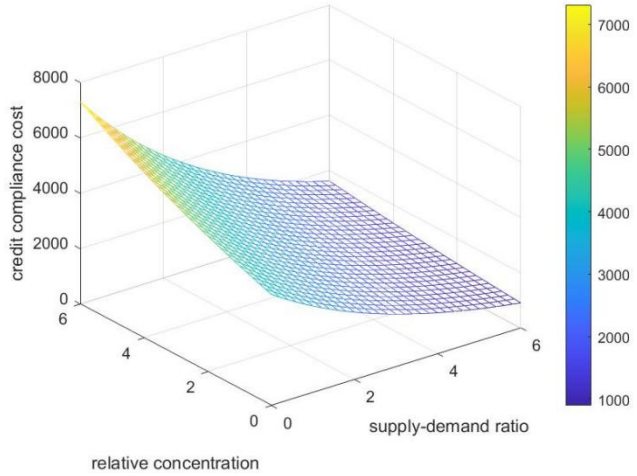


**Fig. 1.** Graphical Representation of Credit Price and Influence Factors

As shown in **Figure 1**, the three-dimensional axes represent the supply-demand ratio, relative concentration, and credit compliance cost, and the grid color indicates the credit price. It can be found that the credit price is positively correlated with the compliance cost, inversely correlated with the supply-demand ratio, and positively correlated with the relative concentration. This validates the analysis of the factors influencing the credit price in this research.

Further, the 2018-2020 credit trading data are used as the training set and the 2021-2022 credit trading data are used as the validation set. Using the Origin software, the forecast model parameters, i.e. $\eta_1$ and $\eta_2$ were fitted with the training set data. See Table 1 for the fitting results.

**Table 1** Parameter Fitting Results

| Parameters to be fitted | Fitted value |
|---|---|
| $\eta_1$ | -0.66 |
| $\eta_2$ | 0.2 |

The validation set data are used to validate the above fitting results, and the forecast accuracy is about 83%. Therefore, the fitting results are considered to be highly reasonable and can be applied in the forecast of credit prices.

## 5 Conclusions

Based on the underlying logic of credit price formation, this paper analyzes the influencing factors of credit price from both qualitative and quantitative aspects, as well as the relationship between price and various influencing factors to build a credit price forecast model accordingly. It is verified that the model is reasonable and can make a relatively accurate

forecast of the credit price, which can support the product planning and policy implementation evaluation of enterprises in the future.

However, this paper mainly considers the scenario where credit deficit enterprises can achieve compliance by increasing their own production of new energy vehicles. In the actual credit trading process, there is also a scenario where credit deficit enterprises achieve credit compliance by purchasing NEV credit surplus from other passenger car enterprises instead of increasing their own production[6]. The underlying logic of credit price in this scenario still needs further research and improvement.

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