An empirical study on the impact of Dual Credit Policy based on Difference-in-Differences Model

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Abstract: Based on combing domestic and foreign automobile industry policy research and related theories, this article takes the monthly production data of China's passenger car companies from 2016 to 2020 as the research object, and constructs a double difference model to quantitatively evaluate the impact of the double points method on the output of low fuel consumption models and new models. The implementation of the double credit policy will significantly increase the output of low-fuel vehicles, but the impact is lagging behind; At the same time, the implementation of the policy will significantly increase the output of new energy vehicles in enterprises. Based on this, some suggestions are put forward, such as promoting the efficiency upgrade of new fleet in energy-saving technology and optimizing the policy orientation of new energy credits.

Keywords: Dual-Credit Policy, Fuel efficient vehicles, New Energy Vehicles, Double difference model

1 Introduction

In 2017, Five departments including Ministry of Industry and Information Technology (MIIT) officially issued the Measures on the Parallel Management of CAFC and NEV(new energy vehicle) Credit of Passenger Car Enterprises(the Dual Credit Policy), which is intended to play the role of management after the withdrawal of fiscal and tax subsidy policy and form a long-term mechanism for sustainable development. The Dual Credit Policy is a binding policy for automobile production enterprises. Taking the average fuel consumption of passenger car enterprises and the proportion of NEV production as two binding assessment targets, the assessment requirements of fuel consumption and NEV production are put forward. When enterprises fail to meet the policy requirements due to their technical level and NEV production, negative credits will be generated. Enterprises that fail to complete the negative credits compensation according to the regulations will face the relevant administrative punishment requirements given by MIIT, such as suspension of production. However, enterprises can also achieve policy compliance through market-oriented mechanisms such as transferring positive credits of fuel consumption and purchasing positive credits of new energy.

The implementation of the credit mechanism has promoted the rapid development of the NEV industry to a certain extent. However, there is no clear research conclusion on the mechanism of the policy's impact upon industrial development, and there is also a lack of support on how to improve the 2026 to 2030's policy. For this purpose, this paper on the basis of combing the domestic and foreign automobile industry policy research and related theories, taking the

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monthly output data of passenger car enterprises in China from 2016 to 2020 as the research object, constructs a Difference-in-Differences Model to quantitatively evaluate the impact of the implementation of fuel consumption credit regulations and new energy credit regulations on the output of low-fuel vehicles, the output of new energy vehicles and the fuel consumption of enterprises, and reveals the mechanism of the Dual Credit Policy through quantitative research, aiming at providing reference suggestions for the further improvement of the policy in the next stage.

2 Management Mechanism of Dual Credit Policy.

2.1 Overview of Research on Dual Credit Policy of Passenger Cars

The current researches have basically confirmed that the dual credit policy has played a certain positive influence in promoting the development of NEVs and reducing the production of conventional energy vehicles. Zhou Zhong[1] analyzed the functioning mechanism of the dual credit policy for passenger cars; Ou[2] found that the "dual credit" system has a driving effect on the development of China's NEV industry by virtue of quantitative comparison among various credit systems in the Chinese auto market; Li[3] simulated the policy compliance behaviors of the 3 virtual car enterprises, and it indicated that enhancing the assessment requirements of NEV credit would inhibit the development of conventional energy vehicles, but may promote the increase of NEV production. Wang[4] et al. found that NEV credits, the cost of technological upgrading and rate of decline in average fuel consumption of conventional energy vehicles are the most important factors that may influence car makers' compliance with the credits policy.Sen[[5]] & Sykes[[6]] show that the US combines the policies of energy conservation and emission reduction with the policies of promoting NEV to accelerate the development of new energy vehicles.

Scholars both at home and abroad have conducted a large number of studies on the industrial policies for various types of energy-saving and NEVs, and as a result have established a sophisticated policy research system for the auto industry. However, due to the lack of accessibility and a large number of influencing factors of NEV incentive mechanism, the majority of the current researches have carried out the corresponding theoretical simulations and evaluations from the perspective of how enterprises respond to the policies, but they lack the empirical researches on the effect of implementation of the dual credit policy, and therefore have no suggestions on the optimization and innovation of implementation process of the dual credit policy.

2.2 Analysis of CAFC Credit Mechanism

The assessment of CAFC credit targets the corporate average fuel consumption. In order to give enterprises more flexibility in product planning, an enterprise is deemed to be compliant if the weighted average of fuel consumption values of all types of products produced by it meet the standard. The mechanism is mainly reflected in 3 aspects: first, adjusting the product structure of conventional energy cars, producing more hybrid and 48V micro-hybrid models with lower fuel consumption, thus improving the production of the low fuel consumption models and effectively reducing the average fuel consumption of enterprises. Since the adjustment of such products involves technological R&D, adjustment of production equipment, etc., and it imposes great impact upon the downstream sales channel, the cycle of the adjustment seems longer.

Second, improving the energy-saving technology of conventional energy vehicles as a whole. Without changing the overall product structure, enterprises can achieve gradual improvement by upgrading part of the technologies of conventional energy models, which is reflected in the decline of average fuel consumption of conventional energy vehicles. Third, increasing the production of NEVs to achieve compliance. Due to the energy consumption of NEVs is accounted by zero with preferential accounting multiples, a more significant policy compliance benefits can be achieved. Except changing their own product structure, enterprises can also purchase NEV credit surpluses; they can accept the CAFC credit surpluses transferred by affiliated enterprises to offset the CAFC credit deficits, and by such a mean achieve compliance in CAFC credit.

In general, the main mechanism of CAFC credit is to guide enterprises to improve the energy-saving technology of their fuel vehicles and produce more NEVs in order to reduce the corporate average fuel consumption through policy assessment.

2.3 Analysis of NEV Credit Mechanism

Implementing the NEV credit assessment requirements; it means directly requiring enterprises to produce a certain number of NEVs in order to obtain the NEV credit surpluses and offset the NEV credit deficits in the annual assessment, and as for the NEVs with different types of technology and technical indicators, they are required to receive the different model credit. In this way, the enterprises can be guided to continue enhancing and improving the technical level of NEVs. Due to the start-up period of NEVs, there is a huge gap among different enterprises in the previous development foundation. For example, BYD and Tesla boast a better foundation for development and thus are positioned as a credit surpluses supplier, while more other enterprises are hard to achieve compliance through the production of NEVS, and have to choose to purchase NEV credit surpluses from other enterprises. Due to the official application of NEV credit since 2019, only NEV credits were accounted from 2016 to 2018 but no assessment requirements were imposed. The NEV credit assessment took effect from 2019 to 2020.

3 Research Hypotheses

For the impact of the dual credit policy on the development of car enterprises, it can be distinguished as the relevant impact brought by the application of CAFC credit and NEV credit respectively. In the application process of CAFC credit, enterprises may achieve compliance via a variety of ways. From the perspective of balancing the development costs and profits, each enterprise may choose different compliance path in accordance with their own resource endowment. From a general view, the application of CAFC credit can prompt enterprises to enhance the production of low fuel consumption vehicles and reduce the production of high-fuel consumption vehicles, but it needs longer time for its influence to be felt because the strength of the policy assessment is weak during the early stage, and the period for the policy to be transmitted to the enterprises to urge them to adjust the product planning is longer. On the other hand, it will also propel the enterprises to improve the fuel economy of conventional energy car models, which is reflected in the decline in the average fuel consumption of the enterprises. For the impact imposed by the application of NEV credits, according to our assessment, it will significantly guide car enterprises to improve the production of NEVs.

Based on the aforesaid theoretical analyses, we have proposed the research hypothesis "H1 Dual Credit Policy will promote the development of energy-saving and NEVs of car enterprises", which consists of 4 sub-hypotheses:

H1a: The application of CAFC credits will significantly increase the production of low fuel consumption vehicles, but its influence will take longer time to be felt.

H1b: The application of CAFC credits can reduce the production of high fuel consumption vehicles, but its influence will take longer time to be felt.

H1c: The application of CAFC credits may significantly reduce the average fuel consumption of conventional energy car models.

H1d: The application of NEV credits will significantly increase the production of NEVs.

4 Empirical Study on the Influence of Dual Credit Policy

4.1 Difference-in-differences Model

The difference-in-differences approach is an econometric method that is widely used in the analysis of specific events, especially in policy assessment[5]. It can estimate the treatment effect of an event in a very intuitive way.

In general, the model of the difference-in-differences approach can be expressed in the following equation:.

$$y_{it} = \alpha + \beta D_i * T_t + \delta D_i + \tau T_t + \varepsilon_{it} \quad (1)$$

Where, $\mathrm{D_i}$ is a two-valued variable indicating whether the individual belongs to the treatment group or control group. If the individual belongs to the treatment group, then $\mathrm{D_i} = 1$, and if the individual belongs to the control group, then $\mathrm{D_i} = 0$.$\mathrm{T_t}$ indicates whether the time is a two-valued variable before or after the event took place. If the time is before the event took place, then $\mathrm{T_t} = 0$, and if the time is after the event took place, then $\mathrm{T_t} = 1$.Among them, the most important parameter is β. It indicates the part of dependent variables of individuals in the treatment group that are changed more frequently before and after the event took place, relative to individuals in the control group, i.e. the treatment effect of the event.

Since all individuals are more or less impacted by the event in certain event contexts, all individuals belong to the treatment group and there is no control group. The treatment intensity indicator at the individual level is constructed based on the impact intensity of the event to which individuals are exposed. Then, replace the two-valued grouping variable which takes only 0-1 in the traditional DID with the continuous treatment intensity, and use the differences in treatment intensity to which individuals are exposed to identify the influence of the event. This method is often referred to as the generalized difference-in-difference (DID) method[8] and is expressed by the following equation:

$$y_{it} = \alpha + \beta TreatmentIntensity_i * Post_t \\ + \mu_i + \gamma_t + \varepsilon_{it} \quad (2)$$

Where, $\text{TreatmentIntensity}_i$ refers to a continuous variable indicating the intensity of treatment of event impact to which an individual is subjected. Post_t refers to a two-valued variable indicating the situation before and after the event impact; take 1 if the time t is after the event shock, or otherwise Post_t takes 0. μ_i refers to the fixed effect of individuals, while γ_t refers to the fixed effect of time.The meaning of the most important parameter β is if the intensity of treatment of event impact to which the individuals are subject to is increased by 1 unit, the value of the individual's dependent variable will be changed by β units after the event.The Dual Credit Policy has been officially implemented nationwide since 2017. As a result, all of the car makers across the country will be impacted by the policy, and it meets the requirements of the generalized difference-in-differences model, so the model is adopted for quantitative assessment and analysis.

4.2 Empirical Model Construction

We use the following model setup to identify the roles of both CAFC credits and NEV credits:

$$y_{ift} = \beta^{CAFC} Intensity_f^{CAFE} * Post_t^{CAFE} + \\ \beta^{NEV} Intensity_f^{NEV} * Post_t^{NEV} + \\ \gamma X_i + Fixeffects + u_{it} \tag{3}$$

Where the subscript i refers to the model, and f refers to car enterprises and t refers to time. The dependent variables that we want to examine in this paper y_{ift} contain a series of policy outputs that involves the production of different types of passenger cars and the fuel consumption level of fuel vehicles.

Among the independent variables that are discussed in the paper, $\text{Intensity}_f^{CAFE}$ refers to the treatment intensity of the enterprises f when facing the impact of CAFC credit policy, which is indicated by the share of non-low fuel consumption cars among the cars produced by each enterprise in the year before the official application of CAFC credit (2016); Intensity_f^{NEV} refers to the treatment intensity of the enterprises being affected by the NEV credit policy, which is indicated by the share of non-NEVs in the cars produced by each enterprise in the year before the official application of NEV credit (2018). Post_t^{CAFE} Take 1 in October 2017 and thereafter, and 0 for the rest of the time; Post_t^{NEV} take 1 in 2019 and thereafter, and 0 for the rest of the time.

The control variables X_i contain a series of vehicle characteristics: including engine power, engine displacement, vehicle weight, volume, fuel consumption of different types of vehicles (which is removed when the dependent variable is fuel consumption), and e-range (which is included only when the production of NEV is examined).We used a range of fixed effects, including the year-month time fixed effects, fixed effect of enterprise, fixed effect of brand, fixed effect of vehicle type, and fixed effect of fuel.

4.3 Data Description and Descriptive Analysis

The paper uses data on the production of passenger car enterprises at the monthly-car model level for 2016-2020. The data is provided by China Automotive Technology & Research Center

Co., Ltd. The data also contains the characteristic variables of vehicles, including technical parameters such as the car enterprise, brand, power, displacement, fuel consumption, etc. It allows us to control a series of vehicle characteristic variables during the empirical analysis.

The descriptive analyses of main variables used in the paper are shown in Table 1:

Table 1. Descriptive Analysis of the Main Variables

Variable	Obs	Mean	Std.Dev.	Min	Max
Production	110,668	925.17	2166.23	1	41978
Treatment Intensity of CAFC Credit	110,668	0.28	0.30	0	1
Treatment Intensity of NEV Credit	110,668	0.34	0.46	0	1
Displacement (ml)	110,668	1641.35	488.32	0	5985
Power (kW)	110,668	113.77	34.75	13.5	310
Curb Weight (kg)	110,668	1508.47	287.49	600	3700
Car Volume (m2)	110,668	13.6	1.95	5.56	28.9
Fuel Consumption (L/100km)	110,668	6.61	1.97	0	20
E-range/km	6,248	278.31	153.57	50	650

5 Empirical Analysis Result

5.1 Benchmark Regression

Table 2 presents the results of the benchmark regression for estimating the model (3). Columns 1-3 present the results of the empirical analyses using the samples of low fuel consumption conventional energy vehicles and non-low fuel consumption conventional energy vehicles, and samples of NEVs respectively and with vehicle production as the dependent variable. Column 4 presents the results of the empirical analyses using the samples of conventional energy vehicles, and with fuel consumption as the dependent variable.

The results in Table 2 show that the CAFC credit does not significantly increase the production of low fuel consumption cars, but the production of conventional energy vehicles with low fuel consumption increases significantly after the NEV credit is applied. When the treatment intensity of the NEV credit policy to which the enterprises are subject is enhanced by 1 standard deviation, the production of low fuel consumption cars goes up by 1.26 standard deviations. This may be due to the fact that after the official implementation of the CFAC credit policy, enterprises began adopting the low fuel consumption energy-saving technologies on a large scale, but it takes a certain longer period of time for the technologies to be put into mass production, so the production of low fuel consumption cars produced by enterprises began to increase in 2019, which is also the year when the NEV credit policy took effect. The empirical results have validated the hypothesis H1a.

The production of non-low fuel consumption conventional energy vehicles has declined significantly with the application of both CAFC and NEV credit. Under the circumstance that the treatment intensity of the CAFC and NEV credit policy to which the enterprises are subject to is enhanced by 1 standard deviation, the production of non-low fuel consumption vehicles declines by 0.111 standard deviations and 0.046 standard deviations respectively. On the one hand, it shows that the CAFC credit constrains the production of non-low fuel consumption vehicles, and enterprises make sure not to produce the CAFC credit deficits by controlling the production of their non-low fuel consumption vehicles. On the other hand, after the application of NEV credit, enterprises may slowly transform to produce more conventional energy vehicles with low fuel consumption or NEVs, and less non-low fuel consumption conventional energy vehicles in order to make sure not to produce any NEV credit deficit. The empirical results have validated the hypothesis H1b.

The CAFC credit has had no significant effect on the production of NEVs, while NEV credit has significantly enhanced the production of NEVs. The empirical results have validated the hypothesis H1d. This suggests that the implementation of the NEV credit policy has encouraged enterprises to enhance the production of NEVs, with a view to achieving the goal of zeroing the NEV credit or to generating the NEV credit surpluses and then sell to other enterprises for profits.

The implementation of both credit policies has enabled the drastic decline in the fuel consumption of conventional energy vehicles. The empirical results have validated the Hypothesis H1c, which indicates that under the effect of both credit policies, enterprises all have endeavored to promote the development of low fuel consumption technologies and reduce the fuel consumption of their vehicles.

Table 2. Benchmark Regression Result

	Production: Conventional Energy Vehicles with Low Fuel Consumption	Production: Non-Low Fuel Consumption Vehicles	Production: NEVs	Fuel Consumption
CAFC Credit	-0.009	-0.111***	-0.305	-0.062***
	(-0.777)	(-10.611)	(-0.601)	(-26.276)
NEV Credit	1.260**	-0.046***	0.179***	-0.040***
	(2.210)	(-4.547)	(4.002)	(-13.860)
Vehicle Characteristics	YES	YES	YES	YES
Year-Month Time Fixed Effects	YES	YES	YES	YES
Fixed Effect of Enterprise	YES	YES	YES	YES
Fixed Effect of Brand	YES	YES	YES	YES
Fixed Effect of Vehicle Type	YES	YES	YES	YES
Fixed Effect of Fuel	YES	YES	YES	YES
Observations	25967	78453	6248	104420
R^2	0.252	0.209	0.302	0.920
Adjusting R^2	0.236	0.199	0.243	0.919

Note:

1.Standardized coefficients are presented in the Table and t-statistics are shown in parentheses.

2.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.2 Parallel Trend Hypothesis Test

An important hypothesis about the difference-in-differences approach is the parallel trend hypothesis. We follow the empirical methodology used in Nunn and Qian to compare the variation of gap between the vehicle production and fuel consumption of companies subject to the greater policy impact and companies subject to the less policy impact before and after the implementation of both CAFC credit policy and NEV credit policy. If there is no significant difference between the vehicle production and fuel consumption of companies subject to the different policy treatment intensity prior to the official implementation of both policies, the parallel trend hypothesis test is deemed to be passed.

In order to test the convenience of the process, we tested the parallel trend hypothesis influenced by the CAFC credit and NEV credit respectively. In order to exclude the interference of the CAFC credit policy after the official implementation of the NEV credit policy, we only used the samples from 2016 to 2018. In the model, the two-valued variable $I_{t,k}^{CAFE}$ indicates whether time t may fall within a certain interval, relative to the gap of implementation time of CAFC credit policy τ^{CAFE}; if $t-\tau^{CAFE} \geq 3k$ and $t-\tau^{CAFE} \leq 3k+2$, $I_{t,k}^{CAFE}=1$ or otherwise $I_{t,k}^{CAFE}$ takes zero.We take the period $k=-1$ as the baseline and therefore do not put the corresponding time indicator variable into the regression. β_k^{CAFE} indicates, in the time interval $[3k, 3k+2]$, the gap between the dependent variables y_{ift} (including the production of low fuel consumption vehicles, production of non-low fuel consumption vehicles, and fuel consumption of conventional energy vehicles) of enterprises subject to the greater policy impact of the CAFC credit policy relative to the companies subject to the less policy impact of the CAFC credit policy. if for $k<0$ (i.e. the time interval $[3k, 3k+2]$ is before the CAFC credit policy takes effect), the estimated coefficient β_k^{CAFE} is not significant, the parallel trend hypothesis test is deemed to be passed.

$$y_{ift} = \sum_{k=-7,k\neq-1}^{4} \beta_k^{CAFE} Intensity_f^{CAFE} I_{t,k}^{CAFE} + \gamma X_i + Fixeffects + u \quad (4)$$

Similarly, we built the following model to test the parallel trend hypothesis of NEV credit. For the NEV credit, since the CAFC credit do not interfere with the role of NEC credit, we used all samples from 2016 to 2020 for the test. The two-valued variable $I_{t,k}^{NEV}$ indicates whether the time t falls within a certain interval relative to the gap of implementation time of the NEV credit policy τ^{NEV}; if $t-\tau^{NEV} \geq 3k$ and $t-\tau^{NEV} \leq 3k+2$, $I_{t,k}^{NEV}=1$, or otherwise $I_{t,k}^{NEV}$ takes zero. We take the period $k=-1$as the baseline and therefore do not put the corresponding time indicator variable into the regression.β_k^{NEV} indicates that in the time interval $[3k, 3k+2]$, the gap between the dependent variables y_{ift}(including the production of NEV) of enterprises subject to the greater policy impact of the NEV credit policy relative to the enterprises subject to the less policy impact of the NEV credit policy. if for $k<0$ (i.e. the time interval $[3k, 3k+2]$is before the CAFC credit policy takes effect), the estimated coefficient β_k^{NEV} is not significant, the parallel trend hypothesis test is deemed to be passed.

$$y_{ift} = \sum_{k=-12,k\neq-1}^{7} \beta_k^{NEV} Intensity_f^{NEV} I_{t,k}^{NEV} + \gamma X_i + Fixeffects + u \quad (5)$$

The coefficients of 4 sets of results of the parallel trend hypothesis test and the 95% confidence intervals of the coefficients are plotted from Figure 1 to Figure 4.It can be seen that in all 4 sets of results, the coefficients of the corresponding time two-valued variable are not significantly different from zero at k < 0 and the parallel trend hypothesis test is passed.

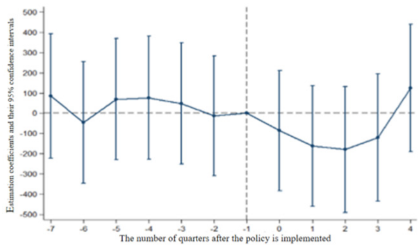

Figure 1. Parallel Trend Hypothesis Test for the Impact of CAFC Credit on the Production of Low Fuel Consumption Vehicles

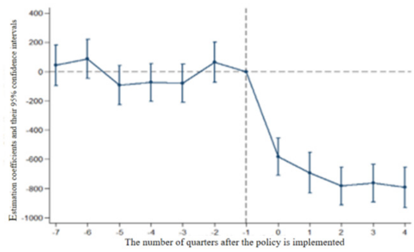

Figure 2. Parallel Trend Hypothesis Test for the Impact of CAFC Credit on the Production of Non-Low Fuel Consumption Vehicles

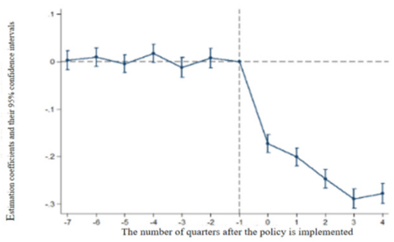

Figure 3. Parallel Trend Hypothesis Test for the Impact of CAFC Credit Policy on the Fuel Consumption of Conventional Energy Vehicles

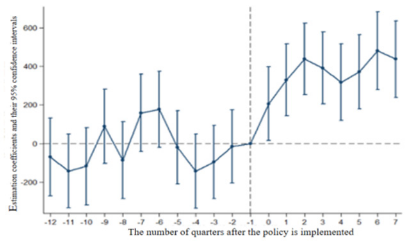

Figure 4. Parallel Trend Hypothesis Test for the Impact of NEV Credit Policy on the Fuel Consumption of NEV

5.3 Robust Analysis

The paper uses the Assessment Measures and Indicators of Fuel Consumption of Passenger Cars when defining the conventional energy vehicles with low fuel consumption. Its target fuel consumption set for the passenger cars with 3 or more rows is relatively high. Since the data used in the paper does not have the variable of seat row number of passenger cars, and there are still a small number of passenger cars with 3 or more rows, the section uses the target fuel consumption level set for passenger cars with 3 or more rows to define the low fuel consumption vehicles, recalculates the intensity of response to the policy and re-groups the types of vehicles, and estimates the baseline model. The statistical results are shown in the Table 3.

Table 3. Robust Test Results

	Production: Conventional Energy Vehicles with Low Fuel Consumption	Production: Non-Low Fuel Consumption Conventional Energy Vehicles	Production: NEVs	Fuel Consumption
CAFC Credit	-0.009	-0.079***	-0.524	-0.031***
	(-1.106)	(-8.227)	(-0.601)	(-15.180)
NEV Credit	0.020	-0.041***	0.179***	-0.039***
	(0.519)	(-3.711)	(4.002)	(-13.431)
Vehicle Characteristics	YES	YES	YES	YES
Year-Month Time Fixed Effects	YES	YES	YES	YES
Fixed Effect of Enterprise	YES	YES	YES	YES
Fixed Effect of Brand	YES	YES	YES	YES
Fixed Effect of Vehicle Type	YES	YES	YES	YES
Fixed Effect of Fuel	YES	YES	YES	YES
Observations	37045	67375	6248	104420
R2	0.236	0.209	0.302	0.919
Adjusting R2	0.222	0.197	0.243	0.919

Note:1.Standardized coefficients are presented in the Table and t-statistics are shown in parentheses.
2.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As can be seen from the result table of the robust test, except for the empirical results of low fuel consumption vehicles, all of the other empirical results are very similar to the results of the benchmark regression, i.e., both CAFC credit and NEV credit have significantly reduced the production of non-low fuel consumption vehicles, and NEV credit has significantly enhanced the production of NEVs; both credit policies have been proved to significantly reduce the production of conventional energy vehicles. In the empirical results of low fuel consumption vehicles, neither CAFC credit nor NEV credit plays a significant role. This may be due to the fact that the target fuel consumption set for passenger cars with 3 or more rows is a more lenient fuel consumption standard. In effect, enterprises are more constrained by the target fuel consumption set for passenger cars with less than 3 rows. As a result, the regression coefficients for low fuel consumption vehicles are insignificant in the results of the robust test.

6 Conclusion

6.1 Conclusion of the study of Dual Credit Policy

Based on the relevant studies both at home and abroad, the paper selects the data of China's passenger car production from 2016 to 2020 as a sample in accordance with the relevant theories, and analyzes the impact of implementation of the dual credit policy for passenger cars in China on the development of energy-saving and new energy vehicle industry. The following conclusions are made based on the research hypotheses and correlation analyses in the paper:

There is a significant correlation between the implementation of CAFC credit and the decline in the average fuel consumption of enterprises, but the correlation with the production of NEV and low fuel consumption models is poor. The main reason behind it is that the CAFC credit doesn't assess the production of NEV and low fuel consumption models, and the enterprises mainly rely on the current technologies of fuel vehicle model to improve the level of energy saving during the early stage of implementation of the policy, so as to comprehensively reduce the energy consumption.

The official implementation of NEV credit has significantly enhanced the production of NEV. The NEV credit directly assesses the share of NEV production. Enterprises can only achieve compliance by producing NEVs or purchasing NEV credit surplus. The corporate decision takes NEV into account, which is the direction of industrial transformation and development, and even if the short-term R&D cost is higher, enterprises tend to enhance the production of NEVs on their own in order to be in line with the policy. Thus, it can be seen, through the implementation of NEV credit, the purpose of guiding enterprises to accelerate the transformation of product electrification is met.

6.2 Policy recommendations

Based on the empirical analysis of the paper, the dual credit policy has achieved a better guiding effect on the energy saving of China's passenger car enterprises and development of NEV industry during years of effective implementation. Specifically speaking, there are several suggestions on the policy shown as below.

Promote the new fleet to improve efficiency and upgrade energy-saving technology. From the results of the empirical study, it can be seen that the correlation among the implementation of CAFC credit and the production of low fuel consumption models and reduction rate of fuel consumption of conventional energy models is relatively weak. It indicates that the current enterprises do not have to invest too much in energy-saving technologies for conventional energy vehicles in order to achieve policy compliance. In order to further strengthen the guidance for conventional energy vehicles, on the one hand, it is suggested that the policy should put forward separate assessment requirements for the fuel consumption of conventional energy models, and point out the directional preferential measures for advanced energy-saving models with very low fuel consumption, with a view to encouraging and guiding enterprises to continuously strengthen their investments in energy saving technologies for conventional energy vehicles. On the other hand, it is recommended that generous accounting preferences should be given to NEVs. On the basis that the impact of development of the NEV market on the compliance with the CAFC credit and the energy-saving effect of fleets is taken into full account, we suggest to reduce the risk of failure to meet the energy-saving goal brought about by the accounting of NEVs.

It is recommended that the competent government authorities give the priority to the positioning of the NEV credit policy. Gradually achieve the transformation to the development of NEV. Priority should be shifted from guiding the improvement of production and sales scale of NEVs in the past, to enhancing both quantity and development of NEVs. There is also a need to further guide the industry to achieve high-quality development, by virtue of the paths like increasing the technical assessment indicators of NEV models.

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