



Model Construction and Empirical Study of China's Automobile Industry and Entrepreneur Confidence Index

Xudong Li^{1*}, Peiwen Zuo², Wenzhuo Wang³

^{1,2,3} China Automotive Information Technology (Tianjin) Co., Ltd., Tianjin, 300300

¹lixudong2019@catarc.ac.cn

²zuopeiwen@catarc.ac.cn

³wangwenzhuo@catarc.ac.cn

Abstract. At present, our country's automobile industry is facing the influence and challenges of many factors such as changes in the international environment and rising raw material prices. The development situation is full of uncertainties. Existing data and evaluation methods are difficult to accurately predict the development prospects of the industry, so it is necessary to build a set of research and evaluation models based on the confidence of the auto industry and entrepreneurs. By analyzing the key factors that restrict the development of the automobile industry, this paper constructs a confidence evaluation system for the automobile industry covering 3 first-level indicators and 12 second-level indicators. Invite industry experts and enterprises to compare and score the weights of the indicators one by one, and obtain the confidence index model after calculation with the help of the analytic hierarchy process. At the same time, extensive industry research work was carried out, and the results of the first phase of confidence index analysis were output to verify the accuracy of the model.

Keywords: Automobile industry; Confidence index; Analytic hierarchy process; Model

1 Introduction

China is the world's most important auto parts production and supply base, with a world-class auto parts industry chain and supply chain system. In 2020, the national retail sales of automobiles reached 3.94 trillion yuan, accounting for 10.1% of the total retail sales of consumer goods in the country. The proportion of our country's automobile tax revenue to national tax revenue and the proportion of employees to the national urban employment have exceeded 10% for many consecutive years. Automobile is an "integrated" industry with a long industrial chain, large synergy and large manufacturing. It is technology- and capital-intensive, with high industrial correlation, prominent scale effect, and large consumption drive. It represents the develop-

ment level of the manufacturing industry and occupies an important position in the national economy status.

At present, driven by electrification and intelligent technology, the global automobile industry is going through great changes unseen in a century. Our country's automobile industry is also in a critical period of industrial upgrading and quality improvement, and there have been many changes in the elements of the industrial development environment. It is mainly reflected in the following aspects: (1) The economic environment is evolving at an accelerated rate, and our country is striving to build a new development pattern in which "dual cycles" promote each other; (2) "Dual-carbon" goals and dual-point policies promote the green development of the industry; (3) Staged production is blocked, The COVID-19 epidemic has led to the production of some important automobile production bases being blocked; (4) The supply of parts and components is tight, and the shortage of chips has not been fundamentally solved, and there is still a risk of supply interruption; (5) The price of raw materials has risen, especially the price of raw materials for power batteries has continued to rise, and some companies have raised the price of electric vehicle products.

Facing the new characteristics of the external development environment, the development confidence of the automobile industry is particularly important. Confidence is quite important. Confidence is a beacon for the achievement of enterprises and the realization of a strong manufacturing country. The auto industry urgently needs to build an industry confidence index in order to give a true feedback on the future expectations and development prospects of auto companies. Existing conventional data such as automobile production and sales, import volume and evaluation methods are difficult to predict the industry prospects. Therefore, it is necessary to build a set of research and evaluation models based on the confidence of the automobile industry and entrepreneurs. On the one hand, the index can monitor the operation status of the automobile industry, carry out forecast and early warning analysis, and provide a basis for the government to formulate relevant policies; On the other hand, it can be used to study the external environment of the automobile industry, corporate business trends, gain insight into the trend of industrial transformation, and provide support for corporate strategic planning and business layout.

2 Construction of China's Auto Industry and Entrepreneur Confidence Index Model System

Numerous factors are affecting the development of the auto industry. In order to improve the pertinence of the research on China's auto industry and the Entrepreneur Confidence Index, it is necessary to identify and select development factors that have a high degree of influence on the industry and are generally of concern to enterprises for key analysis. By investigating the strategic departments of more than ten domestic vehicle and large-scale parts groups and consulting relevant industry reports, it is clear that companies generally pay attention to three primary elements of industrial development environment, corporate strategy and market performance. At the same

time, each type of first-level elements can be further refined into second-level elements.

For example, among the environmental factors of industrial development, industrial policy is a very important secondary factor. For example, in this year's government work report, it is pointed out that the scale of fiscal expenditure has increased by more than 2 trillion yuan compared with last year, corresponding to the budgetary fiscal expenditure of 26.6 trillion yuan in 2022, with a year-on-year growth rate of more than 8%. At the same time, fixed asset investment in the auto industry has accelerated significantly. It can be seen that the relevant government policies and measures will directly affect the investment behavior of auto companies. Therefore, industrial policy and auto industry confidence are inextricably linked.

By further splitting the three first-level indicators of industrial environment, corporate strategy, and market performance, a number of second-level indicators were obtained, and an indicator system as shown in Table 1 was established.

Table 1. Index System of China's Auto Industry and Entrepreneur Confidence [Owner-draw]

Items	First-level Evaluation Index	Second-level Evaluation Index
China's Auto Industry and Entrepreneur Confidence Index	A Industrial Environment	A1 Industrial Policy
		A2 Macroeconomics
		A3 Supply Chain
		A4 Competitive Environment
	B Corporate Strategy	B1 Production and Operation
		B2 Industry Investment and Financing
		B3 Project Research and Development
		B4 Capacity Layout
	C Market Performance	C1 Overall New Car Performance
		C2 Corporate Marketing Investment
		C3 Enterprise Market Performance
		C4 Consumer Demand

3 Method for Determining Indicator Weights of China's Auto Industry and Entrepreneur Confidence Index Model

AHP is a decision analysis method that combines qualitative and quantitative methods to solve complex multi-objective problems. This method combines quantitative analysis with qualitative analysis, and uses the experience of decision makers to judge the relative importance of each measurement target ^[1].

In order to explore the relationship between the first-level and second-level indicators on China's auto industry and the entrepreneur's confidence index, the analysis of hierarchy process was used to quantify the impact level of each evaluation index in the fuzzy comprehensive evaluation, so as to determine the level of the index factors

at all levels' weights. Experts were invited to compare the relative importance of the two indicators mentioned in the questionnaire, using a 1-5 scale method. Taking the first-level indicator weight expert survey questionnaire as an example, the design idea of the questionnaire is as follows: the score is divided into 5 levels: 5 is obviously more important, 3 is more important, and 1 is equally important; the score should meet the principle of consistency of factors at the same level, such as $A > B$, $B > C$, then $A > C$, otherwise the questionnaire is invalid; the questionnaire is in the form of single-choice questions, if A is obviously more important than B, then check the number 5; A is equally important than B, check the number 1^[2].

Table 2. Questionnaire for experts on the weight of the first-level indicators [Owner-draw]

In your opinion, the relative importance of two indicators in the first-level evaluation indicators that affect the confidence index (options closer to the left mean that the left index is more important than the right, and options closer to the right mean that the right index is more important than the left)								
A Industrial Environment - B Corporate Strategy								
5	4	3	2	1	2	3	4	5
A Industrial Environment - C Market Performance								
5	4	3	2	1	2	3	4	5
B Corporate Strategy - C Market Performance								
5	4	3	2	1	2	3	4	5

4 Calculation results of China's auto industry and enterprise confidence index model

The research group invited experts from industry organizations, vehicles and parts to score the weights of primary and secondary indicators according to the AHP method, that is, experts judge the relative importance of different indicators based on their understanding of the automotive industry^[3]. According to the scoring results, SPSSAU was used to calculate and determine the specific weights of all indicators, as shown in Table 3: industrial environment 43.34%, market performance 36.49%, and corporate strategy 20.17%. The secondary indicators of industrial environment in

order of importance are macroeconomics 29.70%, industrial policy 28.88%, supply chain 27.96%, and competitive environment 13.47%; the secondary indicators of market performance in order of importance are consumer demand 40.84%, overall new car performance 27.12%, corporate market performance 22.01%, corporate marketing investment 10.02%; the secondary indicators in the corporate strategy in order of importance are production and operation 44.04%, industrial investment and financing 20.90%, project research and development 19.37%, and capacity layout 15.69%.

Table 3. Calculated results of China's auto industry and entrepreneur confidence index model [Owner-draw]

First-level Evaluation Index	First-level Indicator Weight	Secondary Evaluation Index	Secondary Indicator Weight
A Industrial Environment	43.34%	A1 Industrial Policy	28.88%
		A2 Macroeconomics	29.70%
		A3 Supply Chain	27.96%
		A4 Competitive Environment	13.47%
B Corporate Strategy	20.17%	B1 Production and Operation	44.04%
		B2 Industry Investment and Financing	20.90%
		B3 Project Research and Development	19.37%
		B4 Capacity Layout	15.69%
C Market Performance	36.49%	C1 Overall New Car Performance	27.12%
		C2 Corporate Marketing Investment	10.02%
		C3 Enterprise Market Performance	22.01%
		C4 Consumer Demand	40.84%

5 Survey Questionnaire Design and Confidence Index Calculation Method

The questionnaire has a total of 43 questions, including single-choice, multiple-choice, and fill-in-the-blank questions. It not only collects the basic judgments of experts and entrepreneurs on the industry, but also deeply understands the judgment standards and future development suggestions of experts and entrepreneurs on the industry. For the assignment of questionnaire options, it is set that 1 point is selected for the good option, 0.5 point for the equal option, and 0 point for the indicator worse

option. The confidence index is equal to the sum of the score of each question and the weight of the first-level indicator and the weight of the second-level indicator. When the result is higher than 50%, it means that the industry has increased confidence in the development of the auto industry in the next quarter; when the result is less than 50%, it means that the confidence in the development of the auto industry of the industry in the next quarter will decline. This calculation model effectively guarantees the rigor and scientificity of the confidence index ^[4].

Analysis of the Statistical Results of the First Phase of China's Auto Industry and Entrepreneur Confidence Index

The research team invited industry experts and entrepreneurs to predict the operation of the automobile industry in the third quarter in the form of a questionnaire survey. After the calculation of the calculation model, as shown in Figure 1, the confidence index of China's automobile industry and entrepreneurs in the third quarter of 2022 is 73 %, that is, the confidence in the development of the industry is improving. Among them, the industrial environment index is 69.4%. Industry experts and entrepreneurs generally believe that with the introduction of a series of national and local government policies to promote consumption, as well as the overall recovery of the supply chain brought about by the weakening of the epidemic, the overall industrial environment is improving. The corporate strategy index is 74.0%. Industry experts and entrepreneurs believe that the recovery of the supply chain will promote an appropriate reduction in production costs, and the release of market demand will lead to an increase in corporate operating income, profit and capacity utilization, intensified market competition and product iteration. The increase in speed requirements will also allow car companies to increase investment in research and development. The market performance index is 76.7%. Industry experts and entrepreneurs generally believe that consumers' willingness to spend will increase significantly in the third quarter. On this basis, it is unanimously judged that the market performance of both the industry as a whole and their own companies will be better in the third quarter than in the second quarter.

First-level indicator	Secondary indicator	Specific research questions	Single question score	Secondary indicator weighted score	The final score of the second-level indicator	The first-level indicator index
Industrial environment	industrial policy	A1.1:What impact do you think the national industrial policy will have on the auto industry in the next quarter?	0.893	0.263	11.4%	69.4%
		A1.2: What impact do you think local policies will have on the auto industry in the next quarter?	0.929			
	macroeconomics	A2:What is your attitude towards the national economic trend in the next quarter?	0.750	0.223	9.7%	
	supply chain	A3.1: How do you think the upstream supply chain costs will change in the next quarter compared with the current period?	0.536	0.180	7.8%	
		A3.2: How do you think the upstream supply chain delivery cycle will change in the next quarter compared with the current period?	0.750			
	competitive environment	A4: How do you think the overall competitive environment of the auto market will change in the next quarter compared with the current period?	0.214	0.029	1.3%	
Company Strategy	production and operation	B1.1: How do you think the production cost will change in the next quarter compared with the current period?	0.571	0.341	6.9%	74.0%
		B1.2: How do you think the operating income in the next quarter will change compared with the current period?	0.929			
		B1.3:How do you think the profit in the next quarter will change compared with the current period?	0.821			
	industrial investment and financing	B2.1: How do you think the company's fixed asset investment in the next quarter will change compared with the current period?	0.571	0.137	2.8%	
		B2.2: How do you think the company's equity investment will change in the next quarter compared to the current period?	0.643			
		B2.3: How do you think the company's financing situation will change in the next quarter compared with the current period?	0.750			
	project development	B3.1: How do you think the number of R&D projects of the company in the next quarter will change compared with the current period?	0.679	0.142	2.9%	
		B3.2: How do you think the company's R&D personnel will change in the next quarter compared to the current period?	0.786			
	capacity layout	B4.1: How do you think the company's own production capacity will change in the next quarter compared to the current period?	0.679	0.120	2.4%	
		B4.2: How do you think the company's capacity utilization rate will change in the next quarter compared with the current period?	0.857			
Market performance	overall new car performance	C1.1: How do you think the industry's overall new car sales will change in the next quarter compared with the current period?	0.929	0.228	8.3%	76.7%
		C1.2: How do you think the industry's overall new vehicle inventory will change in the next quarter compared to the current period?	0.750			
	company marketing investment	C2.1: How do you think the company's own sales channels will change in the next quarter compared to the current period?	0.679	0.070	2.5%	
		C2.2: How do you think the company's own brand/marketing expenses will change in the next quarter compared with the current period?	0.714			
	company market performance	C3.1: How do you think the company's own orders will change in the next quarter compared to the current period?	0.857	0.173	6.3%	
		C3.2: How do you think the company's own product selling price will change in the next quarter compared to the current period?	0.607			
		C3.3: How do you think the company's own sales in the next quarter will change compared with the current period?	0.893			
	consumption demand	C4.1: How do you think consumers' willingness to consume automobiles will change in the next quarter compared with the current period?	0.857	0.297	10.8%	
		C4.2: How do you think the consumption level of consumers in the next quarter will change compared with the current period?	0.607			
C4.3: What do you think will be the change in consumer satisfaction in the next quarter compared with the current period?		0.714				
China Auto Industry and Entrepreneur Confidence Index (sum of final scores of all secondary indicators)					73.0%	

Fig. 1. China's Auto Industry and Entrepreneur Confidence Index (Phase 1) [Owner-draw]

In addition, more than 70% of industry experts and entrepreneurs believe that the biggest TOP3 challenges facing the automobile industry and business operations in the second quarter are: further deterioration of the economic environment, uncertainty of the global epidemic, and sharp fluctuations in resource prices. While doing a good job in production and operation in the third quarter, relevant enterprises in the automobile industry should gradually establish a mechanism for ensuring production and supply in response to emergencies, and further strengthen the layout and independent control of core resources, so as to enhance the ability of enterprises to calmly respond to various environmental challenges.

6 Conclusion

Through the example verification of China's auto industry and entrepreneur confidence index model, it can be seen that the model can reflect the development envi-

ronment and next development trend of our country's auto industry to a certain extent, and can achieve the established goals. However, the number of samples in this expert survey is limited, and there is still room for improvement in the accuracy of the model. More extensive industry research work is still needed to revise the model parameters in the future.

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