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Research on the Economic Effect Model of Automobile Exhibition Based on Analytic Hierarchy Process

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ABSTRACT

With the continuous advancement of global economic integration, automobile exhibitions play an increasingly important role in promoting the integration of the automobile industry and regional economic growth due to their strong industrial driving effect. However, in the actual operation process, how to accurately quantify the specific impact of exhibition activities on local economy has become an urgent problem to be solved. Analytic Hierarchy Process (AHP) is a multi criteria decision-making method that combines qualitative and quantitative analysis. It can help decision-makers effectively handle multiple interrelated factors in complex decision-making environments. This article constructs a model framework for evaluating the economic effects of automobile exhibitions based on the Analytic Hierarchy Process, aiming to objectively and comprehensively reflect the economic benefits brought by exhibition activities. By applying the model to relevant data in Beijing from 2013 to 2022, the research results show that the model can not only accurately quantify the specific contribution of automobile exhibitions to the economy of Beijing, but also has more accurate and explanatory power compared to traditional evaluation methods. It can not only help government departments formulate exhibition related policies more scientifically, but also provide more targeted development strategy guidance for enterprises.

KEYWORDS

Automobile Exhibition; Economic Effects; Analytic Hierarchy Process

1. INTRODUCTION

With the rapid development of the Chinese economy and the continuous improvement of consumption levels, the automotive industry, as an important pillar industry of the national economy, has a profound impact on the overall economy. As an important platform connecting upstream and downstream industries, promoting technological exchange and market expansion, automobile exhibitions have played an important role in promoting the development of the market economy and improving the modern economic system in recent years.

2. OVERVIEW OF KEY DOMESTIC AUTOMOTIVE EXHIBITION ACTIVITIES

2.1. International Forum(TEDA) on Chinese Automotive Industry Development

International Forum (TEDA) on Chinese Automotive Industry Development is one of the most influential annual events in the Chinese automotive industry. Since its establishment in 2005, it has become an important platform for governments, businesses, and academia to discuss automotive industry policies, technologies, and market trends. The 2024 Forum was successfully held in Tianjin

Binhai New Area from August 29th to September 1st, attracting numerous domestic and foreign industry elites, experts, scholars, and government officials to gather together for in-depth exchanges on technological innovation, market dynamics, and policy guidance in the automotive industry. The TEDA Automotive Forum not only promotes the progress of China's automotive industry, but also greatly promotes the economic development of Tianjin Economic and Technological Development Zone (TEDA). TEDA, as the venue for the forum, showcases its unique advantages and development potential in the automotive industry through this platform. During the forum, TEDA not only attracts a large amount of domestic and foreign investment attention, but also provides an opportunity for local enterprises to showcase their own strength, which helps to enhance the regional brand image, attract more high-tech projects to settle in, and further consolidate TEDA's position as a highland of China's automotive industry. In addition, the industry influence and media exposure brought by the forum have also created more business opportunities for TEDA, promoting employment growth and industrial upgrading in the region.

2.2. China Auto Forum

China Auto Forum is an important conference for the domestic automotive industry. The 2024 forum was held in Jiading, Shanghai from July 11th to 13th, attracting numerous industry experts, corporate executives, and government officials to participate. The forum has set up multiple segments, including closed door summits, conference forums, themed forums, heavyweight releases, and themed visits, to gather the strength of all parties and promote the high-quality development of the automotive industry. The characteristics of the forum lie in its high standards and professionalism, with discussions covering the latest trends, policy interpretations, and technological innovations in the automotive industry.

2.3. Beijing International Automotive Exhibition

Beijing International Automotive Exhibition is one of the most influential automobile exhibitions in the world. The 2024 exhibition will be held from April 25th to May 4th at the Shunyi Hall of the China International Exhibition Center in Beijing, showcasing numerous new cars, especially new energy and intelligent connected vehicles, attracting a large number of domestic and foreign automobile manufacturers and visitors. The characteristics of the exhibition are its large scale, multiple participating companies, and rich variety of exhibits, covering multiple fields such as passenger cars, commercial vehicles, components, and related services.

3. APPLICATION OF ANALYTIC HIERARCHY PROCESS IN ECONOMIC EFFECT EVALUATION

3.1. Overview of Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is a scientific decision-making method that combines qualitative judgment with quantitative analysis. By systematically analyzing the evaluation object based on the evaluation objectives, the overall evaluation of the evaluation objectives is continuously decomposed, and then the comprehensive scoring index is calculated to evaluate the overall evaluation objectives of the evaluation object. The quality level of the evaluation object is determined according to its importance.

3.2. Application of Analytic Hierarchy Process in Evaluating the Economic Effects of Automobile Exhibition

To evaluate the economic benefits of automobile exhibitions based on the Analytic Hierarchy Process, it is necessary to first determine the main factors that affect the economic effects of automobile

exhibitions; Then, decompose these factors into more specific indicators to form a hierarchical structure; Afterwards, the importance of each indicator will be compared and a judgment matrix will be constructed through expert scoring of survey questionnaires. On this basis, the Analytic Hierarchy Process is used to calculate the weights of each indicator and determine the relative importance of each indicator in the overall evaluation. Calculate the comprehensive economic effects of the automobile exhibition based on the weights of each indicator and actual data.

4. CONSTRUCTION OF ECONOMIC EFFECT MODEL FOR AUTOMOBILE EXHIBITION BASED ON ANALYTIC HIERARCHY PROCESS

4.1. Construction of an Evaluation System for the Promoting Effect of Automobile Exhibitions on Economic Benefits

Table 1. Evaluation System Model for the Promoting Effect of Automobile Exhibition on Economic Benefits

Target layer	Standard layer	Indicator layer
Evaluation system for the promoting effect of automobile exhibitions on economic benefits	Economic benefits of the automotive industry B1	Automobile production B11
		Export value of automobiles (including complete sets of parts) B12
		Number of automobile manufacturing enterprises above designated size B13
		Total assets of large-scale automobile manufacturing enterprises B14
	Overall economic benefits of the region B2	Per capita GDP B21
		Average salary of employed personnel B22
		Growth rate of fixed assets investment B23
		General public budget revenue B24
		Total export value B25

This article uses the Analytic Hierarchy Process to construct an evaluation system for the promoting effect of automobile exhibitions on economic benefits. The evaluation system for the promoting effect of automobile exhibitions on economic benefits is divided into three levels: the target level, the standard level, and the indicator level. Each standard layer factor has several secondary indicators, which together form the indicator layer. The indicators in the economic efficiency standard layer of the automotive industry, including automobile production, automobile export value, number of units of large-scale automobile manufacturing enterprises, and total assets, mainly focus on the direct driving effect of automobile exhibitions on industry development. The changes in automobile production and export value can reflect the promotion effect of exhibitions on product market demand and international market expansion, while the number and total assets of enterprises above designated size reflect the impact of exhibitions on industry structure optimization and capital accumulation. The indicators at the standard level of regional overall economic benefits, such as per capita GDP, average wage of employees, growth rate of fixed assets investment, general public budget revenue and total export, evaluate the driving effect of exhibition on regional economy from the macroeconomic perspective. The increase of per capita GDP and average wage of employees reflects the contribution of exhibition to economic growth and the improvement of residents' income. The growth of fixed assets investment and the increase of public budget revenue indicate the positive role of exhibition in attracting investment and improving fiscal revenue. The change of total export volume shows the enhancement of exhibition to regional external economic ties and international market competitiveness. Through the comprehensive analysis of these indicators, it is possible to more

accurately evaluate the actual role of automobile exhibitions in promoting economic benefits, and help governments and enterprises formulate more effective exhibition policies and development strategies. This article constructs an evaluation system for the promoting effect of automobile exhibitions on economic benefits, as shown in Table 1.

4.2. Establishing a Judgment Matrix

For the scores of different levels of judgment matrices, this article distributed a survey questionnaire to a total of 10 experts in the automotive industry, and scored the importance of each dimension and each level of assessment indicators based on the 1-9 scale of the Analytic Hierarchy Process. The scores were calculated as the average value, and then the judgment matrix was constructed.

The score results of the standard level judgment matrix for the evaluation system of the promotion effect of automobile exhibitions on economic benefits are shown in Table 2.

Table 2. Standard Layer Judgment Matrix

	Economic benefits of the automotive industry B1	Regional overall economic benefits B2
Economic benefits of the automotive industry B1	1	1
Regional overall economic benefits B2	1	1

The score results of the indicator layer judgment matrix for the evaluation system of the promotion effect of automobile exhibitions on economic benefits are shown in Tables 3 and 4.

Table 3. Judgment Matrix of Economic Benefit Indicators in the Automotive Industry

	Automobile production B11	Export value of automobiles (including complete sets of parts) B12	Number of automobile manufacturing enterprises above designated size B13	Total assets of large-scale automobile manufacturing enterprises B14
Automobile production B11	1	1	0.5	0.333
Export value of automobiles (including complete sets of parts) B12	1	1	0.5	0.333
Number of automobile manufacturing enterprises above designated size B13	2	2	1	1
Total assets of large-scale automobile manufacturing enterprises B14	3	3	1	1

Table 4. Judgment Matrix of Regional Overall Economic Benefit Index Layer

	Regional per capita GDP B21	The average salary of employed personnel is B22	Growth rate of fixed assets investment B23	General public budget revenue B24	Total export value B25
Regional per capita GDP B21	1	1	0.333	0.5	0.5
The average salary of employed personnel is B22	1	1	0.333	1	1
Growth rate of fixed assets investment B23	3	3	1	0.5	1
General public budget revenue B24	2	1	2	1	1
Total export value B25	2	1	1	1	1

4.3. Analytic Hierarchy Process Results

The results of the standard level analytic hierarchy process are shown in Table 5.

Table 5. Results of Analytic Hierarchy Process at the Standard Level

term	feature vector	Weight value	Maximum eigenvalue	CI value
Economic benefits of the automotive industry B1	1	50.000%	2	0
Regional overall economic benefits B2	1	50.000%		

The indicator layer judgment matrix is shown in Tables 6 and 7.

Table 6. Analytic Hierarchy Process Results of Economic Benefit Indicators in the Automotive Industry

term	feature vector	Weight value	Maximum eigenvalue	CI value
Automobile production B11	0.577	14.435%	4.021	0.007
Export value of automobiles (including complete sets of parts) B12	0.577	14.435%		
Number of automobile manufacturing enterprises above designated size B13	1.28	31.994%		
Total assets of large-scale automobile manufacturing enterprises B14	1.565	39.137%		

Table 7. Results of Analytic Hierarchy Process for Regional Overall Economic Benefit Indicators

term	feature vector	Weight value	Maximum eigenvalue	CI value
Regional per capita GDP B21	0.562	11.230%	5.303	0.076
The average salary of employed personnel is B22	0.798	15.952%		
Growth rate of fixed assets investment B23	1.323	26.468%		
General public budget revenue B24	1.266	25.317%		
Total export value B25	1.052	21.032%		

4.4. Summary of Evaluation System Index Scores

Based on the weights of the standard layer and indicator layer calculated in the previous text, the indicator scores of each indicator were calculated, and then the comprehensive weights of each indicator in the evaluation system of the promotion effect of automobile exhibitions on economic benefits were calculated, as shown in Table 8.

Table 8. Evaluation System Index Weights for the Promoting Effect of Automobile Exhibition on Economic Benefits

Target layer	Standard layer	Indicator layer	Comprehensive weight
Evaluation of the Promoting Effect of Automobile Exhibition on Economic Benefits	Economic benefits of the automotive industry B1	Automobile production B11	7.22%
		Export value of automobiles (including complete sets of parts) B12	7.22%
		Number of automobile manufacturing enterprises above designated size B13	16.00%
		Total assets of large-scale automobile manufacturing enterprises B14	19.57%
	Regional overall economic benefits B2	Regional per capita GDP B21	5.62%
		The average salary of employed personnel is B22	7.98%
		Growth rate of fixed assets investment B23	13.23%
		General public budget revenue B24	12.66%
		Total export value B25	10.52%

5. APPLICATION OF THE ECONOMIC EFFECT MODEL OF AUTOMOBILE EXHIBITION

Table 9. Standardized Data of Beijing from 2013 to 2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Automobile production B11	0.75	0.79	0.76	1.00	0.73	0.52	0.51	0.52	0.32	0.00
Export value of automobiles (including complete sets of parts) B12	0.38	0.80	0.50	0.41	0.32	0.39	0.23	0.00	0.52	1.00
Number of automobile manufacturing enterprises above designated size B13	0.50	0.94	0.83	1.00	0.94	0.69	0.38	0.23	0.02	0.00
Total assets of large-scale automobile manufacturing enterprises B14	0.00	0.15	0.30	0.62	0.75	1.00	0.92	0.52	0.37	0.58
Regional per capita GDP B21	0.00	0.07	0.15	0.26	0.40	0.56	0.68	0.71	0.97	1.00
The average salary of employed personnel is B22	0.00	0.08	0.16	0.23	0.33	0.45	0.64	0.73	0.88	1.00
Growth rate of fixed assets investment B23	1.00	0.38	0.78	0.65	0.58	0.00	0.17	0.44	0.59	0.52
General public budget revenue B24	0.00	0.16	0.47	0.63	0.78	0.94	0.95	0.80	1.00	0.90
Total export value B25	0.19	0.16	0.00	0.01	0.21	0.54	0.65	0.47	1.00	0.91

This article combines relevant data from Beijing from 2013 to 2022, standardizes them, and applies the economic effect model of automobile exhibitions constructed in the previous text to analyze the promoting effect of automobile exhibitions on regional economy. The standardized data is shown in Table 9.

According to the indicator weights calculated in the previous text, the data on the promoting effect of Beijing's automobile exhibition on the economy from 2013 to 2022 is shown in Figure 1.

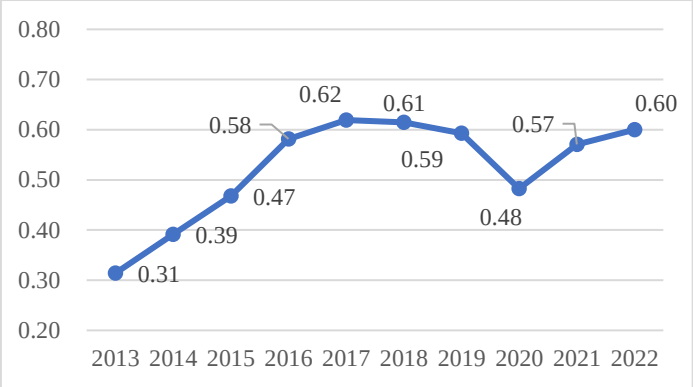

Figure 1. Evaluation Data on the Promoting Effect of Automobile Exhibitions on the Economy in Beijing from 2013 to 2022

The overall promotion effect of automobile exhibitions on the economy of Beijing shows a trend of first strengthening and then fluctuating. The evaluation score has increased year by year from 0.31 in 2013 to 0.62 in 2017, reflecting the significant role of exhibition activities in promoting the economy during this stage. However, since 2018, there have been slight fluctuations in scores, especially dropping to 0.48 in 2020 due to the impact of the pandemic. In 2021 and 2022, the scores rebounded to 0.57 and 0.60, indicating a gradual recovery of the economic promotion effect. This indicates that automobile exhibitions still play an important role in promoting the economic development of Beijing.

6. CONCLUSION

This article constructs an evaluation model for the promoting effect of automobile exhibitions on economic benefits through the application of Analytic Hierarchy Process, and verifies and analyzes it with Beijing as an example. Research has found that automobile exhibitions have a significant promoting effect on regional economy. The Analytic Hierarchy Process, as an effective multi criteria decision-making tool, has demonstrated its unique value in evaluating the economic effects of automobile exhibitions. In the future, with the continuous deepening of theoretical research and technological progress, the application prospects of Analytic Hierarchy Process in this field are very broad. Here are several possible development directions:

One is that the Analytic Hierarchy Process can be integrated with other quantitative analysis methods (such as fuzzy comprehensive evaluation, grey system theory, etc.) to form a more complex and accurate evaluation system, thereby improving the reliability and accuracy of evaluation results. With the development of big data technology and artificial intelligence, it is possible to explore the combination of Analytic Hierarchy Process and machine learning algorithms, use historical data to train models, automatically identify the changing trends of key factors, and predict the impact of exhibition economic effects.

Secondly, the Analytic Hierarchy Process can be refined to various stages such as exhibition preparation, operation, and post evaluation, providing full lifecycle support for exhibition activities. In terms of regional coverage, in addition to large cities, this method can also be extended to small and medium-sized cities to help local governments and enterprises better utilize exhibition resources and promote balanced regional economic development.

Thirdly, in response to the rapidly changing characteristics of the exhibition industry, the Analytic Hierarchy Process needs to have stronger dynamic adaptability, be able to adjust the weight allocation in the model in a timely manner, and ensure that the evaluation results can reflect the latest market situation. Specialized software tools or platforms can be developed to enable non professional users to easily use the Analytic Hierarchy Process for evaluation, reduce application barriers, and improve the popularity and practicality of the method.

Through the efforts in the above directions, the Analytic Hierarchy Process will play a greater role in evaluating the economic effects of automobile exhibitions, providing a solid theoretical foundation and technical support for the healthy development of the exhibition economy.

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