

Analysis of the Influence of the Asian Games Based on Decision Tree Model

Lihuan Cai, Yuanyuan Li, Yimeng Yan, Shijin Wu

School of Artificial Intelligence, Jiangnan University, China

Abstract: Under the background of globalization of sports events and diversification of urban development, the Asian Games, as the highest level comprehensive sports event in Asia, has increasingly become the focus of academic attention in terms of its economic, social and cultural influence. Taking the recent ten Asian Games as the object, this study aims to quantitatively evaluate the impact of the games on the host city in the dimensions of economic growth, infrastructure upgrading, tourism driving and cultural transmission through cluster analysis and SVM model. The study uses multi index panel data, combined with case comparison and econometric analysis, to reveal the temporal and spatial differences and key driving factors of the influence of the Asian Games. The results show that the Asian Games can significantly promote the GDP growth of the host city in the short term and enhance the international attention, but the long-term benefits are significantly affected by the city size, industrial structure and the efficiency of event resource allocation; Infrastructure investment and cultural heritage activation are the core paths to form sustainable influence. Research suggestions: build a collaborative planning mechanism of "event economy urban development", strengthen the market-oriented design of venue operation after the games, and promote the deep integration of sports events and cultural tourism industry, so as to maximize the long-term positive effect of the Asian Games.

Keywords: Asian Games; Economic impact; Differential trend analysis; SVM model; urban development.

1. Introduction

1.1. Research background

Under the background of global urbanization and the promotion of the strategic value of sports events, the Asian Games, as the highest standard comprehensive event in Asia, has economic, social, cultural and environmental impacts beyond the scope of competition and has become an important driving force for urban modernization. The short-term economic growth of Hangzhou Asian Games was driven by infrastructure investment of more than 200 billion yuan, but the long-term benefit difference between Hangzhou Asian Games and some cities' stadiums after the Games was highlighted; "Digital torch" and other practices promote cultural display and mutual learning among civilizations, but lack of in-depth research on the cultivation of citizens' sense of identity; Although green low-carbon and intelligent governance provide a model, the effect transformation mechanism of different cities still needs to be explored. Existing studies focus on a single dimension, and lack of discussion on the multi-dimensional interaction mechanism.

1.2. Research meaning

For Hangzhou, the upgrading of infrastructure driven by the Asian Games has accelerated urban modernization, created jobs and stimulated industrial growth, becoming the engine of economic development. Studying its impact has both theoretical and practical value: theoretically, it can enrich the research framework of the interaction between sports events and urban development; In practice, it can not only provide experience for resource allocation and sustainable operation of subsequent events, but also provide decision-making basis for Hangzhou to optimize venue operation and regional coordinated development planning after the games, help transform the Asian Games heritage into long-term development momentum, and provide "Hangzhou

sample" for global cities' transformation through events.

2. Literature Review and Theoretical Basis

2.1. Theoretical basis

2.1.1. event city theory: the Asian Games have promoted the long-term structural changes in Hangzhou, accelerated the improvement of Hangzhou's subway network, urban construction, sports venues, transportation hubs and other facilities, enhanced global popularity, and stimulated economic growth in the short term.

2.1.2. Multiplier effect and input-output theory: the Asian Games has directly increased the income of tickets and tourist attractions, and provided many jobs such as service industry.

sustainable development theory: the venues and facilities used for the Asian Games are all invested into public sports facilities after use, so as to reuse resources, improve urban construction and provide convenience for residents' lives.

2.1.3. sustainable development theory: the venues and facilities used for the Asian Games are all invested into public sports facilities after use, so as to reuse resources, improve urban construction and provide convenience for residents' lives.

2.2. Current research status at home and abroad

2.2.1. At present, research on the influence of the Asian Games in China has been conducted from various aspects such as politics, economy, culture, and society. It has been concluded that the Hangzhou Asian Games has achieved the goal of promoting infrastructure improvement, driving economic development in surrounding areas, increasing employment opportunities, significantly improving the service industry, showcasing cultural exchanges of the Asian Games, and enhancing the international influence of the host city.

2.2.2. Currently, due to regional limitations, there may be less attention paid to the Asian Games in foreign research. However, almost all studies on the influence of the Asian Games abroad have expressed that the Asian Games have a significant impact on the economic development and cultural dissemination of the host cities.

3. Research Methods and Data Sources

3.1. Data sources

The data for this study were collected from official platforms to ensure the reliability and authority of the data. The main sources of data include the Hangzhou Municipal People's Government's public data website, the National Bureau of Statistics of China, the China Economic Data website, and the Zhejiang Provincial Postal Administration. The research sample covers a total of 16 socio-economic indicators from 2010 to 2023 (see Table 1 for details). The above data are all released by official institutions and have high credibility and accuracy.

This study constructs the data system into a dataset. The dataset covers the period from 2010 to 2023, and contains 16 core attributes, including: gross regional product (GDP), per capita gross regional product, added value of the tertiary industry (added value of the primary industry, added value of the secondary industry, and added value of the tertiary industry), demographic indicators (birth population, total population with registered residence registration at the end of the year), scientific and technological innovation indicators (number of patent grants), information infrastructure indicators (number of Internet users), social security indicators (number of urban basic medical insurance participants), economic operation indicators (total current assets, total retail sales of social consumer goods, number of industrial enterprises above designated size, total industrial output value above designated size), and postal service indicators (total postal business).

3.2. Research method

3.2.1. Differential Trend Change Model:

Model principle:

$$\Delta F = |N(t+n) - N(t)|$$

Among them, N represents the numerical value represented by the feature at a certain moment, $t+n$ and t respectively represent the corresponding time, and N represents the interval year.

3.2.2. Cluster analysis:

The core idea of cluster analysis is to utilize the intrinsic structure of data, without the need for prior labels, and achieve data grouping through similarity measurement. First, normalize the existing data and scale it to the $[0,1]$ interval using the following formula:

$$\bar{X} = \frac{X_{ij} - X_{min}}{X_{max} - X_{min}}$$

3.2.3. SVM regression model:

Using SVR (Support Vector Regression) model:

objective function: $\min[\frac{1}{2}||\omega||^2 + C \sum_{i=1}^n (\xi_i + \xi_i^*)]$

$$\text{constraints: } \begin{cases} y_i - \omega \cdot \Phi(x_i) - b \leq \varepsilon + \xi_i \\ \omega \cdot \Phi(x_i) + b - y_i \leq \varepsilon + \xi_i^* \\ \xi_i, \xi_i^* \geq 0 \end{cases}$$

Select RBF kernel function. The formula is as follows:

RBF (Gaussian kernel): $K(X_i, X_j) = \exp(-\gamma ||x_i - x_j||^2)$

x_i represents the feature vector of the i -th sample, x_j represents the feature vector of the j -th sample. C represents the penalty coefficient, which controls the model complexity and overfitting tendency. γ represents the RBF kernel parameter, which controls the influence range of a single sample, ε represents the tolerance bandwidth, which determines the sensitivity of the regression model, ω represents the normal vector of the hyperplane, b represents the bias term, ξ_i represents the relaxation variable, the degree to which the i -th sample is allowed to violate the interval constraint, and y_i represents the sample label. Adjust parameters C , γ , and ε to optimize model performance.

4. Multidimensional Data Analysis of The Influence of the Asian Games

4.1. Analysis of main influencing factors

To conduct multidimensional data analysis on the influence of the Asian Games in the system, based on the inherent logic and interrelationships of economic and social phenomena reflected by different attributes, this study divides the 16 attributes into four dimensions: economic strength and industrial development, industrial enterprise structure, population structure, and technological innovation and industrial economy. In order to analyze the multifaceted impact of the Asian Games on urban development in a more targeted manner.

This study is based on a differential trend change model to analyze the dynamics of four dimensions from 2010 to 2023, aiming to clarify the core impact indicators of the Asian Games on Hangzhou and select the most representative indicators.

4.1.1. Economic strength and industrial development dimensions

Including 11 indicators such as GDP, industrial added value and total registered residence population at the end of the year, it comprehensively reflects the overall scale of the urban economy, industrial structure and market consumption vitality. By analyzing these indicators, we can gain insight into the driving effects of the Asian Games on Hangzhou's economic growth, industrial upgrading, and market prosperity, revealing the core role of the event in the city's economic development process.

From the analysis of the difference data changes in the differential trend change model, it can be concluded that in terms of industrial structure, the difference in added value of the tertiary industry has significantly increased, reflecting that the competition has promoted the development of the service industry; The secondary industry is affected by factors such as infrastructure construction investment and fluctuates; Although there are fluctuations in the primary industry, they are relatively small and have limited direct impact. Overall, the Asian Games have promoted economic expansion and industrial structure optimization.

4.1.2. Dimensions of Industrial Enterprise Structure

This dimension focuses on the number of industrial enterprises above a certain scale as the core indicator, with a particular emphasis on the changes in the quantity and structure of enterprises in the industrial sector. The aim is to explore the impact of the Asian Games on the layout, quantity increase and decrease, and industrial organization form of industrial enterprises in Hangzhou, providing a key perspective for evaluating the role of the event in the

adjustment of industrial economic structure.

From the analysis of the difference data changes in the differential trend change model, it can be concluded that the changes in the quantity layout of industrial enterprises may be due to factors such as the improvement of investment environment and industrial policy adjustments brought about by the Asian Games, reflecting the reshaping effect of the competition on the structure of industrial enterprises. Enterprises may make adjustments in terms of settlement, expansion, or transformation.

4.1.3. Population structure dimension

Using the number of births as the core observation indicator, this study mainly examines the potential impact of the Asian Games on the natural growth trend and population structure of urban populations. By analyzing the changes in this indicator before and after the event, it is helpful to understand the indirect mechanism of the Asian Games on population structure in terms of population policy, fertility concepts, and social environment.

From the analysis of the difference data changes in the differential trend change model, it can be concluded that the direct impact of the Asian Games on natural population growth is relatively limited. However, it may have an effect through indirect factors such as changing social environment and fertility concepts, but this impact has not yet been fully manifested in the short term.

4.1.4. Technological Innovation and Industrial Economy Dimension

This dimension integrates indicators such as the number of patent authorizations, total current assets, and total industrial output value above designated size, focusing on the synergistic impact of the Asian Games on urban technological innovation capabilities and industrial economic development. By analyzing the changes in the linkage between the three before and after the event, the comprehensive effects of the Asian Games in promoting the transformation of scientific and technological achievements, promoting the operation of industrial enterprise funds, and expanding production scale can be clarified.

From the analysis of the difference data changes in the differential trend change model, it can be concluded that the competition promotes investment in technological innovation and output of achievements; The fluctuation of the difference between the total current assets and the total industrial output value above designated size reflects the adjustment of industrial economy in terms of capital operation and production scale. The three are interrelated, indicating that the Asian Games have played a promoting role in the coordinated development of technological innovation and industrial economy.

Figure 1 shows the change table of GDP difference.

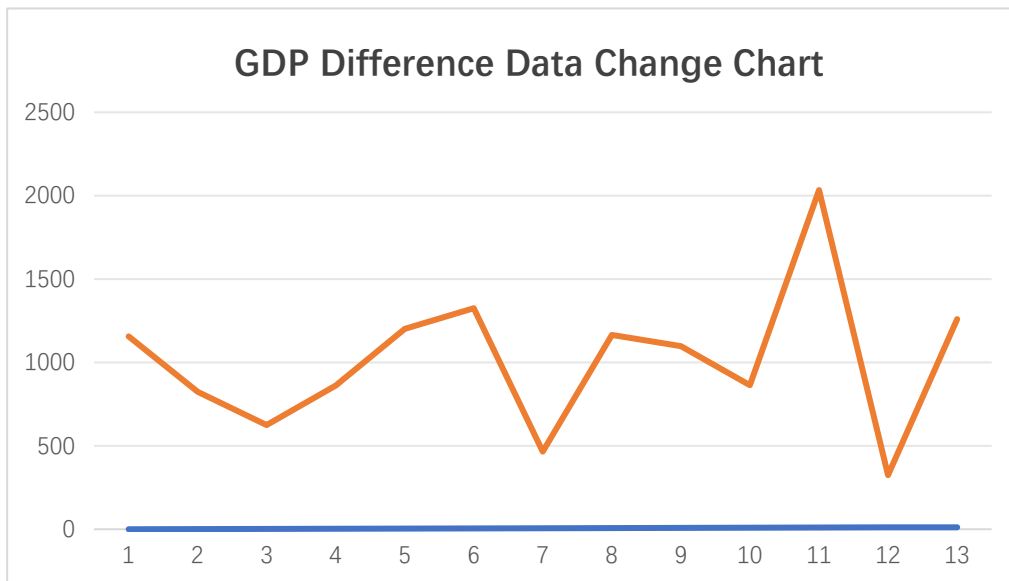


Figure 1. Annual GDP change chart

The main indicators affected by the Asian Games are concentrated in the dimensions of economic strength and industrial development, such as GDP, added value of the tertiary industry, and total retail sales of consumer goods. Among them, GDP, as the core measure of the overall economic scale, as shown in the GDP difference change chart above, shows significant fluctuations after 2022, fully reflecting the fundamental and comprehensive driving effect of the Asian Games on Hangzhou's economic growth. It is the core microcosm of urban economic development and has key guiding significance for overall development. Therefore, GDP is the most prominent indicator of the influence of the Asian Games, providing a core reference for evaluating the effects of the event and urban planning.

Then, key influencing factors were selected through cluster analysis, and the number of patent authorizations, total

current assets, and total industrial output value above designated size were grouped together to construct a core indicator system together with GDP, which reflects the total economic output. Among them, GDP, as the core indicator for measuring the scale of urban economy, plays a fundamental role in the evaluation of urban brand influence; The indicators of technological level focus on the synergistic effect between innovation capability and industrial economy, reflecting the driving role of competitions in technology transformation and industrial efficiency. Based on the Analytic Hierarchy Process (AHP), a judgment matrix is constructed, and the weights of indicators are determined through expert scoring and data verification. Finally, a model for evaluating the impact of the Asian Games is established as follows:

$$\text{Influence} = \text{GDP} \times 0.4 + \text{number of patent authorizations} \times 0.3 + \text{total current assets} \times 0.2 + \text{total industrial output value}$$

above designated size $\times 0.1$

According to the analysis of influence trends, GDP, with a weight of 40%, becomes the main driving factor, and its fluctuations directly reflect the comprehensive driving effect of the event on the urban economy. By predicting the future trend of GDP, the long-term evolution trend of Hangzhou's urban influence after the Asian Games can be quantitatively evaluated, providing scientific quantitative support for urban development planning and event effect evaluation.

4.2. The biggest influencing factor - GDP forecast

Next, we will forecast and analyze the future trend of GDP, quantitatively evaluate the long-term development trend of Hangzhou's urban influence after the Asian Games, and provide data-driven support for the scientific formulation of urban development plans and the objective evaluation of the effects of sports events. The GDP prediction using SVM regression model is shown in the following figure. As shown in Figure 2:

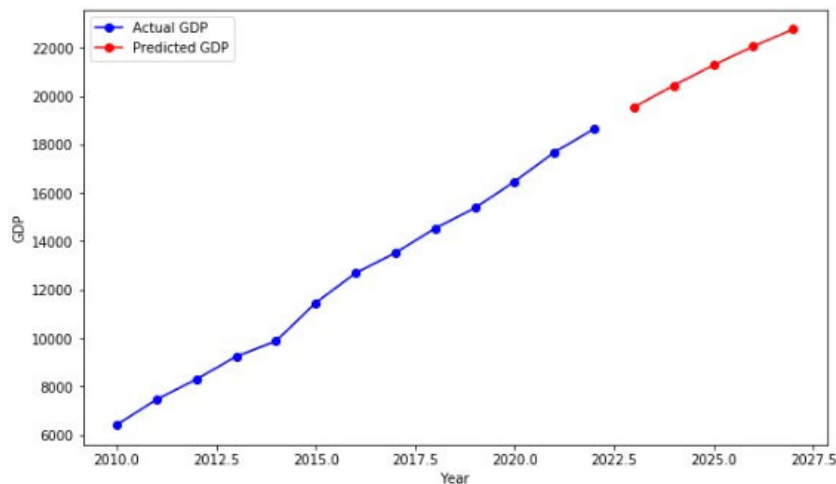


Figure 2. GDP forecast

Given that GDP has the highest weight (0.4) in the impact assessment model, as the core contribution indicator, based on the predicted trend of sustained GDP growth in the graph, an estimate of Hangzhou's future urban impact has been made. This fully verifies that GDP can effectively reflect the influence of the Asian Games, and its growth trend is closely related to the evaluation of influence, providing key support for subsequent evaluations.

5. Conclusions and Recommendations

5.1. Conclusions

1. After the 2022 Asian Games are scheduled to be held in Hangzhou, the city's GDP, number of patent authorizations, total current assets, and total industrial output value above designated size are all significantly affected by the Asian Games, and cluster analysis shows that the GDP attribute is most affected.

2. Use SVM regression model to predict the GDP of Hangzhou in the next five years. It is expected that the GDP of Hangzhou in the next five years will be 20820, 21847, 22874, 23901, and 24928, respectively.

5.2. Recommendations

From the conclusion of this article, it can be clearly seen that the Asian Games have significantly improved the economic development of the host city, indicating that large-scale events have a significant impact on the host city. To enhance the city's influence in multiple ways, more large-scale events can be introduced to promote economic

development, and the experience of hosting the Hangzhou Asian Games can be applied to more aspects. Research can further compare the sustainable development paths of major sporting events in Asia and Europe and America, providing "Asian experience" for global cities to drive high-quality development through sporting events.

Acknowledgements

This work was supported by the Undergraduate Research Program of Jiangnan University "Impact Analysis of Asian Games" (No.2024yb234) and the Teaching Research Project of Jiangnan University (Curriculum Ideology and Politics Special Project) "Construction of Ideological and Political Education and Evaluation System in Mathematical Modeling Courses" (No.KCSZ2432).

References

- [1] Qin Xiwen, Dong Xiaogang, Liu Ming, et al. Mathematical Modeling (Python Edition) [M], Tsinghua University Press, 2024
- [2] Wang Ming, An Empirical Study on the Impact of Major Sports Events on Urban Economy [J], Journal of Economic Research, 2018, 5, P83-95.
- [3] Zhang Tao, Analysis of the Impact of the Asian Games on the Development of Urban Tourism [J], Tourism Guide, 2019, 2, P56-67.
- [4] Li Juan, Research on the Promoting Effect of Major Sports Events on the Development of Urban Cultural Industry [J], Cultural Forum, 2020, 3, P112-125.