



# The Impact of the Beijing Winter Olympics on Regional Economic Development

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**Abstract.** The driving effect of post-Olympic venues and ice-snow tourism on the local economy is a critical issue in policy analysis and theoretical research. Building on the existing literature, this paper employs the Difference-in-Differences (DID) method to examine the economic stimulus effect of the 2022 Beijing Winter Olympics on host cities. Empirical results indicate significant post-event increases in GDP and per capita income in the host cities. This study provides insights for governments considering Olympic bids and strategies for sustainable development of the ice-snow economy.

**Keywords:** Winter Olympics, ice-snow economy, DID (Difference-in-Differences)

## 1 Introduction

Ice and snow sports play a pivotal role in fostering public participation in physical activities while serving as a catalyst for regional economic restructuring. Based on the development trajectory of ice and snow sports in China, it is evident that despite being a major sporting nation, China remains underdeveloped in ice and snow sports. Compared to Nordic countries such as Russia, China still has significant room for growth. The Beijing Winter Olympics, as the first Winter Games ever hosted by China, holds substantial significance for the development of the country's ice and snow sports.

In the lead-up to the 2022 Beijing Winter Olympics, the goal of "300 million people participating in ice and snow sports" was proposed, marking a pivotal shift from elite competition to mass participation and industrialization. This elevated the strategic importance of ice and snow sports, aligning it closely with national health policies and the winter tourism economy.

However, the sustainable use of the Olympic legacy faces serious challenges: ice and snow resources are constrained by seasonality, with southern regions relying heavily on energy-intensive artificial snowmaking technologies; venue facilities suffer from low post-event utilization rates and lack diversified operational models.

Existing research primarily focuses on the impact of the Olympics on tourism during the event, while lacking follow-up analysis on tourism economics and sustainable use

of facilities. There is also limited discussion on the high investment required for infrastructure of ice and snow sports. Therefore, this study begins by examining changes in tourism economics before and after the Olympics and compares China's experience with that of other countries that have hosted the Winter Games. It introduces the concept of sustainable facility development and explores how business model innovation can enable the efficient and sustainable use of Olympic venues and supporting infrastructure.

First, this study summarizes the collaborative models for the sustainable use of Winter Olympic legacies, including venues and railway infrastructure. It specifically examines whether the economies of host cities were affected by the Winter Olympics, evaluates the impact of the Games on the ice and snow tourism sector.

Using panel data from Chinese prefecture-level cities, this study distinguishes between a treatment group (cities directly influenced by the Beijing Winter Olympics) and a control group. Based on a Difference-in-Differences (DID) model, it analyzes the policy effects of the Winter Olympics. The empirical findings indicate that the Winter Olympics had a certain degree of positive impact on regional urban residents' income and regional GDP.

By analyzing the long-term economic effects of the Winter Olympics and the sustainability of its facilities, this study fills a research gap in the field of sports economics related to ice and snow sports. It holds positive significance for promoting the popularization of ice and snow sports in China and advancing the development of the ice and snow industry. The research provides data support for government policy-making on upgrading the ice and snow industry—such as the reuse of venues in Zhangjiakou and Yanqing—and for enterprise investment decisions in areas like ski equipment and tourism platforms. Furthermore, by promoting the widespread participation in ice and snow sports, the study contributes to the national health strategy and regional economic coordination.

In addition, the study enriches the theoretical research in sports economics and, to a certain extent, offers data support for exploring the popularization of non-mainstream sports such as ice and snow sports.

The rest of this paper is structured as follows. Section II summarizes the relevant literature. Section III shows research data, method and results. Section IV concludes.

## 2 Literature Review

Scholars have approached the study of the Winter Olympics from various perspectives, resulting in a diversified research landscape. However, existing research generally focuses on the fields of ice and snow sports and winter tourism. Chengcai T., Rui Z., and Yuanyuan Y. analyzed the current state and challenges of China's ice and snow tourism from a tourism perspective. They proposed improvement measures across multiple dimensions, including policy, products and services, and marketing. Their analysis offers specific insights into the industrial environment for youth sports development in the context of the Beijing Winter Olympics and provides valuable references for the high-quality development of China's ice and snow tourism. Moreover, they emphasize the

critical roles of technological innovation and community engagement in enhancing the ice and snow tourism experience [1].

In terms of ice and snow sports, many scholars have focused on the impact of the Winter Olympics on youth. For example, Ainsworth B. E. and Sallis J. F. studied the importance of physical activity for the physical and mental development of children and adolescents, while also discussing the potential of the Winter Olympics to increase youth participation in sports. Their article proposed strategies for leveraging the Games to promote winter sports among young people through education and encouragement [2].

Liu Yanqin also explored how the Winter Olympics can promote children's participation in ice and snow sports, covering aspects such as infrastructure development, policy support, and market promotion. Her study analyzed the Beijing Winter Olympics' role in advancing youth engagement in winter sports [3].

Regarding the impact of the Winter Olympics on regional economic development, existing literature has directly examined this effect using econometric methods. Jia Yuchen (2022) analyzed the economic development promotion of the 2022 Winter Olympics in the Zhangjiakou region by dividing the Olympic economic impact into direct and indirect effects [4]. Wang Hongmei and Lu Zhihui (2020) used a fuzzy regression discontinuity model to explore the impact of Beijing's successful bid for the Winter Olympics on the economic development of Zhangjiakou. Their results indicated that the successful bidding of the Winter Olympics not only promoted the economic development of Zhangjiakou through fixed asset investment and the development of the tertiary sector, but also significantly increased the income of both urban and rural residents in Zhangjiakou [5].

Ruan Fei et al. (2021) employed an input-output model to study the economic impact of the 2022 Winter Olympics on the Beijing-Zhangjiakou region. The results showed that the Winter Olympics drove an economic growth scale of 357.4 billion RMB in the region, with the GDP growth rates for Beijing and Zhangjiakou at approximately 0.28% and 5.58% per year, respectively [6]. Xin and Kunzmann demonstrated that the Winter Olympic venues had a short-term stimulating effect on the tourism economy of Zhangjiakou [7].

The Winter Olympics not only brought economic benefits but also environmental benefits. Yao (2023) studied the impact of the Winter Olympics on the economic development and environment of Beijing and Zhangjiakou. The study found that, in terms of the environment, air quality in Beijing improved, while the environment in Zhangjiakou worsened. Economically, the successful bid for the Winter Olympics had a significant positive effect on the economic development level of Zhangjiakou, but no significant impact on Beijing [8].

European countries, such as Norway and Switzerland, balance resource utilization with environmental protection through eco-friendly development models (Müller et al., 2021) [9]. The "Olympic Legacy Framework" proposed by the International Olympic Committee (Chappelet, 2003) emphasizes the reuse of venues and the long-term benefits for local communities.

This study uses the Difference-in-Differences (DID) model to quantify the intensity and dynamic changes of the Winter Olympic effects. By combining panel data from

2013 to 2023, it reveals the economic impact of Winter Olympic games, thus supplementing empirical evidence in the literature. Starting from two indicators, the study overcomes the inaccuracies associated with relying on a single economic metric, systematically analyzing the intrinsic logic of sustainable utilization of ice and snow resources and regional coordinated development. It also provides a theoretical supplement to global ice and snow economy research from the perspective of the Chinese context.

### 3 Research Methods and Results

#### 3.1 Research Methods

This study uses panel data from Chinese prefecture-level cities between 2013 and 2023, covering 295 cities across 31 provinces, with a total of 3,454 observations. The data sources include the National Bureau of Statistics, local statistical yearbooks, and special reports on the Winter Olympics. The core variables include GDP, the added value of the primary, secondary, and tertiary industries, fiscal revenue and expenditure, resident population, disposable income, and the balance of financial deposits and loans, among 16 other indicators. The treatment group consists of the cities directly impacted by the Winter Olympics (e.g., Zhangjiakou, Beijing), while the control group is selected from cities with similar economic development levels, industrial structures, and geographic conditions that did not host the Games (e.g., Bozhou, Anhui). Grouping is done using a dummy variable *treat* (treatment group = 1, control group = 0). A Difference-in-Differences (DID) model is employed to quantify the policy effects of the Winter Olympics. The model is specified as follows:

$$Y_{it} = \beta_0 + \beta_1 \text{Treat}_i + \beta_2 \text{Post}_t + \beta_3 (\text{Treat}_i \times \text{Post}_t) + \gamma X_{it} + \epsilon_{it}$$

In this model,  $Y_{it}$  represents the dependent variable (e.g., total GDP, urban residents' income),  $\text{Treat}_i$  is the dummy variable for the treatment group, and  $\text{Post}_t$  is the policy time dummy variable (taking a value of 1 for 2022 and beyond). Control variables  $X_{it}$  include the resident population size, the proportion of the tertiary industry, the share of fiscal expenditure in GDP, and the growth rate of deposit and loan balances, in order to control for factors such as population structure, industrial upgrading, and government intervention. The model construction and data processing are completed using Stata, applying two-way fixed effect to analyze the differential changes in the *treat\_post* treatment group after the policy implementation. The policy impact is further refined into three periods: the preparation period (2015–2021), the event period (2022), and the post-Olympics period (2023 and beyond), with a multi-period Difference-in-Differences (DID) model used to analyze the dynamic changes in effects.

### 3.2 Results

The regression results based on the Difference-in-Differences (DID) model are shown in Tables 1 and 2. The coefficients of the core variables reveal the impact of the Winter Olympics on regional economies.

**Table 1.** DID Regression Results (Total GDP)

Gdp_total	Coefficient	std. err.	t-statistics	P-value
treat	-386841.7*	1196540	-0.32	0.746
post	473596.3***	113946	4.16	0.000
treat_post	259125.5**	123408.8	2.10	0.036
Number of obs	2,894	-	-	-
R-squared	0.9395	-	-	-

Note: \*\*\*, \*\*, \* represent significance levels of 1%, 5%, and 10%, respectively.

This result indicates that although the hosting of the Beijing Winter Olympics had a positive effect on the regional economy and was statistically significant, the coefficient for the post variable is 473,596.3, with a standard error of 113,946, a t-value of 4.16, and a P-value of 0.000, which is significant at the 1% level. This suggests that during the Winter Olympics, the national regional economy exhibited a significant growth trend. The coefficient for the treat variable is -386,841.7, with a P-value of 0.746, which is not significant, reflecting that there is no marginal effect difference in GDP\_total between the treatment group and the control group. The interaction term treat\_post has a coefficient of 259,125.5, which is significant at the 5% level. This indicates that after the policy took effect, the GDP\_total in the treatment group significantly increased compared to the control group, demonstrating that the policy led to a notable increase in the treatment group’s GDP\_total. The overall model fit (R<sup>2</sup>) is 0.94, meaning that this model can cover 94% of the variation in the observed variables, suggesting a very good model fit.

**Table 2.** DID Regression Results (urban\_income)

Variable	Coefficient	Std. Error	t-stat	P-value	95% Conf. Interval
treat	5154.84***	448.83	11.49	0.000	[4274.78, 6034.90]
post	11098.26***	592.11	18.74	0.000	[9937.25, 12259.27]
treat × post	2945.36***	1121.87	2.63	0.009	[745.58, 5145.14]
Constant	31509.29	242.33	130.02	0.000	[31034.12, 31984.46]

Number of observations: 2,796

R-squared: 0.2112

Note: \*\*\*, \*\*, \* represent significance levels of 1%, 5%, and 10%, respectively.

The impact of the Winter Olympics on the income of urban residents in the host cities shows a positive trend. The coefficient for the interaction term (treat  $\times$  post) is 2,945.36, with a standard error of 1,121.872, a t-value of 2.63, and a P-value of 0.009, which is close to the significant threshold at the 1% level. This means the hosting of the Winter Olympics has a positive impact on the income of urban residents in the host cities. Specifically, prior to the Winter Olympics, urban residents in the host cities (treat) earned 5,154.84 yuan more than those in non-host cities (P-value < 0.001). After the Olympics, the income of urban residents in the host cities was 8,100.20 yuan higher compared to non-host cities, and this difference is highly statistically significant. Furthermore, during the Winter Olympics (post), urban residents' income across the country significantly increased by 11,098.26 yuan (P-value < 0.001), reflecting a positive overall economic growth trend.

The model's goodness of fit ( $R^2$ ) is 0.2112, indicating that approximately 21.12% of the variation in urban residents' income can be explained by the selected model, which shows a good overall fit.

Therefore, based on the above results, the hosting of the Winter Olympics has a certain degree of positive effect on the income of urban residents in the region. However, the intensity and significance of this effect require further in-depth analysis and discussion to identify potential influencing factors.

## 4 Conclusion

During the preparation period for the Winter Olympics, a series of investment activities effectively promoted the development of ice and snow venues, facilities, and equipment manufacturing. Taking the Beijing Winter Olympics as an example, the scale of China's ice and snow industry increased from 270 billion yuan in 2015 to 600 billion yuan in 2020, demonstrating strong growth momentum. To explore the effect of the Winter Olympics in boosting economic growth in the host cities, this paper conducts an empirical study using the DID method. The empirical results show that since 2022, the GDP and residents' income in the treatment group cities, as host cities, have significantly increased, with growth rates far exceeding those of the control group cities. This clearly indicates that the Beijing Winter Olympics had a significant short-term stimulating effect on the economic development of the treatment group cities. During the Winter Olympics, the number of visitors surged, and large-scale population movements not only boosted local consumption but also further promoted the construction of the Beijing-Tianjin-Hebei ice and snow economic belt. Cities have established resource-sharing platforms to complement each other's strengths, injecting new momentum into the overall national economic development. To achieve long run economic growth of host cities, it's necessary to develop ice tourism and use ice and snow venues efficiently.

This study enriches the theoretical framework of sports economics and provides a new case for the study of the economic effects of large-scale sporting events. It improves the theoretical framework for both short-term stimulation and long-term impacts of such events. The findings offer valuable reference for governments to evaluate the return on investment from major sporting events, help optimize resource allocation for

future event preparations, and provide strategic guidance for stimulating the economic during such events. However, due to the fact that the 2022 Winter Olympics were only held in Beijing and Zhangjiakou, the experimental group consists of only these two cities, which presents a challenge to the robustness of the regression coefficients. Given the time constraints post-Olympics, the analysis can only address short-term impacts, and the long-term effects remain unknown. Further research can analyze the long-term impacts once the time-series data is more complete, with particular attention to the effects of facility aging and technological updates on economic returns. Additionally, international comparative studies could be conducted to draw on the experiences of existing foreign models, combined with China's policy-driven and market-scale advantages, in order to refine the distinctive path for the high-quality and sustainable development of the ice and snow economy, offering a "China solution" to the global community.

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