Review of the economic aspect of Beijing 2022 Winter Olympic Games

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Abstract. To estimate whether holding the Beijing 2022 Winter Olympic Games could promote notable economic growth within a country or trigger the situation of government deficit to some extent, this article will first introduce two economic models, the Solow Growth Model and the Endogenous Growth Model, which are widely used to solve economic problems, then apply these two models to analysis this issue respectively by comparing to the precise data released by official institutions. Data from some authorities, the Beijing Organizing Committee for the 2022 Olympic and Paralympic Winter Games, and the National Bureau of Statistics of China were used to measure some variables affecting a nation’s economy, such as GDP per capita, TFP, capital, employment, and so on. Finally, through comparing relative variables in each model to determine two results about if Beijing 2022 Winter Olympic Games is positive for economic growth. Inevitably, each kind of model may have limitations that are not able to be adaptable to all sorts of situations, thus, in the last part of this article, some loopholes in analyzing this issue will be shown.

Keywords: Winter Olympic Games, economic Solow Growth Model, Endogenous Growth Model.

1. Introduction

Solow growth model is presented by Robert Solow in the 1950s as a kind of economic growth model [1]. This model provides a basic framework for the long-term economic growth [12]. This model must follow several fundamental assumptions: economic production is carried out by a combination of labor and capital; there is a phenomenon of diminishing marginal return on capital accumulation; the main driving force of economic growth is technological growth, which is not affected by other factors [12].

When the Solow growth model cannot explain growth well, population growth rate and capital information are considered explanatory variables [14]. Therefore, the growth rate of the economy can be determined by the interior of the model, and these models are called endogenous economic growth models. The core ideas indicate that technological innovation is one of the important driving forces of economic growth, and technological innovation is endogenous, driven by innovation and investment; accumulation of human capital, a high-quality labor force can improve labor productivity, thus promoting economic growth; capital market development, a good capital market can promote capital accumulation and investment, thus promoting economic growth [15].

The Olympic Games is one of the greatest comprehensive sporting events on the planet. The 1896 Athens Olympics kicked off the modern Olympic Games, which over the past 120 years have developed a complete system of operational and business models that have evolved and are constantly being challenged to keep up with the times. The Modern Olympic Committee uses a competitive bidding rotation model for event activities, therefore the Olympic Games have gradually become the target of competition between cities. However, there has been financial pressure to host the Olympic Games from the beginning until now. The Olympic Games are based on a delegation model, which means that the right to host the Games is granted to the city that succeeds in its bid. However, the Olympics are organized on a non-profit basis. Starting from the first Athens Olympics in 1896 until the 1984 Los Angeles Olympics, the Olympics were invested in by the government of the host city, with official operational decisions being made. For many countries and cities, the Olympic Games have almost become a costly and heavy burden, resulting in huge debts: the 1972 Olympic Games in Munich, Germany, lost $600 million; the 1976 Montreal Olympic Games lost $1 billion, and the city government was close to bankruptcy, known as the "Montreal Trap". The commercialization of the
Olympic Games is facing great difficulties. After 90 years of losing money and incurring losses, it was not until the 1984 Los Angeles Olympics that the Games made a profit for the first time in history [2]. However, the specific profit and loss of hosting an Olympic Games cannot be generalized. Thus, to better compare the economy of a city before and after the Olympic Games, Beijing can be selected as a specific example. Beijing hosted the 2022 Winter Olympics.

In the following paper, conclusions will be made by comparing the research process of the two models and the data before and after the Beijing 2022 Winter Olympic Games given by the government. However, loopholes in the model will be pointed out according to the actual situation of the research object, and the research results will be drawn on this basis.

2. Analyse and compare

2.1 Solow Growth Model

The model mainly describes the dynamic evolution process among the variables by solving or simulating the equation, quantitative prediction or analysis results about economic growth rate and steady equilibrium state can be obtained.

Production function
Describes how labor and capital are converted into output in the economic system, such as the Douglas production function

\[ Y = F(K, AL) \]

Y represents output, K represents the capital stock, L represents the amount of labor, and A represents the level of technology. The production function describes how the input of capital and labor determines the level of output.

Capital dynamic equation
The model assumes that the change of the capital stock over time follows a dynamic equation:

\[ \dot{K} = sY - \delta K \]

The rate of change in the capital stock, the savings rate, the depreciation rate, and the output. This equation describes the accumulation of capital in an economic system.

Population dynamics equation
Changes in the number of workers over time:

\[ \dot{L} = nL \]

\( \dot{L} \) represents the rate of change in the number of people in the labor force, and n is the rate of population growth.

(Only the most general form is recorded here, which will be improved and described in detail in the various references, reflected in the difference of notation and the change of formula form)

For example, an author have used Solow growth model to analyze the impact of corruption on an economy in 2022.

2.2 Endogenous Growth Model

Endogenous growth theory is a mathematical model that uses a set of differential or difference equations to describe the processes of innovation and technology accumulation within an economic system and their impact on economic growth.

Production function
Describes how knowledge, labor, and capital affect the relationship between total output. The basic production function is usually linear, convex:

\[ Y = F(K, L, A) \]

Y is the total output, K is the capital stock, L is the amount of labor, and A is the level of technology.

Capital dynamic equation
Describes the change of capital stock over time. Including investment, capital depreciation, and other factors that affect capital accumulation:

\[ \dot{K} = I - \delta K \]

Where, \( \dot{K} \) stands for the rate of change of the capital stock, I stands for investment and \( \delta \) stands for the rate of depreciation of capital.

Population dynamic equation
The change of population over time:
\[ \dot{L} = nL \]

\( \dot{L} \) is the rate of change in the number of people, \( n \) is the growth rate of the population.

**Knowledge accumulation equation** Emphasizes the importance of knowledge and technology accumulation for economic growth.

\[ \dot{A} = f(K, L, A) \]

\( K \) is the capital stock, \( L \) is the amount of labor, and \( A \) is the level of technology, and \( \dot{A} \) is the rate of change of technology level.

By solving or simulating these equations, one can obtain the steady state of the endogenous growth model, that is, the long-term stability level of the key variables in the economic system.

For instance, using endogenous growth model to analyze the impact of green innovation development on economy is a good study.

3. **Analysis of results**

Using two different models to analyze the economic changes before and after the 2022 Winter Olympics in Beijing, it is important to first have a basic understanding of the economic situation in Beijing, the city where the 2022 Olympics will take place.

The revenue of the Beijing 2022 Winter Olympics Organizing Committee is 15.39 billion yuan, equivalent to about 2.289 billion U.S. dollars; Expenditure 15.04 billion yuan, equivalent to about 2.237 billion US dollars; The balance is 350 million yuan, equivalent to about 52 million US dollars.[3]. China’s per capita GDP in 2021 was 80,976 yuan, up by 8.0 percent over the previous year; the gross national income in 2021 was 113,351.8 billion yuan, up by 7.9 percent over the previous year; the overall labor productivity was 146,380 yuan per person in 2021, up by 8.7 percent over the previous year [4]. China's per capita GDP in 2023 is 89,358 yuan, an increase of 5.4% over the previous year. China's gross national income in 2023 has reached 125.1297 trillion yuan, an increase of 5.6% over the previous year. The overall labor productivity is 161,615 yuan per person, up by 5.7 percent over the previous year [5].

China gross savings rate was measured at 45.9% in 2021, compared with 45.3% in the previous year [6]; Gross savings (% of GDP) in China was reported at 46.98% in 2022 [7]. The employment figure in 2021 is 746,520,000, while the number of employed people in China reached 740,410,000 in 2023 [4]. 212 technological innovations have been fully integrated into the Beijing Winter Olympics: Mainly around venue construction, weather, travel, opening and closing ceremonies, scientific training, athlete skills optimization, physical training and training monitoring, training base construction, high-performance competition equipment and other aspects of the deployment of tasks [8]. Although China's economy is gradually recovering, and there are innovations in many scientific and technological fields, China's high-tech industry is stuck in a bottleneck. Growth has slowed, and there has even been a precipitous decline. China's total factor productivity (TFP) growth has slowed to 2 per cent a year. As capital and labor encounter obstacles and total factor productivity growth declines, China's economy will shift from high-speed growth to medium-high growth [9].

Before comparing these two models, it is essential to consider two elements: endogenous and exogenous. The so-called endogenous variable is that in the system people set, the change of the system will lead to the change of the variable, and the change of the variable will also change the change of the whole system. In other words, the system and endogenous variables are mutually influencing and cause-and-effect. Exogenous variables are one-way: changes in this variable cause changes in the system.

The Endogenous Growth Model sees technological growth which is an exogenous variable in Solow model as an endogenous variable. This means that the origin of technological growth could be explained, and thus the saving rate and population would lead to long-term economic growth. Firstly, the growth of gross saving rate from 2021 to 2023 would bring the increase capital per capita and output per capita, which is beneficial to economic growth. Secondly, there will be fewer people in
2023 than in 2021, which means capital per person is spread more slowly, so this is also good for economic growth [10]. Consequently, even though the reduce of technological growth did lead the economy worse, the other two parts would still make the economy grow.

To begin with, Solow model indicates that changes in the capital stock are mainly caused by investment and depreciation. Investment increases capital; Depreciation is the depletion of the capital stock with the change of use and time. The accumulation of capital per capita gradually increased, which promoted the growth of GDP per capita. With the accumulation of capital, the depreciation rate increases; the more depreciation, the more investment is needed to keep the capital stock constant. Finally, the equilibrium of "capital formation = capital depreciation" is reached. At this time, capital per capita remains the same (increase = decrease), and the promoting effect of capital accumulation on economic growth disappears.

It is clear that an increase in the savings rate raises capital accumulation and increases capital per capita. The savings rate before the 2022 Beijing Winter Olympics was 45.9% in 2021, but grows to 46.02% in 2023. So it can be considered that capital accumulation has increased [11]. Secondly, In recent years, China's population has been aging and the ratio of men to women is out of balance, with 7,465.2 million people employed in 2021 and 7,404.1 million in 2023. The number of employed people has decreased in two years. A decrease in the human capital would lead a reduce in a nation's GDP. Thirdly, total factor productivity (TFP) is a rough measurement of a country's development in science and technology. China's TFP has been supporting GDP growth in a relatively stable manner, but the growth rate has weakened significantly in recent years. Therefore, China’s increase in the savings rate raises would trigger the temporary economic growth. Because diminishing returns to capital will leas the economy to a stable state, where economic growth depends only on exogenous technological progress, so a change in the savings rate doesn't affect the growth of the economy. Consequently, when China’s economy is in a steady state, the only factor, level of technology, decrease leads to an overall decline in economic growth in Solow Model.

Compared with the actual figures given by the officials, the Beijing Winter Olympic Organizing Committee in 2022 has an income of 15.39 billion yuan, equivalent to about 2.289 billion U.S. dollars; an expenditure of 15.04 billion yuan, equivalent to about 2.237 billion U.S. dollars; and a balance of 350 million yuan, equivalent to about 52 million U.S. dollars. To make the results more credible, a comparison of gdp per capita before and after hosting the 2022 Beijing Winter Olympics is even more convincing: china’s per capita GDP in 2021 was 80,976 MB, and China's per capita GDP in 2023 is 89,358 RMB. China's economic growth is evident around the 2022 Beijing Winter Olympics.

4. Limits and Discussion

When using the Solow model to analyze the national economic situation, many assumptions are unreasonable to set in this context: the model requires that the market is perfectly competitive; factors are perfectly mobile; it is completely free to buy and sell in the market without intervention by government. But in the background of the 2022 Winter Beijing Olympics, these assumptions are not realistic in China or even in many Asian developing countries, because the government has the right to control the market; the factors and commodities in the market are not free to flow; even the corruption of the government agencies is very serious at the grass-roots level, so the use of the Solow model in such a situation will have a big error.

Therefore, it is not fully appropriate to use these two models to analyze the profit and loss of the 2022 Beijing Winter Olympics. But when the assumptions are ignored, it is also possible to compare the different results of the two models. By comparing with reality whether the Olympic Games bring profits is not the most important thing, the most critical thing is to pay attention to the economic situation before and after the Olympic Games, to find out that the Olympic Games bring long-run economic push to a region or even the whole country, which makes economic development.
5. Conclusion

In conclusion, this article focuses on the issue of whether holding the Beijing 2022 Winter Olympic Games has a positive effect on the economic growth within China. Compared to other previous articles about whether the Olympic Games make a profit or lose, promote economic growth, or inhibit economic growth, this article uses two economic models that have not been used to study this topic before to determine through actual data. By comparing the data, like GDP, GDP per capita, employment rate, population, TFP, and so on, two different results are reached. However, the Solow model and endogenous growth model are good models for analyzing economic problems, but there are certain limitations in this research on "whether the Olympic Games gain profit or loss". Because the Solow model can not fully conform to the unique national conditions and economic structure of each country, the general analysis of the problem is not serious. Therefore, in this research and analysis, we can conclude that the Olympic Games can greatly promote the development of an economy, especially the series of late effects brought by the Olympic Games, by comparing the studies of multiple models and the actual data published by the official.

References


