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The Long-Term Impact of the 1998 Nagano Winter Olympic Games on Economic and Labor Market Outcomes†

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Abstract: This paper aims to assess the long-term effects of the 1998 Nagano Winter Olympic Games on various economic and labor market outcomes in Nagano City and its neighboring areas. One-shot and large-size events such as the Olympic Games are expected to boost the local economy and create jobs, thus leading to lower unemployment. In addition, the tightening of the local labor market eventually raises wages. Using the synthetic control methodology, we build counterfactual dynamics of various economic and labor market outcomes (GDP, per capita GDP, production by industry and a jobs-to-applicants ratio) for Nagano City and its neighboring areas, and then compare these with the actual data of these variables. This allows us to determine how the local economic and labor market outcomes in Nagano City and its neighboring areas would have been different had the 1998 Olympic Games not been held there.

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1. Introduction

This paper aims to assess the long-term effects of the 1998 Nagano Winter Olympic Games on area-specific GDP and labor-market outcomes in Nagano City and its neighboring towns and villages. One-shot and large-size events such as the Olympic Games are expected to create jobs, increase consumption, and boost GDP, thus leading to improved living standards. In addition, the tightening of local labor markets eventually lowers the unemployment rate and raises wages. It is not enough to evaluate the economic effect of events such as the Olympic Games in the short-term. It appears that the economic impact of the Olympic Games is positive in terms of local production and labor markets, but these positive effects may be temporary.

One issue that arises, therefore, is how long the positive effects on local labor markets and local economic conditions continue. Needless to say, it is important to assess the permanency of the effects of large-size events such as the Olympic Games. The local government that hosts the Olympic Games must increase infrastructure expenditure for the Olympic Games in the short term (for example, railways, roads and event venues). In compensation for the cost of the Olympic Games, the host must receive economic gains from the Olympic Games over the long term, such that the long-term benefits exceed the short-term costs. Therefore, it is necessary to consider both the short- and long-term effects of the Olympic Games.

Using the synthetic control methodology developed by Abadie, Diamond, and Hainmueller (2010) (hereafter ADH), we build counterfactual dynamics of various outcomes for Nagano City and its neighboring towns and villages, and then compare these with the actual data of these variables. This allows us to determine how the local economic and labor market outcomes in Nagano City and its neighboring areas would
have been different had the 1998 Olympic Games not been held there.

To measure the effects of the 1998 Nagano Winter Olympic Games on business and labor market conditions, we employ two types of time series datasets: System of National Accounts (SNA) and administrative data on job findings (*Shokugyou Antei Gyoumu Tokei*). We then use the synthetic control methodology developed to estimate the impact of the Nagano Olympic Games. This methodology enables us to construct a synthetic counterfactual outcome for the Nagano economy. The counterfactual outcome of Nagano Prefecture (treatment group) is calculated using the weighted average of outcomes of 46 other prefectures (control group).

The main findings are summarized as follows. To begin, we do not find evidence of a long-term positive impact of the Nagano Olympic Games on the local economy, in terms of both total GDP and per capita GDP. Using placebo tests, the difference between actual and counterfactual total GDPs of Nagano Prefecture is found to be reasonably, but not extremely, large, compared with other differences created by placebo studies, treating other prefectures as a treatment group. The same results are obtained for per capita GDP. It appears that the Nagano Olympic Games did not provide a boost to the local economy.

Another finding is that the Nagano Olympic Games did not have a significant impact on production in the construction and manufacturing sectors. However, the positive impacts were found in the real estate and service sectors. The placebo tests confirm that the Nagano Olympic Games had long-run, positive impacts on activity in the service and real estate sectors.

We next summarize our findings about the effect on local labor markets. The actual jobs-to-applicants ratio moves procyclically with economic activity after the
Nagano Olympics. The counterfactual ratio moves closely with the actual ratio, which implies that the difference between the two jobs-to-applicants ratios is very small over the sample period. In other words, we found that the actual jobs-to-applicants ratio is the same as what it would have been if Nagano City had not hosted the Olympic Games. Furthermore, we do not observe either a short- or long-run impact on the local labor markets where Olympic athletic events were held.

The remainder of the paper is organized as follows. We commence with a literature review in Section 2 and then provide an overview of the 1998 Nagano Winter Olympic Games in Section 3. We describe our data in Section 4 and the synthetic control methodology in Section 5. In Section 6, we present the estimation results. We then consider the expected impact of the 2020 Tokyo Summer Olympic Games and discuss their expected costs and benefits. The final section provides some concluding remarks.

2. Literature Review

This section reviews research papers relevant to our analysis of the impacts of the Olympic Games on local economic growth and employment.1 Whenever any city government announces its candidacy for hosting the Olympic Games, a dispute arises over whether the costs or the benefits are likely to be larger. Proponents often argue that a mega-event such as the Olympic Games results in job creation and boosts the local economy, but on the other hand, opponents often counter-argue that the benefits are overestimated and that the local residents will bear most of the cost of building new

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1 Another research direction is to estimate a production function of medals for the Olympic Games mainly using per capita GDP and population size (Bernard and Busse 2004; Ratheke and Woitek 2007).
venues and halls. Many researchers, including some economists, have put considerable effort into analyzing this dispute.

The results of Hotchkiss et al. (2003) supported the proponents for Olympic Games. They estimated the effects of the 1996 Atlanta Summer Olympic Games on employment and wages in local labor markets. Using county-level data from Georgia State, they treated counties where athletic events were held and their neighboring counties as a treatment group and the rest of the counties as a control group. A difference-in-difference method was then employed to identify the impact of the Olympic Games. One of the main findings was that the Olympic Games increased employment by 17% in the treatment group compared with the control group. However, they found that the impact on the relative monthly wage was weak. It is expected that labor supply increases quickly in response to an increase in labor demand, which consequently leaves the wage unchanged. Humphreys and Plummer (1995) also found a positive effect of the Atlanta Olympic Games because the short-run economic impact was $5.1 billion.

There are also studies that present opposite results. Baade and Matheson (2002) counter-argued that the economic impact of the Atlanta Olympic Games was minimal because public investments were inefficiently made with interference from local politicians. Jasmand and Maennig (2008) reported that the 1972 Munich Summer Olympic Games had no or only a small effect on a range of macroeconomic variables. Edds (2012) more comprehensively estimated the impact of the Olympic Games on economic growth. She chose three summer Olympic Games: Barcelona in 1992, Atlanta in 1996, and Sydney in 2000. She compared the economic outcomes of the states or regions where athletic events were held with those of the other states or regions within
the country, using regional data. The main finding was that these three Olympic Games did not have an impact on economic growth, apart from the construction sector in Barcelona.

How do these results compare to the economic effects of the Winter Olympic Games? Baumann et al. (2010) explored the effect on local labor market conditions of the 2002 Salt Lake City Winter Olympic Games that were held following the Nagano Winter Olympic Games. They employed two methods: ARIMA and a comparison analysis between a treatment group and a control group. The following six US states belonged to the control group: Arizona, Colorado, Idaho, Nevada, New Mexico, and Wyoming. They found that although the hospitality industry, which includes restaurants and hotels, benefited from the Olympics, retailers such as general merchandisers and department stores incurred losses. Baumann et al. (2010) additionally found that the losses exceeded the gains, thereby concluding that the Olympics Games did not increase growth within the local economy. Spilling (1996) and Teigland (1999) considered the effect of the 1994 Lillehammer Winter Olympic Games. Spilling (1996) showed that the tourism industry was thriving, but that other industries did not benefit from the Olympics Games. Teigland (1999) found that the Olympic Games did not provide an economic benefit even to the tourism industry.

Overall, the research presents mixed evidence on the economic effects of the Olympic Games. In fact, several studies on sports economics concluded that the economic impacts of the FIFA World Cup as well as of the Olympic Games are minimal (Baade and Matheson 2004; Hagan and Maenning 2007, 2008).

Given this evidence, why do so many cities announce their candidacy to host a mega-event such as the Olympic Games or the FIFA World Cup? Rose and Spiegel
(2011) addressed this question and showed that the Olympic Games have side effects on the hosting country; that is, the host increased its export volume by 20%. They also showed that this effect was large and permanent. In addition, a similar effect was obtained even for countries that lost their bid to host the Olympic Games.

To date, it appears that these studies have focused particular attention on the short-run effects of a mega-event, the Olympic Games in particular, rather than the long-run effects. Even though the short-run effects are small, if they are permanent, the accumulated effect could be enormous. Therefore, the impact of the Olympic Games must be measured in terms of both the short- and the long-run effects.

3. The 1998 Nagano Winter Olympic Games

This section provides an overview of the 1998 Nagano Winter Olympic Games. This Winter Olympic Games was hosted mainly by Nagano City, the prefectural capital of Nagano Prefecture. Nagano Prefecture is one of 47 prefectures in Japan, and is located in the center of Honshu Island. At more than 5,000 square miles, Nagano Prefecture is the fourth largest prefecture in Japan with a population of more than two million as of 2015, the sixteenth largest in Japan. Nagano Prefecture is located high above sea level and is surrounded by mountains on all sides. Therefore, there are many ideal locations for winter sports, such as ski areas, cross-country roads, and a ski-jumping stadium, and the prefectural residents are very active in these winter sports.

With strong support from local politicians and businesses, Nagano City teamed up with the Nagano prefectural government and won a national selection over Morioka City (Aomori Prefecture), Yamagata City (Yamagata Prefecture), and Asahikawa City (Hokkaido Prefecture) to bid to host the 1998 Winter Olympics. Subsequently, Nagano
City edged out Salt Lake City (UT, USA) in the international rounding of bidding at the International Olympic Committee Meeting in June, 1991. Nagano City became the host of the Winter Olympic Games for the first time in Japan since Sapporo in Hokkaido hosted the games in 1972.²

Nagano City is located in the northern part of Nagano Prefecture, with an area of 322 square miles and a population of approximately 38,000, which makes it the largest city in Nagano Prefecture. The current area and population sizes are larger than when the Olympic Games were held in 1998 because several neighboring small villages were merged into Nagano City in 2005 and 2010.

Nagano City and Nagano Prefecture commenced preparation for the Olympic Games long before the Games were opened. After Nagano City was selected as the host, the Japan Olympic Committee, Nagano City, Nagano Prefecture, and other municipalities created the Nagano Organizing Committee (NAOC). NAOC planned to organize 14 athletic events, plus the opening and closing ceremonies in Nagano City and its neighboring towns and villages (Yamanouchi Town, Hakuba Village, Karuizawa Town, and Nozawa–Onsen Village). Figure 1 displays a map of Nagano Prefecture and indicates the locations of the athletic events. In fact, the athletic events were all held in the northern part of Nagano Prefecture, and consequently, new venues for the events were constructed within the small land area of Nagano Prefecture. Jobs were created largely in response to increased labor demand within the construction sector, but only in Nagano City and its neighboring towns and villages. The positive impact of the Olympic Games was heterogeneous across Nagano Prefecture.

NAOC decided to construct five event venues within Nagano City. In addition,

² The 1940 Winter Olympic Games were scheduled to be held in Sapporo, but were canceled because of World War 2.
it constructed the Olympic Village where athletes lived during the Olympic Games, the Main Press Center for the media, and the opening/closing ceremony hall. Table 1 shows the construction costs of these event venues and the financial burdens incurred by the national, prefectural, and city governments. The total cost was JPY129 billion, and the national government incurred the heaviest financial burden of 42.6% of the total cost. The second heaviest burden was incurred by Nagano City (31.8%).

NAOC started to construct these event venues after it was announced that Nagano City was to be the host of the Olympic Games, and these facilities were completed by 1997. NAOC also renovated the ski-jumping stadium located in Hakuba Village and a hall for curling in Karuizawa Town, and constructed a racing road for the biathlon in Nozawa-Onsen Village. Existing facilities were also used for other athletic events.

Significant effort went into the construction of venues for the games, but the work went far beyond that. The Ministry of Transport (currently, the Ministry of Land, Infrastructure, Transport and Tourism) built a new track for the Shinkansen bullet trains between Takasaki Station and Nagano Station in Nagano City, and the line was opened in October 1997, just before the Olympic Games were opened. The Shinkansen bullet train can deliver passengers directly and quickly from Tokyo Station to Nagano Station via Takasaki Station. It should be noted that this line was not built only for the 1998 Nagano Winter Olympic Games. The Ministry of Transport originally planned to build a bullet-train line between Tokyo and Komatsu in Ishikawa Prefecture, located in the

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3 National ministries and agencies were reorganized in 2001, and the Ministry of Transport, the Ministry of Construction, the National Land Agency, and the Hokkaido Development Agency were merged into the Ministry of Land, Infrastructure and Transport. In 2008, the Tourism Agency was incorporated to form the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). The railroad, including Shinkansen bullet trains, was under the jurisdiction of the Ministry of Transport at the time.
middle of Honshu Island on the Sea of Japan coast. Nagano Station was one of the stations on the track.⁴

The Ministry of Transport also built a highway from Fujioka in Gumma Prefecture to Joetsu City in Niigata Prefecture via Nagano City in parallel with the new Shinkansen bullet-train line mentioned above. The highway between Nagano City and Fujisaki was open to traffic before the Winter Olympic Games. Because a highway between Tokyo and Fujisaki already existed, cars could then travel from Tokyo to Nagano City. The NAOC and government at all levels put great effort into preparing venues and public transportation following the announcement of Nagano City as the host of the 1998 Winter Olympic Games.

The Nagano Winter Olympic Games began on February 7, 1998. Seventy-two countries, 2,305 athletes, and 2,333 coaches and staff members participated in the Games.⁵ The participating athletes competed in 7 categories and 68 events.⁶ Around 2.3 million people attended the events and ceremonies. In addition, approximately 32,000 people served as volunteers. Because many people stayed in hotels and purchased consumption goods in Nagano City and its neighborhoods during the Olympic period, it was expected that local businesses would thrive. The Games drew to a successful close on February 22, 1998.

We expect that the Nagano Winter Olympic Games stimulated the local economy. Construction firms were encouraged to construct or renovate event venues and transportation facilities, which created many jobs in the construction sector and thereby lowered the unemployment rate. During the Olympic Games period, businesses

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⁴ The new Shinkansen bullet-train line was opened on March 18, 2015 between Nagano and Kanazawa, prefectural capital of Ishikawa, just before Komatsu.
⁵ The number of Japanese athletes was 166, and the number of coaches and staff members was 183.
⁶ Japan won five gold medals, one silver medal, and four bronze medals.
in the service sector were flourishing, which also created jobs in the service sector and thereby lowered the unemployment rate. In addition, an increase in labor demand is expected to raise the wage, leading to an increase in consumption. The Nagano Winter Olympic Games boosted the local GDP in Nagano City and its neighboring areas.

According to a report by the Nagano Economic Research Institute (1999), while the initial investment for the Olympic Games was JPY1,651 billion, the spillover effects to Nagano Prefecture and the rest of Japan were JPY4,680 billion and JPY2,455 billion, respectively. Approximately 70% of the initial investment went to the public sector to construct the Shinkansen bullet-train line and highways. The institute also estimated that public investment between 1987 and 1996 raised the prefectural GDP growth rate of Nagano by an average of 1.82%, and showed that it accounted for about 40% of the economic growth across Nagano Prefecture over the same period.

There were demerits to hosting the Olympic Games. As mentioned before, both Nagano City and Nagano Prefecture incurred debt to finance the cost of building and renovating event venues and other facilities. In particular, Nagano City issued city debt securities to raise JPY12.7 billion in 1992, one year after Nagano City was selected as the host, and issued triple that amount of city debt securities in 1993, according to Nagano City’s Financial Report released in 2010. Nagano City then issued city debt securities of more than JPY10 billion every year until the opening year of the Olympic Games (1998). Although Nagano City continued to issue city debt securities even after the Olympic Games, the issuance amount has been relatively small.

It was hoped that Nagano City would be able to repay the debt incurred in the preparation for the Olympic Games using the additional tax revenue received from the higher level of business activity during the Games, but it appears that the Games were
not successful enough to allow all of the debt to be repaid. According to the Financial Report, the amount of city bonds on issue was JPY7.7 billion as at 1991, but since then city debt has been ballooning. In 2000, the amount of city bond on issue exceeded JPY20 billion. As at 2009, the amount had increased to JPY22.7 billion, which was comprised of a principal of JPY19.7 billion and interest of JPY3 billion. People living in Nagano City still shoulder the burden of the debt used to finance many public projects. It should be noted that the ballooning city debt was attributable not only to the cost of the Olympic Games, but also to a decrease in tax revenue because of decreases in the population size and the labor force.

4. Data
This section introduces the datasets used in our analysis. Because we aim to measure the long-term effects of the 1998 Nagano Winter Olympic Games on business and labor market conditions, we utilize two types of datasets covering the period from before Nagano City was selected as the host to long after the Olympic Games were closed: SNA and administrative data on job findings (Shokugyou Antei Gyoumu Tokei). The first dataset includes various variables on prefectural-level GDP, population size by prefecture and the value of final production by industry over time. This dataset was released by the Cabinet Office, Government of Japan. We use SNA covering the period between 1985 and 2009, during which Nagano City won domestic and international bids to host and organize the Olympic Games. We analyze these data more than 10 years after the close of the Olympic Games because our objective is to measure how long the economic impact of the Olympic Games lasts.

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One thing that we should consider is that SNA changed the data format in 1993 and that the new format (SNA93) was applied in 1996. In fact, both the old and new formats (SNA68 and SNA93) were applied in the four years after 1996, and only SNA93 has been used since 2000. There are two differences between the two formats. The first is that medical services were moved from the category of household final products to the category of government final products. Secondly, order-taking software was moved from the category of household final products to the category of gross fixed capital formations. The way of categorizing final products has changed, but the method of measuring the value of production remained unchanged. Therefore, there are no significant differences in prefectural-level GDP and other final production not related with medical services and order-taking software between under the old format and under the new format. We used SNA68 until 1999 and then employed SNA93 from 2000.

As mentioned in the previous section, the local economy was thriving particularly in the construction and service sectors. We first focus particular attention on these sectors, and additionally, the real estate and manufacturing sectors. It should be noted that we measure GDP and final production using the GDP deflator on the basis of the 1995 price level. Table 2 shows descriptive statistics of SNA.

The second objective of this paper is to investigate the impact of the Nagano Olympic Games on the local labor market. To address this issue, we employ the second dataset (administrative data on job findings) that contains monthly data on the numbers of job seekers and job vacancies by local employment service offices across Japan. The dataset is compiled by the Japanese Ministry of Health, Labour and Welfare. The dataset provides information on local labor market conditions in the area administered by each
local public employment service office.

The administrative data has two merits for our analysis. First, there is no geographical bias because the dataset comprehensively covers job seekers and job vacancies registered in local public employment service offices throughout Japan. On the one hand, we treat job seekers and job vacancies registered in the local employment service offices located in Nagano City and its neighborhoods as the treatment group, but on the other hand, those registered in employment service offices located in other areas of Nagano Prefecture and other prefectures are treated as the control group. There is no geographical bias for the control group, so we believe that this group is a valid measure. The second merit is that there is no self-selection bias because respondents are not allowed to self-select in the collection of data for administrative reasons.

On the contrary, there are two significant shortcomings of this dataset. First, there is the possibility that aggregate bias arises because data are aggregated by local employment service offices at a monthly frequency. The second shortcoming is sample selection bias, in that this dataset only captures job seekers and job vacancies registered at local employment service offices. Therefore, this dataset excludes unregistered job seekers and unregistered firms with vacancies. Although this dataset has these shortcomings, it is among the best available because the dataset comprehensively covers labor market conditions in local areas throughout Japan.

In our analysis, we use data on job seekers and job vacancies from local employment service offices within Nagano Prefecture and prefectural-level data on those from the other 46 prefectures. All games and related events were held in the

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8 The characteristics of the administrative data on job findings are also discussed in Sasaki et al. (2013).
9 We will explain in more detail later how to distinguish between the treatment and control groups.
northern part of Nagano Prefecture, including Nagano City and its neighboring towns and villages, thus implying that the economic impacts of the Olympic Games are likely to be heterogeneous across Nagano Prefecture. The impacts of the Olympic Games on the local labor market might be underestimated when the entire labor market of Nagano Prefecture is categorized as the treatment group using the prefectural-level data from Nagano Prefecture. It is necessary to distinguish between the treatment and control groups within Nagano Prefecture, taking into account the extent of the spillover effect within Nagano Prefecture.

There are 10 local employment service offices in Nagano Prefecture and five offices are located in the northern part: Nagano (Nagano City), Sasanoi (Nagano City), Iiyama (Iiyama City), Susaka (Susaka City), and Oomachi (Oomachi City). Because Nagano City is the biggest city in terms of the size of the economy and population size, two employment service offices are located there. In the central part of Nagano Prefecture, there are four employment service offices: Ueda (Ueda City), Saku (Saku City), Matsumoto (Matsumoto City), and Suwa (Suwa City). Matsumoto City is the second biggest city in terms of the size of the economy after Nagano City. Suwa City is one of Japan's precision machinery parks. In the south part of Nagano Prefecture, where the population is relatively small compared with the northern part, three employment offices are located: Kiso-Fukushima (Kiso Town), Ina (Ina City), and Iida (Iida City). One of the main industries in these areas is forestry.

Next, we describe how we distinguish between the treatment and control groups in analyzing the impact of the Olympic Games on local labor market conditions. To observe the difference between the two groups comprehensively, we suggest three types of grouping: narrow, broad, and in-between. We choose job seekers and job
vacancies registered in the employment service offices located in the northern areas apart from Oomachi and Iiyama: that is, Nagano, Sasano, and Susaka are the treatment group. Because the majority of athletic events were held in Nagano City, we predict that the impact of the Olympic Games was huge and limited primarily to Nagano City. Susaka City is located next to Nagano City, so we predict that the spillover effect also reached Susaka City. In contrast, the control group includes job seekers and job vacancies registered in other employment service offices in Nagano prefecture and the other 46 prefectures. To define the in-between grouping, we add job seekers and vacancies registered in four more employment service offices into the narrow grouping: Oomachi, Iiyama, Ueda, and Saku. Some athletic events were held in local areas under the jurisdiction of those employment offices. Finally, the broad category covers job seekers and job vacancies registered in all employment service offices in Nagano Prefecture. The rest of the prefectures are used as the control group. Descriptive statistics are provided in Table 3.

5. Econometric Specifications

To estimate the impact of the Nagano Olympic Games on the local economy and labor markets, we need to compare the actual outcome caused by the Olympic Games with the counterfactual outcome that would have been observed if Nagano City had not been selected as the host. To do so, we employ the synthetic control methodology developed by Abadie, Diamond, and Hainmueller (2010). This methodology allows us to construct a synthetic counterfactual outcome for the Nagano economy. ADH estimated the effect of a tobacco-control program implemented in California in 1988, Proposition 99, on statewide tobacco consumption. They treated other US sates as a control group,
estimated the counterfactual outcome of tobacco consumption in California that would have been observed in the absence of the implementation of the tobacco control program, and compared it with the outcome that was actually observed. They found that annual per capita cigarette sales were lower by about 26 packs than what would have been without Proposition 99.

DuPont and Noy (2013) also employed the ADH methodology to estimate the long-term impact on prefectural economy and labor market conditions of the 1995 Hanshin-Awaji Earthquake that occurred around Kobe and Osaka, Japan. Although many people believed that Kobe’s economy had recovered quickly after the quake, DuPont and Noy (2013) concluded that the adverse effect had continued for at least 15 years after the quake occurred. The per capita GDP in 2007, 15 years after the quake, was lower by JPY500,000 than what it would have been without the quake.

DuPont and Noy (2013) mentioned that the ADH methodology was appropriate for investigating the long-lasting impact of an exogenous event such as an earthquake on various economic outcomes of limited regions. We think that the ADH methodology is also appropriate for our analysis. There are two reasons for this. First, winning the domestic and international selections to be the host of the Olympic Games is unexpected and thus exogenous, perhaps not for politicians and business people who had promoted Nagano City as a contender host, but more so for people residing in Nagano City and its neighboring areas. Residents knew that Nagano City had been a host candidate, but they had not participated in the promotion of Nagano City as a host for the Olympics. Therefore, hosting the Olympic Games can be considered an exogenous shock for the residents. Secondly, as explained above, all athletic events including the opening/closing ceremonies were held in Nagano City and its neighboring
towns and villages. Therefore, only a few areas benefited substantially from the Olympic Games, thereby allowing us to identify accurately the effects of exogenous events such as the Olympic Games on the economic outcomes observed in a limited number of areas. Finally, the ADH methodology allows us to estimate the long-term impact of the Olympic Games. It is obvious that the Olympic Games had positive short-term impacts on Nagano’s economy. Our objective in this analysis is to determine how long this positive effect lasted; that is, we need to estimate the long-term impact of the Olympic Games.

We briefly describe our empirical model using the ADH methodology. There is the area-level dataset on various economic outcomes over \( T \) periods \((t=0, 1, 2, \ldots, T_0, \ldots, T-1, T)\). Let \( T_0 \) denote the timing of an exogenous event. Therefore, the subdataset covering \( t=1 \) to \( t=T_0-1 \) indicates the pre-event dataset, and the rest of the dataset is the postdataset. In our analysis, we set up three different timings of the event occurrence. The first one is the point in time when Nagano City won the international selection and became the host in 1991, and the second timing is when the Olympic Games were opened in 1998. Finally, in measuring the impacts of the Olympic on local GDP and sales by industry, using SNA, we also show the results using 1988 as the turning point, which is the year that Nagano City was elected as a national candidate.

Let \( X_{it} \) denote a variable indicating an economic outcome in area \( i \) at time period \( t \). Suppose there are \( N \) areas in the economy. These \( N \) areas are divided into treatment and control groups. We provided an explanation previously about how to distinguish between the two types of groups. We define the areas \( i=1, \ldots, N_0-1 \) as the treatment group, while the rest of the areas is defined as the control group. Let \( Y^T_t \) denote the sum of \( X_{it} \) from \( i=1, \ldots, N_0-1 \) at time period \( t \), with the superscript \( T \) indicating
the treatment group. For convenience, we redefine $X_{it}$ from $i = N_0, \ldots, N$ as $X_{it}^C$ with the superscript $C$ indicating the control group. The ADH model assumes that the exogenous event does not have any impact on economic outcomes before time period $T_0$. This assumption is acceptable because people residing in Nagano City and Nagano Prefecture did not expect the city to host the Games and had not assisted in the bid for the Games.

We directly compare $Y_t$ with its counterfactual outcome denoted by $\hat{Y}_t$ for time period $t \geq T_0$. Because $\hat{Y}_t$ are not observed after the postevent period ($t \geq T_0$), we need to calculate the counterfactual values. According to the ADH methodology, the counterfactual outcome can be calculated as the weighted-average of outcomes from the control groups ($X_{it}^C$). Using the pre-event data, the estimating equation is given by:

$$Y_t = \alpha + \sum_{j=N_0}^{N} \omega_j X_t^C + \varepsilon_{it}, \quad t < T_0,$$

where $\omega_j$ represents the coefficient on the weighted average of a control group $j$, and $\varepsilon_{it}$ indicates an $iid$ shock with a mean of zero. The coefficients on the weighted average are assumed non-negative. The counterfactual economy calculated by the weighted average of the control groups shares a similar economic structure to the economy of the treatment group, and there is no difference in the impact of other external shocks (except the event and $iid$ shocks) between these two economies. We can thus identify accurately the effect of the exogenous event on the outcome variables by ($Y_t - \hat{Y}_t$) over $t \geq T_0$.

To evaluate whether or not ($Y_t - \hat{Y}_t$) is significant, Abadie et al. (2010) suggested the following placebo tests. We calculate the difference between an actual value obtained from a treatment group and a counterfactual value calculated by the
weighted average of control groups as if the Olympic Games were held in each different control group. For example, we proceed as if the Olympic Games were held in area $N_0$, in which case $X_{N_0t}^C$ is treated as the outcome from the treatment group. The rest of the outcomes ($Y_t^T$, $X_{N0+1t}$, $X_{N0+2t}$,....$X_{Nt}$) belong to the control groups. In a similar manner, we calculate the $(N-N_0+1)$ differences, assuming that each outcome from the control groups is treated as the one from the treatment group.

We then need to check two things. The first one is the MSPE (the mean of the squared prediction error between an actual value and its counterfactual value) of $(Y_t^T - \bar{Y}_t^T)$ and the median MSPE among $(N-N_0+1)$ estimates during the pre-event period. If these two MSPEs are relatively small, we can conclude that the synthetic control methodology provides a good fit for the outcome. Secondly, we check whether the difference $(Y_t^T - \bar{Y}_t^T)$ is different in magnitude from the $(N-N_0+1)$ differences created by the placebo tests during the post-event period. If the difference $(Y_t^T - \bar{Y}_t^T)$ is larger or smaller than the $(N-N_0+1)$ differences, we can conclude that the impact of the event on the outcome is significant. Otherwise, our interpretation is that its impact is insignificant.

Because the counterfactual outcome is calculated by the weighted average of the control groups, the error terms of all the control groups are canceled each other out. It implies that the counterfactual outcome does not have a standard deviation. Therefore, the ADH methodology does not allow us to conduct hypothetical test to determine whether or not the estimates are statistically significant.

6. Results

6-1. The Impacts on Local GDP and Sales by Industry

We begin with the long-term impact of the 1998 Nagano Winter Olympic on prefectural
GDP, per capital GDP, and productions by industry. We select four industries: construction, services, real estate, and manufacturing because these industries are more likely to have been affected by a mega-event such as the Olympic Games. Figures 2-1, 2-2 and 2-3 display both the actual and counterfactual trends in Nagano Prefecture’s GDP by three different event timings. Using prefectural-level data from SNA, we define Nagano Prefecture as the treatment group, while the other 46 prefectures are the control group. The counterfactual value of total GDP of Nagano Prefecture is calculated by the weighted average of per capita GDP of the other 46 prefectures.

Figure 2-1 shows the case in which the event occurrence is defined by the year 1991 when Nagano City was selected as the host. The actual GDP is slightly lower than the counterfactual one a few years after 1991, but its relationship turns out to occur in reverse. Nagano Prefecture’s GDP is persistently larger when Nagano City was selected as the host than what it would have been if Nagano City had not been selected. We obtain the same result in a case in which the event occurrence is defined by the year 1988 when Nagano City was selected as the national candidate (Figure 2-3). Nagano Prefecture’s GDP obviously exceeds what it would have been if Nagano City had not won the national selection against other domestic candidates. However, the difference between the actual and counterfactual values in Nagano Prefecture’s GDP is small in the case in which the event occurrence is defined as the year 1998 when the Nagano Olympic Games were opened (Figure 2-2). The year 1998 might not be an appropriate event point because people across Nagano Prefecture had already gained economic benefits from the Nagano Olympic Games even before the Games were opened, which contravenes an assumption of the synthetic control method.

Looking at per capita GDP (Figures 3-1, 3-2, and 3-2), the same results are
obtained; actual per capita GDP is larger than the counterfactual per capita GDP of Nagano Prefecture, except partially when the event point is the year 1998. From these results for prefectural-level GDP and per capita GDP, it appears that the Nagano Olympic Games boosted the Nagano Prefecture’s economy in the long run.

To evaluate whether or not this is true, we ran placebo tests. Due to space limitations, we only present the results of placebo tests in which the event point is 1991 when Nagano City won the international selection as the host. Figure 2-4 shows the differences between actual and counterfactual GDP in Nagano Prefecture and the other 46 prefectures created by the placebo tests. A thick line indicates the difference in Nagano Prefecture. As seen in the graph, the difference in Tokyo is extremely large in both the pre- and postevent periods. This implies that Tokyo is the prefecture with the worst fit. Tokyo’s economy is the largest in Japan; therefore, Tokyo’s counterfactual GDP cannot be produced by a convex combination of GDP from the other prefectures. Tokyo’s MSPE before the event is very high, thus implying that Tokyo’s difference has poor fit and is not useful for measuring the validity of the difference in Nagano Prefecture. Figure 2-5 excludes Tokyo and additionally, other prefectures that have MSPEs over the pre-event period that are more than five times larger than Nagano, from Figure 2-4. The difference in Nagano after the event (thick line) was relatively large compared with those in the other prefectures, but was not substantially the largest. Our analysis does not provide significant evidence that the Nagano Olympic Games had a long-term positive impact on the local economy. The placebo results for per capita GDP are similar; the difference in per capita GDP in Nagano Prefecture is relatively large, but not the largest, compared with the differences for the other 46 prefectures created in the placebo tests. Again, we cannot conclude that the Nagano Olympic Games boosted the
local economy.

Next, we consider the effects of the Olympic Games by industry: construction, services, real estate and manufacturing. In a similar manner, we show both actual and counterfactual production by industry for three different event timings. We begin with the construction sector. According to Figures 4-1, 4-2 and 4-3, actual production started increasing in 1991 and reached a peak in 1996–97 before the Olympic Games were opened, and since then it has been on the decline. The construction sector was flourishing before 1998 because of increased demand for venues. However, the counterfactual production is on the decline after 1991. The difference between the two trends is small except for the late 1990s. According to the placebo tests, excluding Tokyo and other prefectures that have MSPEs more than five times larger than Nagano Prefecture (Figure 4-5), the difference between actual and counterfactual production in the construction sector is not very different from the differences obtained from the placebo studies on the other remaining prefectures over the sample period.\textsuperscript{10} These placebo tests confirm that the Nagano Olympic Games had neither a short-run nor a long-run, positive impact on activity in the construction sector. We obtain a similar result when the event occurrence is defined as the year 1988 (Figure 4-3). In contrast, the difference between actual and counterfactual production is negligible when the event occurrence is defined as the year 1998 (Figure 4-2).

We next focus on the service sector. According to Figures 5-1, 5-2 and 5-3, both actual and counterfactual production increased over the sample period, and the difference between the two production levels was reasonably large, regardless of when

\footnote{10 The prefecture with the largest difference between actual and counterfactual production in the late 1990s is Hyogo Prefecture. This might capture an increase in demand in the construction sectors to recover from the Great Hanshin-Awaji earthquake that occurred in 1995.}
the event point is set. In fact, the placebo studies, excluding Tokyo and other prefectures that have MSPEs more than five times larger than Nagano Prefecture (Figure 5-5), show that the difference between actual and counterfactual production in Nagano Prefecture is the second highest and far higher than the third largest prefecture. We interpret that the impact of the Olympic Games was found in the long term.

Similarly to the service sector, both actual and counterfactual production in the real estate sector increased over the sample period, regardless of when the event occurrence is defined (Figures 6-1, 6-2 and 6-3). In addition, the difference between actual and counterfactual production was negligible in the 1990s, but in the 2000s, actual production was much larger than counterfactual production. The Nagano Olympics induced population inflow into Nagano Prefecture, which resulted in an increase in housing demand. According to the placebo tests, excluding Tokyo and other prefectures that have MSPEs more than five times larger than Nagano Prefecture (Figure 6-5), the difference between actual and counterfactual productions in Nagano Prefecture was the largest among other comparative prefectures. We found significant evidence that the positive impact of the Olympic Games on production in the service sector was found in the long term.

Finally, we consider the impact of the Olympics on the manufacturing sector. The level of activity in Nagano’s manufacturing sector was procyclical with the economy according to Figures 7-1, 7-2 and 7-3; that is, the manufacturing sector was flourishing in the late 1990s and the late 2000s before the Global Financial Crisis. When the event occurrence is defined as 1991, counterfactual production moves closely with actual production, except during the late 1990s (Figure 7-1). In the late 1990s, actual production was larger than what it would have been if Nagano City had not won the
international selection as the host. When the event occurrence is defined as 1988, the difference between the actual and counterfactual production was larger over the sample period (Figure 7-3). In contrast, when the event occurrence is defined as 1998, its difference was very small over the sample period (Figure 7-2). According to the placebo tests, excluding Tokyo and other prefectures that have MSPEs more than five times larger than Nagano Prefecture (Figure 7-5), we find that the overall effect of the Nagano Olympic Games on production in the manufacturing sector was minor.

6-2. The Impacts on Local Labor Markets

This subsection explores the effects of the Olympic Games on local labor markets. Recall that we suggested three types of groupings for the treatment and control groups: narrow, broad, and in-between. It should be noted that we do not estimate the effects of the Olympic Games in the case in which the event occurrence is defined as 1988 because of a lack of data by individual employment service offices within Nagano Prefecture. We begin with estimates for the narrow grouping. We use job seekers and job vacancies registered in the employment service offices located in the area where athletic events were held and their neighboring areas, Nagano, Sasanoi, and Susaka, which form the treatment group. The control group includes job seekers and job vacancies registered in other employment service offices in Nagano Prefecture and the other 46 prefectures.

Figures 8-1 and 8-2 show the actual and counterfactual jobs-to-applicants ratios by two different even timings, using job seekers and job vacancies registered in employment service offices. Because the administrative data on job findings contains the numbers of job seekers and job vacancies at a monthly frequency, we define the
event timings by a month-level (June 1991 and February 1998). As expected, the actual jobs-to-applicants ratio was procyclical with the economy, and in fact, the counterfactual jobs-to-applicants ratio moves closely with the actual ratio, and the difference between the two jobs-to-applicants ratios was very small over the sample period, regardless of when the event occurrence is set. These results imply that the actual jobs-to-applicants ratio was the same as what it would have been if Nagano City had not won the right to host or if the Olympic Games had not been held in Nagano City and its neighboring areas. We conclude that the Nagano Olympic Games had no effect on the local labor market. We do not observe either short- or long-run impacts on the local labor market where the Olympic athletic events were held. Because it is clear that the difference between the actual and counterfactual job-to-applicant ratios is small, we do not display results from placebo tests.  

As mentioned in the previous subsection, the Nagano Olympic Games did not have a positive impact on the local economy, except for the service and real estate sectors. Therefore, our interpretation is that the impact of the Olympic Games on local labor markets was limited. It could be that labor supply increased in response to an increase in labor demand in the service and real estate sectors, so that the jobs-to-applicants ratio remained almost unchanged.

To expand the size of the treatment group, we add job seekers and vacancies registered in four more employment service offices into the narrow category: Oomachi, 

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11 According to the placebo tests, the MSPE before the event was small in this treatment group defined by the narrow grouping. Therefore, the synthetic control method provides a good fit for the jobs-to-applicants ratio in the treatment group. The difference between the actual and counterfactual jobs-to-applicants ratios in the treatment group was small and similar to the differences in the other prefectures created by placebo studies.
Iiyama, Ueda, and Saku. The remainder is then considered as the control group. Overall, the results were similar to those obtained for the narrow grouping. Both the actual and counterfactual jobs-to-applicants ratios moved closely together over the sample period in Figures 8-3 and 8-4. It thereby implies that the Nagano Olympic Games had no effect on local labor markets defined by the in-between grouping.

Finally, we consider the broad case in which job seekers and job vacancies registered in all employment service offices of Nagano Prefecture are included in the treatment group. The rest of the prefectures are used as the control group. Again, we obtained the same result according to Figures 8-5 and 8-6. The difference between the actual and counterfactual jobs-to-applicants ratios was very small over the sample period. This implies that the actual jobs-to-applicants ratio was not very different from what it would have been if Nagano City had not won the right to host or if the Nagano Olympic Games had not been held there.

7. Discussion and Policy Implications
This section discusses the expected costs and benefits to Tokyo and the rest of Japan from the 2020 Tokyo Summer Olympic Games, based on our analysis. Japan’s capital, Tokyo, and Nagano Prefecture are very different in terms of economy size and population. In addition, the summer and winter Olympic Games are different in terms of the number of athletic events and athletes. However, the most recent Olympic Games held in Japan were the 1998 Nagano Winter Olympic Games. Our analysis therefore helps us predict the economic impact of the Tokyo Olympic Games.

As shown in the previous section, we found that the overall effects of the Olympic Games on the local economy and labor markets were very limited in both the
short- and long-run, although the long-term positive effects were observed in selected sectors (service and real estate sectors). We have a similar expectation that the net impact of the Tokyo Olympic Games will be minor on the metropolitan economy and labor markets. Our results are in line with the literature that did not find the positive impact of Olympic Games as discussed in Section 2.

Assuming that the economic benefits from the Tokyo Olympic Games are small, it is necessary to reduce the cost of organizing the Tokyo Olympic Games as much as possible. One suggestion to reduce costs is that the Tokyo Government would use or renovate existing venues rather than build new ones. In addition, we suggest that the Tokyo Government avoids running into debt as much as possible by not investing in wasteful resources for the 2020 Tokyo Olympic Summer Games.

As mentioned in Section 3, both Nagano Prefecture and Nagano City ran into debt to finance the cost of venue preparation. Nagano City in particular issued city debt securities to raise JPY12.7 billion in 1992, which was triple the amount of city debt securities issued in 1993, and more than JPY10 billion every year until the opening year of the Olympic Games. Nagano City is still repaying this debt; as at 2009, the amount of city bonds on issue was JPY22.7 billion. The results of our analysis suggest that it is hard to suggest that the benefits from Olympic Games exceed the costs of running the Games in the long-run.

We predict from our analysis that the economic benefits from the Tokyo Olympics are not large relative to the costs of venue and facilities preparation. However, if one of the important benefits is to boost national dignity and happiness, then the benefits of the Tokyo Olympics are not minor.
8. Concluding Remarks

The objective of this paper is to assess the long-term effects of the 1998 Nagano Winter Olympic Games on various economic and labor market outcomes in Nagano City and its neighboring areas. To do so, we employ the synthetic control methodology developed by Abadie, Diamond, and Hainmueller (2010). Using this method, we estimate counterfactual dynamics of various economic and labor market outcomes (GDP, per capita GDP, production by industry, and jobs-to-applicants ratio) for Nagano City and its neighboring areas, and then compare these with the actual data of these variables. Using this method, we can observe how the local economic and labor market outcomes in Nagano City and its neighboring areas would have changed if the 1998 Olympic Games had not been held there.

Our main finding is that the Nagano Olympic Games did not have a positive impact on the local economy in the long term, apart for the service and real estate sectors. These sectors benefited from an increase in demand for services and housings due to increased population size. We also find that the Nagano Olympics did not improve labor market conditions. Overall, our interpretation is that the effects of the Olympic Games on the local economy except for some sectors and labor markets were limited.

We also expect that the overall impact of the Tokyo Olympic Games on the metropolitan economy and labor markets will be minor. The Tokyo Government should use existing venues and avoid running into debt as much as possible.
References


Figure 1: Events locations in Nagano Prefecture
Figure 2-1 GDP: Nagano vs Synthetic Nagano (1991 as event occurrence date)

Figure 2-2 GDP: Nagano vs Synthetic Nagano (1998 as event occurrence date)

Figure 2-3 GDP: Nagano vs Synthetic Nagano (1988 as event occurrence date)

Figure 2-4 GDP gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date)

Figure 2-5 GDP gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date)

Note: Prefectures with pre-event MSPE five times higher than Nagano’s are excluded.
Figure 3-1 Per-capita GDP: Nagano vs Synthetic Nagano (1991 as event occurrence date)

Figure 3-2 Per-capita GDP: Nagano vs Synthetic Nagano (1998 as event occurrence date)

Figure 3-3 Per-capita GDP: Nagano vs Synthetic Nagano (1988 as event occurrence date)

Figure 3-4 Per-capita GDP gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date)

Figure 3-5 GDP gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date) Note: Prefectures with pre-event MSPE five times higher than Nagano’s are excluded.
Figure 4-1 Construction output: Nagano vs Synthetic Nagano (1991 as event occurrence date)

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Figure 4-3 Construction output: Nagano vs Synthetic Nagano (1988 as event occurrence date)

Figure 4-4 Construction output gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date)

Figure 4-5 Construction output gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date)

Note: Prefectures with pre-event MSPE five times higher than Nagano’s are excluded.
Figure 5-1 Service output: Nagano vs Synthetic
Nagano (1991 as event occurrence date)

Figure 5-2 Service output: Nagano vs Synthetic
Nagano (1998 as event occurrence date)

Figure 5-3 Service output: Nagano vs Synthetic
Nagano (1988 as event occurrence date)

Figure 5-4 Service output gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date)

Figure 5-5 Service output gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date)

Note: Prefectures with pre-event MSPE five times higher than Nagano’s are excluded
Figure 6-1 Real estate output: Nagano vs Synthetic Nagano (1991 as event occurrence date)

Figure 6-2 Real estate output: Nagano vs Synthetic Nagano (1998 as event occurrence date)

Figure 6-4 Real estate output gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date)

Figure 6-5 Real estate output gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date)

Note: Prefectures with pre-event MSPE five times higher than Nagano’s are excluded
Figure 7-1 Manufacturing industry output: Nagano vs Synthetic Nagano (1991 as event occurrence date)

Figure 7-2 Manufacturing industry output: Nagano vs Synthetic Nagano (1998 as event occurrence date)

Figure 7-3 Manufacturing industry output: Nagano vs Synthetic Nagano (1988 as event occurrence date)

Figure 7-4 Manufacturing industry output gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date)

Figure 7-5 Manufacturing industry output gaps in Nagano and Placebo gaps in other control prefectures (1991 as event occurrence date)

Note: Prefectures with pre-event MSPE five times higher than Nagano’s are excluded
Figure 8-1 Jobs-to-applicants ratios: narrow Nagano vs Synthetic narrow Nagano (1991m6 as event occurrence)

Figure 8-2 Jobs-to-applicants ratios: narrow Nagano vs Synthetic narrow Nagano (1998m2 as event occurrence)

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Figure 8-4 Jobs-to-applicants ratios: broad Nagano vs Synthetic broad Nagano (1998m2 as event occurrence)

Figure 8-5 Jobs-to-applicants ratios: in-between Nagano vs Synthetic in-between Nagano (1991m6 as event occurrence)

Figure 8-6 Jobs-to-applicants ratios: in-between Nagano vs Synthetic in-between Nagano (1998m2 as event occurrence)
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<th>The Total Project cost</th>
<th>The Cost of Construction</th>
<th>The Cost of Land Acquisition</th>
<th>Japan</th>
<th>Nagano Prefecture</th>
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<td>A Total of Athletic Facilities</td>
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<td>165</td>
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<td>71</td>
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<td>24</td>
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<td>316</td>
<td>103</td>
<td>141</td>
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<td>Total</td>
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<td>550</td>
<td>331</td>
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(42.6%)(25.6%)(31.8%)

Table 1: Costs of venues for the 1998 Nagano Winter Olympic Games
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