Olympic Games and GDP: An Empirical Investigation using De-trended and difference-in-difference Method

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ABSTRACT

Different researchers in the literature have discussed the relationship between Olympic games and Gross Domestic Product (GDP). This paper analyzes the experiences of 17 past host countries of Olympic games between 1967 to 2015, and the economic outcomes on their GDP per capita. The data was obtained from the World Bank Open Data for the following 17 countries: Australia, Austria, Brazil, Canada, China, Spain, France, Germany, Greece, Italy, Japan, Mexico, Norway, Russia, South Korea, United Kingdom, the United States. To identify the effect of the Olympics on GDP, we remove the linear trend of the GDP using the Ordinary Least Squares (OLS) De-trended method. We study five samples (all Olympic games, Olympics held in developing countries, Olympics held in developed countries, summer Olympics and winter Olympics) to build a set of cyclical components during the Olympic period that includes the cyclical component of GDP per capita and government expenditure of all countries during six Olympic period time-frames (9 years before and 1, 5, and 10 years after; 7 years before and 1, 5, and 10 years after). The Olympic period starting nine years before (that is two years before the Olympic host city is selected) and the Olympic period starting seven years before is the year that the selected Olympic city is announced. There is expected to be some systematic investment a couple years before the Olympic city is chosen (nine years before the Olympics) and even more so, when the host city is selected (7 years before the Olympics). Each Olympic period is studied at either 1, 5, or 9 years after the Olympic year, to measure the short-term, medium-term and long-term spillover effects of the Olympics period. In a second method, we compare the treatment and control groups for each country that held the Olympic games; we chose one country for comparison and conducted the usual difference-in-difference method. Our findings show that overall, hosting the Olympic games has a positive impact on all 17 countries' GDP per capita between 1967 to 2015 during the 6 Olympic periods, but has a negative impact on the post-Olympic period. We believe that the positive impact observed during the Olympic period is due to investment in infrastructure and inflow of tourism attracted around the time of the Olympics. However, for developing countries, and Olympic games held in the summer, we observe a higher impact on GDP after the Olympic Period than during the Olympic Period.

Keywords: Gross Domestic Product, Developing Countries, Economic Outcomes
JEL classification: C10; C13; E65; O12; Z20;

1 Introduction

Hosting world-scale events like the Olympic games can immediately be understood as a positive economic growth strategy. This paper explores 5 distinct samples (all Olympic games, Olympics held in developing countries, Olympics held in developed countries, summer Olympics and winter Olympics) and finds that although there are specific Olympic period effects that are positive, the majority of the post-Olympic period has a significantly negative impact on countries' GDP per capita. In fact, when studied separately, developing countries fare better than developed countries. Hosting the Olympics is not only about competition and fame. Oftentimes, the costs can yield mixed economic outcomes. Although most countries who have hosted the Olympics in the past were developed countries, there are a notable few that were hosted by developing countries. Many of these developing countries spent the most in all of Olympic history. China spent about $44 billion USD, for the 2008 Beijing Games, and Russia, the most expensive games thus far, spent about $51 billion for the 2014 Sochi Games.

This paper studies the effect of the Olympic period treatments on GDP of 17 countries from 1967 to the most recent available data in 2015, an extension to the existing literature on the Olympic games and their macroeconomic effects of Pappa and Bruckner (2015). Using two distinct methods, we find that Olympic periods starting 9 and 7 years before Olympic games have a significant impact that is mostly negative on GDP.

The first method is an OLS de-trending method with fixed effects. Any linear trends in the GDP of the dataset is removed by de-trending and obtaining the residual values of GDP. Then, the Olympic periods are studied to see their effects on these residual data points. We control for the differences among countries and variability of events that occur over the years by using country fixed effects and year fixed effects. We also assume that the effects on the GDP is a significant deciding factor for whether developing countries should host Olympic games.

The second method uses a difference-in-difference technique, whereby each of the seventeen countries studied is matched with a new country similar to its GDP and close in geography, for comparison of the GDP. The seventeen existing countries are the treatments, that have hosted the Olympics during a particular year, while the seventeen new countries, as controls did not host the Olympics during those specific years. Maintaining the panel data set, the pairs of seventeen countries compared with the new countries following are: Australia and New Zealand, Austria and Switzerland, Brazil and Argentina, Canada and the United States, China and Russia, Spain and Italy, France and Germany, Germany and France, Greece and Turkey, Italy and Spain, Japan and South Korea, Mexico and Guatemala, Norway and Sweden, Russia and China, South Korea and Japan, United Kingdom and Ireland, the United States and Canada. The six Olympic periods, as well as government expenditure analysis on GDP is re-conducted for this new set of data for each of the five samples of interest.

By using two methods to study each of the five samples individually it is possible to analyze the disparities of the economic outcomes of Olympic games held in different seasons and in countries of different economic wealth. Moreover, if developing countries gain little improvement in GDP, policy-makers may decide to refrain from bidding as host countries in the first place and avoid large-scale debt or unanticipated consequences. As well, if a certain season allows for better economic outcomes, then countries may decide to focus on bidding for those Olympic games instead.

Part 2 present summaries of the existing literature of the economic outcomes from the Olympics, featuring pooled data, and individual country analysis. Part 3 discuss the data source, namely the World Bank Open Data and the sample restrictions used, along with an explanation of how the Olympics period treatment is measured. Part 4 describes the econometric model that we used to illustrate the impact of the Olympics period treatment for various time-frames, notably, in the short, medium, and long-terms on GDP per capita. Part 5 features our regression results for each of the 5 samples (all Olympic games, Olympics held in developed countries, Olympics held in developing countries, summer Olympics and winter Olympics), each at 6 Olympic periods (9 years before and 1, 5, and 10 years after; 7 years before and 1, 5, and 10 years after), studied in both methods. Key graphs are within the text. Part 6 concludes the research paper. The Appendix further contains additional notes and tables from our regression results for the Olympic periods mentioned above.

2 Economic Outcomes of the Olympics in the Literature

Brückner & Pappa (2015) study the macroeconomic effects of the Olympic games of both bidding and hosting countries between 1950 and 2009. More specifically, they study the impacts on GDP per capita, private consumption, investment, government expenditure and price exchange rate. Their analysis is based on data obtained from the version 7.0 of the Penn World Table. Their results were that bidding countries saw an increase in output growth, investments, and private consumption during the bidding process, about 9 to 7 years before the Olympics. However, they did not have significant long-run effects on output, investment or private consumption. Among hosting countries, there was an increase in GDP before hosting the games with a peak at four years before at 2.5pp. The hosting year caused a positive, but insignificant effect on GDP per capita. Although, the main impacts were significant before the Olympics, many countries followed a 2-4-1 time-line, two years of planning, four years of construction, and one year of testing, to which the authors cite Preuss (2004). Another post-Olympic outcome they find is that upon selection of a host city, which they consider a news shock, there is a positive effect on the consumer price index and the nominal exchange rate. The authors also note the cumulative effects of the Olympics in the long-term which is that infrastructure, and investments toward hosting the Olympics are likely to lead to greater investments and thus, greater GDP per capita in the long-run. This paper provides a contemporary framework for my research. However, different from Pappa and Bruckner, we examine an Olympics period, treatment effect that measures various Olympic time frames' effects on the countries' GDP per capita for a more recent time period. We also study the impacts under different samples, besides the entire sample: developing, developed, winter and summer games under a fixed effects and difference-in-difference technique. Nonetheless, the effect of the Olympics among bidding and hosting countries on another macroeconomic factor, total aggregate exports, is studied by Bista (2016), who fails to find a positive effectBista (2016).

Kasimati & Dawson (2009) assess the impact of the 2004 Olympic Games on the Greek economy. They explain fundamental realities of the costs required to host Olympics in a nation. They note that countries spend great amounts of money first bidding, and then, constructing the stadia if selected to host the mega event. Due to the high costs of the events, the idea that countries benefit afterwards has come to the attention. They also explain thoroughly the input-output (I-O) method and the computed general equilibrium (CGE) models, which are the two most common methods to measure the impact of an Olympic game on an economy. The I-O analysis is based on the dependence between economic sectors (Leontief, 1986). The method, developed by Wassily Leontief, Nobel Memorial Prize Laureate, is commonly used to analyze the impacts of positive or negative economic shocks and the ripple effect consequences in the economy. The I-O method involves using many assumptions in a system. The authors further explain the difference between ex-ante studies and ex- post studies. Ex-ante studies are conducted before the event, and often are seen as promotional because they are conducted on behalf of organizing committees or local chambers of commerce. Ex-post studies, thus follow the occurrence of the event. These two terms help provide a way to classify studies, when describing them in the context of how they measure the impacts of a shock like the Olympics. The I-O method has been popular, but is known to be very restrictive. The two methods also have different approaches when measuring tourism demand and the impact of construction expenditure on the economy. The I-O model consists of input-output tables that include data on the levels of inputs required in a particular industry's production function(Leontief, 1986). This is partly because the I-O model assumes fixed prices and fixed coefficients, which results in higher estimates compared to those of the CGE models. Many ex-ante studies, defined as those conducted before the Olympics and carried out on behalf of organizing committed or local chambers of commerce find that the host city/region find that Olympic games have a positive effect on GDP growth and employment, generating billions of dollars of benefit. Ex post studies scrutinize the previous outcomes foreseen by ex-ante studies. For example, (Baade et al., 2002) found that following the 1984 Los Angeles Olympics and the 1996 Atlanta Olympics the effects were transitory, concluding that changes to the steady-state equilibrium were only possible if the newly built infrastructure and facilities were appropriate for the current and future economy.

Greece was the second smallest country to host the Summer Olympics since Finland in 1952. The 2004 games in Athens was seen as a way to gain sports venues and complete started infrastructural projects. Commentators drew comparisons to Barcelona's 1992 Olympics. The estimated costs of the Greek Olympics were 3.0 billion Euro for the construction of sports facilities, Galpin (2005). Kasimati and Dawson (2009) further note that another 4.2 billion Euro in transportation projects, 1.2 Euro billion in communication, 1.1 billion Euro for security, and 0.7 billion Euro for other infrastructure.

As found by Baade and Matheson (2002), with the exception of Los Angeles and Atlanta, who both show a significantly greater share of costs spent by the private sector, other Olympics have shown a fairly similar mixture between public and private funding. Kasimati & Dawson (2009) emphasize that with Athens (2004), Beijing (2008) and London (2012), a majority of the costs were financed publicly, which further reveal the importance that their governments attached to the Olympics.

The macroeconomic model of the Greek economy is constructed by nine behavioural equations and three identity relations in the long-run and short-run. The authors consider the Olympic games as a demand shock from the time a country is named host, to when the Games conclude. The model is designed on an aggregate level due to the lack of disaggregate data, presenting a challenge to implement the CGE model in this context. Time series data between 1958 to 2005 was used and was collected from the National Statistics Services of Greece, Bank of Greece, Ministry of National Economy and World Bank. The main categories that were studied from the model were consumption, investment, exports, and imports. The authors conclude that after studying their macroeconometric model of the Greek economy, they find that for post-Olympic Games, there was a positive, but minimal impact on the Greek economy. They found that between 1997 to 2005, the Games increased economic activity by about 1.3% of GDP per year, and unemployment fell by 1.9% per year. The overall GDP increase after the Games was estimated to be 2.5 times the total preparation costs. For the period of 2006 to 2012, the Games effect showed more modest outcomes. The authors forecast a GDP increase of about 0.46 to 0.52 percent per year, and unemployment falling on average by 0.17% per year. Thus the Olympic Games showed a positive effect during the preparation phase and the year that the Games took place, but the long-term economic prospects were much more modest. For example, in terms of employment, on average, only 7700 new jobs were added each year from 2006 to 2012. GDP also increased on average between 0.46 and 0.52% per year. The authors still make a note to point out that other studies have shown contrasting outcomes after the Olympics in Sydney in 2000, where Madden (2006) and Giesecke et al. (2007) found negative effects on the Australian economy. When compared to the previous Olympics held in Sydney in 2000, the Greek Olympics similarly had delays in construction of facilities. Other economic implications were that increase in labour demand was equivalent to the increase in real wages. As well, pressures to complete the infrastructure increased the hiring of foreign workers to complete the projects on time. Contrasting from Atkinson et al. (2008) and Walton et al. (2008), as referenced by the authors, this study avoided studying intangible effects such as national pride, and legacies of sporting venues, arguing that it is not tangible to measure.

Madden (2002) studies the economic consequences of the 2000 Sydney Olympics. This study sheds insight for this paper, because it analyzes the effects of the Olympics in a developed country. This insight contributes to our analysis between both developed and developing countries' post-Olympic effects. Madden notes that the CGE model was first used to analyze the impact of Olympic Games. Before it, most studies used the input-output method which has shown to present limitations due to not accounting for supply limitations and price effects. In this study, Madden uses data from the 1999 Centre for Regional Economic Analysis / Arthur Andersen report. Madden notes that tourism peaked in 2001 to 2002. The author finds that over the 12 years ending in 2005/2006, the Sydney Games increased in the southeastern state of Australia, New South Wales' (NSW) Gross State Product (GSP) by about $490 million in a year, with the present value of the the annual GDP effects at an estimated $5.1 billion. The present value of the impact of the Olympics on the Australian GDP was an estimated $6.5 billion, which represented a 0.12% increase over the 12-year period from 1994. Moreover, around two-fifths of the increase in GSP was due to an increase in real household consumption. The Olympics also estimated to increase the NSW and employment in Australia by almost 5300 and 7500 jobs per annum over the period that was studied. Furthermore, the Games provided an increase to the NSW government spending and diversion from other non-Olympic expenses. The diverted expenditure was about $685 million. This solidified the assumption that the Games do not have long-term effects on the government's total financial balance sheet.

Madden (2002) concludes that the labour market response before and after the Games are difficult to frame. The author also notes that the results can be very different depending on the assumptions of the study, which is important to acknowledge. Also the impact of the Olympics on the Australian economic welfare would necessitate a larger project that measures at least the increased utility from national pride, consumer surplus from local ticket purchases, the time zone advantages of the Games being held in one's own time zone. Negative effects such as congestion exist as well.

Preuss (2004) presents a case study on the 2012 bid of the Frankfurt Games. This study provides insight of the impacts of bidding for the Olympics on a regional level. Preuss first notes that despite the Olympics Organising Committee being funded by the International Olympic Committee (IOC), billions are spent by the city and its region to cover all investments related to the sports infrastructure. Also, Olympic Games are events which bring "fresh money" into the city, including infrastructural developments that remain for about 10 years. The value of this resource is that it uniquely studies the regional impact of Olympics. The model uses a combination between a cost-benefit analysis and the input-output model. The input-output method was used, though it was noted that intangibles, relocation, and crowding out effects are part of the limitations. The author believes that the input-output method is flawed due to the fact that it only provides information on the impact on the national economy from Olympic expenditures, instead of being a resource for policy-makers to indicate whether hosting the Olympics is justified in a country. Nonetheless, the cost-benefit portion of the model identifies various costs and benefits of the event. The data findings are based on various studies that the author references, such as from Preuss's 2003 studies.

Generally, the author mentions that larger regions have less inflow of "fresh" money. Though the impact that such larger regions have is larger due to the inherently larger multiplier. Preuss summarizes the results as the following. The concrete economic impacts fade after a short period. The post-Olympic consequences that remain include structural changes, which make up the largest part of the economic Olympic legacy Preuss (2003). The new infrastructure of the Games are usually covered by the state government. Viewed from the regional perspective, construction does not lead to sole positive outcomes for the region due to means of construction partly leaving it. As well, planning for sustainable infrastructure is suggested, since long-term maintenance is required. Finally, Preuss mentions that in order to extend findings beyond those based on the Pareto-Optimum, additional welfare functions must be included.

Wicker et al. (2012) study the rarely studied topic of the importance of Olympic success to the population of the host county using the contingent valuation method (CVM). The CVM is conducted by using data from a national survey of the resident population in Germany. Besides the importance attached to economic growth, the authors cite Atkinson et al., 2008; Barget and Gouguet, 2007; Jinxia and Mangan, 2008 for intangible impacts such as national pride, and elevated development of the elite sport system of the Olympics that occur after the Olympics. This is a valuable study for this paper, since most economic papers focus on the tangible impacts, and avoid the intangibles. This paper contributes a concrete, way to measure national pride toward the Olympics, contrary of what is done in the literature. The authors use data from a nationwide survey of the population in Germany, whereby the 2006 residents were asked to reply their willingness to pay for Olympic success. The survey collected data to see how many people would be willing to pay for being ranked first in the medal table and for winning a gold medal in track and field, the latter that was last won in the 2000 Sydney Olympics. The willingness to pay (WTP) of civilians reflects on the level of importance that they attribute to the Olympics depending on how agreeable they are to spending their taxpayer's dollars towards elite sporting events such as these. The CVM is a non-market valuation method, whereby monetary values are attributed to goods and services that are not traded in the marketplace. The results showed that people living in London are willing to pay 22 pounds on average, those in Manchester at 12 pounds and those in Glasgow at 11 pounds.

A Canadian study of the 2010 Winter Olympic Games in Vancouver showed that Canadian's willingness to pay (WTP) for the Own the Podium programme, that was designed to increase performance of Canadian athletes increased from on average \$54 prior to the Games to an average of \$98. This WTP even exceeded the costs of the programme Humphreys et al. (2011). The authors note that consumption capital, for example, people supporting the Olympics increases when they are interested in a particular sport and that the team they root for are winning. This plays into the concept of intangible factors which are seen to have an impact on the value of Olympic success. For example, symbolic capital referring to resources generated through honour, prestige or recognition (Bourdieu, 1984). Of course, Olympic success differs according to socio-economic class, both in human capital (Becker, 1962) and income.

The empirical evaluation used to measure the perceived Olympic success to the German population was a nationwide telephone survey using computer assisted telephone interviews. Limitations include a potential trickle-down-effect meaning the level of success of the Olympics leading to higher participation numbers after the event, a result of Olympic success that might have occurred, but not measured separately.

Rose & Spiegel (2011) attempt to reconcile between the point of view of economists that Olympics cost a large price tag and yield limited tangible effects. The authors do so by focusing on trade and show that there is generally a positive impact on national exports. In fact, this effect is found to be statistically robust and permanent. The model of international trade as described by the authors measures the bilateral trade flows between pairs of countries through their distance and economic masses. They used a treatment approach when comparing the exports for the host countries or bidding countries with exports for their matched counterpart countries. They use a two-sector specific factor model involving a small open economy whereby liberalization increases prices in the export sector and lowers them in the importing sector. Since governments are not likely to reveal how they value gains from exports, instead, countries make a discrete liberalization and signaling decision based on their expectation of utility following liberalization.

Various data sources were used for Rose and Spiegel's study including the bilateral data sets from the World Trade Organization, and the multilateral data set was based on the Penn World Tables 6.2 data. The result is that trade is found to be 30 percent higher for countries that have hosted the Olympics. Additionally, a counter-intuitive finding is that unsuccessful bids also have a positive impact on trade exports. The authors conclude that holding the

Olympics functions as a signal for trade liberalization. This was demonstrated by China's commitment to trade liberalization after successfully bidding for the 2008 Olympics in 2001. Their paper provides the unique idea that the signal of a country hosting the Olympics can be linked to trade liberalization due to the increase in trade, known as the "Olympic Effect."

3 Data

The data used in this paper is built from multiples sources, with the World Bank Open Data as the primary source. The World Bank national accounts data and the OECD National Accounts data files were the source for the data on GDP per capita.

This study is restricted to 17 countries (Australia, Austria, Brazil, Canada, China, France, Germany, Greece, Italy, Japan, Mexico, Norway, Russia, South Korea, Spain, United Kingdom, United States) that have hosted the Olympics between 1967 to 2015. A few of the countries (Canada, France, Japan, and the United States) have held more than one Olympic game between 1967 and 2015, thus making the analysis to be 24 games in the first sample of all Olympic games. The countries are further studied in four other samples to allow for cross-country comparison between developing countries and developed countries as well as for cross-seasonal comparison in the post-Olympic effects. The number of observations of the effect on GDP per capita after the Olympics, having imposing these restrictions across all Olympic games in total, is 883 (see Table 11). The definitions of the variables of interest used in this research are all based on the definitions provided by the World Bank.

This study analyzes the economic outcomes of all the past host countries of the Olympics between 1967 and 2015, specifically during 6 Olympic periods. The Olympic periods examined, start 9 or 7 years before the actual games are hosted and end at 1, 5, or 9 years after the games. The rationale behind the choice of this time-frame is to analyze the spillover effects of the Olympics in the short-term, medium-term and long-term. The choice of 7 years before the Olympics marks one of the starting times of the periods studied since it is when a host city is selected by the International Olympics Committee. This announcement serves as a signal for that particular city to officially start preparing for the Olympics whether it is to build new infrastructure, repair existing facilities, or increase investments and embark on new projects. The effect of government expenditure on GDP per capita is also studied. The definition of government expenditure follows that of the World Bank, whereby it includes all current government spending of goods and services, including salaries of employees, and spending on national defense and security, but excludes military expenditures that are part of government capital formation. The nine year before reference point takes into consideration that cities likely repair or revamp their city before the official selection of the Olympic host city to increase their chances of being invited as a candidate city and perhaps later be chosen as the host city. In fact, the process of selecting the host city involves the IOC's selection of a few candidate cities, and then, in-country inspection of the cities within approximately, a year.

The Summary Statistics (Table 11) show that the mean of the number of years is 1991 out of the 1967 to 2015 period. The mean of all seventeen countries' GDP residuals which measures the de-trended effect of the GDP fluctuation is 0.0 denoted under GDP, with the range being lowest at -18216.4 and highest at 25879.3. And the average of the relativity measuring the number of years before and after the year that an Olympic Game is held is -3.2. This negative average in the relativity variable makes sense because the analysis is studied for the Olympic effect starting at both nine and seven years before the Olympic Games are held, while the post-Olympic time-frame can start between one to ten years after the Games. The Year, Countries, and Relativity variables have 833 observations, while GDP has 793 observations, and government expenditure is at 808 observations, due to some missing values determined by the data availability,

4 Econometric model

Using two different methods, this paper studies the effect of an "Olympic period" on the GDP per capita in 5 different samples: all Olympic games, Olympic games held in developed countries, Olympic games held in developing countries, summer Olympics, and winter Olympics. By setting the Olympic year as a reference point, '0', the years before that particular Olympic year starts at '-1' and continues to decrease by one each year preceding the Olympic year. The years following the Olympic year start with '1' and continue to increase by one each year of the Olympic year. This is to denote the relative years before and after in order to set the specific Olympic period time-frames. In each sample's regressions, the Olympic period is the treatment group and the time-frame after the Olympic period studied, binding at 10 years, is the control group.

The first method involves removing the linear trend of the GDP using the Ordinary Leased Squares De-trending method as is outlined in equation (1). The linear trend of the GDP for all 17 countries is removed to identify the effect of the 6 different Olympic periods on GDP in each of the 5 samples. By de-trending the GDP values, the line of best-fit is removed. This allows for analysis of the fluctuating data points, without the systematic linear trend. These residual GDP values, without any trends were used in the analysis. In each sample, fixed effects are further used to control for unobserved heterogeneity among the seventeen countries in studying the Olympic period effect on their GDP over time. Factors that are controlled for are year and the country, represented by the country and year fixed effects: αi and γ_t. Government spending is used as control variable.

$$GDP_i = \beta_0 + \beta_1(t_1 \leq OlympicPeriod \leq t_2)_i + \beta_2 Exp_i + \alpha_i + \gamma_t + \epsilon_i \tag{1}$$

The second method outlined in equation (2) studies the effect of a particular Olympic period on the GDP using a difference-in-difference technique in which the difference between each of the studied seventeen countries' GDPs and those of a new set of seventeen countries are obtained. Specifically, for each of the seventeen countries, one country that is most similar in GDP and closest in geography was chosen for comparison. The pairs that were compared, with the new country following were: Greece and Turkey, France and Germany, the United States and Canada, the United Kingdom and Ireland, Germany and France, Australia and New Zealand, Italy and Spain, Japan and South Korea, Mexico and Guatemala, Canada and the United States, Russia and China, Spain and Italy, China and Russia, Brazil and Argentina, South Korea and Japan, Norway and Sweden, Austria and Switzerland. The second difference-in-difference method's results are compared with the results obtained from the OLS De-trended method to provide further insight. An example is shown in (3), of an Olympic period nine years before the Olympic games are hosted and one year after it is hosted using the second method.

$$GDP_i = \beta_0 + \beta_1(t_1 \leq OlympicPeriod \leq t_2)_i + \beta_2 Exp_i + \epsilon_i \tag{2}$$

where GDP_i is a linear dependent variable that reflects the change in GDP per capita after a country, i, holds an Olympic Game during a particular Olympic period. The intercept or constant, is represented by the parameter, β_0 which is the level of GDP per capita given that all the variables in the model are zero. The parameter α_i estimates the effect of the indicator variable, or the GDP per capita levels for the Olympic period for a host country i, calculated by setting t_1 equal to 9 or 7 and t_2 equal to 1, 5 and 9, separately. In this research paper, when t_2 is equal to 1, Olympic period is considered a short-run treatment that is compared to the control period of the post-Olympic 2 to 10 years. For the medium-term Olympic period, when t_2 is set to 5, the Olympic period treatment is being compared to the post-Olympic period of 6 to 10 years. For the long-term Olympic period, when t_2 is set to 9, the Olympic period treatment is being compared to the post-Olympic period control at 10 years. The explanatory variable Exp_i reflects the effect of government expenditures on GDP per capita. The error term accounts for the unobserved effects of the sample.

$$GDP_i = \beta_0 + \beta_1(-9 \leq OlympicPeriod \leq 1)_i + \beta_2 Exp_i + \epsilon_i \tag{3}$$

5 Results

The main findings of this paper is that overall, ceteris paribus, hosting the Olympic games has a significant negative impact on all 17 countries' GDP per capita between 1967 to 2015. This is true in the post-Olympic periods following the studied short-term, medium-term and long-term Olympic periods under both detrended method and difference-in-difference methods. With the exception of the sample of Olympic games held in developing countries and the Olympic games held in the summer, the results among the other three samples showed similar results under both methods. The Olympic period impact is positive for Olympic games held in developing countries, and Olympic games held in the summer.

These results were summarized from the sixty regression tables that display the estimates of the effect of six distinct Olympic periods on the GDP per capita. The regression tables are classified under five samples: all Olympic games, Olympic games held in developing countries, Olympic games held in developed countries, Olympic games held in the summer, and Olympic games held in winter games. Each sample analyzes both the 9, and 7 years before and 1, 5, and 9 years after period, separately. This level of analysis is conducted entirely with the difference-in-difference technique as well. The key tables will be highlighted below, and the remainder, in the Appendix.

In the sample of all the countries' pooled data, the detrended method result show that the Olympic period starting from 9 years before and 5 years after, or the medium-term Olympic period, had most significance among the regression results. As seen in column 1 of Table 1, ceteris paribus, this medium-term Olympic period, or treatment, shows a 1684.5 percentage point (pp) increase on GDP per capita compared to the control or post-Olympic period of 6 to 10 years after the Olympic games. After controlling for government expenditure, column 2 shows this Olympic period to have a 1430.7pp increase on GDP per capita, and government expenditure to have a -293.8pp effect on GDP. The Olympic period effect is shown to be positively significant at the 1% confidence level not only in both columns of this Olympic period, but also for the 7 years before and 5 years after Olympic period. The government expenditure coefficient is negatively significant at the 5% confidence level. Economically, these results imply that compared to the 9 years before and 5 years after Olympic period (treatment), the post-Olympic period of 6 to 10 years after the Olympics (control) show negative effects on the GDP. This shows that the inflow of revenue generated from the Olympics decreases as the years following the games goes by.

The table with the most number of significant coefficients and at the highest significance levels in the fixed effects study (detrended method), 9 years before and 5 years after is seen below in comparison to its counterpart difference-in-difference (DID) results' table for the same Olympic period. For the same sample but using DID technique, all the coefficient estimates are also positively significant at the 1% confidence level.

Table 1: **All Countries' Olympic Period Effect: 9 Years Before, 5 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	1684.5***	1430.7***
	(502.7)	(511.4)
Government Expenditure		-293.8**
		(126.6)
Constant	-2229.6***	3109.8
	(448.3)	(2344.3)
Observations	364	364
Adjusted R^2	-0.016	-0.003

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Among the detrended method with fixed effects regression results for the developing countries (Brazil, China, Greece, Mexico, South Korea, Russia) who held the Olympic games, the Olympic periods starting both 9 and 7 years before and ending at 1 year after the Olympics, or the short-term period shows the most significance. We discuss the Olympic period starting 9 years before in Table 3 and the period starting 7 years before is seen in the Appendix under Table 19. In Table 3, the Olympic period effect is negatively significant at the 1% confidence

Table 2: **All Countries' Olympic Period Effect: 9 Years Before, 5 Years After Games (DID)**

	(1)	(2)
Olympic Period	4745.6***	5975.1***
	(1468.5)	(1445.4)
Government Expenditure		1697.0***
		(347.6)
Constant	-6658.1*	-37161.9***
	(3651.1)	(7164.7)
Observations	350	350
R^2	0.0320	0.0971

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

level with a magnitude of -2624.8, which means that compared to the control group, or the post-Olympic period time-frame of 2 to 10 years, the effect on the GDP per capita is minus 2624.8pp. In the second restriction, this Olympic period continues to be negatively significant at the 1% confidence level with a coefficient of -2505.4pp. The effect of government expenditure on the GDP per capita is positive and insignificant. Economically, the results imply that for developing countries, the post-Olympic period had a positive effect on the GDP per capita compared to the short-term Olympic period that preceded it.

When comparing the detrended method with fixed effects regression results to the DID regression results as seen below in Table 4, the DID results show the effect of the Olympic period to be positive and significant at the 1% confidence level for the same Olympic period. The magnitude of the Olympic period effect on GDP was 3252.9pp, 4362.3pp, as seen in Table 4's columns 1 and 2, respectively. The DID results imply that economically the Olympic period is shown to be negative for the post-Olympic period as is consistent with the findings for when the entire sample was pooled together.

Table 3: **Developing Countries: 9 Years Before, 1 Year After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	-2624.8***	-2505.4***
	(604.7)	(647.9)
Government Expenditure		119.7
		(226.3)
Constant	1824.8***	-39.76
	(458.9)	(3555.2)
Observations	89	89
Adjusted R^2	0.127	0.120

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As seen in Table 5 below, among developed countries (Australia, Austria, Canada, France, Germany, Italy, Japan, Norway, Spain, United Kingdom, United States) the effect of the Olympics period starting 9 years before and 5 years after the Olympics, or the medium-term, is significant at the 1% confidence level in all restrictions. The Olympic period magnitudes are 2169.8pp, and 1841.2pp. The positive effect of government expenditure is significant at the 1% confidence level at a magnitude of -433.1pp. For the Olympic period starting 7 years before,

Table 4: **Developing Countries: 9 Years Before, 1 Year After Games (DID)**

	(1)	(2)
Olympic Period	3252.9***	4362.3***
	(1104.0)	(1077.2)
Government Expenditure		1448.7***
		(315.8)
Constant	-4589.5	-27263.9***
	(4561.6)	(5528.1)
Observations	89	89
R^2	0.0964	0.301

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

as seen in Table 25, significance levels of the coefficient estimates were identical to those that were found in the period starting 9 years before. Economically, among developed countries, the post-Olympic period consistently has a relatively negative impact on the developed GDP per capita in the short, and medium-terms, while government expenditure has a positive impact. This result is also consistent to the results of when the entire sample is studied. For developing countries, several other Olympic periods reflect this, as seen in Tables 22 and Table 24 reflect this.

From the DID results, the Olympic period of 9 years before the Olympics and 5 years after, or medium-term also shows the Olympic period effect to be positive and significant at the 1% confidence level at magnitudes of 5127.5pp, and 6189.7pp. The magnitude of government expenditures is 1807.3pp and is also significant at the 1% confidence level. The main difference between the regression results in both these methods is that in the DID method, the sign of the government expenditures is positive. Their comparison of the results obtained by the two methods is shown below.

Table 5: **Developed Countries: 9 Years Before, 5 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	2169.8***	1841.2***
	(614.8)	(615.4)
Government Expenditure		-433.1***
		(144.2)
Constant	-2964.0***	5227.4*
	(550.0)	(2781.1)
Observations	275	275
Adjusted R^2	0.005	0.035

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

For the summer Olympic games (Australia 2000, Brazil 2016, Canada 1976, China 2008, Germany 1972, Greece 2004, Mexico 1968, South Korea 1988, Spain 1992, United Kingdom 2012, United States 1984 and 1996), the Olympic period starting 9 years before and 1 year after, or short-term had the most significant results for both detrended method with fixed effects and DID. In the fixed effects results, the Olympic period effect was negative and significant at the 5% confidence level in both restrictions, with a magnitude of -1151.4pp and 1296.0pp. Thus,

Table 6: **Developed Countries: 9 Years Before, 5 Years After Games (DID)**

	(1)	(2)
Olympic Period	5127.5***	6189.7***
	(1897.7)	(1863.5)
Government Expenditure		1807.3***
		(450.4)
Constant	-7116.1	-41587.3***
	(5180.5)	(9958.9)
Observations	261	261
R^2	0.0299	0.0868

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

the GDP per capita decreased by 1151.4pp and 1296.0pp in the first and second restrictions, compared to the post-Olympic period of 2 to 10 years (treatment). Government expenditure is negative and insignificant in the fixed effects results. Economically, counter to most of the findings among the distinct samples studied, and similar to the results found for games held in developing countries, the post-Olympic periods have a positive impact on GDP per capita for summer games. This is likely due to positive spillover effects of the summer games on the host countries' economies which grow at a faster pace than without the Olympics.

The regression results from the DID technique as seen in Table 8 also show that for the Olympic period starting 9 years before and 1 year after, or the short-term had the most significant results, which are depicted below. The main difference from the detrended method with fixed effects results is that the coefficient estimates of the Olympic period are now positive in the DID results. The economic interpretation is that the post-Olympic period of 2 to 10 years has a negative impact on GDP per capita, which is found for most of the samples studied.

Table 7: **Summer Games: 9 Years Before, 1 Year After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	-1151.4**	-1296.0**
	(508.8)	(535.2)
Government Expenditure		-190.2
		(217.1)
Constant	-6.269	3209.3
	(374.3)	(3689.5)
Observations	183	183
Adjusted R^2	-0.039	-0.041

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

For the winter Olympic games (Austria 1976, Canada 1988 and 2010, France 1968 and 1992, Italy 2006, Japan 1972 and 1998, Norway 1994, Russia 2014, United States 1980 and 2002), the short and medium-term Olympic periods showed the most significance in both the 9 and 7 years before time-frame. The detrended method with fixed effects result consistently show that the Olympic period effect among winter games is positively significant at the 1% confidence level in both restrictions. Economically, the interpretation is that this medium-term

Table 8: **Summer Games: 9 Years Before, 1 Year After Games (DID)**

	(1)	(2)
Olympic Period	1673.0**	2613.3***
	(727.2)	(717.4)
Government Expenditure		1352.4***
		(292.1)
Constant	-8922.2	-31851.6***
	(5558.6)	(7330.4)
Observations	182	182
R^2	0.0307	0.136

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Olympic period has a positive effect of 3842.3pp and 3627.9pp on the GDP compared to the post-Olympic period of 6 to 10 years. Government expenditure is negative and not significant.

Like the detrended method with fixed effects results, the DID regression results show that consistently, the Olympic period has a positively significant impact at the 1% or 5% on the GDP per capita in both Olympic periods starting 9 or 7 years before for the short and medium terms. Government expenditure is also negative and insignificant. Displayed in Table 9 and 10 is the comparison of the detrended method with fixed effects medium-term table and the DID long-term table for the nine years before period.

Table 9: **Winter Games: 9 Years Before, 5 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	3842.3***	3627.9***
	(604.7)	(645.2)
Government Expenditure		-212.4
		(222.6)
Constant	-4044.5***	29.14
	(526.1)	(4300.6)
Observations	193	193
Adjusted R^2	0.129	0.128

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Government expenditure has mostly a positive impact on GDP per capita during the Olympic periods for all samples using the DID technique, with the exception of the winter games sample. This implies that winter games which generally generate less revenue from the Olympics had a positive impact on GDP from government expenditure. Under the detrended method with fixed effects, the effect of government expenditure on GDP per capita was negative during the Olympic period for the entire sample set, and for Olympic games held in developed countries.

Table 10: **Winter Games: 9 Years Before, 5 Years After Games (DID)**

	(1)	(2)
Olympic Period	2946.5***	2812.2**
	(1059.5)	(1118.3)
Government Expenditure		-150.2
		(396.1)
Constant	-9411.4	-6558.6
	(7598.2)	(10809.5)
Observations	180	180
R^2	0.0440	0.0453

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6 Conclusion

This paper studied the effect of 6 different Olympic period treatments on the GDP per capita of 17 countries for a period of 48 years, from 1967 to 2015. We conclude that despite a majority of the literature finding a positive Olympics effect, our study finds mostly a negative post-Olympics effect. By using two methods, the OLS de-trended method with fixed effects, and the difference-in-difference technique from comparing a new set of control countries, we find that within the entire sample set, there is a positive impact at the 1% confidence level on all countries' GDP following the Olympics, counteracted by a negative post-Olympic effect. This is with the exception of Olympic games held in developing countries and Olympic games held in the summer. For a majority of the samples, notably the entire sample set, Olympic games held in developed countries, and winter games, the post-Olympic effects were seen to be negative on GDP per capita. The results indicate that for Olympic games held in developing countries, in the short-term, starting both 9 and 7 years before, the effect of the Olympic period on GDP per capita is negative and significant at the 1% confidence level (Table 3 and Table 19). Similarly, the short-term and medium-term Olympic periods starting both 9 and 7 years before the Olympics have a negative and significant impact on GDP per capita of summer games at the 1% confidence level (Table 7 and Table 29). This means that the post-Olympic period effect in contrast, is positive. Government expenditure has mostly a positive impact on GDP per capita, during the Olympic periods for all samples using the DID technique, with the exception of the winter games sample. Under the detrended method with fixed effects, the effect of government expenditure on GDP per capita was negative during the Olympic period for the entire sample set, and for Olympic games held in developed countries. Overall, the detrended method with fixed effects and difference-in-difference method yield similar results.

Although countries often compete and bid to host such grand-scale games to improve their economic well-being, analysis of the experiences of 17 past host countries with the most recent available data show that the post-Olympic period effects on the GDP per capita are mostly negative, suggesting that policy-makers may decide otherwise for upcoming Olympic bids. Our findings suggest that the International Olympics Committee may want to select host cities of developing countries and especially for the summer Olympic games in order to help grow their economies. This information may also encourage more developing countries to engage in advanced improvement of their infrastructure in preparation for bidding and potentially be selected for this opportunity that can raise their economies even more at a global stage. On the other hand, developed countries may want to invest in other ways besides bidding for the Olympics, due to the shown significant, negative impacts of the Olympics on GDP per capita.

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7 Appendix

Table 11:

Summary Statistics

	Mean	Standard Deviation	Min	Max	Observations
Year	1991	14.2	1967	2015	833
Countries	9	4.9	1	17	833
GDP	0.0	4644.48	-18216.4	25879.3	793
Government Expenditure	16.8	3.7	6.6	24.5	808
Relativity	-3.2	19.1	-49	47	833

Table 12: **All Countries' Olympic Period Effect: 9 Years Before, 1 Year After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	697.8*	420.9
	(414.2)	(424.2)
Government Expenditure		-337.6***
		(129.0)
Constant	-1283.9***	4780.5**
	(312.2)	(2337.7)
Observations	364	364
Adjusted R^2	-0.041	-0.023

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 13: **All Countries' Olympic Period Effect: 9 Years Before, 9 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	1495.9	1216.4
	(1061.7)	(1055.6)
Government Expenditure		-356.1***
		(125.4)
Constant	-2316.1**	4177.6*
	(1042.3)	(2509.0)
Observations	364	364
Adjusted R^2	-0.043	-0.022

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 14: **All Countries' Olympic Period Effect: 7 Years Before, 1 Year After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	652.2	389.1
	(435.2)	(445.7)
Government Expenditure		-333.1**
		(139.1)
Constant	-1241.2***	4731.8*
	(318.0)	(2514.1)
Observations	336	336
Adjusted R^2	-0.046	-0.031

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 15: **All Countries' Olympic Period Effect: 7 Years Before, 5 Year After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	1658.0***	1424.7***
	(518.5)	(527.7)
Government Expenditure		-285.0**
		(136.5)
Constant	-2187.8***	2981.0
	(457.4)	(2518.3)
Observations	336	336
Adjusted R^2	-0.021	-0.010

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 16: **All Countries' Olympic Period Effect: 7 Years Before, 9 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	1430.7	1174.2
	(1085.4)	(1080.4)
Government Expenditure		-349.5**
		(135.3)
Constant	-2255.4**	4105.7
	(1063.9)	(2678.5)
Observations	336	336
Adjusted R^2	-0.048	-0.029

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 17: **Developing Countries: 9 Years Before, 5 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	-510.1	33.96
	(767.2)	(822.2)
Government Expenditure		428.6^{*}
		(250.4)
Constant	585.8	-6260.9
	(682.5)	(4055.9)
Observations	89	89
Adjusted R^2	-0.067	-0.043

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 18: **Developing Countries: 9 Years Before, 9 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	2795.9^{*}	3493.7^{**}
	(1569.7)	(1560.3)
Government Expenditure		524.3^{**}
		(228.5)
Constant	-2528.5	-11039.9^{***}
	(1542.3)	(4002.0)
Observations	89	89
Adjusted R^2	-0.033	0.018

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 19: **Developing Countries: 7 Years Before, 1 Year After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	-2701.7***	-2629.8***
	(644.3)	(707.7)
Government Expenditure		67.70
		(267.0)
Constant	1882.3***	839.1
	(467.7)	(4140.7)
Observations	79	79
Adjusted R^2	0.129	0.118

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 20: **Developing Countries: 7 Years Before, 5 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	-457.7	155.1
	(802.0)	(875.2)
Government Expenditure		487.1
		(295.2)
Constant	668.4	-7017.4
	(702.0)	(4709.3)
Observations	79	79
Adjusted R^2	-0.078	-0.053

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 21: **Developing Countries: 7 Years Before, 9 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	2829.3*	3564.4**
	(1619.5)	(1611.8)
Government Expenditure		585.2**
		(264.3)
Constant	-2412.7	-11776.7**
	(1587.6)	(4502.2)
Observations	79	79
Adjusted R^2	-0.039	0.014

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 22: **Developed Countries: 9 Years Before, 1 Year After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	1346.1***	992.5**
	(496.1)	(502.8)
Government Expenditure		-441.5***
		(147.4)
Constant	-1995.6***	6289.8**
	(374.8)	(2790.6)
Observations	275	275
Adjusted R^2	-0.013	0.016

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 23: **Developed Countries: 9 Years Before, 9 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	1111.8	797.8
	(1300.6)	(1277.1)
Government Expenditure		-503.4***
		(144.6)
Constant	-2283.8*	7232.1**
	(1276.5)	(3005.4)
Observations	275	275
Adjusted R^2	-0.039	0.003

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 24: **Developed Countries: 7 Years Before, 1 Year After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	1274.0**	953.2*
	(517.5)	(524.3)
Government Expenditure		-425.9***
		(156.6)
Constant	-1949.6***	6031.6**
	(380.9)	(2959.5)
Observations	257	257
Adjusted R^2	-0.020	0.006

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 25: **Developed Countries: 7 Years Before, 5 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	2106.2***	1813.2***
	(630.6)	(632.1)
Government Expenditure		-414.5***
		(153.4)
Constant	-2917.6***	4909.9*
	(559.1)	(2949.1)
Observations	257	257
Adjusted R^2	0.001	0.026

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 26: **Developed Countries: 7 Years Before, 9 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	1017.8	737.3
	(1322.9)	(1302.6)
Government Expenditure		-484.0***
		(153.9)
Constant	-2223.9*	6914.8**
	(1296.6)	(3172.9)
Observations	257	257
Adjusted R^2	-0.042	-0.006

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 27: **Summer Games: 9 Years Before, 5 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	-1255.4**	-1383.2**
	(608.0)	(633.4)
Government Expenditure		-157.8
		(215.5)
Constant	322.1	3020.9
	(535.9)	(3725.9)
Observations	183	183
Adjusted R^2	-0.044	-0.047

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 28: **Summer Games: 9 Years Before, 9 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	49.05	28.55
	(1218.2)	(1232.0)
Government Expenditure		-27.44
		(211.8)
Constant	-726.6	-255.3
	(1194.1)	(3831.3)
Observations	183	183
Adjusted R^2	-0.071	-0.077

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 29: **Summer Games: 7 Years Before, 1 Year After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	-1232.0**	-1348.5**
	(544.6)	(576.8)
Government Expenditure		-159.9
		(256.5)
Constant	-32.69	2658.9
	(384.3)	(4334.5)
Observations	165	165
Adjusted R^2	-0.044	-0.048

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 30: **Summer Games: 7 Years Before, 5 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	-1256.9*	-1353.2**
	(638.1)	(671.1)
Government Expenditure		-121.4
		(255.8)
Constant	277.8	2348.3
	(554.1)	(4396.1)
Observations	165	165
Adjusted R^2	-0.052	-0.057

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 31: **Summer Games: 7 Years Before, 9 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	56.34	82.03
	(1266.3)	(1282.4)
Government Expenditure		36.52
		(249.4)
Constant	-751.2	-1376.0
	(1238.5)	(4444.6)
Observations	165	165
Adjusted R^2	-0.079	-0.086

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 32: **Winter Games: 9 Years Before, 1 Year After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	2361.5***	2096.0***
	(553.4)	(661.2)
Government Expenditure		-193.4
		(262.9)
Constant	-2399.6***	1307.1
	(401.6)	(5053.5)
Observations	193	193
Adjusted R^2	0.031	0.029

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 33: **Winter Games: 9 Years Before, 9 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	2301.9*	1798.9
	(1348.8)	(1340.1)
Government Expenditure		-605.0***
		(227.5)
Constant	-3284.7**	8327.6*
	(1320.0)	(4555.4)
Observations	193	193
Adjusted R^2	-0.050	-0.015

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 34: **Winter Games: 7 Years Before, 1 Year After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	2518.5***	2200.8***
	(535.7)	(637.0)
Government Expenditure		-242.4
		(262.7)
Constant	-2299.2***	2328.5
	(377.0)	(5029.5)
Observations	179	179
Adjusted R^2	0.054	0.053

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 35: **Winter Games: 7 Years Before, 5 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	3823.3***	3548.2***
	(574.8)	(610.1)
Government Expenditure		-293.2
		(221.7)
Constant	-3860.1***	1744.6
	(494.2)	(4266.8)
Observations	179	179
Adjusted R^2	0.153	0.157

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 36: **Winter Games: 7 Years Before, 9 Years After Games (Detrended method with fixed effects)**

	(1)	(2)
Olympic Period	2222.8*	1685.8
	(1293.6)	(1276.0)
Government Expenditure		-690.4***
		(229.9)
Constant	-3100.1**	10119.5**
	(1263.8)	(4572.1)
Observations	179	179
Adjusted R^2	-0.054	-0.005

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 37: **All Countries' Olympic Period Effect: 9 Years Before, 1 Year After Games (DID)**

	(1)	(2)
Olympic Period	4798.7***	5964.7***
	(1198.1)	(1177.5)
Government Expenditure		1785.9***
		(345.8)
Constant	-5731.7	-37496.4***
	(3589.4)	(7072.6)
Observations	350	350
R^2	0.0479	0.120

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 38: **All Countries' Olympic Period Effect: 9 Years Before, 9 Years After Games (DID)**

	(1)	(2)
Olympic Period	4337.2	5300.2*
	(3046.0)	(2982.2)
Government Expenditure		1494.4***
		(350.3)
Constant	-7078.0	-34010.6***
	(4573.3)	(7728.7)
Observations	350	350
R^2	0.00629	0.0560

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 39: **All Countries' Olympic Period Effect: 7 Years Before, 1 Year After Games (DID)**

	(1)	(2)
Olympic Period	4450.1***	5466.9***
	(1241.5)	(1220.2)
Government Expenditure		1741.1***
		(367.4)
Constant	-5698.5	-36703.6***
	(3731.6)	(7491.0)
Observations	322	322
R^2	0.0422	0.108

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 40: **All Countries' Olympic Period Effect: 7 Years Before, 5 Years After Games (DID)**

	(1)	(2)
Olympic Period	4478.3***	5562.5***
	(1487.7)	(1463.3)
Government Expenditure		1677.9***
		(368.8)
Constant	-6693.5*	-36869.4***
	(3804.7)	(7593.3)
Observations	322	322
R^2	0.0304	0.0916

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 41: **All Countries' Olympic Period Effect: 7 Years Before, 9 Years After Games (DID)**

	(1)	(2)
Olympic Period	4042.5	4881.3
	(3045.0)	(2982.1)
Government Expenditure		1492.5***
		(371.5)
Constant	-7114.7	-34016.1***
	(4685.8)	(8118.2)
Observations	322	322
R^2	0.00596	0.0536

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 42: **Developing Countries: 9 Years Before, 5 Years After Games (DID)**

	(1)	(2)
Olympic Period	3586.8***	5406.1***
	(1273.5)	(1234.8)
Government Expenditure		1584.2***
		(325.2)
Constant	-5391.8	-30892.2***
	(4611.8)	(5928.4)
Observations	89	89
R^2	0.0883	0.306

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 43: **Developing Countries: 9 Years Before, 9 Years After Games (DID)**

	(1)	(2)
Olympic Period	2961.5	4534.6*
	(2755.4)	(2669.0)
Government Expenditure		1247.8***
		(348.9)
Constant	-5295.2	-25724.8***
	(5214.4)	(7045.2)
Observations	89	89
R^2	0.0139	0.133

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 44: **Developing Countries: 7 Years Before, 1 Year After Games (DID)**

	(1)	(2)
Olympic Period	2848.1**	4351.4***
	(1131.9)	(1092.4)
Government Expenditure		1636.1***
		(357.2)
Constant	-4557.4	-30358.6***
	(4774.8)	(6383.5)
Observations	79	79
R^2	0.0814	0.309

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 45: **Developing Countries: 7 Years Before, 5 Years After Games (DID)**

	(1)	(2)
Olympic Period	3274.6***	5369.0***
	(1264.8)	(1214.0)
Government Expenditure		1770.4***
		(361.6)
Constant	-5402.2	-33995.3***
	(4817.1)	(6686.0)
Observations	79	79
R^2	0.0852	0.328

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 46: **Developing Countries: 7 Years Before, 9 Years After Games (DID)**

	(1)	(2)
Olympic Period	2700.8	4288.9*
	(2702.8)	(2604.6)
Government Expenditure		1316.7***
		(382.1)
Constant	-5345.6	-26881.9***
	(5371.0)	(7653.5)
Observations	79	79
R^2	0.0137	0.140

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 47: **Developed Countries: 9 Years Before, 1 Year After Games (DID)**

	(1)	(2)
Olympic Period	5240.6***	6389.1***
	(1523.9)	(1496.1)
Government Expenditure		1930.1***
		(447.0)
Constant	-6034.7	-42601.1***
	(5104.8)	(9887.9)
Observations	261	261
R^2	0.0470	0.111

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 48: **Developed Countries: 9 Years Before, 9 Years After Games (DID)**

	(1)	(2)
Olympic Period	4763.7	5518.2
	(3909.9)	(3827.5)
Government Expenditure		1629.6***
		(454.1)
Constant	-7723.7	-38788.0***
	(6345.6)	(10674.2)
Observations	261	261
R^2	0.00612	0.0525

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 49: **Developed Countries: 7 Years Before, 1 Year After Games (DID)**

	(1)	(2)
Olympic Period	4907.2***	5809.1***
	(1569.6)	(1539.9)
Government Expenditure		1843.7***
		(469.6)
Constant	-5993.0	-40980.6***
	(5359.3)	(10398.5)
Observations	243	243
R^2	0.0420	0.0995

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 50: **Developed Countries: 7 Years Before, 5 Years After Games (DID)**

	(1)	(2)
Olympic Period	4879.7**	5728.0***
	(1913.6)	(1877.7)
Government Expenditure		1757.4***
		(472.5)
Constant	-7159.0	-40708.2***
	(5457.7)	(10495.6)
Observations	243	243
R^2	0.0287	0.0810

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 51: **Developed Countries: 7 Years Before, 9 Years After Games (DID)**

	(1)	(2)
Olympic Period	4459.9	5061.7
	(3889.9)	(3810.4)
Government Expenditure		1611.5***
		(476.8)
Constant	-7761.9	-38519.2***
	(6528.6)	(11154.4)
Observations	243	243
R^2	0.00583	0.0498

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 52: **Summer Games: 9 Years Before, 5 Years After Games (DID)**

	(1)	(2)
Olympic Period	888.8	1801.8**
	(874.3)	(867.6)
Government Expenditure		1211.5***
		(297.1)
Constant	-8646.7	-29421.4***
	(5590.2)	(7432.0)
Observations	182	182
R^2	0.00621	0.0910

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 53: **Summer Games: 9 Years Before, 9 Years After Games (DID)**

	(1)	(2)
Olympic Period	380.5	1134.8
	(1730.8)	(1684.7)
Government Expenditure		1076.1***
		(292.3)
Constant	-8299.6	-26827.7***
	(5804.4)	(7585.1)
Observations	182	182
R^2	0.000297	0.0700

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 54: **Summer Games: 7 Years Before, 1 Year After Games (DID)**

	(1)	(2)
Olympic Period	1356.6*	2354.6***
	(738.6)	(726.7)
Government Expenditure		1515.1***
		(325.3)
Constant	-9018.4	-34716.1***
	(5640.5)	(7738.2)
Observations	164	164
R^2	0.0223	0.141

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 55: **Summer Games: 7 Years Before, 5 Years After Games (DID)**

	(1)	(2)
Olympic Period	672.9	1694.2**
	(866.0)	(859.5)
Government Expenditure		1389.6***
		(330.6)
Constant	-8787.3	-32648.2***
	(5676.5)	(7853.6)
Observations	164	164
R^2	0.00413	0.104

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 56: **Summer Games: 7 Years Before, 9 Years After Games (DID)**

	(1)	(2)
Olympic Period	231.6	1041.3
	(1695.6)	(1641.6)
Government Expenditure		1231.6***
		(323.2)
Constant	-8476.8	-29686.5***
	(5884.9)	(7972.8)
Observations	164	164
R^2	0.000133	0.0824

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 57: **Winter Games: 9 Years Before, 1 Year After Games (DID)**

	(1)	(2)
Olympic Period	2909.2***	3112.9***
	(946.2)	(1100.0)
Government Expenditure		158.2
		(434.2)
Constant	-8750.5	-11757.3
	(7570.4)	(11309.4)
Observations	180	180
R^2	0.0532	0.0535

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 58: **Winter Games: 9 Years Before, 9 Years After Games (DID)**

	(1)	(2)
Olympic Period	3305.0	3028.0
	(2128.6)	(2142.0)
Government Expenditure		-396.7
		(383.4)
Constant	-10357.2	-2825.2
	(7806.0)	(10803.5)
Observations	180	180
Adjusted R^2	0.0141	0.0217

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 59: **Winter Games: 7 Years Before, 1 Year After Games (DID)**

	(1)	(2)
Olympic Period	2998.6***	3014.8***
	(992.5)	(1136.2)
Government Expenditure		13.80
		(470.9)
Constant	-8859.1	-9121.2
	(7595.0)	(11819.8)
Observations	166	166
Adjusted R^2	0.0560	0.0559

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 60: **Winter Games: 7 Years Before, 5 Years After Games (DID)**

	(1)	(2)
Olympic Period	2845.6***	2615.7**
	(1090.4)	(1139.3)
Government Expenditure		-303.1
		(432.9)
Constant	-9443.9	-3694.2
	(7621.0)	(11293.9)
Observations	166	166
Adjusted R^2	0.0424	0.0465

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 61: **Winter Games: 7 Years Before, 9 Years After Games (DID)**

	(1)	(2)
Olympic Period	3181.1	2871.8
	(2156.4)	(2164.3)
Government Expenditure		-523.7
		(421.9)
Constant	-10386.3	-449.7
	(7837.0)	(11303.9)
Observations	166	166
Adjusted R^2	0.0139	0.0259

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$