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A Billion Dollar Investment: Is it worth it to host a Mega-Sport Event?

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April 27th, 2019

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&

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Abstract

Hallmark sporting events have evolved from a competitive opportunity of showing national pride to commercially driven entertainment entities which seem to prosper from the economic stimulation of the event. Due to the growing popularity of these mega-sport events, cities and countries around the world are continually evaluating the potential of using these events to draw attention to the host. This thesis seeks to contribute to the controversial discussion of whether or not to invest in hosting a mega-sport event. Every stage of sporting events can reveal positive or negative influences, starting from a competitive bidding process, to the construction of infrastructure, and to the post-event effects. This thesis will focus on three aspects: (i) the anticipated impact of hosting a mega sport event in the short run versus long run by analyzing notable macroeconomic variables: expenditure, investment, and government spending; (ii) econometric analysis of long run panel data of gross domestic product per capita growth; and (iii) will also attempt to answer the question of why hosting a mega sport event did or did not work via. Applying basic macroeconomic principles, the original hypothesis suggested that the impact of hosting a mega-sport event would result in an expected short-run burst domestic product per capita (GDPPC) followed by a slight leveling off of the GDPPC in the medium and long term. Applying linear regressions over a twenty-year period, it is possible to evaluate the impact of hosting an event. Such analysis of the data indicated that it may be worthwhile for a country to host the World Cup but hosting either of the Olympic Games would likely be a costly endeavor.

Acknowledgments

I would like to express my gratitude to my first advisor Professor Nicholas Woolley for guiding me through the initial processes of writing a thesis. His insights and shrewd economic intuition helped me understand the complexities of the topic and begin the planning process throughout the year. His knowledge of macroeconomic theory inspired the first half of this thesis and into the subsequent parts.

I would like to thank my second advisor Professor Mark Stater for helping me see this thesis through. His resourcefulness and expertise in the area econometrics cannot be overstated. Time and time again he helped the reworking of the numerous regressions run until the theory of a triple difference-in-difference model seemed correct.

Lastly, I would like to thank my friends and family for standing by me through the entire process.

List of Figures

List of Tables

Table of Contents: **Page**

Overview/Intro

High-profile sporting events have increasingly been advocated by governments and marketing and decision-making strategists as high impact catalysts for economic development in cities and nations. In particular, the events such as the FIFA World Cup and the Olympic Games draw significant numbers of domestic and international tourists, attract television and corporate sponsorship (Lee, C; 2009).[1] Since 1984, the competition to host the Olympic Games has grown immensely. Economists repeatedly refer to key goals/outcomes behind why cities are so keen to host such an event. These factors that are often though tot motivate corporate involvement and public support include: the opportunity to advertise products to a global audience (raising a host country's or city's corporate investment value), leverage business opportunities in export and new investment, enhance the tourist industry of the host country, and boost citizen pride (Barney, 2002).[2] In reality, the Games begin when cities and nations first devote enormous amounts of organizational time and money with somewhat outlandish expectations of benefiting both empirically and implicitly. Hosting major sporting events is associated with the belief that the 'buzz' will draw sizeable crowds and tourists who will spend money in the city/nation. Further, another perceived economic benefit is than an event is a powerful stimulus due to multiplier effects, employment bonuses, and the overall economic stimulus supplement that a major sporting event naturally offers. On the other hand, organizers often overlook or discount the operational, implicit, and opportunity costs that are associated with this type of event and assume unreasonable expectations. Despite the natural overhyped characteristic linked with mega-sport events, the initial default policy/economic policy expectation is that of a city/nation can afford to host a mega event, the benefits that a nation implicitly acquires, in addition to its tangible benefits (money, revenue), outweigh these inherent up-front incurred costs.

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[1] Lee, C., Taylor, T.; University of Technology (Sydney); Journal of Macroeconomics; *Critical Reflections on the Economic Impact Assessment of a Mega-Event: The Case of the 2002 FIFA World Cup*; https://ac.els-cdn.com/S0261517704000640/1-s2.0-S0261517704000640-main.pdf?_tid=933e6f76-8351-4eed-bc55-020b2952ac15&acdnat=1537848847_0c6d34aa900e40113854713150398b22

[2] R. Barney, S. Wenn, S. Martyn; *Selling the Five Rings: The International Olympic Committee and the Rise of Olympic Commercialism*, The University of Utah Press, Salt Lake City (2002)

The merit of hosting a sporting event is much more than the event itself where sporting events, such as the World Cup and Summer/Winter Olympic Games, are viewed as valuable opportunities for the host nations and urban economies to stimulate economic growth, urban renewal, employment and improve nation stature. There are also intangible benefits (legacy benefits) (Preuss, 2011) of hosting such as: (i) media presence which can lead to long-term increase in tourism and be an attraction of new foreign investment; (ii) long-lasting infrastructure with a potential for a variety of uses; (iii) and a signal of trade liberalization that promotes greater trade activity in the long term. If such results were consistently true, however, then every city, state and nation-governing body would apply to host this world invitational event. Hosting mega-events requires significant investments. Zimbalist (2015) notes emerging economies like China, Brazil, and South Africa have increasingly perceived "mega-events as a sort of coming-out party signaling that [they are] now a modernized economy, ready to make [their] presence felt in world trade and politics."[3] Their intentions may be noble, but the intention of using mega-events as a "coming-out party" means developing countries hoping to host them need to make massive investments. Notably, the 2004 Sumer Olympic Games in Greece cost roughly $16 billion, 2014 World Cup cost Brazil $20 billion, and the 2008 Olympics cost Beijing roughly $40 billion. Prior to the bidding process, should overestimate the total incurred costs and underestimate the total produced benefits.

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[3] Zimbalist 2015; *Is It Worth It?*; Finance and Development; Vol. 47 p. 8-11

Literature Review

In recent decades, major sporting events have been recognized as an opportunity to stimulate economic growth through government expenditure, foreign investment, new money consumption and the introduction of future trade possibilities. Substantiated author and grad student publications have illuminated analysis and measurements of the economic impacts of these major sporting events. Their research has evaluated whether or not mega-events lead to access to previously inaccessible funds and increased investments. These investments would theoretically come from supranational organizations, private stakeholders, public stakeholders, or tourists (Barrios). We also consider whether or not these new expenditures and investments have the direct, indirect, multiplicative, or induced effects (Kasimati). In this field, Kasimati (date), and Lee (date) recognize the different economic approaches that have been considered when trying to measure the impact that hosting mega sporting events incur. On the other hand, Brunet, Overmyer and Plenderleith illustrate strict cost-benefit analysis to indicate the direct impact on the hosts of the major sporting events. Furthermore, studies conducted from Preuss (date) and Collett of Colorado College (date) justify the substantial economic burden incurred for the organization of the mega-event in the face of the consequent increase in consumption spending, foreign investment, and employment. In this line of research are inserted contributions from: (i) Kasimati (date) and Lee (date) that demonstrate the importance of incorporating multipliers into the calculations of macroeconomic impact; (ii) Meurer (date), ERNST & Young Terco (2015) and Collett (date) indicate how the introduction of new money directly and indirectly connected to a mega event, specifically the 1984 Los Angeles Olympics, the 1992 Barcelona Summer Olympics, 2002 FIFA World Cup in South Korea/Japan, and the 2014 FIFA World Cup in Brazil; (iii) and Gong (2008) that theorizes the fragility of the mega investment profile, indicating that a mega-sporting event is a double-edged sword. If it could be used in the right way, it would bring magnificent benefits; otherwise the hosting opportunity of a mega-sporting event would be costly.

Conversely, there are some authors that tend to analyze the adverse effects and consequences that negatively impact economies the of the host country. Barrios and Russel of Harvard Kennedy School (2011) as well as Plenderleith (2012) argue that the vast majority of literature fails to substantiate a relationship between mega-events and the increased economic activity. Overall, the expected economic benefits of hosting an event are vastly overstated and the real benefits are outweighed by the costs associated with event preparation and execution. The only case where the argument of failed substantiation could be justified was made by Kim (2008) and (Lee, 2002) who theorized that in the long term, the Games and world mega events significantly contribute in economic reputation and stature.

The first part of this paper will use macroeconomic theory and analysis to create a generalized hypothesis as to what should happen if a city or country decides to take on the responsibility of hosting such an event. Several authors have ventured into the idea of analyzing the theoretical short term and long term benefits and costs of hosting mega events. One of the most significant of which is Professor Victor Matheson (2006) of Holy Cross, who measured the impact of such events through data and logic and concluded that hosting these events are seemingly high costs and low reward. The early spending may spur quick economic activity, but the tangible benefits in the end are outweighed by the initial costs. He also noted economic variations in hosting economies. The data gathered for the econometric side of this thesis has a wide variance in term of economic differences (developed versus developing) from the World Cup to the Olympics. Essentially, the World Cup hosts are more varied in terms of economic variation where developing countries in South America are just as probable to host the World Cup as developed European or North American countries. The Summer Olympic Games are a little less varied but we see smallest variation in hosting nations of the Winter Olympic Games. The Winter Olympic Games are mainly hosted by Nordic, prosperous European, or North American countries, most of which are characterized with a substantially higher gross domestic product per capita. Matheson stresses that if developing countries want to experience more economy growth, they stay away from hosting the games where the initial costs are too great to overcome.

Events end up not being profitable for primarily one of two reasons: early overestimation of profits or underestimation of costs. While this may be the ‘classic’ investment theory, this just happens to be on a billion-dollar scale. Per the overestimation of revenue streams, both Matheson and Késenne (2005) demonstrate that although mega sport events can generate adequate revenue for a cost-benefit spreadsheet, the distribution of the money does not automatically favor the host city where a substantial portion often falls on the international investors, non-local hospitality and service suppliers, and international sporting government bodies.[4] A possible positive effect was noted by Qi Gong (2012), from the University of Nevada, that building stadiums for the hosting of the Games often create spill-over effects. Infrastructure is often built where the land is cheap and impoverished, any presence of money in those areas due to the mega sport event would be considered a benefit regardless of how much.[5] A possible negative is the aforementioned where the local economy often sees less revenue than originally estimated from the hosted event and thus the overestimation hurts in budgeting for the future, ultimately landing the host in debt. Despite a multitude of documented research that suggests the complexity and

[4] Késeenne, S.; European Sports Management Quarterly, 5, 133-142 (2005); *Do we need an economic impact study or a cost-benefit analysis of a sports event?*
[5] Gong, Qi.; University of Nevada; *The Positive and Negative Economic Contributions of Mega-Sporting Events to Local Communities*; https://digitalscholarship.unlv.edu/cgi/viewcontent.cgi?article=2363&context=thesesdissertations

profitability, applicant cities often take for granted the disparity in the generated revenues in the short-run versus the anticipated long-run revenues generated from trade, upgrading their infrastructure, and attracting future corporate investment (local and foreign) into their local economy.

The second reason why countries become unsuccessful hosts is due to their underestimation of investment costs. A majority of these costs are found in the investment in infrastructure in preparation for the event: stadiums, media villages, and structures to host the influx of millions of people. Harry Arne Solberg and Holger Preuss (2007) analyze the reasoning behind that and conclude that cities spend substantial amounts of money rebuilding versus upgrading infrastructure. While this can create welfare-economic gains (long term implicit benefits), this does not assure that the tangible benefits will exceed the costs. With many of these host cities placing a significant part of their revenue on inbound tourism, this also creates such a high risk gamble on people. When circumstances allow, events can stimulate tourism but this visitor influx is not indicative of a long-term demand curve (of a normal supply demand market) outward shift, but rather a short term burst. If producers behave rationally, they will supply the market with more goods and the supply curve would shift outward as well to regulate the equilibrium price. Indirectly, tourism can improve the host's ability to capitalize on economies of scale but local residents would obtain non-local goods and services, which would disappear over time.

The largest component of hosting is the short term investment and long term impact in infrastructure. A number of factors can inhibit long-term tourism demand but the event's promotion will not consistently be able to draw in the same amount of tourists post-event as during the event. One of the few analysis using (publicly available) data sets was created by Anita Mehrotra (2011).The thesis was a comparative study on the long run impacts specific to the Olympic Games. The study took into account the massive pre-event expenditure on infrastructure and tourism expenditure during the event and compared it to the lack-there-of in a non-host city over a twenty-year period. The study ultimately found that after the initial spurt in economic activity around the event (at time = 0), the economic progress, in terms of gross domestic product (GDP), significantly slowed. In some comparative cases, the GDP growth slowed so much that the control country (non-host) ended up surpassing the host country within ten years after the event.[6] This ultimately led her to conclude that the initial 'sugar rush' of hosting a mega sport event was not worth it in the end on average. The figure below illustrates the long-term comparative study:[7]

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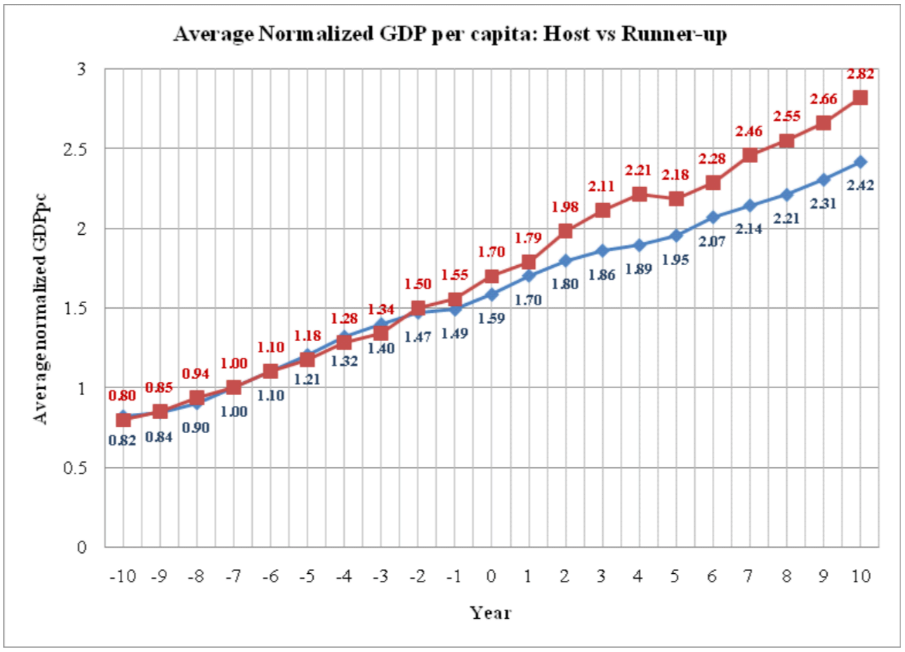
[6] Mehrotra, A., Saez, E.; UC Berkeley; *To Host or Not to Host? A comparison Study of the Long-Run Impacts of the Olympic Games* https://www.econ.berkeley.edu/sites/default/files/mehrotra_anita.pdf
[7] Mehrotra, A., Saez, E.; UC Berkeley; *To Host or Not to Host? A comparison Study of the Long-Run Impacts of the Olympic Games* https://www.econ.berkeley.edu/sites/default/files/mehrotra_anita.pdf

Figure 1



There are many theories that can explain why this conclusion may occur: variances in countries chosen, elimination of positive outliers (Barcelona, Spain), Dutch disease (a net negative impact on an economy that originated from a sharp inflow of foreign currency), or poor allocation of resources. For the most part, research would suggest that it is not worth it to host such an event where the intangible benefits are nearly impossible to measure and the tangible benefits are surpassed by the cost. Based on the leading literature, authors (Victor Matheson, Thomas Miceli, Andrew Zimbalist) would generally conclude that it just purely based on revenue streams, it is possible to generate a profit from a structured event such as the World Cup due to the sheer size, but highly unlikely to yield a profit from an event such as the Olympic Games. Upon attending an economist panel concerning this topic, Victor Matheson and Andrew Zimbalist clarified that it is possible for outliers to occur such as Los Angeles '84 or Barcelona '92. Mr. Matheson dubbed this as the 'hidden gem theory' where the city must be characterized with the right potential in resources to have a long-term positive effect. When Salt Lake City hosted the Winter Olympic Games ('02), their revenue change over the past fifteen years compared to Denver ski slopes have increased significantly. In this sense, a city's potential relies on its ability to change for its future economy and its location. For example, Salt Lake City was a growing and well-known ski destination. Its hosting of the Games only required the park to invest in park improvements for the future (that would have been made anyway) and further boosted its already recognized name. In the case of Atlanta, however, it is not an internationally recognized city. Hosting the Olympics would certainly help in the short term, but the city location and culture is constantly second-rate to Nashville and people naturally regress back to the larger well-known cities. If people ask where someone wants to go on vacation, they would likely say Salt Lake City for a ski vacation or Los Angeles in the winter. This is where the retention of natural tourism differs between cities already developed or considered to be a 'hidden gem' and cities that are not prime for a breakout on the world stage.[8]

The general consensus explains that through econometrics, it nearly impossible to yield positive statistically significant results when analyzing data surrounding the Olympics. According to Mr. Zimbalist, "hosting the event creates the same short-run economic boost equivalent to borrowing a billion dollars and using it to build a hole in the city center." There would be a billion dollars in short term spending, but the city and country would be a billion dollars more in debt than before and have no way to turn that into a profit. Hosting a mega-sport event comes down to the incurred costs, as mentioned before. At the panel, Mr. Zimbalist stated that the cost-overruns are almost the sole reason why hosting fails. If a politician wants to get elected or focus on bring in the Olympics or World Cup, he or she will absolutely understate the costs to gain public support. At a minimum, the bidding cost for the World Cup or Olympics costs anywhere from $60-$100 million. There are four categories of spending: (i) operations budget, which is the cost of operating the event; (ii) permanent sports venues, which include the Olympic village, (iii) infrastructure, which will be stressed later; (iv) and security. The aggregate of such categories varies between $14.8-$23.1 billion. In conclusion, the investment in these games would spur billions of dollars in economic activity, but would not be sustained and would eventually hurt the economy. Econometric analysis illustrates this relationship of an unsustainable expenditure pattern where a short-term economic boost is completely undermined by the long-term downfall, per the Olympic Games. This is why it is nearly impossible to yield statistically positive results when examining the impact of the Games.

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[8] Victor Matheson, Andrew Zimbalist, Thomas Miceli; "Olympics Lecture" (University of Connecticut Law, April 12th, 2019.)

The differentiation between the Games and the World Cup was examined by Dr. Miceli. He explained that due to the spread out nature, size, and duration of the World Cup, the revenue streams will be astronomically larger. This is in part why the World Cup hosts experience just made the games longer and larger to create more revenue. Another reason that World Cup host experience marginally more success is due to the destinations chosen: all places with soccer (fútbol) leagues. This makes the infrastructure costs significantly less. Due to the spread out nature of the event, the costs are spread out among different cities (sometimes other nations) and the profits created catalyze economic activity in all of the different places where the competitions are held; unlike the centralized pattern of the Olympics. Theoretically, it is more probable that hosting the World Cup would produce more positive outcomes than hosting either of the Olympic Games.

Theoretical Model

The literature review suggests there is no general consensus as to whether or not hosting a mega-sport event helps or hinders economic growth. One theory supported by several macroeconomists suggests that hosting a mega-sport event increases international awareness and thus results in a positive, short-lived, economic effect on the output. Conversely, a numerous amount of existing literature indicates the opposite: that hosting such an event causes a negative short-term impact on the growth of the economy.

Short-Term Economic Impact:

We will briefly touch on the subject of legacies and implicit benefits/costs to address possible reasoning as to why host countries and cities primarily desire to host the event and yet some are unable to consistently replicate these results. A legacy is an externality (external phenomenon) that arises in the wake of the event which attempts to capture people's behavior. Some of the positive legacies include: urban revival, improved public welfare, reduced unemployment, host city marketing, projection of cultural values, and economic signaling that the host is ready to engage in business with the rest of the world (if not already). On the other hand, negative legacies include: traffic produced from incoming visitors, production of real estate bubble due to raised prices, employment is only temporary, and further socioeconomic hierarchical differentiation. Unfortunately, further research would suggest that there is no accurate way to accurately measure the impact of the implicit benefits or costs. Two different methods have been used in attempt to capture the gravity of the implicit benefits: top down approach and the bottom up approach. The top down approach is very controversial where one author stated that "In theory one only needs to compare the economic variables of a city/region, which staged the event with the same variables of the city/region not staging the event" (Hanusch, 1992).[9] This model was found to be oversimplified as it assumed many variables were equal between the control and treatment group. The bottom up approach attempted to measure the value of the values by measuring the lasting infrastructure the investment into the games produced. The approach considered the development of the city between the control city versus the treatment (host) city. While both approaches were attempted, both were found to be static and unable to truly capture unforeseen elasticities.

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[9] Preuss, H.; Johannes Guttenberg-Universitat Mainz, Germany; *Lasting Effects of Major Sporting Events;* https://idrottsforum.org/articles/preuss/preuss061213.pdf

While some theories also address the implicit and intangible benefits (country image leading to increased tourism) and costs (increase in human traffic and pollution from increased tourism), this section will primarily focus on the tangible Gross Domestic Product of a country and equation-driven aspects of theoretical macroeconomics. Normally, an economy is determined by either measuring the gross domestic product per a given year via the expenditure, income, or value added approach. The theory explained will use the expenditure approach which suggests GDP is determined by the equation:

$$Y = C(Y - T) + G + I(r) + NX(r)$$

Y= Gross Domestic Product

C = aggregate consumption expenditure of country's goods and services

I = aggregate amount of a country's investment

G = aggregate of a country's government expenditure

NX = net result of a country's exports and imports

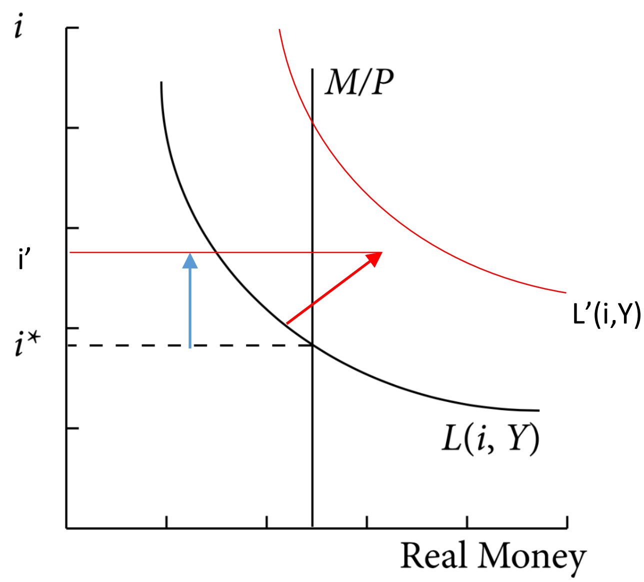
This equation identifies the expenditure approach to measuring the output of an economy (GDP) by accruing the total amount of spending in the economy from consumers, government, investment, and foreign trades. Consumption (C) is normally the largest GDP component in the economy consisting of private (household) expenditures. It is a function of how much income people have subtracted by the amount they owe the government in taxes. Investment (I) includes the purchasing of intermediary goods that would help create the final goods such as business investment in equipment to produce their final good that would appear on store shelves. Government (G) spending is measured as the aggregate if all government purchases of final goods and services. It includes salaries of public servants, purchase of military weapons, and any foreign expenditure by the government. Next exports (NX) represents the gross exports subtracting the total imports. GDP captures the amount a country produces including those from foreign nations' consumption, thus exports are added. Imported goods are deduced to avoid counting the foreign supply as domestic.

Nations and cities compete to host international sporting events such as the World Cup and Summer and Winter Olympic Games even if large investment costs are incurred. When a city decides to undertake a mega sporting event, they do so with the intention that hosting such an event will provide many direct financial benefits as well as countless indirect benefits. Since there has been no credible way of calculating the intangible benefits a country receives due to hosting a mega sport event, this analysis will focus on the theoretical benefits: taxes, income, unemployment, and small project investment and how these variables affect the larger economic indicators a country reflects.

Theoretically, hosting such events as the World Cup would elicit a positive impact on the economy provided that the incurred costs are not exorbitantly larger. Usually, the main source of revenue is generated by the influx of tourists. This mass attraction of international tourists should cause an aggregate increase in the consumption variable (C) in the Keynesian equation. Let us estimate a minimum of two million people enter the country for the duration of the event and each spend a minimum $100 per jersey of their favorite player (World Cup). Conservatively, tourists will contribute a positive $200 million in aggregate expenditure (C).

Hosting a mega sport event would also enact a multitude of chain reactions due to an influx of tourism: (i) decrease in unemployment where there would be more employment opportunities for local workers; (ii) ultimate increase in government spending; (iii) and in increase in net exports due to pre-event spending in infrastructure. With more expenditure occurring in the economy, businesses would have more resources to pay workers higher wages. This increase in income would allow for either more expenditure (increase in C), more savings (more bank lending), and a higher tax rate. A higher tax rate means the government has more money to spend on local projects, such as pre-event investing in infrastructure. This investment in infrastructure in addition to an increase in aggregate expenditure would elicit an increase in Gross Domestic Product (Y) and thus an increase in the overall country interest rate. The figure below illustrates the increase in the interest rate due to an aggregate increase in a country's GDP where liquidity demand (L) is a function of Y (GDP).

Figure 2



As seen in the above figure, an increase in aggregate expenditure elicits an increase in the liquidity demand and macro interest rate. This results in an increase a decrease in the exchange rate where domestic currency becomes more affordable and desirable to foreign nations. An increase in the foreign desire of domestic products indicates a positive sum in net exports. Logically, in influx of tourism should elicit a positive aggregate impact on the economy.

Commonly found, however, is that there appears to be a negative impact on host countries for several years after the Olympic Games are held. As pointed out in the most current research on the long-run effects (PricewaterhouseCoopers, 2002) this negative impact on the host countries may be a result of the increase in domestic investment and excitement for hosting the Olympics. This, in turn, would lead to an increase in domestic and international demand for host country's products and would most likely be seen through the consumption channel of the classic macroeconomic equation for output:

$$Y = C(Y - T) + G + I(r) + NX(r)$$

However, this spike in consumption would be relatively short-lived and as public infrastructure built for the Games remains unused, negative capacity effects could result in a decline in long-run output. Thus though an increase in government spending is expansionary fiscal policy, the spending on the Olympic Games may have an even smaller multiplier effect than current research suggests (Ball, 1999).[10] This may partially be attributed to the multiplier working the opposite direction: the non-recurring boost to expenditure results in a longer-run fall in demand as the economy returns to its pre-Olympic equilibrium income (PricewaterhouseCoopers, 2002).[11] This suggests an explanation for why the impact is negative for a long period of time after the Games are hosted.

Another explanation for results in contradiction of basic macroeconomic theory would be a loss of local expenditure. One of the largest positive explanations promoting hosting a mega sport event is due to the resulting mass of expenditure from tourists and media rights. What is not necessarily considered, however, is the investment from transnational organizations or international investors. Money originally invested by I.e. Coca Cola, a global organization, will be paid back by the revenues generated from tourist expenditures. This money will go to the Coca Cola organization and not necessarily to the local economy. Per the 2014 Brazil, Coca Cola invested around $7.6 billion; since the organization reported a return

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[10] PricewaterhouseCoopers (2002); *Business and Economic Benefits of the Sydney 2000 Olympics*: *A collation of evidence.* Sydney
[11] PricewaterhouseCoopers (2002); *Business and Economic Benefits of the Sydney 2000 Olympics*: *A collation of evidence.* Sydney

roughly 5%, therefore an extra $380 million generated revenues would return to the Coca Cola company and thus out of the local economy.[12] The supplementary part of this theory of generated money leaving the economy can be connected through housing. Mega events are frequently characterized by high capacity constraints and thus high prices for accommodations and hospitality services. Hotel rooms, villas, and village lodges can sell as high as three times the normal rate during a globalized event because many people are initially price inelastic. Out of these inflated prices, the desk clerks, valets, cleaning staff, and complementary services employees' wages do not triple. Thus as the tourist industry allows for a significant returns to capital for these hospitality conglomerates, the majority of these services are based exterior to the local economy and event expenditure leaks of the host economy.

The Impact of Infrastructure Investment:

The empirical section of this thesis will focus on the empirical consequences for long-term economic growth with hosting a mega event. As such it is imperative to cover the main reason of how a host economy fails or prospers: infrastructure. Infrastructure is the largest form of investment (majority of early spending) and government spending with each government's highest hope of profit attached with it. This section will focus on the theoretical direct and implicit effects of infrastructure as a long-term venture due to its sheer importance. The investment in infrastructure is both the key to the financial success of hosting a mega-sport event and the bridge between the short run costs (pre event) and the long term economic progress. The major question is whether or not it is worth it to largely finance a billion-dollar project for the hope that it will pay off in a decade's time. The goal of any business investment is for it to be financially beneficial to the investor. In economics, the objective is to maximize the total amount of profit filling the demand for a product. An investment in infrastructure is a little riskier where the investment guarantees a supply of new infrastructure in hopes that the demand will be met by the sporting event and in the long term by the normal populace. On this supply side of this equation, a city (Olympics) or country (World Cup) needs to be prepared to host millions of new tourists as well as accommodate the countries' sports teams. Precedent illustrates that all hallmark events go through a long period of preparation ranging from four to eleven years.

[12] Narula, S.; *Coca-Cola's investment in the World Cup didn't exactly pay off*; qz.com; https://qz.com/238538/coca-colas-investment-in-the-world-cup-didnt-exactly-pay-off/

Figure 3

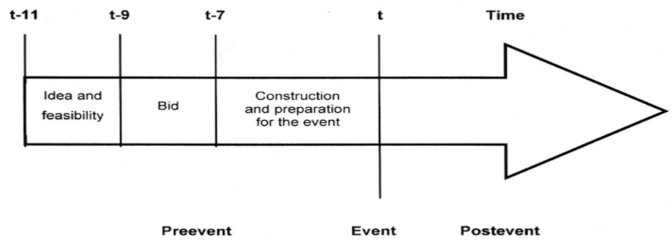


Figure 1 — Stages of the long-term period.

The figure above depicts the timeline necessary for the usual amount of time required to be prepared for the hosting of the mega sport event.[13] Countries and cities often require at least six years to adequately host the event. On the other hand, some cities have infrastructure that enables them to stage major events with very little need for investment. Consequently, a significantly lower amount of revenue generated via ticket sales or media coverage is required; this is where most hosts of mega sport events have come close or experienced profitable returns in both the short and long run.

Many investors understand that while infrastructure investments typically do not generate economic benefits for another decade, they can create many positives if done correctly. Advocates of hosting a mega sporting event claim that stadiums and sports infrastructure can serve as a base element to promoting local economic development. It is envisioned that the stadiums and new transportation build in tandem would serve as an integrated component of an (often times) gentrifying and diversifying local economy. Camp Nou (FC Barcelona Stadium) is an easy representation of advocates' theory; a stadium that has hosted many international events and tournaments. The stadium was built in 1957 and rests in an area known as Les Corts, which fifty years ago was a ghetto. This venture posted the highest revenue in sports history at $770 million annually and generates a host of spillover effects for the local community as millions of fans travel internationally, not necessarily just for the international competition, to watch the event. An improved and almost thriving entertainment district has developed around the stadium with dozens of eating and drinking establishments within a few blocks. While Camp Nou is an example of a thriving measurable economic benefits, advocates also argue that in certain cases, hosting a mega event can create significant intangible benefits (novelty effect) for a country, cultural site restoration, and short term jobs. Some of these short term, intangible benefits stem from the 'novelty effect' where more people

[13] Solberg, H.; Preuss, H.; *Major Sporting Events and Long-Term Tourism Impacts*; https://pdfs.semanticscholar.org/2425/5462c4984e01c1aa075c1be8ac95f74f172b.pdf

come to view the iconic site because it is 'new or substantially rebranded as new.' For example, a recent study was performed suggesting that a city or country having a UNESCO site would significantly improve a city's annual tourism influx. Per the over-hauling of a once-great or outdated sports arena, these restoration projects would theoretically draw more tourists in towards the event area, if not for the event. Another argument is that this investment will create short term jobs until completion, for the duration of nearly a decade. It would not be a solve to unemployment, but it would certainly decrease the rate for the next country census and create a better image for the country.

Long-Term Infrastructure Planning:

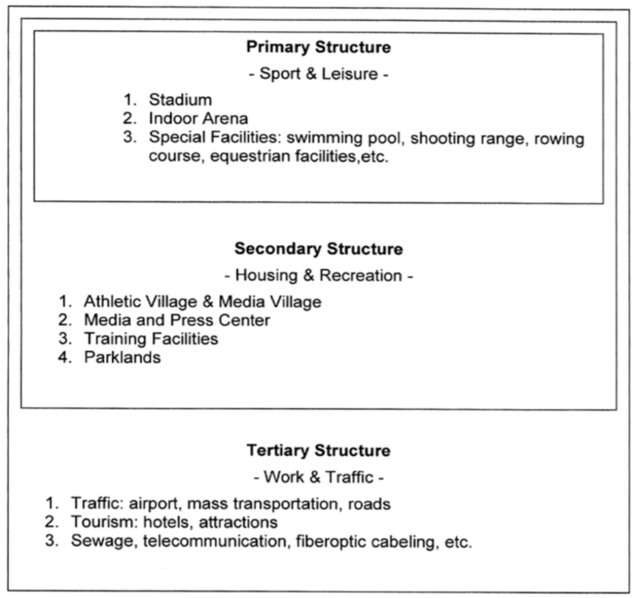
Long-term infrastructure investment is dependent upon the amount of existing infrastructure and the amount that needs to be built. The equation below indicates that the amount of literature required to be built is dependent on the amount of infrastructure a host already possesses. Therefore, if a country already possesses a majority of the edifices in a quality required to host the event or support the influx of tourists for the event, then the initial investment will be sizably less than those without.

$$I\ (I_0, I_n)$$
$$I = I_0 + I_n$$

This implies that city planners would objectively (mathematically) analyze the cost-benefit of refurbishing stadiums and other infrastructure versus new construction of the same. However, many city planners do not take this into account. Research shows that many of the investment costs historically incurred are attributed to the new construction of stadiums that could have been refurbished or building structures in city areas that impede the existing flow of architecture of a city (all primary structures). Figure 2 below illustrates an overview of the structures generally required to host such an event: (i) the primary structure entails the immediate necessities of the athletes for the performance show, (ii) the secondary structure entails the often illustrious Olympic or World Cup Village and all tributary structures that athletes require; (iii) the tertiary structure provides for the influx of tourism for the event and hopefully in the long term.[14]

[14] Solberg, H.; Preuss, H.; *Major Sporting Events and Long-Term Tourism Impacts*; https://pdfs.semanticscholar.org/2425/5462c4984e01c1aa075c1be8ac95f74f172b.pdf

Figure 4



The primary structure of the event-specific construction is for facilities intended for the use by athletes. This includes the stadiums, required arenas, (indoor and outdoor) and Olympic swimming pools. Additional to the stage elements, athletic leisure is also built: locker rooms and spas are considered to be an integral a part of these athletic-specific resorts. The successful host cities tend to transform these facilities into full time resorts or men's fitness clubs. This section of infrastructure is the most impactful in terms of potential costs or benefits. It is necessary for cities to correctly design, integrate and convert these up-front investments into their respective cities' long-term economic plans. Research illustrates that this investment is a 'double-edged sword' and could be worth the risk: difficult to execute, expensive, and necessary for the event; but if performed correctly, this investment could yield positive long-term benefits.

The secondary structure invested in for a mega event is the development of housing: villages for athletes, officials, and media representatives. A benefit of this is the resulting gentrification of that part of the city, which is often a distinct contrast with the previous economic and lifestyle character of the neighborhood. Barcelona, Spain was completely transformed into a tourist city with its creation of a beach and its restructuring of the transportation system to fit the new 'destination city' style. Other examples include Seoul and Atlanta for their prosperous hosting of their Summer Olympic Games. In addition, the sport parks often created around the city as professional training facilities are typically converted in the future to recreational fields or resorts. All of these types of investments anchor future ways for a city to generate long term money from its initial investment into the mega sport event.

The tertiary structure covers all supplementary elements to stage the events: classified herein as destination city tourism structures. This includes hospitality investments in the form of hotels, new public transportation from the airport or train station, and restaurants/bars/clubs that promote lively nightlife. To create destination city structure, further labor is required, which will temporarily allow for the creation of more jobs. Not every host city invests in a tertiary/destination city structure; yet, most cities have yielded a long term benefit in their local economies. Theoretically correlated, the tertiary structure, if built correctly, becomes the building base for rebranding and anchoring the new destination city the mega sport event. The immediate peak demand (tourism, attendance, media attention, etc.) that accompanies such events exceeds the capacity in almost every host city (Essex & Chalkley, 1999),[15] and as such it is imperative that every host city is ready to take in the demand of new tourists or they will lose probably revenue.

When playing the long game, politicians must consider and account for the current infrastructure the city possesses. A city should consider three areas of its development plan when organizing a major event: (i) the city development that is necessary irrespective of the sport event, (ii) the infrastructure required for the sport event that is planned anyway for the general development of the city, and (iii) the infrastructure that is needed for the event that is not yet included in the city's long-term plan.[16] There is a possibility that this third aspect can be so expensive, if $I_n = 0$, further development of the rest (planned development that is not related to the event) slows down. One must take into consideration whether event-specific development exceeds the long-term demand from locals and visitors. A city of 150,000 residents, for example, does not need a stadium with capacity for 80,000 spectators. It may not be able to host as many international tourists at a specific venue but in the long run, there may not be as many empty seats from unsold tickets; thus the initial cost would be minimized. Cities that regard major sport events as instruments to improve their attractiveness as tourist destinations should consider all three areas of their city-development plans before bidding for or creating events. This normally would entail taking structural inventory and then determining the future direction of the city or country: if the host should change economic strategies as Barcelona did (towards Tourism), use this event as an excuse to build more sporting stadiums for their host teams as Brazil did, or if the host will simply use it as an excuse to branch

[15] Essex, S.; Chalkley, B., Leisure Studies, 17, 187-207 (1999); *Olympic Games: Catalyst of Urban Change*
[16] https://pdfs.semanticscholar.org/2425/5462c4984e01c1aa075c1be8ac95f74f172b.pdf

their country/city image to the world. Most successful case occur when cities use mega-events and their investments as a catalyst for a full-scale change; whereas countries that justify hosting the event and its costs solely to leverage or alter the host image with means to attract 'other people's money' and not help the city build new infrastructure in anticipation of creating a new destination city, have failed to achieve the sough after, long-term sustained economic benefits.

An alternative argument that has been recurrently made is that infrastructure not only entails stadiums, but also freeways and train systems. This is considered a large scale hard-infrastructure change where the whole city landscape can be adapted to the its future. While most cities seem to falter in this area, an example of profit comes from Barcelona's hosting of the 1992 Summer Olympics. The regional commissioner of Catalunya decided to completely redo Barcelona's train system, city layout, and beach sites in effort to brand Barcelona as a tourist city. This is one of the few examples in history of long term economic prosperity from a massive change to infrastructure, but it shows that hosting a mega event allows for a large scale investment or reinvention of a city in effort for its betterment. Another instance exemplifies Japan and its use of their upcoming bid for the 2002 FIFA World Cup as an opportunity to expand upon their initial investment in a technologically advanced subway system. Many people express their train system today is still one of the best innovations and train systems the world has to offer. While Japan's economy and demographics struggles in many other ways, technological advancement and implementation into their city foundations is not one of those.

Long-term investment structure is one of the large make-or-break points when preparing to host a mega sport event. Conventional economic theory suggests that the increase in spending via the government, consumers, and private investment would increase short run gross domestic products. In fact, many large sporting events do often generate revenues that cover the operational costs of the event, but not the full investment costs. Despite a large spurt of spending, what the expenditure approach does not indicate, is the big crater of debt this mass-spending creates (per the investment in infrastructure). This can create negative long run effects by reducing other activities that require tax funding. The 2002 Athens Summer Olympics, which left the city with enormous financial debt, is a well-known example of this phenomenon. In general, public and private investment often share the burden of financing the investments but with hefty interest percentage (cost of debt) placed on the returns. Government revenue needed to pay these interest rates and re-pay principal amounts depends on government returns from the initial investment into hosting the event and a higher collection of taxes generated, ironically, by the expected growth in the local economy generated by the event. It is a higher interdependent circle where if the investment is not mapped and carried out correctly, a billion-dollar investment goes to waste (does not generate any return that would go back into the positive-feedback-looped economy). Taxes can also be an independent variable. Whether or not the additional revenue generated by the event or the creation of new jobs makes its way to citizens' pockets (because of their new wages can be taxed) is not necessarily felt by the local individual or health of the city.

Long-Term Theoretical Economic Impact:

The long run goal of hosting a mega-sport event will be to sustain the theoretical economic benefit (from spending in the short run) and capitalizing on the investments made on infrastructure and transportation. The previous few pages have covered the importance of infrastructure investment in the short and long run. This subsequent section will focus on economic theories that relate to the empirical conclusions of this paper: Dutch disease, three forms of overspending and the crowding out effect, and population growth rate as it affects GDP per capita. These theories often examine phenomena that are not taken into account when correlating data empirically and thus it is important to introduce these so they can be addressed as explanations for specific data patterns. The empirical section of this paper will aim to illustrate how hosting a mega event would help or hurt a city/country measured against an averaged timeline of gross domestic product per capita growth.

Dutch disease is a theory that encompasses the idea of a quick unsustainable surge in economic spending. Initially, Dutch disease was first developed in the 1960s when the discovery of Natural gas generated a sharp inflow of currency. This quick inflow of currency lead to very high currency appreciation, which made the country's other products less price competitive in the forex market. In this case, a short run tourism spike as well as foreign investment are natural occurrences when hosting a mega sport event. This sharp increase in expenditure is, in most cases, unsustainable after hosting the event and ends up hurting the rest of the export products for the host country. Analogous to a sugar high, the body feels amazing for a short amount of time until the sugar is completely processed. At the end of the spike, the body regresses to feeling sluggish and takes a few hours to produce the necessary amount of endorphins to make a person feel 'normal' again. This empirical section of this paper will be essentially testing this theory: after the initial spike, a natural downturn in exports will occur due to appreciate currency. Is there a correlation in certain characteristics that allow for certain countries to recover from this natural downturn and perform better in the long run?

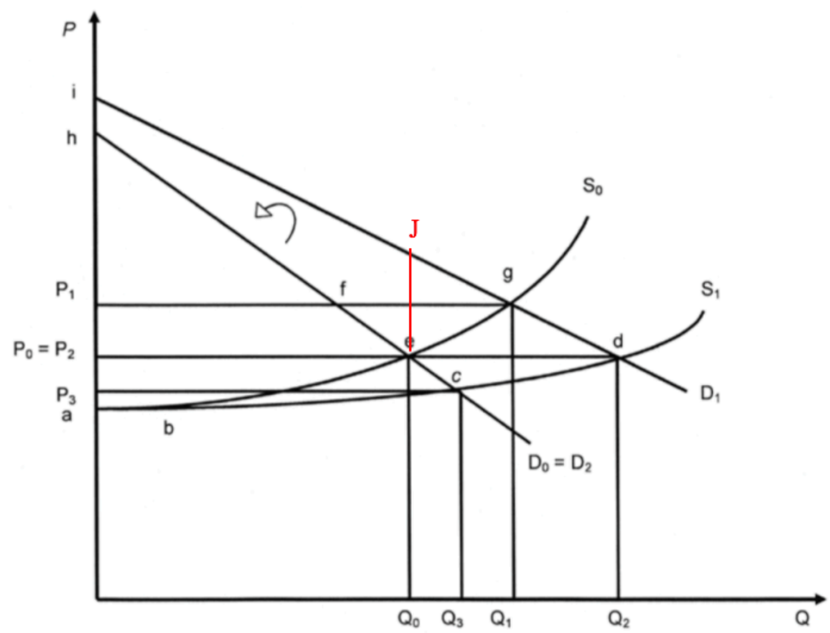
The crowding out effect will be measured in three aspects: one with regards to the displacement of routine tourists; the second with regards to an overestimation of the purchasing of tourism products; and the third with regards to overshadowing large government spending. The late half of (Northern

Hemisphere) spring and summer are the natural traveling periods for most tourists around the world. Europe is habitually visited when a down-jacket is maximum layer required and South America is more frequently visited when the temperature is less than 100 degrees. Normally, Europe receives around 670 million tourists per year with nearly 60% during those time periods and South America also receives roughly 60% of their 100 million of their annual tourists during those seasons as well. With the exception of the winter Olympic Games, the Summer Olympics and World Cup normally happen during those months of frequent international travel. Michael Overmyer authored a thesis about the displacement of tourists from the London 2012 Olympic Games opinionating that London might have actually been better off had it not hosted the event.[17] A city's hotels and restaurants are often at capacity with sports fans, and had those same hotel rooms and restaurants been full of business executives or routine vacationers, the tournament may not have resulted in a short-run net increase in economic activity. His article indicates the primary idealism of the crowding out effect where the influx of tourists caused a less-than-expected number of tourists the year the Olympics occurred. Pre-tournament tourism predictions were clearly overstated as seasonal vacationers cannot be considered if they are displaced. Mr. Overmyer also noted that this displacement of tourists during the event effected the number of routine tourists a year post-event. Tourists who believe the host city will be too crowded look for other places to vacation and thus the following when the tournament effects become minimal, the host would actually lose cyclic tourists.

The second illustration of the crowding out effect come due to an excessive amount of spending on tourism products. Naturally, as a demand for a product increases or the supply of the product decreases, its price will decrease incentivizing consumers to purchase less. There are a couple possibilities as to why this occurs during a mega sports event: a monopolized market for tourism products and a fixed supply of products. As visitors influx into the host economy, the sellers can essentially charge an exorbitant price they desire. Tourists, many traveling internationally, are likely to still buy the memorabilia offered at the event making tourism products a slightly more inelastic good in the beginning. On the other hand, however, local demand of the memorabilia will likely be displaced by the tourists purchases. The other possibility is that the host economy vendors have a select supply of goods and thus as the supply decreases with each purchase, the price of such products increases. For this example, it will be assumed that there not a fixed supply of tourist products. Figure 5 below illustrates the crowding out effect's impact on the demand for tourism products and thus the resulting long term consequences as more expenditure occurs.

[17] Overmyer, M.; Grand Valley State University; *Economic Impact Analysis on Olympic Host-Cities;* *https://scholarworks.gvsu.edu/cgi/viewcontent.cgi?article=1646&context=honorsprojects*

Figure 5



The figure above illustrates the long term potential changes in demand and supply to tourism products due to a country's hosting of an event.[18] In this figure, tourism products are represented as a single market commodity. D_0 is the initial downward sloping demand curve and S_0 is the initial upward sloping supply curve. Another simplification, we assume that the D_0 curve only includes local residents and the S_0 curve only consists of local producers. Point (P_0, Q_0) represents the initial market equilibrium where P_0 is the equilibrium price and Q_0 is the initial equilibrium quantity. Consumer incentive to buy can be captured by the area P_0eh and producer surplus can be represented by the area P_0ae.

Hosting a mega sport event causes an outward shift in the demand curve due to arrival of tourists. This shift brings the new equilibrium to the point (P_1, Q_1). A shift in the demand curve lessens the incentive to consumers to purchase tourist products as the price increases (area P_1jg). This change in the consumer surplus affects both residential and tourist expenditures. Just as locals would be less

[18] Solberg, H.; Preuss, H.; *Major Sporting Events and Long-Term Tourism Impacts*; https://pdfs.semanticscholar.org/2425/5462c4984e01c1aa075c1be8ac95f74f172b.pdf

incentivized to purchase high priced items, purchases by regularly-travelled tourists would likely be displaced due to the increase in price.

As the price increases, the producer incentive to keep supplying products into the market decreases. This can only be remedied by attracting more tourists with a higher willingness to pay (who are price inelastic) than those being displaced. Depending on the place, the event may attract more than leisure vacationers such as business executives or convention delegates, who commonly spend more than the average vacationer (Solberg, Andersson, Shibli, 2001).[19] If the venue fails to attract these types of consumers with deeper pockets, then fewer commodities will be purchased.

The subsequent shift in the tourism product market is an outward shift in the supply curve from S_0 to S_1. As producers see the influx of tourists purchasing goods, they become more optimistic and supply more product to match the demand of the consumers. This positive shift in the supply curve will lower the price equilibrium price and increase the quantity of goods bought to the new equilibrium (P_2, Q_2). The supply curve needs to be shifted such that the new price is equal to the initial price (P_0) to simplify the progressing theory. This shift hypothetically compensates for the crowding-out effect from the previous demand curve shift. Despite the initial simplification of having the demand curve only apply to local consumers, this would likely not be the case. In reality, the initial demand curve, D_0, would contain tourists where producers would only logically only supply more goods with the confidence that the products will be bought by incoming consumers. The consumer surplus has increased to the area of P_2di, but the aggregate consumer surplus will have increased to the original level. The price reduction increases the quantity of goods traded but lessens the amount of revenue generated per item exchanged.

The final stage of the long term analysis in the displacement of tourism product expenditure is the final inward shift in demand. Long term assumes that the event has passed and tourism is fading out significantly. While it can be assumed that a lack of tourists would allow for local residents, the test subject in the displayed model, to purchase more goods, the ultimate lack in promotion (of the product) and 'buzz' surrounding the event would have died out leaving the products less desirable. Realistically, the initial demand curve, D_0, would have included tourists, thus as tourists leave the host country, there will be a heavy decrease in the amount of consumers. The demand curve is allowed to shift back to the starting position D_0=D_2 to simplify the theory. This implies and important assumption that there are no

[19] Solberg, H.; Preuss, H.; *Major Sporting Events and Long-Term Tourism Impacts*; https://pdfs.semanticscholar.org/2425/5462c4984e01c1aa075c1be8ac95f74f172b.pdf

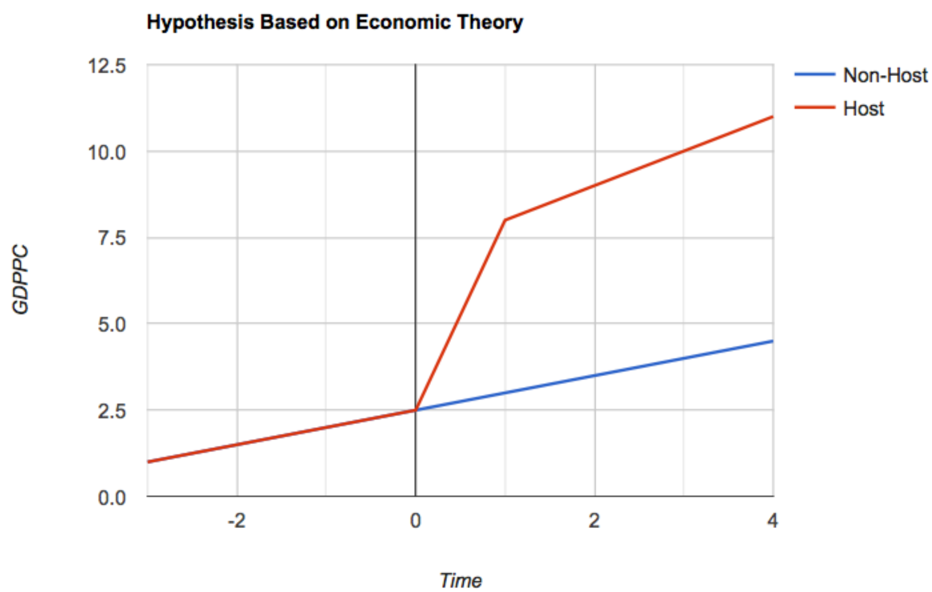
legacies, implicit externalities, surrounding the event. To be clear, legacies are an important part to a host country, but are nearly impossible to calculate and are not implemented into this theoretical model.

The third illustration of the crowding out effect: an alternate direction of expenditure where the government could have invested its billions of currency on other city projects instead of on the specific event. Logically, the initial increase in GDP, income, and thus raised taxes would allow for a larger government budget. If the government had decided to not to invest in event infrastructure, but rather natural infrastructure (i.e. freeways) or improving other means of transportation. Without the event, the government would have spent money on numerous other projects, which theoretically would have still improved the aggregate gross domestic product of the country. Who's to say this would not have been the more efficient and beneficial option? Hypothetically had the event not occurred, London could have spent the billions of investment money on other pressing projects.

Connection to the Empirical Model:

Theory would naturally suggest that a host of such an event as the World Cup, Summer Olympics, or Winter Olympics would incur a positive short term boost in the country's gross domestic product per capita due to excessive spending (C), Investment (I), Government spending (G), and a positive change in New Exports (NX). Not taking into account any legacy, externalities, or implicit benefits, the following figure (**Figure 6)** illustrates what is generally hypothesized from the data gathered from each of the events. It is hypothesized that the host country will incur a short-run boost in economic activity surrounding the time of the event.

Figure 6



Macroeconomic theory would suggest that, holding the total population of a country constant, the host economy would experience a short-term boost due to expected increases in aggregate consumption and government spending. As tourism dissipates, this expected boost is suggested to leave with it and would thusly cause an overall decreasing of the GDPPC growth rate. The empirical portion of this paper will test (with data from the World Bank) the validity of the theory.

This model will make a parallel trends assumption which insinuates that the difference between the 'treatment' and 'control' group will remain constant over time. The figure above illustrates the initial difference as zero but will be represented by an interactive variable, which will be explained further in the next section. It is hypothesized that at Time = 0, the short term tangible benefits will come into full effect within a year and shift the intercept and slope the GDPPC of the host country by the start of a year after the event (Time = 1). One factor that is not accurately displayed in the graph above is that it is expected that the slope of the GDPPC curve will eventually begin to level out (similar to that of a Solow growth output curve) versus keeping its new steep shape (from the Time = 1 'jump'). On the other hand, it is expected that the non-host country GDPPC will neither change in slope or intercept as it has not undertaken or invested in any substantial event that would allow for a drastic change in its GDPPC. The aforementioned hypothesis will be tested with data from a twenty year (long run) period per event in attempt to answer the question of whether or not it is worth it to host a mega sport event.

*Note: that the theoretical model and empirical are separate entities. The theoretical model speculates what should happen in the short run, according to economic theory, if a country decided to host a mega sport event. The empirical model will test the validity of the macroeconomic theory against the data in the short and long run where the effects of such can also be seen by the β_5 and β_6 variables. *

Data Set:

In order to determine the positive or negative impact on host countries' gross domestic product per capita levels, data was obtained from the World Bank. World Bank data was used for the sole reason that it was the platform that had the largest amount of consistent data. Other data platforms charged fees, or had very incomplete data sets with ten to twenty year gaps. The World Bank data was not perfect and other sources (Statista and FED) were sought out to complete the remaining gaps. The fully constructed data set of this thesis is comprised of three separate subsidiary data sets of all mega-sport tournaments (World Cup, Summer Olympics, and Winter Olympics) from 1960 until present date. Each data set is comprised of the annual gross domestic product per country of the host and runner-up countries. The first data set consists of the annual macro data surrounding the World Cup hosts and runner-up countries from the bidding process. The second data set consists of the annual macro data surrounding the Summer Olympic hosts and runner-up countries. The third data set consists of the annual macro data surrounding the Winter Olympics hosts and runner-up countries.

The empirical section of this thesis will be used to test the validity of the suggested outcome theorized from basic macroeconomic influences and determine if host countries, on average, perform better/reach higher economic standing in the long-run. The dependent variable used to judge the impact on the host country is the gross domestic product per capita (GDPPC) to capture the macroeconomic standing of a country incorporating its population. Time will also be accounted for in this model in two respects: (i) a normal progression to account for GDP's natural correlation over time; and (ii) to account for four major events that severely affected the world economy. A set of binary variables will be used to simplify the effect of a country hosting versus not hosting an event where the host retains a '1 value' and a non-host retains a '0 value.' A set of interactive independent variables will be generated from multiplying the dummy variables with Time to create the necessary distinction of a difference-in-difference model. This will be explained further in the next section. The final component of the data is a set of macro-variable controls such as a country's population, interest, and inflation rate. Originally, a few more control variables were to be used but the downside is that as these variables trend over time, they would mitigate the visual effects of the binary and interactive independent variables. The Parallel Trends assumption is already implicit, thus only a select few number of controls will be used in the empirical regressions. In other words, a fairly large assumption of the data will already be made to capture all the differences in the data (from the interactive variable) versus having the controls overshadow the answer to the question.

The empirical section of this thesis will utilize a difference-in-difference (DID) model. It is a quasi-experimental technique that uses longitudinal data (against time) from treatment versus control groups to obtain an appropriate counterfactual and measure a casual effect.[20] The basic idea is to compare the treatment group and the control group before and after the stimulus. In this model, the treatment group are all the host cities and countries of either an Olympic Games or World Cup and the control group are the runner-up cities that were unable to host the event. Should it be found that the runner-up hosted the event later on, the runner-up was replaced with another (runner-up) country that displayed a similar GDPPC growth rate as the host country.

In order to estimate any casual effect from a sudden stimulus, three assumptions must hold: exchangeability, positivity, and a Stable Unit Treatment Value Assumption. In this model a fourth assumption must also hold: Parallel Trends in outcome. This assumption ensures internal validity of the difference-in-difference model where it requires that the difference between the 'treatment' and control group is constant over time. It is imperative that this assumption hold such that violation of the assumption would lead to a biased estimation of the casual effect.

[20] Pinschke, J.; University of Columbia; *Difference-in-Difference Estimation;* https://www.mailman.columbia.edu/research/population-health-methods/difference-difference-estimation

Variable List

Dependent Variable:

GDPPC: (Gross domestic product per capita) A measure of a country's economic output accounting for its number of people

Independent Variables:

Time:

Time: progression of years from t=0 per the year 1960.

Time2, Time3, Time4: 1^{st}-4^{th} degree polynomials in time.

Event_year: accounts for years preceding and post event.

Event_timeline: timeline established of 10 years before the event to 10 years post event.

Host_announced: whether or not a country will host the event activated when host country is announced to the host and public. Captures the amount of prep time a host has prior to the event. 1=country selected to host, 0=not selected.

Binary Comparisons:

Host_wc: whether or not a country hosts a World Cup Event. 1= host, 0 = not host

Host_wc: whether or not a country hosts the Summer Olympic Games. 1= host, 0 = not host

Host_wo: whether or not a country hosts the Winter Olympic Games. 1= host, 0 = not host

Post_wc: whether or not a country successfully hosts the event. Accounts for difference in intercept for non-hosts. 1= host, 0 = not host

Post_so: whether or not a country successfully hosts the event. Accounts for difference in intercept for Summer Olympics non-hosts. 1= host, 0 = not host

Post_wo: whether or not a country successfully hosts the event. Accounts for difference in intercept for Winter Olympics non-hosts. 1= host, 0 = not host

Interactive Variables:

Time_Post_wc: Captures the Pre-Post time trend difference for the non-hosts of the World Cup.

Time_Post_so: Captures the Pre-Post time trend difference for the non-hosts of the Summer Olympics.

Time_Post_wo: Captures the Pre-Post time trend difference for the non-hosts of the Winter Olympics.

Time_host_post_wc: Captures the difference of the change (diff in diff) in World Cup host GDPPC compared to non-host GDPPC over time.

Time_host_post_so: Captures the difference of the change (diff in diff) in Summer Olympics host GDPPC compared to non-host GDPPC over time.
Time_host_post_wo: Captures the difference of the change (diff in diff) in Winter Olympics host GDPPC compared to non-host GDPPC over time.
Host_post_wc: Captures intercept difference in GDPPC 'jump' over one year between World Cup hosts versus non-hosts.
Host_post_so: Captures intercept difference in GDPPC 'jump' over one year between Summer Olympics hosts versus non-hosts.
Host_post_wo: Captures intercept difference in GDPPC 'jump' over one year between Winter Olympics hosts versus non-hosts.

***Did not interact Host_time where the interaction that would represent the difference in time trend for hosts and non-hosts prior to the event. Not including it shows parallel trends assumption and allows for diff in diff approach.**

Controls:
Total_Population: Total population of a country.
Gov_spending_gdp_ratio: fractional amount of government expenditure compared to a country's gross domestic product.
Real_interst_rate: aggregate rate of a proportion of a loan charged as interest to the borrower adjusted for inflation.
Inflation_rate: is the percent growth in the price levels from the previous year.
Broad_money_billions: the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper.

Difference-in-Difference Model

Table 1:

	Treatment Group	Control Group
Pre-Stimulus	Treatment*pre	Control*pre
Post-Stimulus	Treatment*post	Control*post

Intuitively, a difference-in-difference is a comparison of four cell-level means where only once cell is treated per regression.[21] When this occurs, it can be simplified to the [treatment*post-stimulus], which is essentially an interactive independent variable in a simple OLS regression. A typical regression of this model should be shown as followed at the minimum:

$$Y_{i,t} = \beta_0 + \beta_1[\text{Host}] + \beta_2[\text{Post\_Stimulus}] + \beta_3[\text{Host*Post\_Stimulus}] + \beta_4*[\text{Control}] + \varepsilon_t$$

Where:

Post_Stimulus is an indicator = 1 when t=0

B_3 is the coefficient of interest (the treatment effect)

Time is the time trend

Control are various independent bases

ε_t is the random error term

[21] Jagielka, P., Ozier, O.; University of Maryland, College Park; *Applied Econometrics: Difference-in-Difference Estimation;* http://economics.ozier.com/econ626/lec/econ626lecture3_handout.pdf

To allow for the differences in intercepts and time trends, this method has been adapted to create a triple interaction between the independent variables where Time and whether or not a country hosted the event have to be taken into account. This thesis-specific regression is as shown without controls:

$$GDPPC_t = \beta_0 + \beta_1[Host] + \beta_2[Time] + \delta_1[Time^2] + \delta_1[Time^3] + \delta_1[Time^4] + \beta_3[Post] + \beta_4[Time*Post] + \beta_5[Time*Host*Post] + \beta_6[Post*Host] + \varepsilon_t$$

Where:

$GDPPC_t$ = gross domestic product per capita per country

Host is binary for hosting an event

Time is an annual progression from t =0 to t = 64

$Time^2$, $Time^3$, and $Time^4$ are fourth degree polynomial terms in the time trend to account for possible changes to the GDPPC slope

Post is binary hosting an event and accounts for extra event stimulus

Time*Post is the primary difference between hosts v. non-hosts

Time*Host*Post is the difference in pre-post time trend differences for hosts and non-hosts

Post*Host is the primary change in GDPPC slopes

ε_t is the random error term

***Did not interact Host_time where the interaction that would represent the difference in time trend for hosts and non-hosts prior to the event. Not including it shows parallel trends assumption and allows for diff in diff approach.**

Thesis-specific regression with controls:

$$GDPPC_t = \beta_0 + \beta_1[Host] + \beta_2[Time] + \delta_1[Time^2] + \delta_1[Time^3] + \delta_1[Time^4] + \beta_3[Post] + \beta_4[Time*Post] + \beta_5[Time*Host*Post] + \beta_6[Post*Host] + \beta_7[Total\_population] + \beta_8[Inflation\_rate] + \varepsilon_t$$

Where:

Total_population is the country initial population at the time of the event

Inflation-rate is the country inflation rate at the time of the event

Gross domestic product per capita has often been thought to be a better indicator of the development of an economy as it takes into account in the population versus just an aggregate of total goods bought and sold. Often times, a country's gross domestic product can be due to size of the country. The total population (at the time of the event) allows for the control of the initial state of the economy to ensure a better estimation of tourism effects. The inflation rate was also included as a key control to account for the purchasing power in the host country's economy. The inclusion of the total population and inflation improved the R^2 (linear indicator) value but, as predicted, made most of the interactive variable coefficients insignificant. This may be due to increased multicollinearity, but further research would suggest that the inclusion of these controls simply overshadowed the impact of the interactive variables of interest. This is partially why more macro-variable controls were not included. Since GDP trends over time (serial correlation is almost certain) with these macro-variable controls, it was likely that these controls would improve the linear significance but would mitigate the diff-in-diff effects.

The regressions were created to illustrate the full impact of hosting a mega-sport event. The βHost variable is a summation of the βPost and βPost*Host variables where βPost and βPost*Host indicate the difference between hosting and not hosting the event. When 'time' is factored in, then this allows for the calculation of GDP per capita growth where the summation of βTime*Post and βTime*Host*Post are equal to the aggregate effect on the long-term growth GDP per capita growth rate. Theory would indicate that the overall effect should be positive, but literature would indicate otherwise. The manufactured regressions were set up to indicate what parts of the 'full impact' cause the difference between what theory suggests than what literature concludes.

Methodology

The theory previously stated suggests that a positive relationship should occur between GDPPC and hosting a mega-sport event. Referring to previous research, however, long-run graphs showing ten years before and after the mega-sport events were hosted illustrate that runner-up countries fared better than the host countries of the Olympics (**Figure 1**).

Subsequently, regressions were run to test the theory. Since there were three events, the regressions were run individually to ensure a better estimation of the effect of hosting the individual events. This also allows for an easier analysis of the effect on a country's GDP per capita of each event. For each of the three events, two regressions were performed: one without controls to measure the full consequence of hosting the event and the other with controls. These regressions were as follows:

OLS1: World Cup no controls

$$GDPPC_t = \beta_0 + \beta_1[Host\_wc] + \beta_2[Time] + \delta_1[Time^2] + \delta_1[Time^3] + \delta_1[Time^4] + \beta_3[Post\_wc] + \beta_4[Time*Post\_wc] + \beta_5[Time*Host*Post\_wc] + \beta_6[Post*Host\_wc] + \varepsilon_t$$

OLS2: World Cup no controls

$$GDPPC_t\ \beta_0 + \beta_1[Host\_wc] + \beta_2[Time] + \delta_1[Time^2] + \delta_1[Time^3] + \delta_1[Time^4] + \beta_3[Post\_wc] + \beta_4[Time*Post\_wc] + \beta_5[Time*Host*Post\_wc] + \beta_6[Post*Host\_wc] + \beta_7[Total\_population] + \beta_8[Inflation\_rate] + \varepsilon_t$$

OLS3: Summer Olympics no controls

$$GDPPC_t = \beta_0 + \beta_1[Host\_so] + \beta_2[Time] + \delta_1[Time^2] + \delta_1[Time^3] + \delta_1[Time^4] + \beta_3[Post\_so] + \beta_4[Time*Post\_so] + \beta_5[Time*Host*Post\_so] + \beta_6[Post*Host\_so] + \varepsilon_t$$

OLS4: Summer Olympics with controls

$$GDPPC_t\ \beta_0 + \beta_1[Host\_so] + \beta_2[Time] + \delta_1[Time^2] + \delta_1[Time^3] + \delta_1[Time^4] + \beta_3[Post\_so] + \beta_4[Time*Post\_so] + \beta_5[Time*Host*Post\_so] + \beta_6[Post*Host\_so] + \beta_7[Total\_population] + \beta_8[Inflation\_rate] + \varepsilon_t$$

OLS5: Winter Olympics no controls

$$GDPPC_t = \beta_0 + \beta_1[Host\_wo] + \beta_2[Time] + \delta_1[Time^2] + \delta_1[Time^3] + \delta_1[Time^4] + \beta_3[Post\_wo] + \beta_4[Time*Post\_wo] + \beta_5[Time*Host*Post\_wo] + \beta_6[Post*Host\_wo] + \varepsilon_t$$

OLS6: Winter Olympics with controls

$$GDPPC_t\ \beta_0 + \beta_1[Host\_wo] + \beta_2[Time] + \delta_1[Time^2] + \delta_1[Time^3] + \delta_1[Time^4] + \beta_3[Post\_wo] + \beta_4[Time*Post\_wo] + \beta_5[Time*Host*Post\_wo] + \beta_6[Post*Host\_wo] + \beta_7[Total\_population] + \beta_8[Inflation\_rate] + \varepsilon_t$$

After the results were obtained, several tests were conducted to examine the possible extent of heteroscedasticity, multicollinearity, and serial correlation. Heteroscedasticity occurs when the spread of the error term, GDPPC, is related to the values of an independent variable. In other words, the variance of the error term (at the end of the regression equation) is changing, which alters the significance of the results and hypothesis testing. Multicollinearity is problematic because it increases the chance of identifying a relevant variable as insignificant within the model. It is likely that this model will have some multicollinearity since many of the control variables may trend over time. Gross domestic product is a macroeconomic variable that depends on its value from the previous period; therefore, the data will likely exhibit serial correlation. Since no variables can be omitted without unsatisfying the basic necessities of performing a standard difference-in-difference OLS regression, the final model can only be corrected for the aforementioned variations of econometric assumptions. The only independent variables that will be omitted from the final model are the control variables, total population and inflation rate, to capture the full possible impact of a country hosting a mage-sport event.

Results:

i. Descriptive Statistics:

Descriptive statistics provide insight into the sample used in the study. The mean, median, maximum, minimum, standard deviation, and the coefficient of variation (CV%) all reveal some different aspects of variables in the sample. The statistics for each of the events with and without controls are displayed below: **Tables 2-5.**

The coefficient of variation (CV%) represents the ratio of the standard deviation to the mean and is used when comparing the degree of variation from one data series to another. Since the increased spread decreases the standard error of the coefficient, an independent variable with a high CV% value will have a decreased standard error and a higher t-statistic. Thus, the CV% value can be used to predict whether or not a variable may be significant when included in the model. Although none of the variables will be removed from the model, apart from the controls, these significant suggestions can be concluded in further analysis and discussion of the final-adjusted model.

TABLE 2: SUMMARY OF STATISTSICS: WORLD CUP

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	9953.595	4596.88	48603.48	341.5928	11617.22	117%	4857354	6.57E+10
TIME	31.68443	33	57	0	14.13759	45%	15462	97337.4
HOST_WC	0.526639	1	1	0	0.499802	95%	257	121.6537
POST_WC	0.522541	1	1	0	0.500004	96%	255	121.752

TABLE 3: SUMMARY OF STATISTSICS: WORLD CUP WITH CONTROLS

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	10797.03	5617.742	48603.48	341.5928	12058.07	112%	4653520	6.25E+10
TIME	32.79814	34	57	0	13.61236	42%	14136	79677.44
HOST_WC	0.545244	1	1	0	0.498527	91%	235	106.8677
POST_WC	0.522042	1	1	0	0.500094	96%	225	107.5406
EVENT_TIMELINE	-0.06033	0	10	-10	5.935003		-26	15146.43
GDPPC_BASE	8875.49	2982	48603.48	341.5928	12935.14	146%	3825336	7.19E+10
TOTAL_POPULATION	75173651	56797087	2.93E+08	22037610	56794476	76%	3.24E+10	1.39E+18
INFLATION_RATE	12.79106	5.017158	874.2457	-1.352837	48.05608	376%	5512.946	993036.3

TABLE 4: SUMMARY OF STATISTSICS: WORLD CUP

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	23691.32	22061.16	60283.25	828.5805	13955.76	59%	7675987	6.29E+10
TIME	37.19753	37.5	57	14	10.36118	28%	12052	34675.36
HOST_SO	0.5	0.5	1	0	0.500773	100%	162	81
POST_SO	0.506173	1	1	0	0.500735	99%	164	80.98765

TABLE 5: SUMMARY OF STATISTSICS: SUMMER OLYMPICS WITH CONTROLS

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	20317.79	20087.54	51936.89	1398.479	11035.55	54%	4266735	2.55E+10
TIME	32	32	50	14	8.306336	26%	6720	14420
HOST_SO	0.5	0.5	1	0	0.501195	100%	105	52.5
POST_SO	0.52381	1	1	0	0.500626	96%	110	52.38095
EVENT_TIMELINE	0	0	10	-10	6.06977		0	7700
GDPPC_BASE	10920.78	9646.252	19115.05	1398.479	6122.532	56%	2293365	7.83E+09
TOTAL_POPULATION	93231492	57482591	2.98E+08	17065100	84811355	91%	1.96E+10	1.50E+18
INFLATION_RATE	4.398682	3.127596	28.69759	-0.12790	3.869783	88%	923.7231	3129.82

TABLE 6: SUMMARY OF STATISTSICS: WINTER OLYMPICS

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	21284.31	20670.82	57579.5	1148.494	13800.32	65%	6853548	6.11E+10
TIME	31.13354	31	54	8	10.23086	33%	10025	33599.26
HOST_WO	0.521739	1	1	0	0.500305	96%	168	80.34783
POST_WO	0.546584	1	1	0	0.4986	91%	176	79.80124

TABLE 7: SUMMARY OF STATISTSICS: WINTER OLYMPICS WITH CONTROLS

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	22028.39	21427.26	57579.5	1148.494	13525.51	61%	6828801	5.65E+10
TIME	31.46774	31	54	8	10.27694	33%	9755	32635.18
HOST_WO	0.541935	1	1	0	0.499044	92%	168	76.95484
POST_WO	0.548387	1	1	0	0.498458	91%	170	76.77419
EVENT_TIMELINE	0.332258	1	10	-10	6.100766		103	11500.78
GDPPC_BASE	12002	10587.29	25646.7	2238.803	8037.756	67%	3720620	2.00E+10
TOTAL_POPULATION	66954272	24746500	2.88E+08	3985258	84852574	127%	2.08E+10	2.22E+18
INFLATION_RATE	8.916902	2.940634	338.4491	-13.70632	35.57829	399%	2764.24	391136.7

Two types of regressions were run for each of the three types of events. In general, the summary of statistics would indicate a minimal difference between the aggregated values. The difference in the means seem to be +/- a standard deviation and the CV-percentage change seems to only vary about five percent. The negative change in the coefficient of variation-percentage is indicative that the inclusion of the control variables allow for a more precise estimate of the coefficients where a lessened CV percentage means that the data is more centered around the regressed expected value (line). This, however would only further the theory that the inclusion of the control independent variables would only mitigate the visual effects (in the data) of the stimulus (event) effect. The inclusion of the control variables centers the data but since these controls move linearly (across time) with GDPPC, it only mitigates the impact of hosting a mega-sport event.

A comparison of the summary of statistics (**Tables 2-3)** of the first regression (World Cup) exhibits a wide variation in the gross domestic product per capita between both hosts and runner up countries: a minimum value of $341.59 and a maximum value of $48603.48, and an average of $10797.03. It is important to mention that these two (hosts and runner-ups) should be able to be compared because of the parallel trends assumption where the difference in GDPPC slope and intercept should be mitigated. Concerning the hosts of the World Cup, there is large variation in this number across the countries where the CV is 117% without controls and 112% with controls. With that said, the GDPPC_BASE, the gross domestic product per capita at the beginning of the twenty-year period has a lower GDPPC with a higher CV. One theory driving the difference between the averaged GDPPC and the averaged base year of GDPPC is overall, the taking on of the bidding process and hosting of the World Cup not only raised the GDPPC higher than normal inflation would have, but also brought some of the developing countries closer in GDPPC to being developed. The variance in the CV narrows from the averaged base year towards the averaged GDPPC, which suggests that countries' GDPPC are slowly starting to converge despite only half hosting the World Cup.

A comparison of the summary of statistics (**Tables 4-5**) of the second regression (Summer Olympics) displays a wide variation in the gross domestic product per capita: a minimum value of $828.58, a maximum value of $60283.25, and an average of $22061.16. Concerning the hosts of the Summer Olympics, there is a significantly lessened variation in this number across the countries where the CV is 59% without controls and 54% with controls. Although both of these values are considered as not-reasonably high, the still indicate that there is a realistic amount of variation in the data but a significantly lessened amount than the World Cup. This could merely suggest that more places considered to host the Summer Olympics were more developed. This is substantiated by the data where the mean GDPPC_BASE and GDPPC are significantly higher than those representing the World Cup.

A comparison of the summary of statistics (**Tables 6-7**) of the second regression (Winter Olympics) indicates a wide variation: a minimum value of $1148.49, a maximum value of $57579.50, and an average of $21284.31. While the variance is somewhat wide, CV is 65% without controls and 61% with controls, the GDPPC numbers are significantly higher than either of the other two mega-sport events. The GDPPC_BASE starts at $12002, over $1000 per capita higher than the Summer Olympic considered countries and $2000 per capita higher than countries considered to host (and hosts) of the World Cup. This, in theory, fits where most Winter Olympic hosts are both Nordic, Western Europe, or North American developed countries and the GDPPC are historically higher.

Preliminary Model:

World Cup:

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 13:29
Sample (adjusted): 1 525
Included observations: 488 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5054.861	3353.761	-1.507221	0.1324
TIME	553.5682	652.6676	0.848162	0.3968
TIME2	-29.25761	41.31923	-0.708087	0.4792
TIME3	1.099419	1.018810	1.079121	0.2811
TIME4	-0.012925	0.008543	-1.512957	0.1310
HOST_WC	8535.497	1052.975	8.106075	0.0000
POST_WC	3437.064	2450.066	1.402845	0.1613
TIME_POST_WC	-72.06404	69.73273	-1.033432	0.3019
TIME_HOST_POST_WC	699.0694	75.28295	9.285893	0.0000
HOST_POST_WC	-20673.82	3026.406	-6.831147	0.0000

R-squared	0.535763	Mean dependent var	9953.595
Adjusted R-squared	0.527022	S.D. dependent var	11617.22
S.E. of regression	7989.557	Akaike info criterion	20.82994
Sum squared resid	3.05E+10	Schwarz criterion	20.91580
Log likelihood	-5072.505	Hannan-Quinn criter.	20.86367
F-statistic	61.29410	Durbin-Watson stat	0.170855
Prob(F-statistic)	0.000000		

The first independent variables regarding time are constants to account for in the model, thus their relative insignificance is justified. The Host_WC variable is an indicator of the binary effect of hosting an event. It is the total intercept difference for hosting an event: $B_3 + B_6$. The variable Host_WC = 8535.50 suggests that overall, countries that host the World Cup exhibit a positive $8535.50 difference in their gross domestic product per capita compared to non-hosts countries. The Post_WC variable indicates the binary effect of successfully hosting the World Cup. It represents the intercept difference for the non-host. Post_WC = 3437.06 indicates that on average, non-hosts experience a positive $3437.06 short-term effect on host GDPPC despite not hosting. This variable is relatively insignificant and will be tested for one of the econometric assumption violations. The variable Time_Post_WC captures the change in GDPPC growth non-host countries. Although statistically insignificant, its value of -72.06 indicates that overall, non-hosts countries exhibit a relatively horizontal (slightly negative) response in the years of not hosting the World Cup compared to the host countries. The main variable of interest is Time_Host_Post_WC, which indicates the difference in the change in long-run GDPPC growth. Its value of 699.07 indicates that overall, host countries exhibit a $699.07 increase in GDPPC growth over a ten-year span compared to non-host countries. The final variable, Host_Post_WC, represents the difference in difference of the

GDPPC intercept of host versus non-host countries. In essence, how much larger or smaller the intercept jump is (in terms of GDPPC) in that year of hosting the event. Its value of -20673.82 illustrates that on average, host countries exhibit a negative $2067.82 short-term change in GDPPC. This is surprising where macroeconomic theory would suggest the exact opposite. Due to a tourism influx, one can expect an increase aggregate spending in addition to a heavy increase government spending would result in short-run increase in the aggregate gross domestic product per capita. The data clearly suggests if a country hosts the World Cup, the resulting stimulation may not impact in the short-run as economic theory would normally indicate.

World Cup: With Controls

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 15:18
Sample (adjusted): 1 504
Included observations: 431 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1981.415	3316.322	-0.597474	0.5505
TIME	425.7068	600.4290	0.709004	0.4787
TIME2	-18.01714	37.57689	-0.479474	0.6319
TIME3	0.448339	0.920441	0.487092	0.6264
TIME4	-0.004636	0.007681	-0.603577	0.5465
HOST_WC	2244.503	1054.438	2.128625	0.0339
POST_WC	-2559.375	2651.992	-0.965076	0.3351
TIME_POST_WC	-6.995379	65.57957	-0.106670	0.9151
TIME_HOST_POST_WC	376.7807	72.64501	5.186601	0.0000
HOST_POST_WC	-8974.673	2979.025	-3.012621	0.0027
EVENT_TIMELINE	451.9272	107.5836	4.200706	0.0000
GDPPC_BASE	0.418814	0.033992	12.32111	0.0000
TOTAL_POPULATION	5.48E-05	6.14E-06	8.934822	0.0000
INFLATION_RATE	-23.16287	6.850279	-3.381303	0.0008

R-squared	0.712809	Mean dependent var	10797.03
Adjusted R-squared	0.703856	S.D. dependent var	12058.07
S.E. of regression	6561.893	Akaike info criterion	20.44789
Sum squared resid	1.80E+10	Schwarz criterion	20.57997
Log likelihood	-4392.520	Hannan-Quinn criter.	20.50004
F-statistic	79.61514	Durbin-Watson stat	0.189690
Prob(F-statistic)	0.000000		

The differences exhibited in this regression with controls have been restated throughout the paper. Although the R^2 value increases dramatically and the t-statistics became more significant for the most part, all of the coefficients diminished distinctively. According to the data, all of the control variables appear to be significant, which intuitively makes sense, as they are macroeconomic independent variables correlating with the macroeconomic dependent variable across time. The final model will not take into account the control independent variables to ensure that the full impact of the binary and interactive independent variables is captured.

Summer Olympics:

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 13:33
Sample (adjusted): 1 336
Included observations: 324 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22075.65	7720.369	2.859404	0.0045
TIME	-1071.945	480.1004	-2.232752	0.0263
TIME2	-1.951984	34.53328	-0.056525	0.9550
TIME3	1.441988	1.017850	1.416700	0.1576
TIME4	-0.017138	0.009005	-1.903091	0.0579
HOST_SO	-10268.28	1770.430	-5.799879	0.0000
POST_SO	1409.470	7024.645	0.200646	0.8411
TIME_POST_SO	55.58008	178.9325	0.310620	0.7563
TIME_HOST_POST_SO	-296.1314	187.1754	-1.582106	0.1146
HOST_POST_SO	6462.086	8150.810	0.792815	0.4285

R-squared	0.588061	Mean dependent var	23691.32
Adjusted R-squared	0.576254	S.D. dependent var	13955.76
S.E. of regression	9084.612	Akaike info criterion	21.09693
Sum squared resid	2.59E+10	Schwarz criterion	21.21362
Log likelihood	-3407.703	Hannan-Quinn criter.	21.14351
F-statistic	49.80539	Durbin-Watson stat	0.143527
Prob(F-statistic)	0.000000		

The first independent variables regarding time are constants to account for in the model, thus their relative insignificance is justified. The variable Host_SO = -10268.28 suggests that overall, countries that host the World Cup exhibit a negative -$10268.28 difference in their gross domestic product per capita compared to non-hosts countries. Post_SO = 1409.47 indicates that on average, non-hosts experience a positive $1409.47 short-term effect on host GDPPC despite not hosting. The variable Time_Post_SO captures the change in GDPPC growth non-host countries. Although statistically insignificant, its value of 55.58 indicates that overall, non-hosts countries exhibit a relatively horizontal (slightly positive) response in the years of not hosting the World Cup compared to the host countries. The variable Time_Host_Post_SO has a value of -296.13, which indicates that overall, host countries exhibit a -$296.13 decrease in GDPPC growth over a ten-year span compared to non-host countries. This would essentially suggest that it is not worth it for countries to host the Summer Olympics. Host_Post_SO exhibits a value of 6462.09, which illustrates that on average, host countries exhibit a positive $6462.09 short-term change in GDPPC. Despite being insignificant, this positive change is in-line with the macroeconomic theory. This analysis of the impact of the Summer Olympic Games is somewhat problematic where most of the variables are insignificant in the model and the binary 'Host_SO' variable is negative.

Summer Olympics: With Controls

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 15:21
Sample (adjusted): 127 336
Included observations: 210 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-35496.63	10187.63	-3.484288	0.0006
TIME	2729.056	884.5472	3.085258	0.0023
TIME2	-13.59481	40.61892	-0.334692	0.7382
TIME3	-1.268290	1.128234	-1.124137	0.2623
TIME4	0.020354	0.010178	1.999721	0.0469
HOST_SO	496.9328	1291.325	0.384824	0.7008
POST_SO	2624.442	5361.664	0.489483	0.6250
TIME_POST_SO	-24.34461	158.3468	-0.153742	0.8780
TIME_HOST_POST_SO	53.15395	119.6852	0.444115	0.6574
HOST_POST_SO	-4716.190	4512.823	-1.045064	0.2973
EVENT_TIMELINE	214.5006	320.2492	0.669793	0.5038
GDPPC_BASE	0.249425	0.322294	0.773905	0.4399
TOTAL_POPULATION	6.22E-05	1.45E-05	4.278525	0.0000
INFLATION_RATE	175.9291	102.9554	1.708790	0.0891

R-squared	0.897018	Mean dependent var	20317.79
Adjusted R-squared	0.890187	S.D. dependent var	11035.55
S.E. of regression	3656.960	Akaike info criterion	19.31099
Sum squared resid	2.62E+09	Schwarz criterion	19.53413
Log likelihood	-2013.654	Hannan-Quinn criter.	19.40120
F-statistic	131.3263	Durbin-Watson stat	0.484172
Prob(F-statistic)	0.000000		

The differences exhibited in this regression with controls have been restated throughout the paper. Similarly to the World Cup controlled regressions, the R^2 value dramatically increased but at the cost of minimization of the coefficients of the independent variables. The final model will not take into account the control independent variables to ensure that the full impact of the binary and interactive independent variables is captured.

Winter Olympics

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 13:35
Sample (adjusted): 1 336
Included observations: 322 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3446.027	6385.917	0.539629	0.5898
TIME	-1000.795	432.2961	-2.315068	0.0213
TIME2	47.32961	26.70917	1.772036	0.0774
TIME3	-0.219293	0.757602	-0.289457	0.7724
TIME4	-0.004090	0.006329	-0.646149	0.5187
HOST_WO	-10554.72	1643.285	-6.422937	0.0000
POST_WO	-42882.61	6237.180	-6.875321	0.0000
TIME_POST_WO	1302.186	190.2210	6.845650	0.0000
TIME_HOST_POST_WO	-940.7796	165.9518	-5.668994	0.0000
HOST_POST_WO	36939.12	6306.058	5.857720	0.0000

R-squared	0.610719	Mean dependent var	21284.31
Adjusted R-squared	0.599490	S.D. dependent var	13800.32
S.E. of regression	8733.652	Akaike info criterion	21.01832
Sum squared resid	2.38E+10	Schwarz criterion	21.13554
Log likelihood	-3373.949	Hannan-Quinn criter.	21.06512
F-statistic	54.38640	Durbin-Watson stat	0.212378
Prob(F-statistic)	0.000000		

The first independent variables regarding time are constants to account for in the model, thus their relative insignificance is justified. The variable Host_WO = -10554.72 suggests that overall, countries that host the World Cup exhibit a negative -$10554.72 difference in their gross domestic product per capita compared to non-hosts countries. Post_WO = -42882.61 indicates that on average, non-hosts experience a negative $42882.61 short-term effect on host GDPPC despite not hosting. The variable Time_Post_WO exhibited a value of 1302.19 indicates that overall, non-hosts countries exhibit a $1302.19 postive response in the years of not hosting the World Cup compared to the host countries. The variable Time_Host_Post_WO has a value of -940.78, which indicates that overall, host countries exhibit a $940.78 decrease in GDPPC growth over a ten-year span compared to non-host countries. This would essentially suggest that it is not worth it for countries to host the Winter Olympics. Host_Post_WO exhibits a value of 36939.058, which illustrates that on average, host countries exhibit a positive $36939.058 short-term boost in GDPPC. This analysis of the impact of the Winter Olympic Games also shows that hosting this event would go against general academic macroeconomic theory, but there are possible theories why. The data essentially indicates that although host countries may fair better in the short term, the non-host countries experience a better growth in GDPPC over the long-term and that hosting of the Winter Olympics is not worth it. One possible theory as to why non-hosts may fair better is because of the type of countries that are chosen to host. For the most part, developed nations are considered to host (either host or are the runner-up in bidding) and it may fair that more 'less-developed' countries are chosen to host (to hopefully boost their economies). On the average, this would show that the more developed countries not chosen to host fair better than the 'less-developed' nations (I.e. Russia and South Korea).

Winter Olympics: With Controls

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 13:35
Sample (adjusted): 1 336
Included observations: 310 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15397.87	3975.541	3.873152	0.0001
TIME	-1521.023	263.9466	-5.762619	0.0000
TIME2	27.41173	15.80999	1.733823	0.0840
TIME3	-0.142765	0.449785	-0.317407	0.7512
TIME4	-0.000618	0.003747	-0.164858	0.8692
HOST_WO	-1656.489	1078.819	-1.535465	0.1257
POST_WO	-7948.453	4621.728	-1.719801	0.0865
TIME_POST_WO	220.8815	131.5623	1.678912	0.0942
TIME_HOST_POST_WO	-105.8334	107.2744	-0.986567	0.3247
HOST_POST_WO	4297.824	4134.435	1.039519	0.2994
EVENT_TIMELINE	1203.793	110.0321	10.94038	0.0000
GDPPC_BASE	1.480043	0.072267	20.48007	0.0000
TOTAL_POPULATION	1.52E-05	3.91E-06	3.898313	0.0001
INFLATION_RATE	-25.22733	9.039639	-2.790745	0.0056

R-squared	0.866356	Mean dependent var	22028.39
Adjusted R-squared	0.860486	S.D. dependent var	13525.51
S.E. of regression	5051.983	Akaike info criterion	19.93706
Sum squared resid	7.55E+09	Schwarz criterion	20.10581
Log likelihood	-3076.244	Hannan-Quinn criter.	20.00452
F-statistic	147.6029	Durbin-Watson stat	0.290993
Prob(F-statistic)	0.000000		

The differences exhibited in this regression with controls are similar to those above. The R^2 value increased, the t-statistics became partially less significant for the independent variables, while the control variables show their significance. The coefficient effects are lessened due to the addition of the control variables where their linear correlation with gross domestic product per capita only improves the value of the data on the expected value line. The final model will not take into account the control independent variables to ensure that the full impact of the binary and interactive independent variables is captured.

Violation of the Assumptions:

World Cup:

White Test:

The White test determines if one or more of the independent variables is causing heteroscedasticity. In this test, the residuals squared are run as a function of all other independent variables. A white test performed illustrates the F-statistic of the set of heteroscedastic variables and probability of the F-statistic being significant. If the probability is less than 0.05 accompanied with a significant F statistic, then reject the null hypothesis and conclude that the data set has heteroscedasticity. If heteroscedasticity is found, the model will be corrected using a Newey-West correction.

H_0: Homoscedasticity with respect to one or more independent variables

H_A: Heteroscedasticity with respect to one or more independent variables

F-statistic = 40.69

Prob(F-Statistic) = 0.00

Reject H_o if Prob(F-statistic) < 0.05

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	40.69363	Prob. F(9,478)	0.0000
Obs*R-squared	211.7003	Prob. Chi-Square(9)	0.0000
Scaled explained SS	252.7893	Prob. Chi-Square(9)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/09/19 Time: 15:41
Sample: 1 525
Included observations: 488

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-16077519	13040789	-1.232864	0.2182
TIME^2	38569.36	61973.06	0.622357	0.5340
TIME2^2	52.31404	84.91628	0.616066	0.5381
TIME3^2	-0.054713	0.041616	-1.314711	0.1892
TIME4^2	1.27E-05	6.66E-06	1.902405	0.0577
HOST_WC^2	63101064	9877194.	6.388562	0.0000
POST_WC^2	34472975	16004098	2.154009	0.0317
TIME_POST_WC^2	-27923.51	10555.88	-2.645303	0.0084
TIME_HOST_POST_WC^2	97427.04	10191.17	9.559944	0.0000
HOST_POST_WC^2	-1.30E+08	19869687	-6.520333	0.0000

R-squared	0.433812	Mean dependent var	62524973
Adjusted R-squared	0.423152	S.D. dependent var	98747133
S.E. of regression	74998975	Akaike info criterion	39.12413
Sum squared resid	2.69E+18	Schwarz criterion	39.20999
Log likelihood	-9536.287	Hannan-Quinn criter.	39.15785
F-statistic	40.69363	Durbin-Watson stat	0.547753
Prob(F-statistic)	0.000000		

Conclusion:

Reject H_0 and conclude that there is heteroscedasticity in the model.

Multicollinearity:

Multicollinearity:

A way to detect multicollinearity is by calculating the Variance Inflation Factor (VIF), which estimates the inflation on the standard error of each coefficient due to the presence of multicollinearity. In short, this test measures the degree to which the variation in an independent variable is explained by the other independent variables. To calculate VIF, a regression using one independent variable is run against all remaining independent variables. The R^2 for this model is plugged into following equation:

$$\text{VIF} = \frac{1}{1-R^2}$$

A generated rule of thumb indicates that a VIF value less than five can be accepted as the data not having any multicollinearity. Some research would suggest that any value less than ten is acceptable as well but further tests would also have to be utilized. Any value greater than ten essentially signifies that the variable identified exhibits multicollinearity.

Variance Inflation Factors
Date: 04/08/19 Time: 21:45
Sample: 1 1347
Included observations: 488

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	11247714	85.98816	NA
TIME	425975.0	3918.824	649.5587
TIME2	1707.279	29097.90	10197.40
TIME3	1.037974	38790.87	18722.05
TIME4	7.30E-05	6557.840	3785.067
HOST_WC	1108757.	4.463999	2.113081
POST_WC	6002823.	23.98006	11.44950
TIME_POST_WC	4862.654	27.65807	15.03348
TIME_HOST_POST_WC	5667.522	17.32095	13.13429
HOST_POST_WC	9159133.	19.08361	13.88254

Table 1:

Variable	**VIF**	**Conclusion**
Host_WC	2.11	VIF < 10.0 suggests there is no multicollinearity due to Host_WC.
Post_WC	11.44	VIF > 10.0 suggests there is multicollinearity due to Post_WC
Time_Post_WC	15.03	VIF > 10.0 suggests there is multicollinearity due to Time_Post_WC
Time_Host_Post_WC	13.13	VIF > 10.0 suggests there is multicollinearity due to Time_Host_Post_WC
Host_Post_WC	13.89	VIF > 10.0 suggests there is multicollinearity due to Host_Post_WC

In conclusion, these calculated VIFS suggest a severe multicollinearity problem throughout the regression. The normal solution to a multicollinearity problem is to minimize the collinear variables. A possibly significant error in this model, however, is that since the minimum independent variables for a diff-in-diff regression have already been met, there is no way to correct for the suggested multicollinearity.

Serial Correlation:

Serial correlation occurs when corr(ε_i, ε_{i-1}) $\neq 0$, the random error terms from different observations are correlated. This correlation indicates a pattern across the random error terms and, therefore, there is a pattern to what should be a random term. Serial correlation does not cause a bias on the coefficient of the independent variable, but rather may make the coefficients easier to accept.

In any given model, serial correlation might depend upon how the data is organized. Per this model, it is possible for there to be serial correlation across a region. If a shock had occurred in a region early in the timeline, then it may influence the error team of the subsequent city but at a later point in time. More than likely, however, this model displays serial correlation across time where gross domestic product per capita is naturally a serially correlated variable as it depends on the past period's value. To determine if this model exhibits serial correlation, we conduct the Breusch-Godfrey/LM Test. If it is found, serial correlation can be corrected by and estimating the standard errors using the Newey-West method.

Breusch-Godfrey LM Test

The Breusch-Godfrey, or LM Test, is used for determining if there is serial correlation between the error terms of consecutive periods. In this test, a t-test will be run on the coefficient of the lagged residual. If it turns out to be significant, then it can be determined that there is serial correlation in the regression.

H_0: βResid(-1) ≤ 0

H_A: βResid(-1) > 0

Level of Significance = 5 %

tcritical: 1.960

tcomputed: 46.45

Decision rule: reject if tcomputed> tcritical

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 1 lag

F-statistic	2157.836	Prob. F(1,477)	0.0000
Obs*R-squared	399.6545	Prob. Chi-Square(1)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/08/19 Time: 21:53
Sample: 1 525
Included observations: 488
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1017.737	1428.632	-0.712386	0.4766
TIME	262.3175	278.0473	0.943427	0.3459
TIME2	-18.97114	17.60379	-1.077673	0.2817
TIME3	0.464870	0.434056	1.070991	0.2847
TIME4	-0.003542	0.003639	-0.973312	0.3309
HOST_WC	59.25089	448.4944	0.132111	0.8950
POST_WC	100.7102	1043.556	0.096507	0.9232
TIME_POST_WC	2.579989	29.70124	0.086865	0.9308
TIME_HOST_POST_WC	-43.94755	32.07914	-1.369973	0.1713
HOST_POST_WC	1174.605	1289.282	0.911054	0.3627
RESID(-1)	0.920983	0.019826	46.45252	0.0000

R-squared	0.818964	Mean dependent var	-4.60E-13
Adjusted R-squared	0.815169	S.D. dependent var	7915.388
S.E. of regression	3402.983	Akaike info criterion	19.12498
Sum squared resid	5.52E+09	Schwarz criterion	19.21943
Log likelihood	-4655.494	Hannan-Quinn criter.	19.16208
F-statistic	215.7836	Durbin-Watson stat	1.846330
Prob(F-statistic)	0.000000		

Conclusion:

Reject H_0 and conclude that there is serial correlation in the model.

Summer Olympics:
Heteroscedasticity:

White Test

H_0: Homoscedasticity with respect to one or more independent variables

H_A: Heteroscedasticity with respect to one or more independent variables

F-statistic = 21.52

Prob(F-Statistic) = 0.00

Reject H_o if Prob(F-statistic) < 0.05

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	21.51762	Prob. F(9,314)	0.0000
Obs*R-squared	123.5976	Prob. Chi-Square(9)	0.0000
Scaled explained SS	137.6894	Prob. Chi-Square(9)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/09/19 Time: 15:42
Sample: 1 336
Included observations: 324

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-66178029	26890096	-2.461056	0.0144
TIME^2	190013.6	72727.64	2.612674	0.0094
TIME2^2	-202.8498	76.61704	-2.647581	0.0085
TIME3^2	0.106114	0.036228	2.929073	0.0036
TIME4^2	-1.65E-05	5.61E-06	-2.942188	0.0035
HOST_SO^2	1.15E+08	17357833	6.597673	0.0000
POST_SO^2	1.33E+08	41199396	3.219905	0.0014
TIME_POST_SO^2	-78917.21	24766.82	-3.186409	0.0016
TIME_HOST_POST_SO^2	80641.18	23905.75	3.373296	0.0008
HOST_POST_SO^2	-1.51E+08	51175325	-2.953981	0.0034

R-squared	0.381474	Mean dependent var	79982947
Adjusted R-squared	0.363746	S.D. dependent var	1.23E+08
S.E. of regression	98414619	Akaike info criterion	39.67765
Sum squared resid	3.04E+18	Schwarz criterion	39.79434
Log likelihood	-6417.780	Hannan-Quinn criter.	39.72423
F-statistic	21.51762	Durbin-Watson stat	0.376650
Prob(F-statistic)	0.000000		

Conclusion:

Reject H_0 and conclude that there is heteroscedasticity in the model.

Multicollinearity:

Variance Inflation Factors
Date: 04/08/19 Time: 22:35
Sample: 1 1347
Included observations: 324

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	1.23E+08	387.2474	NA
TIME	1149446.	3921.844	273.8992
TIME2	5715.810	35514.60	6659.407
TIME3	4.523314	54330.76	18334.40
TIME4	0.000348	9275.024	4391.279
HOST_SO	18139498	7.668031	6.616948
POST_SO	1.32E+08	73.58304	64.09226
TIME_POST_SO	95760.11	89.56554	78.86713
TIME_HOST_POST_SO	158652.5	38.66358	37.40028
HOST_POST_SO	2.36E+08	39.59438	38.05598

Decision Rule: Acceptable VIF values < 10 < definite multicollinearity

Table 2:

Host_WC	6.62	VIF < 10.0 suggests there is no multicollinearity due to Host_WC.
Post_WC	64.09	VIF > 10.0 suggests there is multicollinearity due to Post_WC
Time_Post_WC	78.86	VIF > 10.0 suggests there is multicollinearity due to Time_Post_WC
Time_Host_Post_WC	37.40	VIF > 10.0 suggests there is multicollinearity due to Time_Host_Post_WC
Host_Post_WC	38.06	VIF > 10.0 suggests there is multicollinearity due to Host_Post_WC

Serial Correlation: Correction with Newey-West

Breusch-Godfrey LM test

H_0: βResid(-1) ≤ 0

H_A: βResid(-1) > 0

Level of Significance = 5 %

tcritical: 1.960

tcomputed: 42.06

Decision rule: reject if tcomputed> tcritical

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 1 lag

F-statistic	1769.434	Prob. F(1,313)	0.0000
Obs*R-squared	275.3012	Prob. Chi-Square(1)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/08/19 Time: 22:36
Sample: 1 336
Included observations: 324
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4529.220	2999.834	1.509823	0.1321
TIME	-114.6883	186.4480	-0.615122	0.5389
TIME2	-11.82031	13.41258	-0.881285	0.3788
TIME3	0.468010	0.395398	1.183640	0.2375
TIME4	-0.004435	0.003499	-1.267672	0.2059
HOST_SO	-262.0336	687.5050	-0.381137	0.7034
POST_SO	563.1927	2727.777	0.206466	0.8366
TIME_POST_SO	-21.07054	69.48320	-0.303247	0.7619
TIME_HOST_POST_SO	69.88619	72.70119	0.961280	0.3372
HOST_POST_SO	-2298.299	3165.517	-0.726042	0.4684
RESID(-1)	0.933349	0.022188	42.06464	0.0000

R-squared	0.849695	Mean dependent var	-1.35E-11
Adjusted R-squared	0.844893	S.D. dependent var	8957.152
S.E. of regression	3527.651	Akaike info criterion	19.20801
Sum squared resid	3.90E+09	Schwarz criterion	19.33637
Log likelihood	-3100.698	Hannan-Quinn criter.	19.25925
F-statistic	176.9434	Durbin-Watson stat	1.847613
Prob(F-statistic)	0.000000		

Conclusion:

Reject H_o and conclude that there is serial correlation in the model.

Winter Olympics:

Heteroscedasticity:

White Test:

H_0: Homoscedasticity with respect to one or more independent variables

H_A: Heteroscedasticity with respect to one or more independent variables

F-statistic = 9.97

Prob(F-Statistic) = 0.00

Reject H_o if Prob(F-statistic) < 0.05

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	9.977843	Prob. F(9,312)	0.0000
Obs*R-squared	71.96552	Prob. Chi-Square(9)	0.0000
Scaled explained SS	90.22818	Prob. Chi-Square(9)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/09/19 Time: 15:46
Sample: 1 336
Included observations: 322

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12877617	25710006	0.500880	0.6168
TIME^2	132392.6	94090.60	1.407076	0.1604
TIME2^2	-66.97099	57.15396	-1.171765	0.2422
TIME3^2	0.029727	0.024150	1.230928	0.2193
TIME4^2	-4.10E-06	3.38E-06	-1.213481	0.2259
HOST_WO^2	3120623.	19015281	0.164111	0.8697
POST_WO^2	2.24E+08	42002219	5.332000	0.0000
TIME_POST_WO^2	-148988.0	36187.54	-4.117106	0.0000
TIME_HOST_POST_WO^2	173977.2	27662.28	6.289330	0.0000
HOST_POST_WO^2	-2.76E+08	46724622	-5.906818	0.0000

R-squared	0.223495	Mean dependent var	73907838
Adjusted R-squared	0.201096	S.D. dependent var	1.21E+08
S.E. of regression	1.08E+08	Akaike info criterion	39.86609
Sum squared resid	3.65E+18	Schwarz criterion	39.98332
Log likelihood	-6408.441	Hannan-Quinn criter.	39.91289
F-statistic	9.977843	Durbin-Watson stat	0.513357
Prob(F-statistic)	0.000000		

Conclusion:

Reject H_0 and conclude that there is heteroscedasticity in the model.

Multicollinearity:

Variance Inflation Factors
Date: 04/08/19 Time: 22:41
Sample: 1 1347
Included observations: 322

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	77848184	210.6510	NA
TIME	496877.1	943.0812	143.6075
TIME2	2160.351	15276.03	3743.801
TIME3	1.691274	28246.81	12107.12
TIME4	0.000110	5077.105	2939.460
HOST_WO	10934050	20.49710	5.781446
POST_WO	2.61E+08	343.8696	201.2339
TIME_POST_WO	218474.4	320.4087	192.7727
TIME_HOST_POST_WO	132190.1	104.8943	73.51364
HOST_POST_WO	1.80E+08	166.9449	114.6066

Decision Rule: Acceptable VIF values < 10 < definite multicollinearity

Table 3:

Host_WC	5.78	VIF < 10.0 suggests there is no multicollinearity due to Host_WC.
Post_WC	201.23	VIF > 10.0 suggests there is multicollinearity due to Post_WC
Time_Post_WC	192.77	VIF > 10.0 suggests there is multicollinearity due to Time_Post_WC
Time_Host_Post_WC	73.51	VIF > 10.0 suggests there is multicollinearity due to Time_Host_Post_WC
Host_Post_WC	114.61	VIF > 10.0 suggests there is multicollinearity due to Host_Post_WC

Serial Correlation: Correction with Newey-West

Breusch-Godfrey LM test

H_0: βResid(-1) ≤ 0

H_A: βResid(-1) > 0

Level of Significance = 5 %

tcritical: 1.960

tcomputed: 34.58

Decision rule: reject if tcomputed> tcritical

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 1 lag

F-statistic	1195.678	Prob. F(1,311)	0.0000
Obs*R-squared	255.5346	Prob. Chi-Square(1)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/08/19 Time: 22:42
Sample: 1 336
Included observations: 322
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7830.505	2914.775	2.686487	0.0076
TIME	-344.2979	196.9717	-1.747956	0.0815
TIME2	-15.51945	12.16251	-1.276006	0.2029
TIME3	0.581981	0.345164	1.686103	0.0928
TIME4	-0.004339	0.002883	-1.505032	0.1333
HOST_WO	387.6723	747.8747	0.518365	0.6046
POST_WO	7245.793	2846.005	2.545952	0.0114
TIME_POST_WO	-219.1808	86.79341	-2.525316	0.0121
TIME_HOST_POST_WO	136.1787	75.62036	1.800820	0.0727
HOST_POST_WO	-5515.148	2874.053	-1.918944	0.0559
RESID(-1)	0.900844	0.026052	34.57858	0.0000

R-squared	0.793586	Mean dependent var	-6.53E-12
Adjusted R-squared	0.786949	S.D. dependent var	8610.347
S.E. of regression	3974.321	Akaike info criterion	19.44666
Sum squared resid	4.91E+09	Schwarz criterion	19.57560
Log likelihood	-3119.912	Hannan-Quinn criter.	19.49814
F-statistic	119.5678	Durbin-Watson stat	1.728339
Prob(F-statistic)	0.000000		

Conclusion:

Reject H_o and conclude that there is serial correlation in the model.

Final Model:

The final model will not include any of the control variables to show the full impact of hosting a mega sport event. Previous analysis of regressions with the control variables illustrated that they lessened the effect of the binary and interactive independent variables. The final model also employs the Newey_West method to correct for heteroscedasticity and serial correlation. Newey-West method produces standard errors for coefficients estimated by an OLS regression where the error structure is assumed heteroscedastic and somewhat serially correlated up to a determined lag. The traditional route in correcting for multicollinearity would be to limit the number of irrelevant variables. The final model uses the minimum amount of independent variables needed to satisfy the diff-in-diff requirement.

World Cup:

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/08/19 Time: 14:53
Sample (adjusted): 1 525
Included observations: 488 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 6.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5054.861	4134.413	-1.222631	0.2221
TIME	553.5682	990.6564	0.558789	0.5766
TIME2	-29.25761	72.18437	-0.405318	0.6854
TIME3	1.099419	1.952500	0.563083	0.5736
TIME4	-0.012925	0.017518	-0.737786	0.4610
HOST_WC	8535.497	1928.167	4.426742	0.0000
POST_WC	3437.064	2803.466	1.226005	0.2208
TIME_POST_WC	-72.06404	92.04038	-0.782961	0.4340
TIME_HOST_POST_WC	699.0694	170.6451	4.096626	0.0000
HOST_POST_WC	-20673.82	5405.906	-3.824303	0.0001

R-squared	0.535763	Mean dependent var	9953.595
Adjusted R-squared	0.527022	S.D. dependent var	11617.22
S.E. of regression	7989.557	Akaike info criterion	20.82994
Sum squared resid	3.05E+10	Schwarz criterion	20.91580
Log likelihood	-5072.505	Hannan-Quinn criter.	20.86367
F-statistic	61.29410	Durbin-Watson stat	0.170855
Prob(F-statistic)	0.000000	Wald F-statistic	11.13973
Prob(Wald F-statistic)	0.000000		

Variable Interpretation:

βHost_WC = 8535.50; On average, the host country experienced a positive $8535.50 impact on its GDPPC over a twenty-year period.

βPost_WC = 3437.06; On average, the non-host country exhibits a positive $3437.06 change in GDPPC over a twenty-year period.

βTime_Post_WC = -72.06; On average, the non-host country exhibits a slight negative $72.06 change in GDPPC growth over a twenty-period.

βTime_Host_Post_WC = 699.07; On average, the host country exhibits a positive $699.07 difference in GDPPC growth compared to a non-host country over a twenty-year period.

βHost_Post_WC = -20673.82; On average, the host country exhibits a negative $20673.82 difference in short-term GDPPC change compared to non-host countries over a one-year period.

Summer Olympics:

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/08/19 Time: 15:03
Sample (adjusted): 1 336
Included observations: 324 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 6.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22075.65	11090.15	1.990564	0.0474
TIME	-1071.945	1072.122	-0.999835	0.3182
TIME2	-1.951984	75.60298	-0.025819	0.9794
TIME3	1.441988	2.126808	0.678006	0.4983
TIME4	-0.017138	0.018663	-0.918289	0.3592
HOST_SO	-10268.28	4259.049	-2.410933	0.0165
POST_SO	1409.470	11496.64	0.122598	0.9025
TIME_POST_SO	55.58008	309.4513	0.179608	0.8576
TIME_HOST_POST_SO	-296.1314	398.3121	-0.743466	0.4578
HOST_POST_SO	6462.086	15353.48	0.420887	0.6741

R-squared	0.588061	Mean dependent var	23691.32
Adjusted R-squared	0.576254	S.D. dependent var	13955.76
S.E. of regression	9084.612	Akaike info criterion	21.09693
Sum squared resid	2.59E+10	Schwarz criterion	21.21362
Log likelihood	-3407.703	Hannan-Quinn criter.	21.14351
F-statistic	49.80539	Durbin-Watson stat	0.143527
Prob(F-statistic)	0.000000	Wald F-statistic	31.28714
Prob(Wald F-statistic)	0.000000		

Variable Interpretation:

βHost_SO = -10268.28; On average, the host country experienced a negative $10268.28 impact on its GDPPC over a twenty-year period.

βPost_SO = 1409.47; On average, the non-host country exhibits a positive $1409.47 change in GDPPC over a twenty-year period.

βTime_Post_SO = 55.58; On average, the non-host country exhibits a slight positive $55.58 change in GDPPC growth over a twenty-period.

βTime_Host_Post_SO = -296.13; On average, the host country exhibits a negative $296.13 difference in GDPPC growth compared to a non-host country over a twenty-year period.

βHost_Post_SO = 6462.09; On average, the host country exhibits a positive $6462.09 difference in short-term GDPPC change compared to non-host countries over a one-year period.

Winter Olympics:

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/08/19 Time: 15:04
Sample (adjusted): 1 336
Included observations: 322 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 6.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3446.027	8823.162	0.390566	0.6964
TIME	-1000.795	704.8951	-1.419778	0.1567
TIME2	47.32961	46.47957	1.018288	0.3093
TIME3	-0.219293	1.300490	-0.168623	0.8662
TIME4	-0.004090	0.010486	-0.390021	0.6968
HOST_WO	-10554.72	3306.667	-3.191950	0.0016
POST_WO	-42882.61	16158.39	-2.653891	0.0084
TIME_POST_WO	1302.186	467.4124	2.785947	0.0057
TIME_HOST_POST_WO	-940.7796	363.5796	-2.587548	0.0101
HOST_POST_WO	36939.12	13408.56	2.754891	0.0062

R-squared	0.610719	Mean dependent var	21284.31
Adjusted R-squared	0.599490	S.D. dependent var	13800.32
S.E. of regression	8733.652	Akaike info criterion	21.01832
Sum squared resid	2.38E+10	Schwarz criterion	21.13554
Log likelihood	-3373.949	Hannan-Quinn criter.	21.06512
F-statistic	54.38640	Durbin-Watson stat	0.212378
Prob(F-statistic)	0.000000	Wald F-statistic	33.98226
Prob(Wald F-statistic)	0.000000		

Variable Interpretation:

βHost_WO = -10554.72; On average, the host country experienced a negative $10554.72impact on its GDPPC over a twenty-year period.

βPost_WO = -42882.61; On average, the non-host country exhibits a negative $42882.61change in GDPPC over a twenty-year period.

βTime_Post_WO = 1302.19; On average, the non-host country exhibits a positive $1302.19 change in GDPPC growth over a twenty-period.

βTime_Host_Post_WO = -940.78; On average, the host country exhibits a negative $940.78 difference in GDPPC growth compared to a non-host country over a twenty-year period.

βHost_Post_WO = 36939.12; On average, the host country exhibits a positive $36939.12 difference in short-term GDPPC change compared to non-host countries over a one-year period.

Conclusion: Is it worth it to host a mega-sport event?

Preceding analysis provides insight into the theoretical and empirically measured impact of hosting a mega sport event. Unlike previous literature that only measure one event, this thesis empirically measured the effect across all three of the mega-sport events: World Cup, Summer Olympics, and Winter Olympics. Due to this, it is possible to not only conclude if this billion-dollar investment is worth it, but what type of event would best be host if a country decided to host one. Previous literature and basic macroeconomic theory have allowed for the drawing of a uniform hypothesis on the ten-year impact of hosting this type of event: the massive heighten of expenditure in preparation for the events accompanied with a generous influx of tourism would create a short run burst of economic activity with slight leveling off of GDPPC curve (slope) in the long run. To test this theory, three empirical regressions were run to measure the full impact of hosting the games and three more were run to test the impact of macroeconomic control variables.

It was determined empirically that overall, a mega-sport event is not the most efficient use of resources and is probably not worth the investment. One of the exceptions to this, however, is dependent on the type of economy hosting the event: developed versus developing. Previous literature suggests that hosting a mega-sport event is only an investment that should be made by developed countries and that the risk of investment is significantly higher for developing countries. Developing countries usually lack the base resources to host such a tournament and end up incurring the incurred startup costs in infrastructure, which are already hard enough to overcome. Developed countries, on the other hand, are usually somewhat prepared with having multiple sports arenas and developed cities that could be easily refurbished or already are state-of-the-art. Since infrastructure is the largest investment any country or city has to sustain, developed countries spend millions of dollars less in aggregate versus the developing countries. Therefore, developed economies generally begin from a place of economic neutrality versus that of the underdeveloped economy/country.

It can also be determined from the empirical model that if an attempt to host such an event did occur, then the best option would be to host the World Cup. It is a substantially larger event compared to either of the Olympic Games and would yield significantly more tangible benefits (revenue). Results indicated that although there may be a slight economic downturn relative to investment surrounding the event, countries that hosted the event yielded a significantly higher GDPPC growth curve over a ten-year span after hosting the World Cup. The Olympic Games, although almost requiring almost as much funding and preparation costs, are city or county specific and thus yield a fraction of the benefits. One of the downfalls is the Olympic Games' city-specific nature of the event is that the event is city-specific where it is unlikely that the revenue would spread beyond thirty miles outside the city. The lack of wide-spread economic activity over the entire country is what can be captured and evaluated by the regression analysis. If city data had been used, the results may have been slightly different. Based on country data, however, it can be theorized that hosting the World Cup would be the best option.

Upon meeting and discussing this thesis results with economists Dr. Thomas Miceli, Mr. Victor Matheson, Mr. Andrew Zimbalist, we decided to create a theoretical model that couple possibly resolve some of the issues surrounding hosting the Olympic Games. Since the econometric analysis indicated that hosting the World Cup could end up benefiting the host nation, some of the principles of the World Cup were adapted to an Olympic model. Some aspects that cannot be avoided or changed include: security, transportation, and events themselves. The major issues surrounding the Olympics, however, rest in sport-specific infrastructure, size, and centralization. When considering sport specific infrastructure, this ultimately comes down to the International Olympic Committee (IOC) choosing hosts that are already better prepared. This reflects on Victor Matheson's theory that developing countries should not use hosting a mega-sport event as opportunities to bolster their economies. The size of the competition has more to do with the duration of the event versus the international recognition. It will be assumed that these types of events already capture the attention of the world and thus do not need extra marketing. Certain events cannot be made longer where almost every race is a medal event with the preceding event the qualifying for the medal round. What could happen is that more time is allotted between each event where this would also give athletes extra time to rest. The largest issue with the Olympic Games is its centralization. History recognizes the Olympic Games as a tournament celebrating a coming together of athletes to show a lack in differences among people. This is what all the athletes stay in the Olympic village and compete in a maximum of four locations (with the exception of soccer and occasional other field sports). A brief note about this: The Olympics has a history of this and people like to preserve history, but any athlete competing international sporting event is respected based on his or her performance. If a city wants to successfully host the Olympics, history may need to be forgone in order to maximize business, as hosting mega-sport events have become a business decision.

The proposed adapted model is the decentralization of the competitions (not the opening ceremony) such that competitions are paired by rank and location. This way, an A-rank sport (Women's Volleyball) is in the same city (location) as a B-rank Sport (Fencing, Judo) and a C-rank rank sport (speed-walking) to attract an evenly distributed amount of tourism. This also makes revenue streams easier where consumers can buy single event or a package of tickets based on location such that host would create a boosted viewership and revenue on the non-A-rank sports.[22] This would theoretically spur economic activity in different places, which improves money-in-circulation and thus would increase those macroeconomic variables. The incurred costs of security and transportation would increase but these costs can be spread out over other cities such that one city is not suffering all of them. In theory, this could increase revenue and spread out the cost of hosting where the event is larger and longer, and would retain more tourism to yield an evener and wider boost in economic activity.

[22] Victor Matheson, Andrew Zimbalist, Thomas Miceli; "Olympics Lecture" (University of Connecticut Law, April 12th, 2019.)

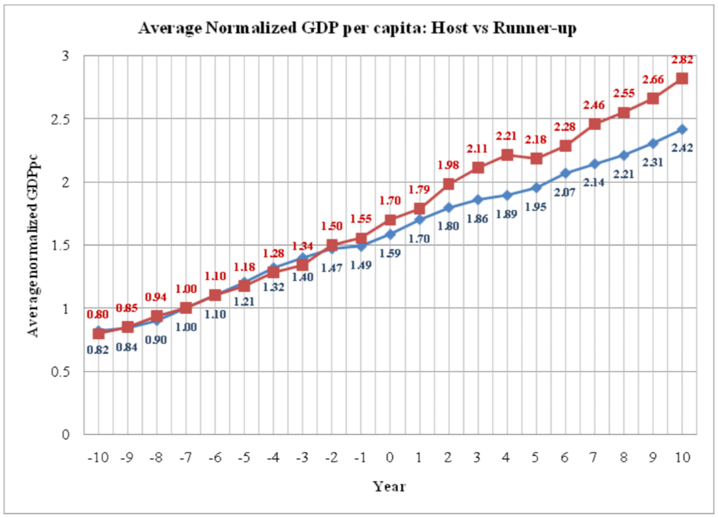
Errors and Possible Deviations:

Possibilities and limitations of these results include: variation of destinations of the hosted events, empirical errors, and data retained. The reason the data could be skewed in favor of hosting the World Cup is because there is a larger variation in the types of countries that hosted the event: countries that hosted are on the upper scale of developing or developed. Therefore, the model would show a positive difference when comparing hosts to non-hosts. Summer Olympics and Winter Olympic hosts have less differences in GDPPC level between hosts and non-hosts; in fact, more developing countries or less developed countries hosted the Winer Olympics. Therefore, intuitively it would make sense that non-hosts would fair just as well if not better than the hosts. Empirical error is always something to be accounted for and is another term for human error. The data retained was from the World Bank, if the source of that data is skewed, then this thesis results would also be incorrect.

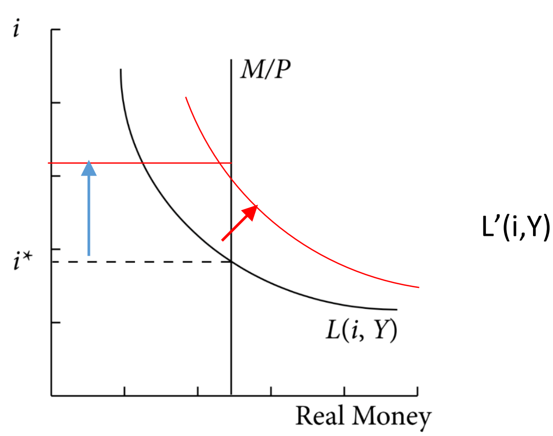
Appendix:

Appendix A: Economic Figures:

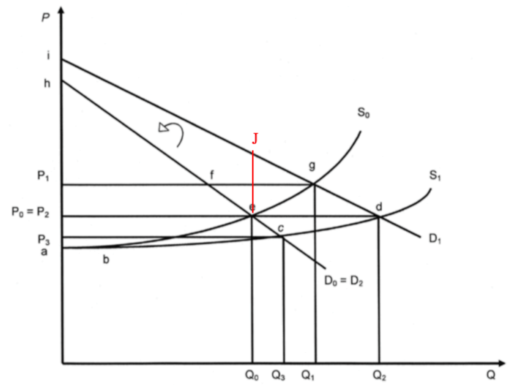
Literature Review: Host GDPPC v. Runner-Up



Real Money Market



Tourism Supply and Demand: Crowding Out Effect



Appendix B: Supportive Figures
Infrastructure Timeline:

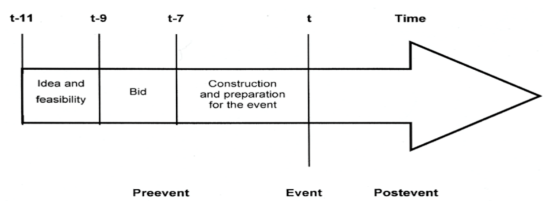


Figure 1 — Stages of the long-term period.

Infrastructure Type:

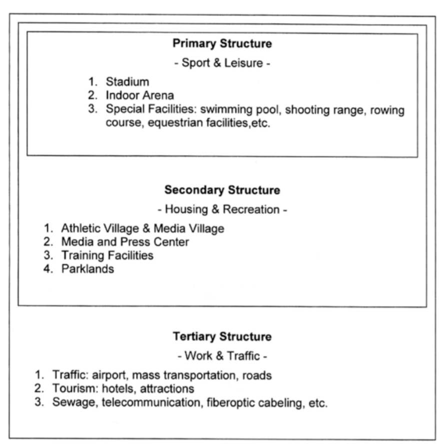
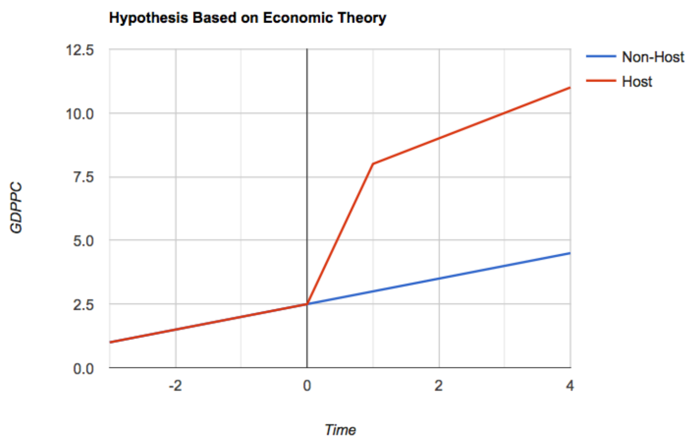


Figure 2 — Structural demands of sport events on cities.

Appendix C: Graphical Hypothesis



Appendix D: Tables

Difference-in-Difference Model

	Treatment Group	Control Group
Pre-Stimulus	Treatment*pre	Control*pre
Post-Stimulus	Treatment*post	Control*post

Appendix E: Equations

Sample Diff-in-Diff

$$Y_{i,t} = \beta_0 + \beta_1[Time] + \beta_2[Post\_Stimulus] + \beta_3[Time*Post\_Stimulus] + \beta_4*[Control] + \varepsilon_t$$

Thesis Regression:

$$GDPPC_t = \beta_0 + \beta_1[Host] + \beta_2[Time] + \delta_1[Time^2] + \delta_1[Time^3] + \delta_1[Time^4] + \beta_3[Post] + \beta_4[Time*Post] + \beta_5[Time*Host*Post] + \beta_6[Post*Host] + \varepsilon_t$$

Thesis Regression with Controls:

$$GDPPC_t\, \beta_0 + \beta_1[Host] + \beta_2[Time] + \delta_1[Time^2] + \delta_1[Time^3] + \delta_1[Time^4] + \beta_3[Post] + \beta_4[Time*Post] + \beta_5[Time*Host*Post] + \beta_6[Post*Host] + \beta_7[Total\_population] + \beta_8[Inflation\_rate] + \varepsilon_t$$

Appendix F: Descriptive Statistics

OLS1_NO_CONTROLS_WC

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	9953.595	4596.88	48603.48	341.5928	11617.22	117%	4857354	6.57E+10
TIME	31.68443	33	57	0	14.13759	45%	15462	97337.4
TIME2	1203.365	1089	3249	0	884.8115	74%	587242	3.81E+08
TIME3	50289.87	35937	185193	0	48622.99	97%	24541458	1.15E+12
TIME4	2229374	1185921	10556001	0	2607402	117%	1.09E+09	3.31E+15
HOST_WC	0.526639	1	1	0	0.499802	95%	257	121.6537
POST_WC	0.522541	1	1	0	0.500004	96%	255	121.752
TIME_POST_WC	18.42828	13	57	0	20.13035	109%	8993	197347.5
TIME_HOST_POST_WC	9.829918	0	57	0	17.4287	177%	4797	147930.9
HOST_POST_WC	0.272541	0	1	0	0.445724	164%	133	96.75205

OLS1_WCONTROLS_WC

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	10797.03	5617.742	48603.48	341.5928	12058.07	112%	4653520	6.25E+10
TIME	32.79814	34	57	0	13.61236	42%	14136	79677.44
TIME2	1260.585	1156	3249	0	866.6131	69%	543312	3.23E+08
TIME3	52814.92	39304	185193	0	48100.09	91%	22763232	9.95E+11
TIME4	2338350	1336336	10556001	0	2595047	111%	1.01E+09	2.90E+15
HOST_WC	0.545244	1	1	0	0.498527	91%	235	106.8677
POST_WC	0.522042	1	1	0	0.500094	96%	225	107.5406
TIME_POST_WC	19.12993	14	57	0	20.58893	108%	8245	182278.7
TIME_HOST_POST_WC	10.4594	0	57	0	18.08951	173%	4508	140709
HOST_POST_WC	0.280742	0	1	0	0.449884	160%	121	87.03016
EVENT_TIMELINE	-0.06033	0	10	-10	5.935003		-26	15146.43
GDPPC_BASE	8875.49	2982	48603.48	341.5928	12935.14	146%	3825336	7.19E+10
TOTAL_POPULATION	75173651	56797087	2.93E+08	22037610	56794476	76%	3.24E+10	1.39E+18
INFLATION_RATE	12.79106	5.017158	874.2457	-1.352837	48.05608	376%	5512.946	993036.3

OLS2_NO_CONTROLS_SO

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	23691.32	22061.16	60283.25	828.5805	13955.76	59%	7675987	6.29E+10
TIME	37.19753	37.5	57	14	10.36118	28%	12052	34675.36
TIME2	1713.988	1640.5	3481	256	777.7444	45%	555332	1.95E+08
TIME3	76462.94	66460.5	205379	4096	49336.35	65%	24773992	7.86E+11
TIME4	3540773	2692881	12117361	65536	2918352	82%	1.15E+09	2.75E+15
HOST_SO	0.5	0.5	1	0	0.500773	100%	162	81
POST_SO	0.506173	1	1	0	0.500735	99%	164	80.98765
TIME_POST_SO	21.14815	24.5	57	0	21.85747	103%	6852	154312.9
TIME_HOST_POST_SO	10.57407	0	57	0	18.73584	177%	3426	113383.2
HOST_POST_SO	0.253086	0	1	0	0.435453	172%	82	61.24691

OLS2_WCONTROLS_SO

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	20317.79	20087.54	51936.89	1398.479	11035.55	54%	4266735	2.55E+10
TIME	32	32	50	14	8.306336	26%	6720	14420
TIME2	1333.467	1296	2704	256	580.2408	44%	280028	70365984
TIME3	52135.2	46656	140608	4096	32752.46	63%	10948392	2.24E+11
TIME4	2113209	1679616	7311616	65536	1718913	81%	4.44E+08	6.18E+14
HOST_SO	0.5	0.5	1	0	0.501195	100%	105	52.5
POST_SO	0.52381	1	1	0	0.500626	96%	110	52.38095
TIME_POST_SO	19.38095	26	50	0	19.11055	99%	4070	76329.52
TIME_HOST_POST_SO	9.690476	0	50	0	16.64215	172%	2035	57884.88
HOST_POST_SO	0.261905	0	1	0	0.440722	168%	55	40.59524
EVENT_TIMELINE	0	0	10	-10	6.06977		0	7700
GDPPC_BASE	10920.78	9646.252	19115.05	1398.479	6122.532	56%	2293365	7.83E+09
TOTAL_POPULATION	93231492	57482591	2.98E+08	17065100	84811355	91%	1.96E+10	1.50E+18
INFLATION_RATE	4.398682	3.127596	28.69759	-0.12790	3.869783	88%	923.7231	3129.82

OLS3_NO_CONTROLS_WO

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	21284.31	20670.82	57579.5	1148.494	13800.32	65%	6853548	6.11E+10
TIME	31.13354	31	54	8	10.23086	33%	10025	33599.26
TIME2	1839.444	1764	4096	256	839.5193	46%	592301	2.26E+08
TIME3	85009.81	74088	262144	4096	56245.77	66%	27373159	1.02E+12
TIME4	4086158	3111696	16777216	65536	3523494	86%	1.32E+09	3.99E+15
HOST_WO	0.521739	1	1	0	0.500305	96%	168	80.34783
POST_WO	0.546584	1	1	0	0.4986	91%	176	79.80124
TIME_POST_WO	19.40373	23	54	0	18.93862	98%	6248	115133.5
TIME_HOST_POST_WO	9.701863	0	54	0	16.54555	171%	3124	87875.38
HOST_POST_WO	0.273292	0	1	0	0.446343	163%	88	63.95031

OLS3_WCONTROLS_WO

	Mean	Median	Maximum	Minimum	Std. Dev.	CV%	Sum	Sum Sq. Dev.
GDPPC	22028.39	21427.26	57579.5	1148.494	13525.51	61%	6828801	5.65E+10
TIME	31.46774	31	54	8	10.27694	33%	9755	32635.18
TIME2	1872.087	1764	4096	256	838.3756	45%	580347	2.17E+08
TIME3	87076.28	74088	262144	4096	56303.87	65%	26993647	9.80E+11
TIME4	4205316	3111696	16777216	65536	3537297	84%	1.30E+09	3.87E+15
HOST_WO	0.541935	1	1	0	0.499044	92%	168	76.95484
POST_WO	0.548387	1	1	0	0.498458	91%	170	76.77419
TIME_POST_WO	19.69355	24	54	0	19.0998	97%	6105	112723.9
TIME_HOST_POST_WO	10.07742	0	54	0	16.7508	166%	3124	86702.14
HOST_POST_WO	0.283871	0	1	0	0.451604	159%	88	63.01935
EVENT_TIMELINE	0.332258	1	10	-10	6.100766		103	11500.78
GDPPC_BASE	12002	10587.29	25646.7	2238.803	8037.756	67%	3720620	2.00E+10
TOTAL_POPULATION	66954272	24746500	2.88E+08	3985258	84852574	127%	2.08E+10	2.22E+18
INFLATION_RATE	8.916902	2.940634	338.4491	-13.70632	35.57829	399%	2764.24	391136.7

Appendix G: Preliminary Model

World Cup:

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 13:29
Sample (adjusted): 1 525
Included observations: 488 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5054.861	3353.761	-1.507221	0.1324
TIME	553.5682	652.6676	0.848162	0.3968
TIME2	-29.25761	41.31923	-0.708087	0.4792
TIME3	1.099419	1.018810	1.079121	0.2811
TIME4	-0.012925	0.008543	-1.512957	0.1310
HOST_WC	8535.497	1052.975	8.106075	0.0000
POST_WC	3437.064	2450.066	1.402845	0.1613
TIME_POST_WC	-72.06404	69.73273	-1.033432	0.3019
TIME_HOST_POST_WC	699.0694	75.28295	9.285893	0.0000
HOST_POST_WC	-20673.82	3026.406	-6.831147	0.0000

R-squared	0.535763	Mean dependent var	9953.595
Adjusted R-squared	0.527022	S.D. dependent var	11617.22
S.E. of regression	7989.557	Akaike info criterion	20.82994
Sum squared resid	3.05E+10	Schwarz criterion	20.91580
Log likelihood	-5072.505	Hannan-Quinn criter.	20.86367
F-statistic	61.29410	Durbin-Watson stat	0.170855
Prob(F-statistic)	0.000000		

World Cup with controls:

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 15:18
Sample (adjusted): 1 504
Included observations: 431 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1981.415	3316.322	-0.597474	0.5505
TIME	425.7068	600.4290	0.709004	0.4787
TIME2	-18.01714	37.57689	-0.479474	0.6319
TIME3	0.448339	0.920441	0.487092	0.6264
TIME4	-0.004636	0.007681	-0.603577	0.5465
HOST_WC	2244.503	1054.438	2.128625	0.0339
POST_WC	-2559.375	2651.992	-0.965076	0.3351
TIME_POST_WC	-6.995379	65.57957	-0.106670	0.9151
TIME_HOST_POST_WC	376.7807	72.64501	5.186601	0.0000
HOST_POST_WC	-8974.673	2979.025	-3.012621	0.0027
EVENT_TIMELINE	451.9272	107.5836	4.200706	0.0000
GDPPC_BASE	0.418814	0.033992	12.32111	0.0000
TOTAL_POPULATION	5.48E-05	6.14E-06	8.934822	0.0000
INFLATION_RATE	-23.16287	6.850279	-3.381303	0.0008

R-squared	0.712809	Mean dependent var	10797.03
Adjusted R-squared	0.703856	S.D. dependent var	12058.07
S.E. of regression	6561.893	Akaike info criterion	20.44789
Sum squared resid	1.80E+10	Schwarz criterion	20.57997
Log likelihood	-4392.520	Hannan-Quinn criter.	20.50004
F-statistic	79.61514	Durbin-Watson stat	0.189690
Prob(F-statistic)	0.000000		

Summer Olympics:

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 13:33
Sample (adjusted): 1 336
Included observations: 324 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22075.65	7720.369	2.859404	0.0045
TIME	-1071.945	480.1004	-2.232752	0.0263
TIME2	-1.951984	34.53328	-0.056525	0.9550
TIME3	1.441988	1.017850	1.416700	0.1576
TIME4	-0.017138	0.009005	-1.903091	0.0579
HOST_SO	-10268.28	1770.430	-5.799879	0.0000
POST_SO	1409.470	7024.645	0.200646	0.8411
TIME_POST_SO	55.58008	178.9325	0.310620	0.7563
TIME_HOST_POST_SO	-296.1314	187.1754	-1.582106	0.1146
HOST_POST_SO	6462.086	8150.810	0.792815	0.4285

R-squared	0.588061	Mean dependent var	23691.32
Adjusted R-squared	0.576254	S.D. dependent var	13955.76
S.E. of regression	9084.612	Akaike info criterion	21.09693
Sum squared resid	2.59E+10	Schwarz criterion	21.21362
Log likelihood	-3407.703	Hannan-Quinn criter.	21.14351
F-statistic	49.80539	Durbin-Watson stat	0.143527
Prob(F-statistic)	0.000000		

Summer Olympics: With Controls

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 15:21
Sample (adjusted): 127 336
Included observations: 210 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-35496.63	10187.63	-3.484288	0.0006
TIME	2729.056	884.5472	3.085258	0.0023
TIME2	-13.59481	40.61892	-0.334692	0.7382
TIME3	-1.268290	1.128234	-1.124137	0.2623
TIME4	0.020354	0.010178	1.999721	0.0469
HOST_SO	496.9328	1291.325	0.384824	0.7008
POST_SO	2624.442	5361.664	0.489483	0.6250
TIME_POST_SO	-24.34461	158.3468	-0.153742	0.8780
TIME_HOST_POST_SO	53.15395	119.6852	0.444115	0.6574
HOST_POST_SO	-4716.190	4512.823	-1.045064	0.2973
EVENT_TIMELINE	214.5006	320.2492	0.669793	0.5038
GDPPC_BASE	0.249425	0.322294	0.773905	0.4399
TOTAL_POPULATION	6.22E-05	1.45E-05	4.278525	0.0000
INFLATION_RATE	175.9291	102.9554	1.708790	0.0891

R-squared	0.897018	Mean dependent var	20317.79
Adjusted R-squared	0.890187	S.D. dependent var	11035.55
S.E. of regression	3656.960	Akaike info criterion	19.31099
Sum squared resid	2.62E+09	Schwarz criterion	19.53413
Log likelihood	-2013.654	Hannan-Quinn criter.	19.40120
F-statistic	131.3263	Durbin-Watson stat	0.484172
Prob(F-statistic)	0.000000		

Winter Olympics

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 13:35
Sample (adjusted): 1 336
Included observations: 322 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3446.027	6385.917	0.539629	0.5898
TIME	-1000.795	432.2961	-2.315068	0.0213
TIME2	47.32961	26.70917	1.772036	0.0774
TIME3	-0.219293	0.757602	-0.289457	0.7724
TIME4	-0.004090	0.006329	-0.646149	0.5187
HOST_WO	-10554.72	1643.285	-6.422937	0.0000
POST_WO	-42882.61	6237.180	-6.875321	0.0000
TIME_POST_WO	1302.186	190.2210	6.845650	0.0000
TIME_HOST_POST_WO	-940.7796	165.9518	-5.668994	0.0000
HOST_POST_WO	36939.12	6306.058	5.857720	0.0000

R-squared	0.610719	Mean dependent var	21284.31
Adjusted R-squared	0.599490	S.D. dependent var	13800.32
S.E. of regression	8733.652	Akaike info criterion	21.01832
Sum squared resid	2.38E+10	Schwarz criterion	21.13554
Log likelihood	-3373.949	Hannan-Quinn criter.	21.06512
F-statistic	54.38640	Durbin-Watson stat	0.212378
Prob(F-statistic)	0.000000		

Winter Olympics: With Controls

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/09/19 Time: 13:35
Sample (adjusted): 1 336
Included observations: 310 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15397.87	3975.541	3.873152	0.0001
TIME	-1521.023	263.9466	-5.762619	0.0000
TIME2	27.41173	15.80999	1.733823	0.0840
TIME3	-0.142765	0.449785	-0.317407	0.7512
TIME4	-0.000618	0.003747	-0.164858	0.8692
HOST_WO	-1656.489	1078.819	-1.535465	0.1257
POST_WO	-7948.453	4621.728	-1.719801	0.0865
TIME_POST_WO	220.8815	131.5623	1.678912	0.0942
TIME_HOST_POST_WO	-105.8334	107.2744	-0.986567	0.3247
HOST_POST_WO	4297.824	4134.435	1.039519	0.2994
EVENT_TIMELINE	1203.793	110.0321	10.94038	0.0000
GDPPC_BASE	1.480043	0.072267	20.48007	0.0000
TOTAL_POPULATION	1.52E-05	3.91E-06	3.898313	0.0001
INFLATION_RATE	-25.22733	9.039639	-2.790745	0.0056

R-squared	0.866356	Mean dependent var	22028.39
Adjusted R-squared	0.860486	S.D. dependent var	13525.51
S.E. of regression	5051.983	Akaike info criterion	19.93706
Sum squared resid	7.55E+09	Schwarz criterion	20.10581
Log likelihood	-3076.244	Hannan-Quinn criter.	20.00452
F-statistic	147.6029	Durbin-Watson stat	0.290993
Prob(F-statistic)	0.000000		

Appendix H: World Cup Econometric Assumption Tests

White Test:
H_0: Homoscedasticity with respect to one or more independent variables
H_A: Heteroscedasticity with respect to one or more independent variables
Critical value = 31.410
Obs*R-squared = 18.77
Decision rule: reject H_0 IFF and only if Obs*R-squared > critical value (Chi squared)

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	40.69363	Prob. F(9,478)	0.0000
Obs*R-squared	211.7003	Prob. Chi-Square(9)	0.0000
Scaled explained SS	252.7893	Prob. Chi-Square(9)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/09/19 Time: 15:41
Sample: 1 525
Included observations: 488

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-16077519	13040789	-1.232864	0.2182
TIME^2	38569.36	61973.06	0.622357	0.5340
TIME2^2	52.31404	84.91628	0.616066	0.5381
TIME3^2	-0.054713	0.041616	-1.314711	0.1892
TIME4^2	1.27E-05	6.66E-06	1.902405	0.0577
HOST_WC^2	63101064	9877194.	6.388562	0.0000
POST_WC^2	34472975	16004098	2.154009	0.0317
TIME_POST_WC^2	-27923.51	10555.88	-2.645303	0.0084
TIME_HOST_POST_WC^2	97427.04	10191.17	9.559944	0.0000
HOST_POST_WC^2	-1.30E+08	19869687	-6.520333	0.0000

R-squared	0.433812	Mean dependent var	62524973
Adjusted R-squared	0.423152	S.D. dependent var	98747133
S.E. of regression	74998975	Akaike info criterion	39.12413
Sum squared resid	2.69E+18	Schwarz criterion	39.20999
Log likelihood	-9536.287	Hannan-Quinn criter.	39.15785
F-statistic	40.69363	Durbin-Watson stat	0.547753
Prob(F-statistic)	0.000000		

VIFS

Variance Inflation Factors
Date: 04/08/19 Time: 21:45
Sample: 1 1347
Included observations: 488

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	11247714	85.98816	NA
TIME	425975.0	3918.824	649.5587
TIME2	1707.279	29097.90	10197.40
TIME3	1.037974	38790.87	18722.05
TIME4	7.30E-05	6557.840	3785.067
HOST_WC	1108757.	4.463999	2.113081
POST_WC	6002823.	23.98006	11.44950
TIME_POST_WC	4862.654	27.65807	15.03348
TIME_HOST_POST_WC	5667.522	17.32095	13.13429
HOST_POST_WC	9159133.	19.08361	13.88254

LM Test for serial correlation:

H_o: There is no serial correlation

H_A: There is serial correlation

Chi-Squared test at 5% level of significant

Degrees of freedom (# of lags) = p = 1

Critical value = 3.841

Reject H_o if Critical Value ≤ Observed R^2

Observed R^2 = 399.66

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 1 lag

F-statistic	2157.836	Prob. F(1,477)	0.0000
Obs*R-squared	399.6545	Prob. Chi-Square(1)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/08/19 Time: 21:53
Sample: 1 525
Included observations: 488
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1017.737	1428.632	-0.712386	0.4766
TIME	262.3175	278.0473	0.943427	0.3459
TIME2	-18.97114	17.60379	-1.077673	0.2817
TIME3	0.464870	0.434056	1.070991	0.2847
TIME4	-0.003542	0.003639	-0.973312	0.3309
HOST_WC	59.25089	448.4944	0.132111	0.8950
POST_WC	100.7102	1043.556	0.096507	0.9232
TIME_POST_WC	2.579989	29.70124	0.086865	0.9308
TIME_HOST_POST_WC	-43.94755	32.07914	-1.369973	0.1713
HOST_POST_WC	1174.605	1289.282	0.911054	0.3627
RESID(-1)	0.920983	0.019826	46.45252	0.0000

R-squared	0.818964	Mean dependent var	-4.60E-13
Adjusted R-squared	0.815169	S.D. dependent var	7915.388
S.E. of regression	3402.983	Akaike info criterion	19.12498
Sum squared resid	5.52E+09	Schwarz criterion	19.21943
Log likelihood	-4655.494	Hannan-Quinn criter.	19.16208
F-statistic	215.7836	Durbin-Watson stat	1.846330
Prob(F-statistic)	0.000000		

Appendix I: Summer Olympics Econometric Assumption Tests

White Test

H_0: Homoscedasticity with respect to one or more independent variables
H_A: Heteroscedasticity with respect to one or more independent variables
Critical value = 31.410
Obs*R-squared = 18.77
Decision rule: reject H_0 IFF and only if Obs*R-squared > critical value (Chi squared)

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	21.51762	Prob. F(9,314)	0.0000
Obs*R-squared	123.5976	Prob. Chi-Square(9)	0.0000
Scaled explained SS	137.6894	Prob. Chi-Square(9)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/09/19 Time: 15:42
Sample: 1 336
Included observations: 324

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-66178029	26890096	-2.461056	0.0144
TIME^2	190013.6	72727.64	2.612674	0.0094
TIME2^2	-202.8498	76.61704	-2.647581	0.0085
TIME3^2	0.106114	0.036228	2.929073	0.0036
TIME4^2	-1.65E-05	5.61E-06	-2.942188	0.0035
HOST_SO^2	1.15E+08	17357833	6.597673	0.0000
POST_SO^2	1.33E+08	41199396	3.219905	0.0014
TIME_POST_SO^2	-78917.21	24766.82	-3.186409	0.0016
TIME_HOST_POST_SO^2	80641.18	23905.75	3.373296	0.0008
HOST_POST_SO^2	-1.51E+08	51175325	-2.953981	0.0034

R-squared	0.381474	Mean dependent var	79982947
Adjusted R-squared	0.363746	S.D. dependent var	1.23E+08
S.E. of regression	98414619	Akaike info criterion	39.67765
Sum squared resid	3.04E+18	Schwarz criterion	39.79434
Log likelihood	-6417.780	Hannan-Quinn criter.	39.72423
F-statistic	21.51762	Durbin-Watson stat	0.376650
Prob(F-statistic)	0.000000		

Multicollinearity:

Variance Inflation Factors
Date: 04/08/19 Time: 22:35
Sample: 1 1347
Included observations: 324

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	1.23E+08	387.2474	NA
TIME	1149446.	3921.844	273.8992
TIME2	5715.810	35514.60	6659.407
TIME3	4.523314	54330.76	18334.40
TIME4	0.000348	9275.024	4391.279
HOST_SO	18139498	7.668031	6.616948
POST_SO	1.32E+08	73.58304	64.09226
TIME_POST_SO	95760.11	89.56554	78.86713
TIME_HOST_POST_SO	158652.5	38.66358	37.40028
HOST_POST_SO	2.36E+08	39.59438	38.05598

Breusch-Godfrey LM test for serial correlation:

H_o: There is no serial correlation

H_A: There is serial correlation

Chi-Squared test at 5% level of significant

Degrees of freedom (# of lags) = p = 1

Critical value = 3.841

Reject H_o if Critical Value ≤ Observed R^2

Observed R^2 = 275.30

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 1 lag

F-statistic	1769.434	Prob. F(1,313)	0.0000
Obs*R-squared	275.3012	Prob. Chi-Square(1)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/08/19 Time: 22:36
Sample: 1 336
Included observations: 324
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4529.220	2999.834	1.509823	0.1321
TIME	-114.6883	186.4480	-0.615122	0.5389
TIME2	-11.82031	13.41258	-0.881285	0.3788
TIME3	0.468010	0.395398	1.183640	0.2375
TIME4	-0.004435	0.003499	-1.267672	0.2059
HOST_SO	-262.0336	687.5050	-0.381137	0.7034
POST_SO	563.1927	2727.777	0.206466	0.8366
TIME_POST_SO	-21.07054	69.48320	-0.303247	0.7619
TIME_HOST_POST_SO	69.88619	72.70119	0.961280	0.3372
HOST_POST_SO	-2298.299	3165.517	-0.726042	0.4684
RESID(-1)	0.933349	0.022188	42.06464	0.0000

R-squared	0.849695	Mean dependent var	-1.35E-11
Adjusted R-squared	0.844893	S.D. dependent var	8957.152
S.E. of regression	3527.651	Akaike info criterion	19.20801
Sum squared resid	3.90E+09	Schwarz criterion	19.33637
Log likelihood	-3100.698	Hannan-Quinn criter.	19.25925
F-statistic	176.9434	Durbin-Watson stat	1.847613
Prob(F-statistic)	0.000000		

Appendix J: Winter Olympics Econometric Assumption Tests

White Test:
H_0: Homoscedasticity with respect to one or more independent variables
H_A: Heteroscedasticity with respect to one or more independent variables
Critical value = 31.410
Obs*R-squared = 18.77
Decision rule: reject H_0 IFF and only if Obs*R-squared > critical value (Chi squared)

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	9.977843	Prob. F(9,312)	0.0000
Obs*R-squared	71.96552	Prob. Chi-Square(9)	0.0000
Scaled explained SS	90.22818	Prob. Chi-Square(9)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/09/19 Time: 15:46
Sample: 1 336
Included observations: 322

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12877617	25710006	0.500880	0.6168
TIME^2	132392.6	94090.60	1.407076	0.1604
TIME2^2	-66.97099	57.15396	-1.171765	0.2422
TIME3^2	0.029727	0.024150	1.230928	0.2193
TIME4^2	-4.10E-06	3.38E-06	-1.213481	0.2259
HOST_WO^2	3120623.	19015281	0.164111	0.8697
POST_WO^2	2.24E+08	42002219	5.332000	0.0000
TIME_POST_WO^2	-148988.0	36187.54	-4.117106	0.0000
TIME_HOST_POST_WO^2	173977.2	27662.28	6.289330	0.0000
HOST_POST_WO^2	-2.76E+08	46724622	-5.906818	0.0000

R-squared	0.223495	Mean dependent var	73907838
Adjusted R-squared	0.201096	S.D. dependent var	1.21E+08
S.E. of regression	1.08E+08	Akaike info criterion	39.86609
Sum squared resid	3.65E+18	Schwarz criterion	39.98332
Log likelihood	-6408.441	Hannan-Quinn criter.	39.91289
F-statistic	9.977843	Durbin-Watson stat	0.513357
Prob(F-statistic)	0.000000		

Multicollinearity:

Variance Inflation Factors
Date: 04/08/19 Time: 22:41
Sample: 1 1347
Included observations: 322

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	77848184	210.6510	NA
TIME	496877.1	943.0812	143.6075
TIME2	2160.351	15276.03	3743.801
TIME3	1.691274	28246.81	12107.12
TIME4	0.000110	5077.105	2939.460
HOST_WO	10934050	20.49710	5.781446
POST_WO	2.61E+08	343.8696	201.2339
TIME_POST_WO	218474.4	320.4087	192.7727
TIME_HOST_POST_WO	132190.1	104.8943	73.51364
HOST_POST_WO	1.80E+08	166.9449	114.6066

Breusch-Godfrey LM test for serial correlation:

H_o: There is no serial correlation

H_A: There is serial correlation

Chi-Squared test at 5% level of significant

Degrees of freedom (# of lags) = p = 1

Critical value = 3.841

Reject H_o if Critical Value ≤ Observed R^2

Observed R^2 = 399.66

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 1 lag

F-statistic	1195.678	Prob. F(1,311)	0.0000
Obs*R-squared	255.5346	Prob. Chi-Square(1)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/08/19 Time: 22:42
Sample: 1 336
Included observations: 322
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7830.505	2914.775	2.686487	0.0076
TIME	-344.2979	196.9717	-1.747956	0.0815
TIME2	-15.51945	12.16251	-1.276006	0.2029
TIME3	0.581981	0.345164	1.686103	0.0928
TIME4	-0.004339	0.002883	-1.505032	0.1333
HOST_WO	387.6723	747.8747	0.518365	0.6046
POST_WO	7245.793	2846.005	2.545952	0.0114
TIME_POST_WO	-219.1808	86.79341	-2.525316	0.0121
TIME_HOST_POST_WO	136.1787	75.62036	1.800820	0.0727
HOST_POST_WO	-5515.148	2874.053	-1.918944	0.0559
RESID(-1)	0.900844	0.026052	34.57858	0.0000

R-squared	0.793586	Mean dependent var	-6.53E-12
Adjusted R-squared	0.786949	S.D. dependent var	8610.347
S.E. of regression	3974.321	Akaike info criterion	19.44666
Sum squared resid	4.91E+09	Schwarz criterion	19.57560
Log likelihood	-3119.912	Hannan-Quinn criter.	19.49814
F-statistic	119.5678	Durbin-Watson stat	1.728339
Prob(F-statistic)	0.000000		

Appendix K: Final Model

World Cup:

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/08/19 Time: 14:53
Sample (adjusted): 1 525
Included observations: 488 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 6.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5054.861	4134.413	-1.222631	0.2221
TIME	553.5682	990.6564	0.558789	0.5766
TIME2	-29.25761	72.18437	-0.405318	0.6854
TIME3	1.099419	1.952500	0.563083	0.5736
TIME4	-0.012925	0.017518	-0.737786	0.4610
HOST_WC	8535.497	1928.167	4.426742	0.0000
POST_WC	3437.064	2803.466	1.226005	0.2208
TIME_POST_WC	-72.06404	92.04038	-0.782961	0.4340
TIME_HOST_POST_WC	699.0694	170.6451	4.096626	0.0000
HOST_POST_WC	-20673.82	5405.906	-3.824303	0.0001

R-squared	0.535763	Mean dependent var	9953.595
Adjusted R-squared	0.527022	S.D. dependent var	11617.22
S.E. of regression	7989.557	Akaike info criterion	20.82994
Sum squared resid	3.05E+10	Schwarz criterion	20.91580
Log likelihood	-5072.505	Hannan-Quinn criter.	20.86367
F-statistic	61.29410	Durbin-Watson stat	0.170855
Prob(F-statistic)	0.000000	Wald F-statistic	11.13973
Prob(Wald F-statistic)	0.000000		

Summer Olympics:

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/08/19 Time: 15:03
Sample (adjusted): 1 336
Included observations: 324 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 6.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22075.65	11090.15	1.990564	0.0474
TIME	-1071.945	1072.122	-0.999835	0.3182
TIME2	-1.951984	75.60298	-0.025819	0.9794
TIME3	1.441988	2.126808	0.678006	0.4983
TIME4	-0.017138	0.018663	-0.918289	0.3592
HOST_SO	-10268.28	4259.049	-2.410933	0.0165
POST_SO	1409.470	11496.64	0.122598	0.9025
TIME_POST_SO	55.58008	309.4513	0.179608	0.8576
TIME_HOST_POST_SO	-296.1314	398.3121	-0.743466	0.4578
HOST_POST_SO	6462.086	15353.48	0.420887	0.6741

R-squared	0.588061	Mean dependent var	23691.32
Adjusted R-squared	0.576254	S.D. dependent var	13955.76
S.E. of regression	9084.612	Akaike info criterion	21.09693
Sum squared resid	2.59E+10	Schwarz criterion	21.21362
Log likelihood	-3407.703	Hannan-Quinn criter.	21.14351
F-statistic	49.80539	Durbin-Watson stat	0.143527
Prob(F-statistic)	0.000000	Wald F-statistic	31.28714
Prob(Wald F-statistic)	0.000000		

Winter Olympics:

Dependent Variable: GDPPC
Method: Least Squares
Date: 04/08/19 Time: 15:04
Sample (adjusted): 1 336
Included observations: 322 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 6.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3446.027	8823.162	0.390566	0.6964
TIME	-1000.795	704.8951	-1.419778	0.1567
TIME2	47.32961	46.47957	1.018288	0.3093
TIME3	-0.219293	1.300490	-0.168623	0.8662
TIME4	-0.004090	0.010486	-0.390021	0.6968
HOST_WO	-10554.72	3306.667	-3.191950	0.0016
POST_WO	-42882.61	16158.39	-2.653891	0.0084
TIME_POST_WO	1302.186	467.4124	2.785947	0.0057
TIME_HOST_POST_WO	-940.7796	363.5796	-2.587548	0.0101
HOST_POST_WO	36939.12	13408.56	2.754891	0.0062

R-squared	0.610719	Mean dependent var	21284.31
Adjusted R-squared	0.599490	S.D. dependent var	13800.32
S.E. of regression	8733.652	Akaike info criterion	21.01832
Sum squared resid	2.38E+10	Schwarz criterion	21.13554
Log likelihood	-3373.949	Hannan-Quinn criter.	21.06512
F-statistic	54.38640	Durbin-Watson stat	0.212378
Prob(F-statistic)	0.000000	Wald F-statistic	33.98226
Prob(Wald F-statistic)	0.000000		

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Key words: mega-events, implicit benefits, underestimated costs, overestimated benefits, crowding out, empirical costs/benefits, profit prediction

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