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# Optimal Asset Allocation

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# ECONOMIC IMPACT OF SPORTS MEGA-EVENTS

A Meta-Analysis

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Applied Research Methods

## Economic Impact of Sports Mega-Events

### Background to the Question

The concept of “sport” has been a moral stalwart in human culture and history for thousands and thousands of years. For all its breadth and variety, sporting culture has been (and continues to be) characterized with a variety of meanings and natures. There are many government programs worldwide devoted to encouraging their citizens to exercise for health benefits, and there are numerous organizations predicated on regulating sporting competitions across many sports at nearly every age level. Americans, with too many regional stories to list, recount the likes of James Cleveland (Jesse) Owens, winning four gold medals at the 1936 Olympics, as a great win against the Nazis, or the 1975-76 NHL Tour of the Soviet Union, where the undefeated Red Army lost decisively to the Philadelphia Flyers, as well as so many other tales (RHP 2016, Fleischman 2015). The political activists in today’s NFL games and other sports protesting police brutality echo back to the 1968 Mexico City Summer Olympics, when John Carlos (gold) and Tommie Smith (bronze) raised their fists during the American national anthem on the 200m medal ceremony stand (Cosgrove 2014). These are, of course, non-American examples, such as Feyisa Lilesa (gold medal winner), an Oromo from Ethiopia, protesting the Tigrayan oppression and government brutality on the finish line of the Olympic Marathon in 2016 (which he could be jailed for at home) (Victor and Gettleman 2016). People across the world value athletics very highly, for all of these reasons and more, and are willing to spend over \$1.5 trillion USD per year (2015) on apparel, tickets, memorabilia, equipment, concessions, and more (Plunkett Research 2015).

A significant portion of that \$1.5 trillion is public spending, either by local or state governments, which means that not only do people want to spend their own money on sports, but their tax dollars as well. This is why governments bid so fiercely and invest so heavily in lobbying committees for permission to host Olympics, Super Bowls, Tour de France stages, and world championships for various sports. Governments not only create jobs through increased administration and safety personnel, but also by creating and improving infrastructure to support these mega-sporting events, such as stadiums, transportation, and housing. The reasons governments bid to host sporting events are multi-fold, and include high voter popularity, infrastructure revitalization of cities and regions, and hopes of increases in economic growth (The Economist, 2013).

This is called direct spending, and includes both the wages and materials purchased, as well as certain kinds of spending by people (operating expenses and tourist expenditures) and companies (advertising) that would not have occurred if the event had not occurred. The additional related spending to the event is called the indirect or induced spending, essentially any spending caused by the direct in-scope spending. This is spending by the organizations to other organizations in the economic activity zone being studied, and is followed until the expenditures have fully leaked out of the economy (Jago and Dwyer 2006). The question for taxpayers, though, is whether the money spent on these mega-events is worth it, or stated differently, how effectively was it used? This question is open to various interpretations, but many of these organizations hire firms to create economic impacts studies for these events.

## Introduction to the Answer

Governments create and/or commission these economic impacts studies to quantify how the event impacted the economy, whether it be local or country-wide. But what impacts do these studies quantify? Economic impact studies tend to estimate several different factors. The first is total economic impact, which is all the economic activity generated as a result of the event. Studies also try to quantify the indirect/induced spending, as well as number of jobs created as a result of the event. Governments, of course, want all of these numbers to be very high, as it shows their direct spending was done very efficiently and effectively, significantly helping their community and people. However, this inherently biases the reports, as the firms creating the study know this and thus have incentives to influence the results. There are independent studies, which are economic impact studies commissioned and paid for by parties other than the government. These independent parties tend to be less common than government commissioned studies, as governments are often required to report to the public the effect on the economy of their spending.

A meta-analysis of economic impact studies demonstrates what the results say on average, as well as what leads to higher or lower estimates. It helps to counteract this self-serving government bias, as a greater number of studies and the inclusion of independent studies diminishes the bias and leads to more significant results. This meta-analysis takes into account the nature, size, duration, and demographic-related statistics about the event, as these factors change the net economic impact the event had on the economy. From these results, the average economic impact of a mega-event can be derived, and then augmented by various statistics, giving governments a more complete picture of what their investment will yield. These meta-analyses can even be used to determine the effect of a specific event, like a World Cup or specific kind of World Championship, and potentially be used as guidelines for what to expect from hosting.

## Literature Review

In order to conduct a meta-analysis of economic impacts of sporting mega-events, it is necessary to first review scholarly literature on meta-analyses themselves, both best practices in conducting as well as pitfalls to avoid. While the practice of meta-analyses had been going on for some time prior to this paper, Gene V. Glass's "Primary, Secondary, and Meta-Analysis of Research" article in *Educational Researcher* (1976) earned him the title "Father of Meta-Analysis", and launched the modern study of meta-analyses. He defined "meta-analysis" as "the analysis of analyses...a statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings". The statistical analysis replaces the summarizing and descriptive method that is also commonly used when integrating multiple studies' findings. This methodology does not split the results of a great number of studies between statistically significant and not significant, but examines the results of these studies as primary analysis does with the original data. This examines the relationships between like data and attempts to correct for poor study design producing significant relationships that should have been insignificant. His meta-analysis also added ambient conditions related to each study, varying with the field, to more accurately show broader contexts. This meta-analysis approach was followed very closely for this paper.

While Gene V. Glass argued for the increased use and benefits of meta-analysis, there are also downsides to this statistical methodology. “Meta-analysis: Its strengths and limitations” published in the *Cleveland Clinic Journal of Medicine* by Walker et al. (2008) discusses how “small violations of...critical conditions can produce misleading results” in meta-analyses. They argue that while meta-analyses can “overcome small sample sizes...to analyze end points that require larger samples sizes” and “increase precision in estimating effects”, the study selection, results heterogeneity, information availability, and analysis of the data can significantly bias a meta-analysis relatively easily. Study selection has three primary issues: publication bias, search bias, and selection bias. Positive results are typically published far more often than negative (or insignificant) results. Search and selection biases then are capturing all relevant studies and further refining this set of relevant data by a large set of criteria to find the highest quality data and least replication of studies. Heterogeneous results also lower the quality of meta-analysis by showing contradictory results and lowering the significance of the integrated results. In some cases, meta-analyses can suffer from lack of availability of information. Without certain types of data or information, studies can present findings that are in fact dissimilar but appear the same. Walker et al. caution that this also lowers the quality of meta-analysis and integration.

In 2013, Li and Jago coauthored “Evaluating economic impacts of major sports events – a meta-analysis of the key trends” (*Current Issues in Tourism*) to study the best methods for integrating economic impacts studies of “mega and periodic hallmark (sports) events”. The first key set of trends according to the authors was including the multipliers from individual studies in meta-analyses of sports-events and that the scale of direct economic expenditure enlarged overall economic impact. The next key trend identified is that some sports mega-events, like the Olympics and World Cups, have greater economic impact that is not proportional to their direct expenditure, or that their impact is greater relative to expenditure than a similarly sized event (when including long-term economic and sociological effects). However, Li and Jago conducted a qualitative meta-analysis, not a quantitative one. These assumptions and analyses were tested in this paper’s quantitative meta-analysis.

John Siegfried and Andrew Zimbalist published “The Economic Impact of Sports Facilities, Teams and Mega-Events” in *Policy Forum: Economics of Sport* that gives a broad overview of the problems associated with meta-analyses of sports mega-events and explore the topic of independent studies vs. publicly commissioned studies. They find in their meta-review analysis that promotional government studies “adopt unrealistic assumptions regarding local value added, new spending, and appropriate multipliers”, and independent studies show “no statistically significant positive relationship between sports facility construction and economic development...and that sports teams do not stimulate economic growth”. On mega-events, they found that economic impacts can be very positive for local and state economies, while having lesser effects on countries as a whole. They did criticize certain kinds of events, namely, but not necessarily limited to, the National Football League’s Super Bowls, as often crowding out normal local spending, leading to far less additional economic impact than claimed. They also comment that events, like the 2000 Sydney Olympics, can cause losses when handled incorrectly (in terms of infrastructure spending, etc.). This meta-analysis sought to investigate statistical differences between independent and commissioned studies, as well as differences between Super Bowls and other events, in terms of economic impacts.

John L. Crompton published the article “Economic Impact Analysis of Sports Facilities and Events: Eleven Sources of Misapplication” in the *Journal of Sports Management* (1995),

which discussed the abuses of economic impact studies and data used in conjunction with these studies. These discussions were taken into account when calculating multipliers and populations for given areas. When direct spending figures were given, multipliers could be calculated by the “gross” method referred to by Crompton, also known as “real multiplier”. While Crompton disagrees with the use of “gross multipliers”, both independent studies and government sponsored publications use this type of multiplier. By explaining exactly what this is and what it means, this paper seeks to make fully aware to readers that this represents the “(direct spending + indirect spending + induced spending) / direct spending” as defined in “Li and Jago 2013” as opposed to Crompton’s definitions of these terms. This averts the confusion Crompton argues such a multiplier will occur as a result. Additionally, when economic impact studies defined the area of their impacts, but neglected to provide the population of their defined area, government estimates and housing information were used to show the effect on people. Crompton argues that defining the area of interest is critical to the event analysis success and must be suitably large enough to avoid bloated visitor expenditures.

Lastly, economic impact meta-analyses typically involve regressions of results. The best practices for meta-regressions are detailed in T. D. Stanley’s “Wheat from Chaff: Meta-Analysis as Quantitative Literature Review” in the *Journal of Economic Perspectives* (2001). Stanley outlines how to choose summary statistics (dependent variables) and the important characteristics measured in the studies themselves (moderator independent variables). These results are also highly unlikely to be autocorrelated, and wield more explanatory power together. It also allows for the study of more variables and different relationships than one study could test.

### Data Collection Methods and Explanations

The majority of the data used in this meta-analysis was culled from economic impact studies. These studies were identified and selected from numerous searches on Google Scholar, Microsoft Academic, and press releases from government websites. However, there was additional data and information integrated from the United States Census, US Bureau of Economic Analysis, CIA Factbook, as well other countries’ government websites. Some of the unstructured information from the studies were manipulated and/or inferred into data, and these will be discussed in detail with each data point.

The summary statistic (independent variable) used from each selected study was the Total Economic Impact. This was generally outright stated in most publications, or (could be easily summed from the direct, indirect, induced, derived, and other activity found in the conclusions. However, in order to have this data be comparable, all figures were first converted to US dollars at the then-present conversion rates. That figure in US dollars was then converted to the value in 2015 US dollars. Thus, the true summary statistic for the economic impact meta-analysis was the Total Economic Impact in 2015 USD. The same manipulations occurred for the meta-analysis on Economic Impact per Day figures, converting them to 2015 USD. This last figure is exactly as it is described; the total economic impact divided by the number of days of the event. There are 46 data points for Total and 46 for Per Day impacts.

Population figures were reasonably common in terms of being reported in the studies. However, nearly every study defined their activity area, and thus, the area’s population is frequently reported by the local, state, or federal governments. This means that regardless of the study reporting population, it is possible to obtain such data. Therefore, many of the population

figures are additional information added to create a more complete image of the studies, and allow the effect of population on total economic impact to be estimated. There are 46 population data points.

Multiplier figures were less commonly reported among economic impact studies. This could be for a variety of reasons, including, but not limited to, focusing on multiplier analysis methods rather than results, assuming primary audiences would not understand the meaning, or (in government commissioned studies) intentional suppression of multiplier results. However, some independent and government commissioned studies included their multipliers, and others gave direct spending figures, allowing multipliers to be derived relatively simply. There are only 23 multiplier data points.

The duration of the different mega-events is regularly reported by every study, framing the time period before and after an event that was included in the total economic activity. This figure described as “number of days” was used in both meta-analyses, as an independent variable in the total impact and as a component of the dependent variable in the EI per Day. This variable allows the testing of whether shorter events or longer events are better for the economy. There were 46 duration data points collected.

The median income was not a topic mentioned often and none of the studies used it as an explanatory factor in size of economic impact. However, by finding the median incomes of the areas surrounding these events, this paper sought to find a link between the two. If the relationship is positive, it could mean that high median incomes allow for greater disposable income for sports. If the relationship is negative, it could mean that higher median incomes cause higher cost of living in the area, which could potentially discourage visitor expenditures. The information was found on government websites of various countries, states, and counties, and they were adjusted to 2015 USD. This created 44 data points for the meta-analysis.

There were then four different binary variables tested for explanatory power. The first was “US”, with a 1 meaning located in the US and a 0 for anywhere else. This tested the theory of “American Exceptionalism” in sports events, or that an event held in America would have larger impacts, or even that Americans were simply more likely to spend larger amounts on sports. The next variable, “Super Bowl”, is somewhat related, in that it tests whether Super Bowls have disproportionately large impacts over other events, with a 1 being a Super Bowl and a 0 being any other event. The third binary variable, “Independent study”, was testing whether the study being independently commissioned or government sponsored affected the economic impact (1 being independent and 0 being government sponsored). Lastly, the Olympics (Summer or Winter) and World Cups involve far larger infrastructure investments, go on for far longer periods of time, and thus seem capable of larger impacts. Any World Cup or Olympics was coded with a 1 and all other events were coded with a 0.

### Econometric Methods

This meta-analysis of economic impact studies was conducted using an Ordinary Least Squares for Multiple Regression model, as the data is cross-sectional and has multiple independent explanatory variables (Hill et al., 2001, 148). The general model for such can be seen below:

$$y_t = B_1 + B_2x_{t2} + B_3x_{t3} + B_kx_{tk} + e_t$$

There are also three types of independent variables used in the three categories of models. The first type used are standard independent, continuous variables, representing a value and operating in the manner shown in the general model above. The second type are called interaction terms, and these aim to “alter the relationship between” two continuous variables by multiplying one by the other and examining its new relationship to the dependent variable (Hill et al., 2001, 220-221). The third type is the binary variable, discussed earlier. This is a variable that takes the value of 1 or 0 to denote the “presence or absence of a characteristic” (Hill et al., 2001, 201).

In the Total Economic Impact models, K is equal to 7, and a summary model can be seen below:

$$\varepsilon(EI) = B_1 + B_2Pop + B_3Mult + B_4Days + B_5MI + B_6PopDays + B_7MIPop + \delta(O\&WC)$$

where Pop is population, Mult is multiplier, Days is number of days, MI is median income, PopDays is an interaction term between population and number of days, MIPop is an interaction term between population and median income, and a binary variable for whether the event was an Olympics or FIFA World Cup event.

In the Economic Impact per Day models, K is equal to 5, and a summary model can be seen below:

$$\varepsilon\left(\frac{EI}{Day}\right) = B_1 + B_2Pop + B_3Mult + B_4MI + B_5MIPop + \delta\left(\frac{O}{WC}\right)$$

Finally, a binary variable model for Total Economic Impact and Economic Impact per Day was created with four variables, as shown below:

$$\begin{aligned}\varepsilon(EI) &= \delta_1IS + \delta_2US + \delta_3O/WC + \delta_4SB \\ \varepsilon\left(\frac{EI}{Day}\right) &= \delta_1IS + \delta_2US + \delta_3O/WC + \delta_4SB\end{aligned}$$

where IS represents whether the study was independent, US is a United States-based event, O/WC once again means whether the mega-event was an Olympics or World Cup, and SB denotes whether the event was a Super Bowl.

While the binary variable models are presented in the results as shown above, the Total Economic Impact and Economic Impact per Day show multiple models, or variations of the summary models shown above. This allows greater significance lent to different variables. The six Total Economic Impact models are shown below:

- 1)  $\varepsilon(EI) = B_1 + B_2Pop + B_3Mult + B_4Days + B_5MI$
- 2)  $\varepsilon(EI) = B_1 + B_2Pop + B_3Mult + B_4Days + B_5MI + B_6PopDays$
- 3)  $\varepsilon(EI) = B_1 + B_2Pop + B_4Days + B_5MI + B_7MIPop$
- 4)  $\varepsilon(EI) = B_1 + B_2Pop + B_3Mult + B_4Days + B_5MI + B_6PopDays + B_7MIPop$
- 5)  $\varepsilon(EI) = B_1 + B_2Pop + B_3Mult + B_4Days + B_6PopDays + \delta O/WC$
- 6)  $\varepsilon(EI) = B_1 + B_2Pop + B_4Days + B_5MI + B_7MIPop + \delta O/WC$



The five Economic Impact per Day models are then shown below:

- 1)  $\left(\frac{EI}{Day}\right) = B_1 + B_2Pop + B_3Mult + B_4MI$
- 2)  $\left(\frac{EI}{Day}\right) = B_1 + B_2Pop + B_3Mult + B_4MI + B_5MIPop$
- 3)  $\left(\frac{EI}{Day}\right) = B_1 + B_2Pop + B_4MI + B_5MIPop$
- 4)  $\left(\frac{EI}{Day}\right) = B_1 + B_2Pop + B_4MI + B_5MIPop + \delta\left(\frac{O}{WC}\right)$
- 5)  $\left(\frac{EI}{Day}\right) = B_1 + B_2Pop + B_3Mult + B_4MI + B_5MIPop + \delta\left(\frac{O}{WC}\right)$

## Results

All OLS regression results are shown in tabular format with parameter estimates and standard errors (in parentheses). Statistical significance is shown at the 1%, 5%, and 10% levels, denoted by (\*\*\*), (\*\*), and (\*), respectively. The first table shown is the binary variable regressions.

### Binary Variables Models

(in millions)	<b>EI 2015 US Dollars</b> <b>(46), R<sup>2</sup> = .45</b>	<b>EI 2015 Per Day</b> <b>(46), R<sup>2</sup> = .51</b>
<b>Intercept</b>	991.55 (2,526.73)	34.77 (97.33)
<b>Independent Study</b>	-11,000*** (3972.69)	-478.07*** (153.02)
<b>US - Based</b>	650.98 (3,156.87)	56.99 (121.60)
<b>Olympics or World Cup</b>	21,200.29*** (4,202.38)	945.42*** (161.87)
<b>Super Bowl</b>	-1246.03 (3,410.85)	-42.94 (131.38)

The two regressions have the Total Economic Impact and Economic Impact per Day as the dependent variables and use four binary variables as the independent variables. Between the intercept and four binaries, only two are significant in both models (the same two). The variable “Independent Study” shows a decrease in Total Economic Impact of over \$11 billion and a decrease in Economic Impact per Day of over \$478 million, both statistically significant at the 1% level. The other variable, Olympics or World Cup, shows an increase of over \$21 billion in Total Economic Impact and of over \$945 million in Economic Impact per Day, statistically significant at the 1% level.

### Total Economic Impact Models

The second table shows the six Total Economic Impact models from the Econometric Methods section. It has various combinations of the four primary independent variables, two interaction variables, and one included binary variable. This was done to examine the strength of different relationships and eliminate noise caused by certain models. It was also used to show significance in both the smaller sample of 23 (that which contained the multiplier) and the larger sample of 44 (that without). These can all be seen below.

EI 2015 US Dollars	R <sup>2</sup> = .82	R <sup>2</sup> = .87	R <sup>2</sup> = .57	R <sup>2</sup> = 0.94	R <sup>2</sup> = .95	R <sup>2</sup> = .67
	Model 1 (23)	Model 2 (23)	Model 3 (44)	Model 4 (23)	Model 5 (23)	Model 6 (44)
<b>Intercept (millions)</b>	-4,005.46 (5,601.09)	4,241.19 (5,769.37)	158.23 (5,688.38)	-7,847.38 (4,740.60)	3,069.35 (2,301.65)	-4,771.25 (5,272.96)
<b>Population</b>	275.37*** (37.36)	10.79 (105.23)	367.73*** (63.53)	421.25*** (115.17)	-62.29 (62.37)	317.63*** (58.49)
<b>Multiplier (millions)</b>	4,332.41** (1,803.40)	3,612.74** (1585914744)		4,435.36*** (1,094.32)	1,669.84* (925.95)	
<b># of Days (millions)</b>	-335.70** (151.68)	-683.95*** (186.10)	-25.53 (123.39)	-210.35 (163.93)	-766.86*** (102.33)	-70.95 (110.67)
<b>Median Income</b>	-35024* (100184)	-88050 (89083)	34278 (103088)	41776 (67003)		115175 (94887)
<b>Cross_Pop_Days</b>		9.62** (3.64)		-0.233 (3.29)	11.89*** (2.19)	
<b>Cross_Median_Population</b>			-0.01*** (0.00)	-0.01*** (0.00)		-0.01*** (0.01)
<b>Olympics_OR_World Cup (millions)</b>					10,451.52*** (1,812.46)	10,463.64*** (3,123.72)

Model 1 is a basic one that includes the four primary independent variables, all of which are statistically significant to some level (not the intercept). Population shows a \$275 increase in Total Economic Impact (TEI) for each person in the population of the economic activity area, statistically significant at the 1% level. Multiplier and Number of Days are both statistically significant at the 5% level. The multiplier, for each .1 point increase, shows an increase in TEI of \$433 million. The number of days actually shows that for each additional day the event goes on, TEI decreases by \$335 million, however this is examined more closely in later models and becomes more intuitive. Median Income also shows a decrease, albeit a \$35,000 per dollar of median income, statistically significant at the 10% level. This relationship is also examined more closely in later models.

Model 2 examines whether there is noise between the Population and Number of Days variables by creating the Cross\_Pop\_Days (CPD) interaction term. In this model, Multiplier increased TEI by \$361 million per .1 increase, statistically significant at the 5% level. Number

of Days was also statistically significant at the 1% level, decreasing TEI by \$683 million per day. However, CPD was statistically significant at the 5% level, and increased TEI by \$9.62 per person per day. This shows a more positive relationship between duration of the event.

Model 3 examines whether there is noise between the Population and Median Income variables by creating the Cross\_Median\_Population (CMP) interaction term. This is the first model to use the full larger sample (44). In this model, Population and CMP were statistically significant at the 1% level (only). Population increased TEI by \$367.73 per person. The CMP, however, showed a decrease of 0.01 per person per dollar of Median Income.

Model 4 combines the previous two models to show the variables all together. Population, Multiplier, and CMP are statistically significant at the 1% level. Population increases TEI by \$421.25 per person and Multiplier increases TEI by \$443 million per .1 multiplier increase. CMP again shows decrease of 0.01 per person per dollar of Median Income.

Model 5 examines how the relationships in Model 2 are affected by the binary variable “Olympics or World Cup” (O/WC). Once again, the Multiplier, Number of Days, and CPD are statistically significant. The Multiplier, at the 10% level, shows an increase in TEI of \$166 million per .1 increase. The Number of Days, at the 1% level, decreases TEI by \$733 million per day. The CPD was also significant at the 1%, increasing TEI by \$11.89 per person per day at the event. Lastly, the O/WC binary was statistically significant at the 1% level, increasing TEI by nearly \$10.5 billion, if an Olympics or World Cup.

Model 6 examines how the relationships in Model 3 are affected by the binary variable O/WC. Again, Population and CMP are statistically significant at the 1% level. Population increases TEI by \$317.63 per person, and CMP decreases TEI by 0.01 per person per dollar of Median Income. O/WC is also statistically significant at the 1% level and increases TEI by almost \$10.5 billion.

### Economic Impact Per Day

In the third and final table (below), the five Economic Impact per Day models from the Econometric Methods are examined. It has various models of the three primary independent variables (as Number of Days has joined the dependent variable), one interaction term, and one binary dependent variable. These models also examine the relationships between the variables, in context of both the smaller and larger sample sizes.

EI 2015 Per Day	R <sup>2</sup> = .70	R <sup>2</sup> = .88	R <sup>2</sup> = .30	R <sup>2</sup> = .90	R <sup>2</sup> = .49
	<b>Model 1 (23)</b>	<b>Model 2 (23)</b>	<b>Model 3 (44)</b>	<b>Model 4 (23)</b>	<b>Model 5 (44)</b>
<b>Intercept (millions)</b>	-293.51 (194.97)	-350.10** (129.90)	171.07 (243.05)	-427.90*** (124.03)	-173.30 (227.94)
<b>Population</b>	6.977*** (1.394)	12.393*** (1.422)	10.47*** (3.25)	10.99*** (1.46)	7.58** (2.91)
<b>Multiplier (millions)</b>	145.98** (67.13)	166.72*** (44.75)		119.78** (46.36)	
<b>Median Income</b>	544.87 (3538.94)	2001.23 (2366.77)	-1197.57 (4891.27)	4433.71* (2440.95)	4192.34 (4445.15)
<b>Cross_Median_Population</b>		-0.0004*** (0.00)	-0.0003** (0.0002)	-0.0003*** (0.00)	-0.0002 (0.0001)
<b>Olympics_OR_World Cup (millions)</b>				228.52** (106.64)	592.00*** (153.98)

Model 1 is the primary model that has the three independent variables regressed against the Economic Impact per Day (EI<sub>pD</sub>). Population and Multiplier are both statistically significant, respectively, at the 1% and 5% levels. Population increases EI<sub>pD</sub> by \$6.98 per person, and the Multiplier increases EI<sub>pD</sub> by \$14.5 million per .1 increase in multiplier.

Model 2 expands upon Model 1 by adding CMP to the regression. In this model, the Intercept, Population, Multiplier, and CMP were all statistically significant. The intercept would be the Economic Impact if all other variables were 0 (impossible, of course, but useful as an estimator). The intercept, statistically significant at the 5% level, would be a negative \$350 million. Population would increase EI<sub>pD</sub> by \$12.39 per person, statistically significant at the 1% level. The Multiplier would increase EI<sub>pD</sub> by \$16.7 million per .1 increase, statistically significant at the 1% level. As in the Total Economic Impact Models, CMP shows a negative relationship with EI<sub>pD</sub>, decreasing it by 0.0004 per person per dollar in Median Income, statistically significant at the 1% level.

Model 3 examines the same relationships in Model 2, but without the Multiplier, expanding the sample size. The Population and the CMP are both statistically significant, respectively, at the 1% and 5% levels. Population increases EI<sub>pD</sub> by \$10.47 per person. CMP again decreases EI<sub>pD</sub> by 0.0003 per person per dollar of Median Income.

Model 4 included all three dependent variables, the interaction term, and the binary dependent variable, and everything was statistically significant at some level. The intercept was statistically significant at the 1% level, and was estimated at a negative \$427 million. The Population increased EI<sub>pD</sub> by \$10.99 per person, significant at the 1% level. The Multiplier increases EI<sub>pD</sub> by nearly \$12 million per .1 increase in multiplier, statistically significant at the 5% level. Median Income was actually significant (10% level) in this model, increasing EI<sub>pD</sub> by \$4433 per dollar of median income. The CMP decreases EI<sub>pD</sub> by 0.0003 per person per dollar of median income, significant at the 1% level. O/WC increases EI<sub>pD</sub> by \$228 million, if the event is an Olympics or World Cup.

Model 5 uses the same variables as Model 4, except it does not include the Multiplier, enlarging the sample size to 44. Only Population and O/WC were statistically significant,

respectively, at the 5% and 1% level. Population increases EIpD by \$7.58 per person and O/WC increases EIpD by \$592 million, when a 1.

### Conclusions and Expansions

The binary variables model showed strong evidence that independent studies have lower economic impacts than government commissioned studies, lending credence to the presence of bias amongst these studies. It also showed that the largest of mega-events, Olympics and World Cups, have outsized proportional economic impacts relative to their measurable statistics. It also could not lend any credence to proving or disproving American exceptionalism or a Super Bowl economic impact mythos.

The Total Economic Impact models yield strong evidence saying the Population in an economic activity area greatly affects the economic impact, \$275 to \$421 per person. It also shows the importance of accurate Multiplier estimation, as .1 increases showed \$166 million to \$433 million increases. The duration of the event, when significant, showed a negative relationship with TEI. However, the Cross\_Pop\_Days interaction term corrected this and showed some evidence that the duration of the mega-event can increase economic impact, a more intuitive relationship. The Median Income in an area did not show much significance (10% once), but the Cross\_Median\_Population did show an interesting relationship. There was an economic impact dampening effect (at the 1% level in several models), that the wealthier and larger the population actually decreased the economic impact.

Parsing the Economic Impact to a Per Day Impact further strengthened the evidence for the relationships in the TEI Models. There was strong evidence that the Population in an area increased EIpD by \$6.97 to \$12.94 a person, a strong positive relationship. Evidence that Multiplier analysis is still crucial showed that per day, a .1 increase could enlarge EIpD by \$12 million to \$16 million. While Median Income by itself again did not have much evidence to support anything one way or another, the economic impact dampening effect (at the 1% level) occurred again, with the wealthier and larger a population, the smaller the EI.

The biggest limitation, and thus the first planned expansion, is enlarging the sample in order to create a more representative sample. While the larger events, Olympics and World Cups, are rather well covered, some of the smaller events and World Championships for smaller events need to have greater representation, preferably with a multiplier variable. Further development might include different geographic binary analysis or a way to develop some insight into the infrastructure improvements made by a government.

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