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The Economic Impact of the Olympic Games: Ex Ante Predictions and Ex Poste Reality

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This article uses data from the 1996 Summer Olympic Games and the 2002 Olympic Winter Games to test the predictions of regional input-output models. Real changes associated with these events are insignificant. Nominal measures of demand overstate demand increases and factor price increases absorb the impact of real increases in demand. Nominal changes appear to be limited to hotel prices. Input-output models of a regional economy are often used to predict the impact of short-duration sporting events. Because I-O models assume constant factor prices and technical coefficients between sectors are calibrated from long-run steady-state relations in the regional economy, the predictions greatly overstate the true impact. Because the predictions of these models are increasingly used to justify public subsidies, understanding these deficiencies is crucial.

During the competition between communities for the right to host a future Olympic Games, politicians and proponents bring forth predictions touting the economic benefits to the region that ultimately wins the right to host the Games. These predictions are used as justification for public subsidies and to help convince voters that it is good business to use scarce tax revenues to secure and promote the Games. Although the winning community will be required to make substantial sacrifices, the promised payoff is so large that the competition between communities is fierce, even resulting in illegal bribes and kickback to Olympic officials empowered to choose the site.[1] However, when the Games are over the host communities are often left with substantial debts and, as we demonstrate below, little or no noticeable benefits. In this article we explore how the predictions are made and what reality shows us. We advocate measuring the impact of past events to ascertain the likely consequence of future events like the Olympic Games, and to avoid predictions based on simulated regional economic models.

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This article focuses on the misapplication of regional input-output (I-O) models to one-time-only events like the Olympic Games that draw huge audiences to a region for a short period of time. Although the demand for regional products used for the event or by its patrons is easy to estimate and the I-O model can quickly produce a host of predictions (often mistakenly called measurements) about the impact of demand changes on the regional economy, it appears that the model's users fail to understand the nature of the application, using a long-run model to predict the consequences of a short-term event. This leads to anomalous results. For example, the Atlanta Olympic Committee touted an I-O study that predicted that the 3-week 1996 Summer Olympic Games would have a spending impact of $5.1 billion and create "over 77-thousand jobs"(Humphreys & Plummer, 1996) even though at the time the entire Atlanta population of 3.5 million persons and its many visitors had never generated a month of retail spending greater than $3.5 billion. Similarly, three days of the 1996 Super Bowl in Phoenix, Arizona was said to generate more than 12,000 full-time jobs and $305.8 million of new spending (Center for Business Research, 1996) roughly equal to the spending of the entire indigenous community for a similar 3-day period. It is the pervasive misuse of I-O models to justify public subsidies for major sporting events that stimulates this research.

The ease and accessibility of computer-driven regional input-output models has spawned a new industry of regional planners and forecasters. For a negligible fee one can lease a fully automated I-O model for a region as small as a county or MSA.[2] The models are so user-friendly that one need only enter data—for example, an anticipated increase in demand for a product of the region—and the model will predict changes in regional sales, taxes, incomes, or employment. Used correctly, these models can be useful tools for planning and policy analysis. The model obscures, however, the underlying assumptions and working principles of the model at the same time it makes using it easy. Couple this with the growing, and profitable, market for impact studies, and you have a recipe for mistakes: one part profit, one part easy economic forecast, and one part naiveté yields a host of economic impact studies that are wholly inaccurate and misleading.

Although the major journals no longer publish impact analyses, many academicians (in addition to myriad private consulting firms) use the common I-O models to perform economic impact studies. A recent search for impact analyses in the academic literature turned up 724 studies published since January 2000. Several authors have critiqued the use of I-O models. For the most part these critiques focus on the model and its assumptions but ignore its application. For example, Mills (1993) points out that the REMI model does not introduce additional taxes, cut existing government services or transfers, or increase government debt in order to finance government investment. As a result of this incomplete modeling of the government sector, the REMI model exaggerates the net public benefit of government investments. Oosterhaven and Stelder (2002) argue that if the total impact of each sector, including the direct, indirect, and induced impact, is calculated using I-O models, "each and every sector is economically more important than its own share in total employment or value added. . . . When the claims of all sectors in an economy are added an (implicit) estimate of the total size of the economy will result that is many times larger than its actual size." Oosterhaven and Stelder suggest a "net multiplier" that does not overstate the sector's importance in the economy. In their empirical examples, the net multipliers tend to be approximately one third smaller than the multipliers derived from common I-O models. Lahr and Stevens (2002) show that the higher levels of aggregation typically found in regional I-O models, together with improper measurement of regional purchase patterns or the region's industrial mix, can lead to errors in impact estimates of approximately 100 percent. Crompton (1995, 2006) discusses eleven common errors in impact studies that contribute to the inaccuracy of impact analysis results. Among these is the misrepresentation of employment multipliers, especially with one-time events, definitions of the impacted area that are inconsistent in a single study, and the omission of opportunity costs in the analyses. When the calibration of the I-O model or the accuracy of its assumptions is imprecise, the model naturally makes inaccurate predictions and measures. When the application is inappropriate, the predictions and measure that flow from the model may bear no resemblance to reality.

There is a growing appreciation for the errors inherent in the I-O model. Dwyer, Forsyth, and Spurr (2006) among others advocate using a Computable General Equilibrium model to assess the impact of events. Such models can incorporate supply constraints, even short-run fixed capital constraints. These models will make better predictions than the standard I-O model described here previously, but, as we argue, are inferior to a postevent, retrospective analysis of what actually happened.

An interesting paper by Baade and Matheson (2002) deserves particular attention for two reasons. First, like this article, it takes a retrospective approach to analyzing the impact of the Games. Baade and Matheson study the employment effects of the Atlanta and Los Angeles Games by comparing the expected growth path of employment in these communities with actual, postevent employment. They find that I-O studies overstate the employment impact and, more importantly, that the impacts are transitory. Second, this article focuses attention on the political aspects of bidding for the games. Rent-seeking in the bidding process is likely to use up some benefits, and configuring infrastructure to meet the requirements of the International Olympic Committee rather than the requirements of the host community implies that the long-run value of infrastructure improvements will be less than anticipated. We differ in our approach by looking for any immediate impact. We seek the footprint the Games left on the host community and draw conclusions from that. If the only evidence of the games is nominal (hotel price increases) with no real increases (hotel occupancy, airport and transportation impacts, real spending), the benefits accrue to resource owners rather than resource suppliers and quickly leave the area.

The article is organized as follows. In Section II, the assumptions behind the I-O model are outlined in order to highlight the real production relations on which the model rests. These contrast with the nominal relations that, in practice, are the only means of implementing the model. The implications of violating these assumptions are made explicit. Section III presents empirical evidence from the 1996 Summer Olympic Games and the 2002 Winter Olympic Games. During each event, factor prices are not constant so that price increases in critical sectors of the regional economy absorb the real impact. Hotel prices rose precipitously, but hotel occupancy, retail trade, and transportation use did not significantly change. Section IV considers how increases in demand are measured. Failing to recognize the consequences of increases in factor prices lead to overestimates of real demand increases. Concluding remarks are made in Section V.

The Role of Real vs. Nominal Spending in Impact Analysis

Economic impact analysis is a prediction of the economic consequences of a change in demand based on the standard input-output model that provides a means of connecting the demands in one sector with the needed supply activities from other sectors. A thorough understanding of the I-O model is not needed for the purposes at hand, so we provide only a cursory exposition, emphasizing its explicit and implicit assumptions regarding the assumed production function, output and input supply functions, and the distinction between physical and money magnitudes (see Miller & Blair, 1985, pp. 6-15).

In practice, impact analysis of an event like the Olympic Games begins with an estimate of the spending the event brings to the local economy. Estimates are made from surveys of attendees or from projections from past events. Care is (or should be) taken to ascertain that the visitors are new to the area and attracted by the event and that the estimates are net of any activity crowded out by the event. That is, estimates of visitor spending for this purpose should represent net new spending attributable to the event. This estimate is called the direct economic impact on the region and is a proxy for the increase in the demand for the region's output.

For a region to respond to real increases in output needed to meet the increase in demand, there must be an associated increase in the employment of factors needed to support and produce the goods demanded by the influx of visitors. That is, if there is an increase in the number of hotel rooms paid for by new visitors, there must be an increase in the amount of bricks, mortar, and labor employed by the hotel industry. Hence, there might be a secondary increase in the demand for factors needed to produce what the visitors purchase. This is called *indirect impact* and is calculated by applying a multiplier obtained from the I-O model to the direct spending increase. Note, however, that if the increase in demand is met with increased prices and not with an increase in output, no new resources are demanded from the regional economy.

There are three critical assumptions employed in the traditional application of input-output analysis to changes in final demand: Production is characterized by a fixed-factor production function, factor supply is perfectly elastic, and leakages from the economy do not vary over time. Fixed-factor production is an assumption about the underlying real economic relation among inputs and the production of output by a region. It treats production like a recipe in which so many units of each input are needed to produce one unit of output and when two (or n) units of output are required one must double (or increase n-fold) the number of each input to accomplish this. Knowing how much bricks, mortar, and labor are embodied in the delivery of one unit of output facilitates the calculation of the multiplier to capture the indirect impact.

Perfectly elastic input supply is a necessary assumption to make the model operational. First, note that expenditures, not quantities, must be used to measure output and input demand. Real measures cause insurmountable data problems. It is true that one can measure the real output of milk in gallons and eggs in dozens, but to connect each item consumed during a typical visitor's stay would require many product definitions and quality distinctions to construct accurate real measures. Consequently, data must be aggregated at some level—like housing, food, and transportation. Aggregation requires a common unit of measurement and I-O analysis relies on nominal expenditures (sales) to measure economic activity in each sector. Then, if a typical hotel room costs $150 per day, an average meal costs $30, and an average cab ride costs $20, a visitor's day that typically requires a hotel room, three meals and two cab rides is measured by the visitor spending $280 in the local economy and is associated in the I-O model with $150 of hotel expenditure, $90 of restaurant purchases, and $40 of cab fares.

Second, the change from real relations that are the theoretical basis for the I-O model to the nominal relations used in practice are valid only if input prices remain constant (i.e., if input supply is perfectly elastic). For example, a $28 million estimate of net new visitor spending associated with an event implies 100,000 visitors, 100,000 one-day hotel room rentals, 300,000 meals, and 200,000 cab rides are to be supplied if prices are constant at the levels in the above example. If the price of a hotel room were to rise during the sampling period to $430, however, a typical visitor's day would cost $560 ($430 + $90 + $40). With these prices, $28 million in visitor spending is associated with only 50,000 visitors, 50,000 hotel days, 150,000 meals, and 100,000 cab rides. Although the real impact on the economy is reduced by half, the model, which was calibrated using prices that exist at all other times, would still interpret the estimate of spending as if there were 100,000 net new visitors, drastically overestimating the indirect impact on the demand for bricks, mortar and labor.

Another critical assumption of the I-O model is that leakages from the local economy remain constant across applications. Leakages occur when inputs are purchased outside the local economy and, therefore, do not stimulate additional indirect local demand. In a competitive hotel market a $150 room supports indirect spending of about $100 for labor, materials, and upkeep that are purchased from the local economy and $50 to pay for capital that is usually acquired from the national (or even international) market and a normal profit for the owner, who need not reside in the region. The model is built on the assumption that about two thirds of the visitor's hotel spending reverberates in the local economy in subsequent rounds of spending. When that same hotel room temporarily rents for $430, however, $330 leaks out of the local economy in the form of debt service and profit and less than one fourth of visitor spending on hotels generates any direct or indirect impact on the local economy.

Finally, consider the internal workings of the I-O model. I-O models are calibrated by surveying firms in the various sectors defined in the model and asking how much they purchase over time from the other sectors of the economy. Combined with the revenues of the firms this information yields measures called technical coefficients. A technical coefficient for the hotel industry would show that for every dollar spent on a hotel room by a visitor, the hotel spent some fraction of a dollar to purchase inputs from the household sector (the technical coefficient of labor in the hotel industry), the construction sector, the energy sector, and so on. Thus, the I-O model is long-run in nature (every input varies with output) and the importance of timing is ignored. When the hotel was built and when the rooms were rented is not critical to the way the model works. If over the functional life of a hotel room it is rented to 10,000 visitors, the model will associate 1 million visitors with the construction spending needed to build a 100-room hotel even when all 1 million visitors came on the same day and could not possibly stay in one hotel. The absence of timing and the long-run nature of the I-O model render the model inappropriate for studying events.

We state formally the maintained hypotheses of impact analysis as follows. H_0:

1. Relative factor prices are constant during the period of analysis.

2. The supply of each factor of production varies proportionately with changes in output demand.

Consider Figure 1 which depicts long-run, steady-state demand for consumption goods in a region and the extraordinary level of demand that is associated with hosting an event like the Olympic Games. Under the maintained hypotheses of impact analysis an increase in output requires a proportional increase in all inputs and, at constant input prices, results in a proportional increase in total cost, keeping average cost constant. Spending in the local economy during normal times is given by area B where output Q_0 sells at price P_0. When there is an increase in demand, the model works as if there were an associated increase in output, wherein all input purchases increase in proportion to the increase in output demand. With event level demand the model simulates the expansion of the regional economy to output level Q_1 and spending for consumption output (direct impact) increases by area $C = P_0(Q_1 - Q_0)$. With real increases in output, which is the only change the model considers, there must be an increase in all the inputs needed to produce it

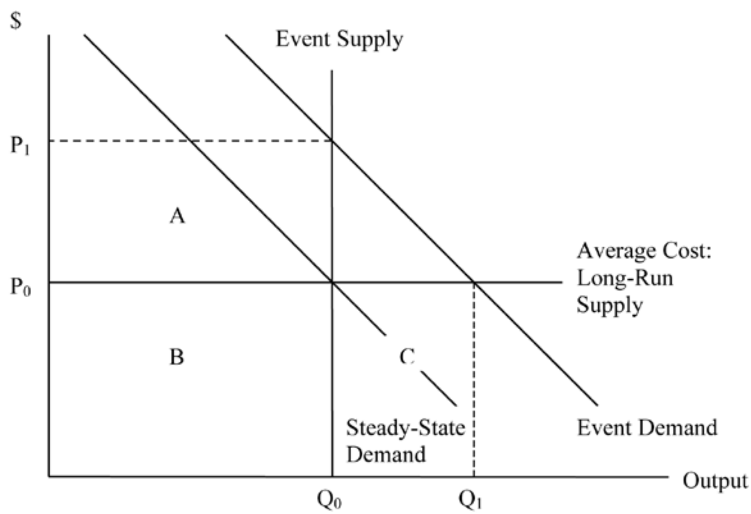

Figure 1 — Nominal vs. real economic impacts.

and the model measures this increase in input demand, the indirect effect, by the application of the multiplier to the direct impact.

In Figure 1, everything below the average cost line represents real changes. Thus, when output increases from Q_0 to Q_1, the region must purchase additional inputs. Everything above the average cost line represents nominal changes. Prices rise but there is no increase in output and no associated increase in inputs. Surveys of visitor spending are assumed to measure area C as net new spending or direct impact. The multiplier is applied to this amount to capture indirect impacts and assumes the steady-state mix of local and extra-regional (leakage) input purchases.

When the assumption of constant prices does not hold, increased spending might result from increased prices and not from real changes in output. This is likely to be the response to temporary increases in demand during the Olympic Games. In Figure 1, the regional economy will have capacity to satisfy steady-state demand at Q_0. With events that increase demand for only a short time, the region's capacity cannot be increased. Fixed production capacity in the short run is represented by the curve labeled "Event Supply" in Figure 1. Here prices rise rather than output increasing, and no real impacts are forthcoming. During the event, visitors buy the same things they usually buy but pay more for it. Surveys of visitors' expenditures that ask how much is spent in the local economy capture area A as net new spending when visitors pay higher prices. Such an increase represents a pure economic profit not associated with any increase in output and accrues to business owners who often do not live in the region. Thus, with no real increase in output there is no indirect impact, and with nationally owned businesses much of the direct impact is outside the region.

Notice that area A is unrelated to area C. When demand is very inelastic, area A can be significantly larger than area C. This means the estimate of the direct spending impact can greatly overstate the increase in demand. Because this nominal estimate of the increase in demand is the value to which the investigator applies the multiplier and because the multiplier is zero when there are no real output changes, estimates forthcoming from the I-O model applied to short-duration events greatly overstate the economic impact of the event. If profits leak to the national economy, the economic impact may be zero.

We state formally the alternative hypotheses of the impact of new nominal spending within the I-O model in the short run as follows.[3]

H_A:

1. The price of at least one factor of production rises.

2. The employment of productive factors and the real output of the region does not change.

Empirical Analysis of the Economic Impact of Olympic Events

We test the null and alternative hypotheses with real and nominal data collected for two Olympic venues: the 1996 Summer Olympic Games in and around Atlanta, Georgia and the 2002 Winter Games in and around Salt Lake City, Utah. Table 1

Table 1 Input-Output Projections of Olympic Impacts

Location	Spending Effects	Tourism Effects	Employment Effects
Atlanta 1996	$5.1 billion	>1 million	77,000 full and part time
Salt Lake City 2002	$4.8 billion	850,000	35,000 full time
Sydney 2000	$6.0 billion	1.6 million	Not given

presents the published results of the traditional application of input-output analysis to both events. The 1996 Summer Olympic Games were said to generate $5.1 billion of spending on regional output: direct expenditures of $2.8 billion and indirect expenditures (re-spending) of $2.3 billion. In addition, the Games were said to attract more than 1,000,000 visitors, and to create 77,000 jobs (Humphreys & Plummer, 1996). The 2002 Winter Olympic Games were said to generate $4.8 billion in economic output and sales, to attract 50,000 net new tourists every day of the Olympic Games (850,000 in 17 days), and create 35,000 job-years of employment. Although we do not have data to test for effects in Australia, similar results are reported by Pricewaterhouse Coopers for the Sydney 2000 Olympic and Paralympic Games, which are said to have generated $6.0 billion of inbound tourist spending from some 1.6 million tourists (Pricewaterhouse Coopers, 2002).

Real data used in this study include hotel occupancy rates and airport traffic measures. Nominal data include hotel room prices. In addition, we use total retail trade and taxable sales, which have elements of real and nominal values. Total retail trade is nominal sales from all sectors of retail trade. It includes, as a small component, the sales of hotel rooms that, under the alternative hypothesis, should be increased substantially as a result of price increases in that component. If hotel capacity is the bottleneck that prevents real expansions of sales in other components of retail trade and this component is small, however, discounting total retail trade by the retail consumer price index should give a real measure of trade that is substantially free of the one period price effects in the hotel industry. We therefore look for changes in real retail trade greater than that measured as nominal increases in the hotel sector as indicative of real effects of the event.

Smith's Travel Services, a supplier of data to the hotel industry, provided us with hotel data. These data include monthly average hotel room prices and occupancy rates for January 1987 to April 1999 for Atlanta and April 1998 to May 2002 for Salt Lake City. We also use monthly retail sales for the Atlanta Metropolitan Statistical Area from January 1986 through December 1996 from the U.S. Census Bureau's Monthly Retail Trade Survey along with the total retail sales for the United States for the same period as a control. Data at the MSA level are available only for selected cities, and Salt Lake City is not among them. Thus, data on taxable sales for Salt Lake City and the greater Salt Lake (Wasatch) area are quarterly and were provided by the Utah State Tax Commission, Economic & Statistical Unit. Data for the other Utah counties are included as controls. We use passenger enplanements to capture airport traffic. These data were secured from the local international airport serving each city. Only annual data on the total number of passengers (enplaned and deplaned) are available for Hartsfield International

Airport in Atlanta, for 1994 to 2001. We divide this number by two to represent enplanements. Salt Lake City Airport and Denver International Airport monthly enplanements are for January 2000 through June 2002. Table 2 presents summary statistics for these variables.

We use ordinary least squares regression with a dummy variable for the period of the Olympic event to judge whether there is a significant change in the dependent variables during the Olympic Games. Prices and sales are adjusted for inflation using the regional Consumer Price Index. When the necessary data are available we include retail sales, hotel occupancy, hotel rates, or enplanement for another location as a control. To reduce bias from measurement error, we use controls from the same data source when possible. Therefore, in the Salt Lake City and Wasatch Region sales regressions, we use sales in the remainder of Utah to control for sales in the affected area. In Atlanta, we use total retail sales in the United States less Atlanta retail sales to control for sales there. For Salt Lake City Airport, we capture trends using data from Denver's airport, a similarly situated Western airport serving a large ski resort area. For hotel variables and for Atlanta's Hartsfield airport, we use time to capture trends. Additional control variables include seasonal or quarter dummies and, when appropriate, a dummy to reflect the effect of terrorism on air travel after September 11, 2001.

The null hypothesis of homoskedasticity is rejected in most of the Atlanta specifications as well as the Salt Lake City sales specifications; we incorporate Huber-White robust standard errors in these regressions. We fail to reject homoskedasticity in the Salt Lake City air traffic and hotel regressions, so these include homoskedasticity-only standard errors. Ramsey RESET tests were performed to determine whether the models are missing important nonlinearities. The Atlanta regressions and Salt Lake City taxable sales regressions include quadratics of the explanatory variables where possible. The RESET test fails to reject the null hypothesis of no omitted nonlinearities in the Salt Lake City air regressions; thus, these models do not incorporate quadratic terms. Models were run in linear, log-linear, and log-log form. The results were robust across specifications, but the linear model offered the best fit; we present these results in Tables 3 and 4. The Atlanta results are reported in 1996 dollars, while the Salt Lake City results are reported in 2002 dollars.

Table 3 presents the results of the various regressions for Atlanta. For the Summer Olympic Games in Atlanta, there were two monthly Olympic dummy variables, one each for July 1996 (two weeks of games) and August 1996 (one week of games) in all regressions but the one for air traffic. As the only air traffic data available are annual, the Olympic dummy is for 1996. Tables 4a, b, and c present the results for Salt Lake City and the Wasatch area. For the Olympic Winter Games hotel regressions, the dummy variable is for February 2002, whereas for the taxable sales regressions it is for the first quarter of 2002.

In each area the estimated effect of the Olympic Games on average hotel rates is large, positive, and statistically significant. In Atlanta the rate increase for the month of August, when there is only one week of the Olympic Games, is half that of the month of July where there are two weeks of the Olympic Games. In both cases, this increase is sufficient to make the monthly average increase in rates significant. Atlanta rates appear to have increased approximately $20 from a base of $46, or 43%, during the Olympic Games.

Table 2a Summary Statistics and Values During Olympic Games: Atlanta and U.S.

Variable	Obs.	Mean	Standard Deviation	Minimum	Maximum	Value During Olympics	
						July	August
Atlanta:							
Real taxable sales	129	2,411.4	319.1	1,820.4	3,653.4	2,861.0	2,972.3
Hotel occupancy	145	64.1	7.3	44.0	79.6	74.1	67.2
Real hotel rates	145	46.0	3.3	37.8	53.7	76.5	60.7
Enplanements	7	34,830,124	5,086,918	27,046,526	35,081,204	31,651,586	
U.S.:							
Real sales	129	185,847	18,314	143,670	243,324	206,128	213,928

Note. Summary statistics are shown for the months (or, for enplanements, years) in which there were no Olympic Games. The number of observations is the number of months or years in which there were no Olympic Games. Monthly data for Atlanta and U.S. taxable sales are from the U.S. Census Bureau's Monthly Retail Sales Survey from 1986 through 1996 and are in thousands of 2002 dollars. Monthly mean hotel room prices are in 2002 dollars and occupancy rates are from Smith Travel Services. Annual enplanements are from Hartsfield International Airport and are total passengers divided by two. Dollar values are adjusted for inflation using the regional CPI.

The Olympic Games occurred in July and August of 2006. There are 126 observations on taxable sales before the Olympic Games and three after the Olympic Games. There are 114 observations on hotel room prices and occupancy rates before the Olympic Games and 31 afterwards. There are two observations on air traffic before the Olympic Games and five afterwards.

Table 2b Summary Statistics and Values During Olympic Games: Salt Lake City and Vicinity

Variable	Obs.	Mean	Standard Deviation	Minimum	Maximum	Value During Olympics
Salt Lake County taxable sales						
Current total	33	3,716,534	371,342	2,848,890	4,267,917	3,754,771
Eating and drinking	33	186,680.4	17,575.7	154,712.1	209,491.6	213,242.4
Hotel	33	56,496.7	8,088.2	42,479.0	80,890.6	107,318.6
Amusements	33	61,641.4	15,065.6	34,206.3	95,481.4	93,815.3
Wasatch region taxable sales						
Current total	33	4,996,918	513,901	3,771,588	5,725,354	5,046,226
Eating and drinking	33	249,531.6	23,038.2	206,249.8	279,682.8	280,825.2
Hotel	33	64,162.0	8,360.6	48,164.5	86,969.4	118,538.9
Amusements	33	80,255.5	14,072.7	50,410.8	110,981.9	110,494.4
Other Utah taxable sales						
General merchandise	33	184,291.4	47,891.0	110,214.0	306,685.1	227,795.2
Eating and drinking	33	115,930.6	14,300.9	88,165.4	137,388.9	134,549.6
Hotel	33	56,343.6	12,042.0	38,155.9	77,446.6	69,832.3
Amusements	33	46,630.5	12,589.9	23,323.0	76,835.2	71,441.7
Salt Lake City						
Real hotel rates	54	41.9	3.6	35.7	51.3	100.3
Hotel occupancy	54	61.4	8.0	44.1	76.3	85.2
Enplanements	29	798.8	97.1	565.6	967.9	681.8
Denver						
Enplanements	29	1,544.2	226.5	983.6	1,913.5	1,251.8

Note. Summary statistics are shown for the quarters or months in which there were no Olympic Games. The number of observations is the number of quarters or months in which there were no Olympic Games. Quarterly taxable sales data are from the Utah State Tax Commission in 2002 dollars. Monthly mean hotel room prices in 2002 dollars and occupancy rates are from Smith Travel Services. Monthly enplanements are from Salt Lake City and Denver International Airports. Dollar values are adjusted for inflation using the regional CPI.

There are 32 observations for taxable sales before the Olympic Games and one afterwards. There are 49 observations for hotel room prices and occupancy rates before the Olympic Games and five afterwards. There are 25 observations for air traffic before the Olympic Games and four afterwards.

Table 3 Regression Results: Atlanta

Variable	Real Taxable Sales	Enplanements	Hotel Room Price	Hotel Occupancy Rate
July Olympics	–63.82[a]		31.60[a]	2.90[a]
	(2.52)		(92.21)	(3.59)
August Olympics	–81.43[a]		15.62[a]	–4.00[a]
	(2.95)		(44.90)	(4.93)
Olympics year		28,670		
		(0.14)		
Real U.S. sales	–0.0052			
	(0.57)			
Real U.S. sales squared	0.0000[b]			
	(2.17)			
Time trend	–11.34[a]	2,306,302[a]	–0.0014[a]	0.1559[a]
	(10.72)	(16.89)	(8.73)	(3.51)
Time trend squared	0.09[a]		0.0000[a]	–0.0007[b]
	(12.30)		(9.53)	(2.33)
9/11 dummy		–5,225,178[a]		
		(7.19)		
Winter dummy	14.80		–0.0081	–5.94[a]
	(0.59)		(1.19)	(3.70)
Spring dummy	–1.20		0.0030	2.27[b]
	(0.05)		(0.85)	(2.24)
Summer dummy	–38.98[b]		–0.0262[a]	4.79[a]
	(2.12)		(6.57)	(4.55)
Intercept	1,816[b]	24,704,010[a]	0.4929[a]	57.36[a]
	(2.07)	(55.08)	(91.50)	(37.72)
Observations	131	8	147	147
Adj. *R* squared	0.94	0.99	0.72	0.43

Note. Absolute *t* statistics in parentheses. The dependent variable is shown in the column heading, and the explanatory variables are shown in the row heading. Taxable sales are in thousands of 1996 dollars and room prices are in 1996 dollars. July (August) Olympics is a dummy variable equaling one if the observation was in July (August) of the Olympic year. 9/11 dummy equals one in September 2001.

[a]Significant at the 99% level; [b]Significant at the 95% level; [c]Significant at the 90% level.

In Salt Lake City, where the Olympic Games lasted 17 days in February, the rates appear to have risen approximately $59.15 from a base of $41.90, or 141%. Hotel occupancy rose slightly in Atlanta (2.9 percentage points) and by more in Salt Lake City (31.6 percentage points) during the Olympic month(s). Both areas typically have excess hotel capacity during these months.

Far from the increase in retail sales predicted by I-O models, retail trade in Atlanta and total retail trade in Salt Lake City and the Wasatch Area fell. There was a statistically insignificant increase in Salt Lake City's eating and drinking taxable sales and a statistically significant increase of $6.6 million in the Wasatch

Table 4a Regression Results: Salt Lake City Taxable Sales

Variable	Current Total	Eating and Drinking	Hotel	Amusements
Olympics	–63,318[b]	3,401	41,048[a]	3,218
	(2.13)	(1.49)	(6.80)	(1.14)
Outside area	1.98[b]	–0.0007	0.0004	0.0002
	(2.59)	(0.95)	(0.39)	(0.74)
Outside area squared	0.0000	0.0000[c]	0.0000	0.0000
	(0.79)	(1.86)	(0.06)	(0.73)
Time trend	10,593	2,572[a]	842[b]	2,004[a]
	(0.65)	(5.86)	(2.08)	(4.68)
Time trend squared	–688.2[a]	–40.10[a]	–15.68	–29.74[a]
	(2.78)	(3.85)	(1.28)	(2.84)
Quarter	–319,771[a]	–13,708[a]	–32,356[a]	–69,380[a]
	(3.79)	(2.96)	(3.30)	(16.35)
Quarter squared	69,052[a]	2,923[a]	5,581[a]	12,032[a]
	(4.85)	(3.11)	(2.72)	(13.87)
Intercept	71,210	217,718[a]	73,117[b]	130,078[a]
	(0.08)	(4.47)	(2.37)	(13.27)
R squared	0.9763	0.9720	0.9027	0.9491

Note. Absolute *t* statistics in parentheses. There are 34 observations, each of which is a quarter from first quarter of 1994 through second quarter of 2002. The dependent variable is taxable sales for each of the items shown in the column heading, in thousands of 2002 dollars. The explanatory variables are shown in the row heading. Olympics is a dummy variable equaling one if the observation was in the first quarter of 2002, the Olympic year. Outside area is the mean value of the taxable sales item in the dependent variable, over the Utah counties not in the Wasatch area.

[a]Significant at the 99% level; [b]Significant at the 95% level; cSignificant at the 90% level

area's eating and drinking taxable sales. There appears to have been no significant increase in airport traffic. Because there are only eight observations on hotel air traffic for Atlanta, our results must be regarded as suggestive rather than definitive. The statistically insignificant result, however, is consistent with the results from Salt Lake City. Although we do not know if people were staying longer (recall that hotel occupancy rates increased), there appears to be no evidence that the Olympic Games attracted more people to the region.

Further Considerations: Estimating Demand

Capacity constraints in the short run and the attendant increase in hotel prices during an Olympic Games are not the only way the use of nominal values distort the impact of short-duration events. Refer to Tables 1 and 2. The 3-week 1996 Summer Games were said to generate $5.1 billion in economic impacts and 77,000 jobs in Atlanta. Were this true, it would be more than twice what the entire population of 3.5 million people living in the Atlanta region spent on retail sales in an average month during 1996, and would have accounted for approximately one in every 20

Table 4b Regression Results: Wasatch Area Taxable Sales

Variable	Current Total	Eating and Drinking	Hotel	Amusements
Olympics	–99,837[b]	6,594[b]	46,659[a]	4,563
	(2.71)	(2.37)	(7.45)	(1.50)
Outside area	2.53b	–0.0014	0.0004	0.0010[a]
	(2.49)	(1.60)	(0.36)	(2.65)
Outside area squared	0.0000	0.0000[b]	0.0000	0.0000[b]
	(0.94)	(2.30)	(0.14)	(2.08)
Time trend	21,852	4,374[a]	840[c]	2,031[a]
	(1.07)	(7.80)	(1.96)	(4.29)
Time trend squared	–898.8[a]	–71.89[a]	–17.02	–29.49[b]
	(2.84)	(5.77)	(1.30)	(2.61)
Quarter	–239,876[b]	–1,473	–26,950[a]	–34,565[a]
	(2.14)	(0.26)	(2.65)	(7.33)
Quarter squared	59,618[a]	600	4,557[b]	5,423[a]
	(3.14)	(0.53)	(2.13)	(5.73)
Intercept	138,571	319,854[a]	74,732[b]	87,384[a]
	(0.12)	(5.20)	(2.21)	(7.32)
R squared	0.9795	0.9780	0.9001	0.9292

Note. Absolute *t* statistics in parentheses. There are 34 observations, each of which is a quarter from first quarter of 1994 through second quarter of 2002. The dependent variable is taxable sales for each of the items shown in the column heading, in thousands of 2002 dollars. The explanatory variables are shown in the row heading. Olympics is a dummy variable equaling one if the observation was in the first quarter of 2002, the Olympic year. Outside area is the mean value of the taxable sales item in the dependent variable, over the Utah counties not in the Wasatch area.

[a]Significant at the 99% level; [b]Significant at the 95% level; [c]Significant at the 90% level

jobs. Similarly, the 17-day 2002 Winter Games were said to have an economic impact 18% greater than taxable spending for the entire Wasatch region in a typical quarter of a year and to create 35,000 full-time jobs. These seemingly impossible results are also a result of price distortions.

Comparisons from Tables 3 and 4 show that Salt Lake City hotel sales increased $46.6 million in the first quarter of the Olympic year. Rates in February increased $59.15 during the Olympic Games from an average base of $41.90. As the Olympic events lasted only 17 days, it is not unreasonable to estimate that hotel prices tripled during the event. The same is true for Atlanta where average monthly prices increased $31.60 for July (two weeks of events) and $15.62 for August (one week of events) from an average of $46. Because the I-O model is calibrated from surveys of expenditures over time when there are no extraordinary events, it attributes an increment of hotel demand equal to, say, $75 (a nominal measure) with one day's room rental (a real measure) and the incremental demand for supporting real inputs that flow from the model. When the price of a hotel room doubles, one day's room rental is reported as $150. Input into the model as an incremental increase in demand, the model interprets this as two day's room rental and doubles the

Table 4c Regression Results: Salt Lake City Air Traffic and Hotel

Variable	Enplanements	Enplanements	Enplanements	Hotel Occupancy	Hotel Room Price
Olympics	−6,982	−35,880	5826	31.22[a]	59.15[a]
	(0.21)	(0.67)	(0.17)	(4.95)	(23.19)
Time trend	−234.76	−2,337[b]	−312.28	−0.14[b]	−0.13[a]
	(0.30)	(2.07)	(0.40)	(2.64)	(6.34)
Winter dummy	18,818	9,639	28,631	1.72	4.18[a]
	(1.13)	(0.34)	(1.60)	(0.72)	(4.33)
Spring dummy	26,742	77,024[b]	33,134	7.73[a]	3.01[a]
	(1.36)	(2.57)	(1.66)	(3.35)	(3.23)
Summer dummy	70,631[b]	192,305[a]	66,724[b]	13.58[a]	0.77
	(2.49)	(6.21)	(2.38)	(5.80)	(0.81)
Denver enplane-ment	0.32a		0.37[a]		
	(6.37)		(6.15)		
9/11 dummy		−51,847	34,316		
		(1.54)	(1.37)		
Intercept	270,737[a]	766,437[a]	192,833[c]	58.95[a]	43.42[a]
	(3.52)	(28.90)	(2.04)	(26.61)	(48.51)
Observa-tions	30	30	30	55	55
Adj. *R* squared	0.9077	0.7686	0.9110	0.5192	0.9225

Note. Absolute *t* statistics in parentheses. The dependent variable is shown in the column heading and the explanatory variables in the row heading. Olympics is a dummy variable equaling one if the observation was in the first quarter of 2002, the Olympic year. Denver enplanements are the number of passenger enplanements at Denver International Airport. 9/11 dummy is equal to one for September through December 2001.

[a]Significant at the 99% level; [b]Significant at the 95% level; [c]Significant at the 90% level

required real inputs associated with what is still only a one-day stay. The model assumes that if one spends twice as much for the same room, it will take twice as many maids to clean it and attributes the extra employment and spending for maids as an economic impact.

Conclusion

Economic impact analysis that relies on the standard input-output model attributes regional output change and, therefore, economic impact to a change in final demand. This is correct only if the input supply curves are perfectly elastic (H_0), a situation that might be approximated for final demand changes of long duration. We have argued that the assumption of perfectly elastic supply curves is incorrect for short-duration activities to which economic impacts are attributed. In those cases in which supply curves are perfectly inelastic (H_A), we have shown that the input-output model will incorrectly attribute economic impacts to final demand changes when, in fact, the impact is solely on prices in one or a few sectors, thereby attributing real economic impact when there is none. We have also shown that for cases in which some supplies are perfectly inelastic and some perfectly elastic, the input-output model will incorrectly attribute economic impact to both kinds of products, thereby overestimating the true economic impact.

In addition, surveys of spending by those who attend the event overstate the real impact of the event by incorporating increases in the price for inelastically supplied final goods in the measure of real incremental demand. For short duration sports events, even events of the magnitude of the Olympic Games, real output, and hence real equilibrium quantity demanded, changes very little. Instead, the brunt of the increase in demand is absorbed by price increase in the sector that is least capable of supply increases, namely the hotel industry. Price increases generate economic profits for resource owners rather than a demand for regional supplies and can be quickly exported. Given the short-term nature of sport events, predictions should be drawn from studying the *ex poste* impact on areas hosting past event and not from application of a long-run, steady state model of the regional economy.

Notes

1. See, for example, CNN (1999) at http://www.cnn.com/US/9901/08/olympic.bribes.03/

2. Descriptions of the model, prices, and a demonstration can be obtained from Regional Economic Models, Inc. (REMI) at www.remi.com. As an indication of its popularity, note the list of clients presently using the REMI model.

3. Because I-O models are based on the assumption of fixed factor production, this is the only alternative when one factor is fixed in the short run. In reality, there is likely to be some input substitution and perhaps some idle resources, so that price increases and real output changes occur simultaneously. How much of either change occurs is the focus of the empirical section that follows.

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