Economics Letters 122 (2014) 268–271

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Olympic Games: No legacy for sports

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HIGHLIGHTS

- We test whether the host advantage in the Summer Olympic Games is lasting or not.
- We employ dynamic panel estimation methods controlling for past performance.
- The problem of endogeneity in the host election is confronted by the use of runner up countries.
- We show that the host effect fades away immediately after hosting.

ARTICLE INFO

Article history:
Received 1 July 2013
Received in revised form
14 November 2013
Accepted 6 December 2013
Available online 12 December 2013

JEL classification:
L83
R53

Keywords:
Olympic Games
Host
Sport success

ABSTRACT

Countries whose cities host the Summer Olympic Games increase significantly their success during the competition. We study whether such effect is lasting or not. We compute the effect of hosting on the total number of medals in the subsequent games. To confront the issue that the selection of the host city is endogenous, we use a natural counterfactual: countries whose cities also bid for the Olympics but were not selected by the International Olympic Committee. In all cases, we find that Olympic success on medals fades away immediately after hosting.

1. Introduction

Economists are skeptical about the economic benefits of mega-events such as the Summer Olympic Games (Baade and Matheson, 2002; Rose and Spiegel, 2012; Billings and Holladay, 2012). An immediate benefit for the country whose city is hosting the games is an increase in its total medal count (Bernard and Busse, 2004; Johnson and Ali, 2004). The question of this paper is about the effect of such sport success on posterior competitions. If games produce a "big push" for sports in a country, then future economic benefits will be derived directly from becoming more competitive[2] and indirectly through health and social indicators associated with sports. Indeed, lasting sport success is a strong argument given in favor of hosting. The Legacy Action Plan for London 2012 promised "*making the UK a world-leading sporting nation*" and "*inspiring a new generation of young people*".

This paper studies the "ex-host effect", defined as the effect of hosting the Summer Olympic Games on the total number of medals in the subsequent games.[3] Does hosting create a positive structural break or the process does reverse to the mean? And in the case of a reversion, how lasting is the effect? Hosting involves an advantage in terms of being local, but it also compromises resources in sport training and facilities, which are likely to have a more permanent effect.

We explore a dynamic panel for all Summer Olympic Games during the post-war period. When we use the standard specification of Bernard and Busse (2004) with reversion to the mean, we

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1 Jose L. Contreras thanks CONICYT (grant 21100122) for financial support.

2 Sport activities generate as much as 3.0% of GDP in OECD countries, being an industry bigger than agriculture and not so far behind manufacturing. In the US, the size of the sports industry was $152 billion in 1995, and supported an additional $259 billion in economic activity (Meek, 1997).

3 Vagenas and Vlachokyriakou (2012) described the ex-host effect as the medal success of countries that at least once hosted a Summer Olympic Game. Unsurprisingly, this effect is positive given that hosts are typically selected among the more competitive countries.

0165-1765/$ – see front matter
http://dx.doi.org/10.1016/j.econlet.2013.12.006

observe that ex-host effects are overestimated in about ten medals by the authors, suggesting that the decay in success is faster than that. In fact, our results indicate that Olympic success on medals fades away immediately after hosting. Additionally, to disregard the possibility of being capturing an effect previous to the hosting, we compare the ex-host effect with total medals before the countries were elected hosts, showing that there is no significant difference between them.

We confront here the issue that the selection of a host city is endogenous. If IOC is more likely to award the games to countries with strong athletic programs that outperform their economic size and population size, then estimation will be biased. We follow the strategy proposed by Rose and Spiegel (2012) and Billings and Holladay (2012), who use as counterfactuals the countries whose cities also bid for the Olympics, but unsuccessfully. In all cases we confirm that the "ex-host effect" is null, that is, there is no legacy for sports in Summer Olympic Games.

2. Data and econometric methods

We study Summer Olympic Games, henceforth the "games", from 1948 to 2012. The election of this period allows comparability with previous works and it provides a large number of countries for each of the games. The base sample is unbalanced since participating nations increased from 59 in 1948 to 204 countries in 2012.

The dependent variable is the total medal count by country, data publicly available from the International Olympic Committee (IOC). Our results are robust to the use of alternative measures of sport success, such as the use of gold medals or the share of medals. The main explanatory variable is "hosting". Cities bid for hosting, and hosts are decided in elections where each non-candidate country casts a vote. For the purposes of our paper, "hosting" takes the value one for the country whose city hosted the event. In the period 1948–2012, 14 countries hosted 17 games, with US, UK and Australia hosting twice.[4] We have also data on unsuccessful bidders for the Olympics, which are natural candidates as counterfactuals of actual hosts.

As for controls, we use log of GDP per capita and log of population, both from Maddison (2003), and a dummy index equal to one if the country was a Socialist regime in 1982. Our results are robust to several other measures of these controls.[5]

The baseline specification is as follows:

$$m_{i,t} = \alpha\, m_{i,t-1} + \gamma_1\, h_{i,t} + \gamma_2\, h_{i,t-1} + \beta\, x_{i,t} + \theta_i + \theta_t + \varepsilon_{i,t}, \qquad (1)$$

where $m_{i,t}$ is the total medal count by country i at the games in period t. Hosting $h_{i,t}$ is equal to one if country i hosted the games in period t and zero otherwise.[6] Parameters θ_t and θ_i are time and country effects respectively, and $\varepsilon_{i,t}$ is a disturbance term, which we assume to be heteroskedastic. Estimation uses robust standard errors clustered by country.

The dynamic specification (1) was studied by Bernard and Busse (2004) with $\gamma_2 = 0$. In that case, the ex-host effect, namely the effect of hosting over the number of medals in the next game, is given by reversion to the mean, i.e. the term $\alpha\,\gamma_1$. We add the term γ_2 to study any additional effect. First, we look for significance in γ_2. Second, we quantify the total ex-host effect as $\alpha\,\gamma_1 + \gamma_2$ and we test whether this term is significantly different from zero or not.[7]

A possible concern about our results is that positive effects on medals emerged even before the hosting period. The election of the host city occurs on average 7 years in advance, and so the countries favored could induce a sporting acceleration in the games previous to being host. To consider this possibility, we control for the pre-trend in medals two periods before hosting. We change specification (1) to a static panel, replacing the lag term by the two dummies $h_{i,t+1}$ and $h_{i,t+2}$ that takes the value one for host one and two periods before hosting, respectively.[8] To suppress the lagged term makes interpretation easier and it does not introduce any change in our results.

The static specification is as follows:

$$m_{i,t} = \gamma_1\, h_{i,t} + \gamma_2\, h_{i,t-1} + \gamma_3\, h_{i,t+1} + \gamma_4\, h_{i,t+2} + \beta\, x_{i,t} + \theta_i + \theta_t + \varepsilon_{i,t}. \qquad (2)$$

In specification (2), $h_{i,t+2}$ accounts for the historical trend of the country and $h_{i,t+1}$ for the effect once it wins the election. The purpose of the exercise is to compare all the dummy coefficients with the historical trend, that is, we provide hypothesis tests for the change of the coefficient compared with $h_{i,t+2}$.

We provide several estimation methods for each specification. First, we consider fixed effects OLS. As the dynamic panel (1) is estimated over a short time period, we also compute the GMM (Arellano and Bond, 1991) estimator using the correction provided by Kiviet (1995).[9] Second, we use a Tobit model in order to confront the issue that a large fraction of countries has no medals in several periods.[10] Our baseline estimator uses pooled regressions with errors clustered by countries. When we move to a fixed effect Tobit estimation, however, the results are inconsistent because of the incidental parameter problem, that is, the fixed effects cannot be omitted through differencing. A practical solution is to parameterize the specific effects, an approach referred as "correlated random effects". For the static case, Chamberlain (1980) proxies the country effects for the average value of the observable independent variables plus a random effect term. Wooldridge (2005) generalizes the method for the dynamic case, adding the initial condition of the lagged dependent variable to the parameterization.[11] Akay (2012) shows that the approximation works well for unbalanced panels of moderately long duration.

3. Baseline results

Table 1 summarizes our results for the specification (1). We provide results for different estimation methods (see description in Table 1), and for that we use the whole sample of countries participating in the games (columns 1–4) as well as a subsample of hosting countries (columns 5–8). The last row provides the p-value for the hypothesis test $\alpha\,\gamma_1 + \gamma_2 = 0$.

Table 1 exhibits two interesting findings. First, we observe that γ_2 is negative and significant in all the regressions, justifying its incorporation. A standard mean reversion model, with $\gamma_2 = 0$,

[4] Since 1960 there could be only one city candidate per country.

[5] We used the Penn World Tables for alternative indicator of GDP and population. Instead of Socialism, we tried Soviet countries, or a time-varying index of Socialism, without change in our results. The inclusion of Policy IV for democracy was also used, but its effect vanishes once we control for Socialism.

[6] Data is every four years.

[7] We use non-linear hypothesis tests where the standard errors are computed through the delta method.

[8] For instance, Mexico City hosted the games in 1968 and the host election was done in 1963. Accordingly, we have $h_{i,t+2}$, $h_{i,t+1}$, $h_{i,t}$ and $h_{i,t-1}$ equal to one in 1960, 1964, 1968 and 1972, respectively, and zero otherwise.

[9] See also, Bun and Kiviet (2003), and Bruno (2005).

[10] Our data is not actually censored but a case called "corner solution" by the literature, a problem that can also be handled by Tobit.

[11] See Benhabib et al. (2013) for the use of these estimators in a panel with similar features. Results also hold for the simpler unconditional FE Tobit that introduces country dummies in the Tobit estimation.

Table 1
Baseline results.

	Sample: All countries				Sample: Hosting countries			
	OLS/FE (1)	GMM (2)	Tobit (3)	CorrRe (4)	OLS/FE (5)	GMM (6)	Tobit (7)	CorrRe (8)
$m_{i,t-1}$	0.550	0.611	0.349	0.252	0.47	0.53	0.64	0.47
	(0.108)	(0.026)	(0.014)	(0.014)	(0.138)	(0.140)	(0.04)	(0.04)
$h_{i,t}$	14.089	14.013	5.518	5.375	14.10	14.02	10.09	10.75
	(2.786)	(1.217)	(1.245)	(0.647)	(2.696)	(2.469)	(2.54)	(1.65)
$h_{i,t-1}$	−5.763	−6.813	−4.160	−3.042	−5.13	−6.09	−7.95	−5.65
	(2.624)	(1.867)	(1.573)	(0.691)	(2.523)	(3.039)	(2.29)	(1.83)
Observations	1253	1107	1253	1253	161	161	161	161
Countries	135	135	135	135	12	12	12	12
	F-test	Chi2	F-test	F-test	F-test	Chi2	F-test	F-test
p-value	0.614	0.291	0.723	0.426	0.659	0.74	0.929	0.951

Note: dependent variable in total medals. Estimators: fixed effect OLS with clustered errors in columns (1) and (5); GMM estimates Arellano–Bond in the first stage and provides the Kiviet correction in the second stage, in columns (2) and (6); Tobit with clustered errors in columns (3) and (7); and correlated RE, in columns (4) and (8), uses the Wooldridge approximation for fixed effects, with mean and initial values not reported. All the Tobit regressions report the marginal effects. Standard errors in parentheses, year dummies and controls (log GDP per capita, Log of Population and Socialist) not reported.

Table 2
Pre-trends in medals.

	Sample: All countries			Sample: Hosting countries		
	OLS/FE (1)	Tobit (2)	CorrRe (3)	OLS/FE (4)	Tobit (5)	CorrRe (6)
$h_{i,t+2}$	3.53	5.02	2.00	3.72	4.78	4.25
	(2.526)	(1.679)	(0.748)	(2.870)	(2.55)	(1.76)
$h_{i,t+1}$	6.23	4.53	2.74	5.36	4.86	5.32
	(2.936)	(1.408)	(0.790)	(2.780)	(2.20)	(1.86)
$h_{i,t}$	20.56	10.99	6.02	19.80	16.94	11.94
	(4.937)	(3.197)	(0.765)	(4.617)	(3.88)	(1.79)
$h_{i,t-1}$	6.77	6.28	2.59	5.77	6.74	4.32
	(3.007)	(1.555)	(0.753)	(2.318)	(2.03)	(1.79)
Observations	1321	1321	1122	157	157	149
Countries	135	135	135	12	12	12
	F-test	F-test	F-test	F-test	F-test	F-test
$(t+1)$						
p-value	0.141	0.336	0.466	0.54	0.95	0.66
(t)						
p-value	0.002	0.001	0.000	0.01	0.00	0.00
$(t-1)$						
p-value	0.351	0.345	0.579	0.61	0.57	0.98

Note: dependent variable in total medals. Estimators: fixed effect OLS with clustered errors in columns (1) and (4); Tobit with clustered errors in columns (2) and (5); and correlated RE, in columns (3) and (6), uses the Chamberlain approximation for fixed effects, with mean values not reported. All the Tobit regressions report the marginal effects. Standard errors in parentheses, year dummies and controls (log GDP per capita, Log of Population and Socialist) not reported.

overestimates the total medals of an ex-host country. Second, we test whether this negative effect is counteracting the positive lagged effect of hosting or not. We observe that in all columns the simple product $\alpha\,\gamma_1$ gives absolute values close to the negative ex-host coefficient γ_2. In fact, the test does not reject the hypothesis that the aggregate effect $\alpha\,\gamma_1+\gamma_2$ is zero, suggesting that the reversion to the mean is immediate.[12]

Next we turn into the issue that sport success may be induced before hosting. The purpose of specification (2) is to compare all the dummy coefficients with the historical trend. Table 2 provides our results. The last three rows in the table describe the p-values for the linear hypothesis test $h_{i,t+1} = h_{i,t+2}$; $h_{i,t} = h_{i,t+2}$; and $h_{i,t-1} = h_{i,t+2}$.

Results in Table 2 confirm that the ex-host effect is null. The p-values do not reject the null hypothesis, but only when the country is local. That is, the host effect is significantly different from the pre-election trend at 1% in all regressions. On the contrary, the effect after the announcement of hosting $h_{i,t+1}$ and the ex-host effect $h_{i,t-1}$ are not significantly different from $h_{i,t+2}$. That is, four years after hosting the games, countries obtain statistically the same number of medals than before being elected as host.[13]

4. Endogeneity

In the previous section, our statistical model compares hosts with non-hosts for every given year. A question that arises immediately is that countries are not randomly chosen to host the Olympics.[14] One way to get at this issue is to compare the medal patterns of host countries with those that bid unsuccessfully for the games (Rose and Spiegel, 2012 and Billings and Holladay, 2012). The IOC elects host cities in several stages: from all applicant cities, the IOC Executive Board selects a number of applicants to be considered candidate cities, and non-candidate members vote to select among them. Our implicit assumption for the use of candidate cities as counterfactuals is that cities that compete for hosting are already self-selected and they are similar in a number of characteristics. As bidders are decided in sequential rounds of voting, we select the counterfactual "bidder" as the country whose city lost the final round against the winner hosting city.

For estimation, we construct the variable bidder similar to the variable host: if a city bids unsuccessfully for hosting the games until the last round, we place a one in that games to the country whose city is bidding. We estimate the specification (2), adding the counterfactual bidder at the same four time periods. Table 3 describes our results. The hypothesis tests provided in the last rows of the table compare coefficients for hosts and bidders in each period, in order to investigate whether there are significant departures or not.

Table 3 exhibits all the coefficients for hosts and bidders at different times. Tests for the periods at $t+2$ and test $t+1$ show that pre-trends are not significantly different between the two groups,[15] which is consistent with the assumption of using bidders as counterfactuals. In the year of hosting, on the contrary, the local country shows a positive and significant effect as compared to the bidders. Finally, the hypothesis that effects are different at $t-1$ is

12 We also check long run effects. In non-reported regressions, we change the dummy $h_{i,t-1}$ for a variable that equals one in all periods after the first hosting event. We confirm that the ex-host effect is null immediately after the games and it does not turn positive into the future.

13 Results in Tables 1 and 2 are robust to the exclusion of boycotted games in 1980 and 1984.

14 Effectively, the data indicates that host cities come mostly from countries with strong Olympic performance.

15 When we estimate for all sample with the "correlated random effects" the test for period $t+1$ is not rejected at 10%.

Table 3
Host and bidders.

	Sample: All countries			Sample: Hosting and bidders countries		
	OLS/FE (1)	Tobit (2)	CorrRe (3)	OLS/FE (4)	Tobit (5)	CorrRe (6)
$h_{i,t+2}$	4.42	4.75	2.18	4.31	6.68	4.48
	(2.539)	(1.684)	(0.752)	(2.781)	(2.94)	(1.73)
$h_{i,t+1}$	5.93	3.87	3.00	5.00	5.97	5.86
	(2.814)	(1.797)	(0.800)	(2.892)	(3.17)	(1.84)
$h_{i,t}$	21.34	11.34	6.50	20.33	19.44	13.02
	(4.808)	(3.122)	(0.770)	(4.680)	(4.67)	(1.74)
$h_{i,t-1}$	8.23	7.59	3.16	6.87	10.58	5.49
	(3.036)	(2.247)	(0.761)	(2.474)	(2.78)	(1.77)
$b_{i,t+2}$	2.50	5.41	1.77	1.75	6.07	3.13
	(5.998)	(1.207)	(0.783)	(5.218)	(2.98)	(1.80)
$b_{i,t+1}$	2.45	5.82	1.05	1.48	6.07	1.84
	(3.084)	(2.412)	(0.816)	(2.536)	(3.10)	(1.89)
$b_{i,t}$	3.01	4.86	1.89	2.89	5.78	3.34
	(3.137)	(1.401)	(0.810)	(2.111)	(1.99)	(1.88)
$b_{i,t-1}$	8.97	9.86	1.72	7.81	13.14	3.05
	(2.761)	(3.687)	(0.797)	(3.401)	(4.55)	(1.87)
Observations	1321	1321	1122	197	197	187
Countries	135	135	135	15	15	15
	F-test	F-test	F-test	F-test	F-test	F-test
$(t+2)$ p-value	0.71	0.63	0.69	0.63	0.86	0.57
$(t+1)$ p-value	0.24	0.21	0.07	0.16	0.97	0.11
(t) p-value	0.00	0.00	0.00	0.00	0.00	0.00
$(t-1)$ p-value	0.85	0.37	0.17	0.82	0.52	0.31

Note: dependent variable in total medals. Estimators: fixed effect OLS with clustered errors in columns (1) and (4); Tobit with clustered errors in columns (2) and (5); and correlated RE, in columns (3) and (6), uses the Chamberlain approximation for fixed effects, with mean values not reported. All the Tobit regressions report the marginal effects. Standard errors in parentheses, year dummies and controls (log GDP per capita, Log of Population and Socialist) not reported.

rejected in all regressions. Once again, we did not find support to the existence of a positive ex-host effect.

These results confirm the previous ones. Olympic hosting countries increase significantly their success in the games, but that effect is not lasting. We compare the ex-host effect with the pre-trend of medals in the country and with the contemporary success of countries that unsuccessfully bid for hosting. In all cases, Olympic success on medals fades away immediately after hosting.

5. Conclusions

This paper shows that host countries of the Olympic Summer Games win significantly more medals than predicted by their size and wealth, but this effect fades away immediately after hosting. The result opens several questions for future research, related to whether the channels through which host countries win additional medals are economic or not. The fleeting nature of the medal count bump suggests that this sort of shock has no transmission mechanism, that is, it may be an athlete fans effect rather than an investment of resources effect.

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