Determinants of Participation and Success at the Earlier Modern Olympic Games

By Gerard Kuper and Elmer Sterken

Introduction

In the modern era, Olympic success is increasingly seen in terms of winning medals. This attitude has informed the sports policies of a majority of national governments.[1] Athletes are trained and supported in many ways to achieve the ultimate goal of winning Olympic medals and are mostly professional. The extensive qualification procedures mean that athletes are subjected to a rigorous selection process. Nowadays in most cases there are no financial obstacles or pressures on time to constrain the ability to participate. The key determinants of success are talent, perseverance, and luck. Matters were very different at the start of the modern Olympic Games in 1896 when Olympic Games was an elitist event, mostly for men.[2]

In the early years of the modern Olympic Games (1896-1936) there were no strict qualification barriers and professionalism was discouraged. Participation was not only driven by talent, but also by financial conditions, home economic conditions, Olympic traditions and the opportunity to travel long distances. Success was conditional on participation because obviously you needed to participate in order to be able to win. We thus debate the Olympic creed that "…the important thing in the Olympic Games is not so much the winning but the taking part, just as the important thing in life is not so much to conquer but the struggle".[3] In fact there is a strong argument that simply taking part enhanced the possibility of success in the period before the Second World War.

Both in the early years and the more recent celebrations of the modern Olympic Games participation is a key determinant of success, but the areas in which participation affects success are different. In the early years participation depended on the involvement of the relevant National Olympic Committee, economic conditions at home, the size of the population, and the distance to be travelled. Transportation costs were high, both in monetary terms and in the investment of time needed to travel to the Games. Participation remains a key determinant of success to this day[4] but for completely different reasons. Travelling costs have decreased dramatically since the first half of the 20th century, and global economic conditions have improved. Olympic involvement is now almost global, given the number of countries present which take part in the Olympic Games in the modern day. Rigorous selection and qualification procedures now turn participation into a core determinant of Olympic success. The arguments have changed, but participation still is a basis for success.

In what follows we analyze participation and success at the early Olympic Games of the modern era. Our goal is to investigate the role of key determinants such as population size, per capita income, distance travelled to the Games and home advantage in determining participation and success. We make a distinction between female and male participation and success, and we analyze Summer Games and Winter Games separately. Analyzing female participation and success acknowledges the increase in female participation at the Olympics. Not only has the number of sports available to female competitors increased, also the number of female athletes has also grown over time. The distinction between Summer Games and Winter Games is relevant, because of the differences in the program and the composition of participating nations. Because we separate the Winter Games from the Summer Games, we have divided some of the events held at Olympic Games before the first Winter Games held in Chamonix in 1924 into winter and summer events. More background information is given in the following sections.

We present an econometric analysis of the role of economic and geographic conditions in explaining participation and success at the pre-World War II Olympic Games. The main reason why studies of the Olympic Games up to now have only studied events after the Second World War is the alleged lack of data on historical economic development. We use the historical database developed by Maddison,[6] and are the first to apply this unique dataset to analyze Olympic participation and success. We hypothesize that economic conditions had greater relevance before World War II than in recent times. Richer countries have been better able to gather relevant Olympic information, to train athletes, and to cover travel costs. Before we discuss the methodology, the data and the econometric models, we first give an overview of related work. We also present basic insight into the institutions of the early editions of the Olympic Games. We summarize our main findings in the last section.

Literature

The Olympic Games seriously interact with economic and political developments for various reasons. Firstly, in the early editions of the Games, economic conditions rather than athletic qualities determined participation. At the end of the 19th century sports was the exclusive preserve of wealthier people who

came from developed nations. Secondly, the Games have been used to stimulate nationalistic sentiments (the major example being the 1936 Berlin Summer Games). Thirdly, it may be argued that organizing large scale sporting events, like the Olympic Games, lead to significant economic benefits. National success at the Games may even lead to higher rates of economic growth by raising consumer and producer confidence.[7]

Our aim is to analyze participation and success at the pre-War Olympic Summer and Winter Games. For the post-War games sociologists and economists have analyzed the impact of social and economic conditions on the outcomes of the Olympic Games competition. Earlier examples are Ball, Levine, and Grimes et al..[8] More recently Shughart et al. focuses on transitional economies while Johnson and Ali and Bernard and Busse analyze recent editions of the Games with a focus on prediction Olympic success.[9] This literature shows that in post-War Games factors such as income per capita, home advantage and whether the country had a socialist/communist tradition all had a major impact on success achieved at the Games. According to these studies a higher income allows for labor specialization, gives better opportunities to train athletes, to send a larger group to the Games, etc. Home advantage allows a nation to send a bigger team. The rules allow them to have more competitors and the host nation is able to participate in the majority of events. They also benefit from greater crowd support during the Games. Post-War studies estimate the home country advantage to be about two percentage points in terms of medal share.[10] After World War II both professionalization of sports in the Western world and the communist tradition helped to create a professional sports environment and to increase labor division even further. The communist system is estimated to have an even greater impact leading to a three percentage points increase in medal share.

The question is to what extent do the pre-War editions of the Games differ from the more recent ones? An answer might relate to the nature of competition. In the early Games competition in most events was not fierce.[11] Participation had as great an importance as winning. The wealthier countries in particular (sometimes represented by 'wealthy' athletes) participated and collected medals. Gradually winning became more important and competition increased. A second answer may be found in politics. The Olympic Games were not generally used for nationalistic propaganda or as a political tool and were not subject to boycotts up to and including Los Angeles 1932. The single exception in pre-War games is Berlin 1936.These Games were heavily politicized by Nazi Germany. From that day the focal point of attention moved from individual success to national success. A third answer to our question, and perhaps the most important one, is increased globalization of participation and competition through improvement of global economic conditions after World War II.

Official Poster of the last Winter Olympic Games before the War

Beforehand the Olympic Games had a more local atmosphere, which rendered geographic determinants of participation more important. A fourth answer may be found in professionalism. The early Summer Games were largely organized for amateur sportsmen. After the War some socialist countries sent competitors that had prepared in a "professional" manner and after 1988, professional sportsmen were at last, officially allowed to participate. A final element is that pre -War Games were not affected by drug abuse, a problem which afflicted Games in the post-War period, mainly because drugs were not outlawed until 1967.

Data sources

We have applied econometric models to quantify and identify determinants of Olympic participation and Olympic success. We have used the data set developed by the International Society of Olympic Historians (supplied by W.J. Mallon) for the information on participant numbers (male and female) and the numbers of sports per nation at each celebration of the Games. We included 59 countries in our total sample. These 59 countries sent athletes to the first 11 Modern Olympic Games, including the 1906 Intercalated Games in Athens. Of these 59, 32 sent athletes to the Winter Games, including the winter sports events held at the 1908 and 1920 Summer Games. There are six Olympic Winter Games in total in the sample. For consistency, we have included Bohemia as part of

the Czech Republic, Crete as part of Greece, Serbia as Yugoslavia, and Smyrna with Turkey, although these countries participated in some Games under their own name. Koreans participated as members of the Japanese team in 1932 and 1936, and we have considered those athletes to be Japanese. Table 1 presents an overview of the number of male and female participants and the number of sports events at the pre-World War II Olympic Summer and Winter Games. In the next section we discuss in detail the development of the Olympic Games.

For data on medal winnings we rely on Wallechinsky and Loucky.[12] If needed, we include data from the official website of the IOC.[13] Although gold, silver and bronze medals were not awarded until 1904, in the database, we award medals to the top three finishers. As Wallechinsky and Loucky describe, it is not completely straightforward which events are reported in the medal tallies. We do not want to enter this debate and follow Wallechinsky and Loucky's publications. However, note that up to and including the 1912 edition of the Games some medals were handed over to teams that consisted of athletes from various countries. Another problem is the medal split of the mixed events. In sailing, tennis, and figure skating mixed events were and still are common. For tennis and figure skating we have been able to split the medal winnings accordingly.

As an indicator for the level of income in a country level we use Maddison's data on Gross Domestic Product (GDP) per capita.[14] Maddison presents consistent data of GDP and population from the year 1 to 2008 AD for a large number of countries. The period considered begins three years prior to the Games and includes the year in which the Games are held. We use the same source to get data on total population per country. This is supplemented with data from the 'Populstat'

Table 1 – *Overview of the Olympic Summer and Winter Games*

Year	Site	Men	Women	Total	Events Men	Events Women	Mixed Events
1896	Athens	246	0	246	43	0	0
1900	Paris	1,591	22	1,613	70	2	0
1904	St. Louis	643	6	649	92	2	0
1906	Athens	834	6	840	72	1	0
1908	London - Total	1,979	44	2,023	96	3	1
	London (Summer)	1,965	37	2,002	95	2	0
	London (Winter)	14	7	21	1	1	1
1912	Stockholm	2,324	53	2,377	91	5	0
1920	Antwerp - Total	2,585	77	2,662	130	7	1
	Antwerp (Summer)	2,511	65	2,576	128	6	0
	Antwerp (Winter)	74	12	86	2	1	1
1924	Paris	2,931	135	3,066	112	10	0
1924	Chamonix	278	13	291	9	1	1
1928	Amsterdam	2,597	274	2,871	92	14	0
1928	St. Moritz	591	77	668	8	1	1
1932	Los Angeles	1,203	126	1,329	99	14	0
1932	Lake Placid	231	21	252	7	1	1
1936	Berlin	3,626	329	3,955	110	15	0
1936	Garmisch-Partenkirchen	588	80	668	8	2	1

website.[15] Again we take averages over three years prior to and including the year the Games are held.

The impact of geographical factors is also analyzed. The distance to be travelled by participating nations had an impact on the cost of getting to the Games. More specifically, we have used data on the latitude and longitude of the capital cities of the relevant countries. As an approximation we use latitude and longitude of the capital instead of the cities where the Games are organized. In general this approximation is satisfactory for small countries. But this holds also for Games organized in for instance the USA; it was as expensive for Europeans to participate in the St Louis Games as it was to travel to the Games in Los Angeles. So it would have been if the Games had been organised in Washington. Similarly for the Antwerp Games we use latitude and longitude data for Brussels and have applied the similar principles to Winter Games`, thus for Chamonix, we have taken the Paris coordinates and so on. We have used the "Haversine formula", to compute the distance between two capital cities as "the crow flies". This formula gives the shortest distance between two points on a sphere from their longitudes and latitudes. The geographical data is drawn from the CEPII website.[16]

The Modern Olympic Games before World War II

Since 1896 the modern Olympic Games have shown an increase participants and nations. The number of events grew from 43 in Athens 1896 to over a hundred at the Berlin Summer Games of 1936. This is illustrated in Table 1. In the first Games of the Modern era, 13 countries participated in 43 events with 246 participants of which the vast majority were Greek. In Berlin 1936 almost four thousand athletes from 49 countries competed in 129 events. Table 1 also illustrates that female participation was rather low (less than ten per cent). There were few events open to women in those early years and it might also be due to the rather modest degree of emancipation in those years. Table 1 also shows that when the Olympic Games, summer and winter, were staged in the United States, they attracted fewer participants. This may be an indication that the cost of travelling and therefore the distance to the Games, restricted Olympic participation. It should be noted that the first officially recognised Olympic Winter Games took place in Chamonix in 1924; winter sports were held at the 1908 and 1920 Games. In London figure skating was part of the programme and to this was added Ice Hockey in 1920. This is also shown in Table 1.

Only Australia, USA, Great Britain, France, Greece, Italy and Switzerland participated in the first eleven celebrations of the Olympic Summer Games. Of the 59 countries who took part, 42 won at least one medal at the Summer Games. The so-called "big seven" (USA, Great Britain, France, Sweden, Germany, Finland and Italy) won almost 70 percent of all the medals and sent just over half of the participants. In total 21,524 athletes went to the Games in this period. Average participation productivity – or the percentages of medals won per participant – at the Summer Games was about 5 percent for men and about 7.5 percent for women.

In the Olympic Winter Games until Garmisch-Partenkirchen, 32 countries participated at least once. Only Great Britain, Sweden and the USA took part on every occasion. Of the 32 countries that took part over this period only 14 won at least one medal. The "big four" in this case were Norway, Finland, Sweden and the USA and between them sent a quarter of the total competitors but won almost won 65 percent of the medals. Average participation productivity at the Winter Games was about 3.5 for men and 5.5 percent for women. Table 2 presents an overview of the average medal productivity data for both the Summer and Winter Games per country. According to this table all Russian participants won gold. In fact only one Russian athlete participated in a winter event in the period 1908–1936: Nikolai Panin (1872–1956) won the gold medal in men's special figures in figure skating in 1908 in London. Table 2 also shows that Cuba sent athletes who were very successful with one gold medal for every three male athletes on average. American athletes were also very successful, especially their women. The medals won by Greek women were all in the tennis events at the Intercalated Games of 1906 in Athens.

One of the determinants of participation and success is the wealth of nations. As an approximation we have used real per capita GDP. Table 3 presents an indication of cross country differences in average based on capita GDP earnings over the years 1896–1936. In this period these differences remain fairly constant. Table 3 shows that the Anglo-Saxon countries were relatively wealthy, followed by the other Western European nations and those from Scandinavia. The countries that ranked highest at the Olympics were also the wealthiest. The same holds true if we rank countries based on success at the Olympics. This indicates the relevance of per capita income in explaining participation and success.

Another determinant of Olympic success might be home advantage. Home advantage leads to a larger participation at the Olympic Games, and larger home crowds may stimulate success. Home competitors might have better awareness of conditions and were sometimes thought to have received the benefit of the doubt from officials and judges. Balmer et al. (2001) presented evidence of significant home advantage in the Winter Olympic Games especially in those events judges assessed performance (e.g., skating) home competitors performed better.[17] Table 4 shows how the participation of home teams and the success that they enjoyed. It demonstrates that in the early years of

	Men			Women		
Country	Gold	Silver	Bronze	Gold	Silver	Bronze
Argentina	3.7	3.3	2.5	0.0	100.0	0.0
Australia	7.6	3.2	10.0	13.3	20.0	0.0
Austria	3.1	5.4	4.6	2.4	0.0	4.8
Belgium	2.5	3.1	2.9	0.0	0.0	0.0
Brazil	0.7	0.7	0.7	0.0	0.0	0.0
Canada	3.9	4.3	6.7	4.8	7.1	9.5
Chile	0.0	0.9	0.0	0.0	0.0	0.0
Cuba	33.4	7.1	0.0			
Czechoslovakia	1.3	2.9	2.7	0.0	5.0	5.0
Denmark	1.7	4.3	3.2	4.4	4.4	6.7
Egypt	3.1	2.7	2.3			
Estonia	5.7	5.7	8.5			
Finland	9.9	8.9	9.6	0.0	0.0	0.0
France	3.8	4.2	3.6	2.4	2.4	1.2
Germany	6.7	7.1	6.5	5.9	10.6	11.8
Great Britain	5.9	6.4	4.9	5.5	11.5	10.3
Greece	2.7	4.7	4.6	14.3	14.3	14.3
Haiti	0.0	7.7	7.7			
Hungary	4.9	4.3	4.0	5.1	0.0	5.1
India	3.7	0.0	0.0	0.0	0.0	0.0
Ireland	4.0	0.0	0.0	0.0	0.0	0.0
Italy	6.1	4.3	3.8	2.9	2.9	0.0
Japan	4.5	4.5	4.5	2.9	2.9	0.0
Latvia	0.0	2.7	1.3	0.0	0.0	0.0
Luxembourg	0.6	0.6	0.0	0.0	0.0	0.0
Mexico	0.0	1.3	2.7	0.0	0.0	0.0
Netherlands	1.9	2.1	3.6	10.7	9.3	0.0
New Zealand	5.0	2.2	8.9	0.0	0.0	0.0
Norway	3.9	3.3	3.8	0.0	11.1	11.1
Philippines	0.0	0.0	12.2			
Poland	0.4	2.5	3.7	10.0	0.0	10.0
Portugal	0.0	0.0	2.9			
Romania	0.0	0.9	0.9	0.0	0.0	0.0
Russia	0.5	2.2	3.3	0.0	0.0	0.0
South Africa	7.2	5.4	2.4	0.0	0.0	22.2
Spain	0.8	1.0	0.4	0.0	0.0	0.0
Sweden	6.0	6.5	7.4	2.9	1.4	11.4
Switzerland	4.6	5.8	5.6	0.0	0.0	0.0
Turkey	1.0	1.0	1.9	0.0	0.0	0.0
United States	13.4	10.4	10.0	24.2	16.1	14.9
Uruguay	2.5	0.0	1.3			
Yugoslavia	1.8	1.2	1.8	0.0	0.0	0.0

Table 2 – Panel A: *Average medal productivity Olympic Summer Games 1896-1936 calculated as the percentage medal winnings per participant (blank: country is not participating)*

	Men			Women		
Country	Gold	Silver	Bronze	Gold	Silver	Bronze
Austria	2.7	3.3	2.7	8.3	16.7	2.8
Belgium	0.0	0.0	2.6	0.0	0.0	0.0
Canada	4.0	2.0	5.1	0.0	0.0	0.0
Finland	13.9	10.7	13.1	16.7	16.7	0.0
France	0.8	0.0	1.3	16.7	0.0	8.3
Great Britain	1.0	2.6	5.2	3.7	5.6	11.1
Germany	2.8	2.8	2.8	7.1	7.1	0.0
Hungary	0.0	0.0	3.7	0.0	0.0	20.0
Norway	21.0	26.5	22.2	21.4	3.6	0.0
Russia	100.0	0.0	0.0			
Switzerland	1.7	2.6	1.7	0.0	0.0	0.0
Sweden	7.1	6.3	3.6	20.0	20.0	20.0
Czechoslovakia	0.0	0.0	1.9	0.0	0.0	0.0
United States	6.3	5.3	3.1	0.0	7.1	14.3

TOP: **Table 2 – Panel B:** *Average medal productivity Olympic Winter Games: 1908-1936 calculated as the percentage medal winnings per participant (blank: country is not participating)*

	Summer Games			
	Gold	Silver	Bronze	Participation
Greece	17.0 (0.2)	28.1 (0.3)	33.8 (0.2)	53.8 (1.1)
France	18.0 (7.6)	26.2 (6.9)	19.8 (6.7)	38.3 (6.2)
USA	57.3 (24.3)	58.7 (16.2)	57.8 (14.7)	51.0 (7.2)
Great Britain	50.9 (7.2)	48.1 (9.3)	36.8 (7.7)	36.2 (6.3)
Sweden	22.8 (5.5)	23.1 (6.2)	16.3 (9.2)	18.7 (4.9)
Belgium	8.4 (1.5)	7.5 (2.3)	8.1 (2.1)	12.5 (3.4)
Netherlands	5.5 (1.7)	8.3 (1.5)	3.7 (2.6)	7.5 (3.3)
Germany	25.4 (6.1)	20.3 (7.7)	23.1 (6.2)	8.8 (6.0)
	Winter Games			
	Gold	Silver	Bronze	Participation
Great Britain	25 (1.5)	50 (3.1)	75 (12.9)	52.4 (7.6)
Belgium	0 (0)	0 (0)	0 (3.5)	10.5 (4.4)
France	0 (3.5)	0 (0)	7.1 (1.4)	14.8 (6.5)
Switzerland	0 (3.3)	0 (4.7)	6.7 (1.8)	8.8 (7.2)
USA	42.9 (5.5)	28.6 (12.3)	14.3 (11.1)	25.4 (8.3)
Germany	17.6 (8.3)	17.6 (8.3)	0 (7.0)	8.2 (10.6)

Table 4 – *Home advantage: medal and participation shares (percentages). The figures are medal and participation shares for the country that hosted the event. Between brackets is the corresponding figure for the average medal and participation shares if the country did not host the event.*

Country	Income
United States	4,963
New Zealand	4,764
United Kingdom	4,724
Australia	4,596
Switzerland	4,344
Belgium	4,020
Netherlands	4,002
Denmark	3,730
Canada	3,622
Argentina	3,469
France	3,219
Germany	3,176
Austria	2,973
Sweden	2,846
Uruguay	2,839
Ireland	2,691
Chile	2,533
Norway	2,341
Italy	2,330
Czechoslovakia	2,186
Spain	2,015
Hungary	2,011
Finland	1,934
Greece	1,814
Costa Rica	1,629
Poland	1,625
Mexico	1,608
South Africa	1,602
Japan	1,477
Cuba	1,467
Russia	1,430
Romania	1,375
Portugal	1,306
Bulgaria	1,217
Colombia	1,205
Yugoslavia	1,089
Peru	1,080
Turkey	1,052
Philippines	1,036
Iran	1,000
Egypt	902
Brazil	845
India	655
China	554

Table 3 – *Average real GDP per capita (Maddison definition) over the period 1896-1936*

both the Olympic Summer and Winter Games home advantage played a serious role. When the Games were organized in the USA, home advantage seemed to matter even more. However, home advantage may be correlated with other variables. If the richer and larger countries were host countries, population and real income per head added to the home advantage to some extent. In the case of the USA it might also have been due to geographical distance to the Games that few European fans attended.

Modeling Olympic Participation

We have used econometric models to explain variation in the dependent variables (participation and success) through variations in the explanatory variables. These explanatory variables have to be independent to avoid the so-called endogeneity bias. Success is modeled conditional on participation arguing that participation may be based on expected success. To cope with endogeneity we required instrumental variables (IV) estimator to estimate success. But other motives might also have played a role. Examples are national pride and politics. Since we considered the results on a national basis and not by individuals, a strategy to model success conditional on participation seems to be the appropriate one. So, we first considered participation. Then, we looked at Olympic performance in terms of medal share for gold, silver and bronze. Performance is modeled conditional on participation. We estimated the model in a combined time-series cross-section form, and we used the fixed-effects estimator to account for unobserved differences between countries or time periods.

We present simple models that explain participation and success at national level. There are various reasons to consider these from a national perspective rather than to take individual or event cases. First, the impact of income cannot be measured on an individual level. Second, modeling at the individual or event cases is more susceptible to measurement errors. Thirdly, success is discussed mostly on a national basis.

The determinants for national Olympic participation are demographic (population), economic (income per head), and geographic (distance to the host country) in nature. Also home advantage may determine participation. The choice for these determinants for participation is motivated in earlier sections. These variables also may explain Olympic success. Distance to the Games translates into travelling costs, which could also be considered as an economic component. The main argument why economic welfare is important in explaining Olympic welfare is division of labor. If a country becomes wealthier, specialization of labor input is allowed and individuals can make a living out of their specialist sports, which gives them competitive advantages. In nineteenth-century England the concept of amateurism developed as a means of preventing the working classes from competing with the aristocracy. Wealthy people did not need to worry about making a living and could use their leisure time to take part in sports. Working people had to give up training time in order to make a living, or else take money for sports success. By excluding professional sportsmen from Olympic Games competition, the aristocracy guaranteed their own success. This process developed in the early part of the 20th century. De Coubertin tried to circumvent this process by asking wealthy people to support working-class athletes. Despite that, we can conclude that income was an important determinant of Olympic participation and success. The amateur rules were 'adapted' by some of the socialist countries in the 1950s. They practiced 'State Amateurism.' Summarizing, income per capita of a country is, or may be, an important determinant of participation and success at the Olympic Games.

Participation

The dependent variable is p_{it}, which represents the fraction in percentages of athletes at game t from country i from the total number of participating athletes. Modeling in shares avoids problems of nonstationarity. Let p_{it} be the absolute potential number of athletes delegated by country i. Suppose now that each world citizen has an equal probability to become a top athlete. In that case p_{it} will be dependent on the size of the total population of a country at the time of the t^{th} edition of the Olympic Games N_{it}. There are several valid arguments why Olympic participation is not proportional to the absolute size of the population. Suppose we have a stochastic series $X_1,\ldots, X_T$ which is identical independently standard normal distributed with mean zero and unit variance. The expected value of the supremum X_{sup} of all possible outcomes is of order $(\log T)^{1/2}$.[18] So it is likely that the maximum performing individual of a population of size N_{it} will be of the order $(\log N_{it})^{1/2}$. In our model we use population shares n_{it} and we approximate $\log (1+n_{it})$ with n_{it} (first-order Taylor series approximation). So, the participation share p_{it} will be determined by the square root of the population share n_{it}.

Next, we assume that income per capita Y_t will determine the training, access to training facilities, and health conditions of the potential athletes. We expect the population share and income per capita to have a positive effect on participation. The potential share of athletes p_{it} is also affected by the home advantage and the geographical distance to the Games. The home advantage H_{it} is a dummy variable (1 if country i host the Games t, and 0 in other cases). Home countries are allowed to send more athletes. We measure the distance to the Games D_{it} as "the crow flies." This leads to the following specification:

$$p_{it} = c_1 n_{it}^{1/2} + c_2 Y_{it} + c_3 H_{it} + c_4 D_{it} + c_t + e_{it}, \qquad (1)$$

	Summer Games			Winter Games		
	Total	Women	Men	Total	Women	Men
n 1/2	1.400	3.107	1.364	1.780	4.210	1.505
	(0.371)	(1.024)	(0.372)	(0.597)	(1.026)	(0.841)
Y/1000	0.857	1.784	0.814	0.731	0.859	0.696
	(0.172)	(0.546)	(0.175)	(0.183)	(0.481)	(0.178)
D/1000	-0.256	-0.215	-0.254	-0.463	-0.877	-0.391
	(0.044)	(0.090)	(0.044)	(0.152)	(0.374)	(0.112)
H	23.059	21.179	22.736	9.474	2.276	9.575
	(8.512)	(7.581)	(8.544)	(5.059)	(4.865)	(4.951)
R2	0.527	0.780	0.517	0.597	0.597	0.573
Countries	40	33	40	26	18	26
Observations	252	112	252	89	54	89

Table 5 – *Participation at the Olympic Games with fixed effects for events (White cross-sectional corrected standard errors are in brackets).*

Dependent variable: the percentage participation share p.

Explanatory variables: H = 1 if a country hosts the Olympic Games, else 0;
Y = GDP per capita of a country;
n = country population share of the world population;
D = distance from the capital of the host country to the capital ofthe participating country.

Summer Games	Total	Women	Men						
	Gold	Silver	Bronze	Gold	Silver	Bronze	Gold	Silver	Bronze
p	0.554	0.667	0.723	0.563	1.017	1.369	0.494	0.632	0.739
	(0.200)	(0.228)	(0.199)	(0.659)	(0.553)	(0.718)	(0.264)	(0.269)	(0.197)
Y/1000	-0.226	-0.066	0.057	1.449	3.249	1.216	-0.398	-0.197	0.199
	(0.322)	(0.157)	(0.316)	(3.365)	(2.698)	(3.091)	(0.312)	(0.156)	(0.306)
H	7.009	7.069	2.237	4.971	-6.260	-35.794	7.786	7.557	1.635
	(6.846)	(5.297)	(5.861)	(22.980)	(18.462)	(29.776)	(7.037)	(5.780)	(6.160)
R2	0.867	0.912	0.852	0.775	0.826	0.580	0.859	0.898	0.841
Countries	40	40	40	33	33	33	40	40	40
Observations	252	252	252	112	112	112	252	252	252
Winter Games	Total	Women	Men						
	Gold	Silver	Bronze	Gold	Silver	Bronze	Gold	Silver	Bronze
p	1.171	1.172	1.376	0.985	0.821	1.479	1.195	0.916	1.771
	(0.336)	(0.501)	(0.229)	(0.542)	(0.778)	(0.563)	(0.531)	(0.637)	(0.386)
Y/1000	3.490	3.141	3.037	3.460	3.708	17.250	4.345	2.169	3.002
	(1.127)	(1.710)	(1.821)	(4.255)	(2.702)	(6.698)	(1.950)	(1.739)	(2.087)
H	-3.781	-3.266	-6.179	2.513	-5.398	18.030	-7.173	2.750	-14.024
	(8.254)	(7.654)	(4.830)	(10.624)	(10.534)	(3.125)	(13.009)	(7.108)	(5.644)
R2	0.560	0.813	0.731	0.336	0.411	0.624	0.450	0.766	0.624
Countries	26	26	26	18	18	18	26	26	26
Observations	89	89	89	54	54	54	89	89	89

Table 6 – *Medal counts for the Olympic Games with country-specific fixed effects (White cross-sectional corrected standard errors are in brackets).*

Dependent variable: percentage medal share om (m=G, S, B,)

Explanatory variables: pe = estimated participation share of athletes sent by a country;
H = 1 if a country hosts the Olympic Games, else 0;
Y = GDP per capita of a country.

Instruments: H = 1 if a country hosts the Olympic Games, else 0;
Y/1000 = GDP per capita of a country (rescaled);
D/1000 = distance from the capital of the host country to the capial of the participating country;
n = country population share of the world population;

where e_{it} is a white noise residual and c_t are the event specific fixed effects. These represent factors that change over time but are the same across countries. The event specific effects allows for the analysis of so-called time-to-build effects. If a country wants to participate with a large number of athletes this probably requires more than four years of training and acquiring experience, so that it will be likely that the previous participation share will explain the current one. Table 5 presents the estimated results of the participation model without reporting the event-specific fixed effects. The sample of Summer Olympic Games (11 Games) included 40 countries for men and 33 countries for women. The sample for the Winter Games (six Games) is smaller: The number of countries for men and women are 26 and 18 countries respectively. For both the Winter Games and the Summer Games we applied the same period fixed effects model. We scaled income and distance, but this did not affect the results. The results were:

i) Population size has a positive effect on participation: For a country that is 100 times bigger, the participates shares are 14 percentage points higher for the Summer Games and 18 percentage points higher for the Winter Games. The effect of population size for female participation is higher than for male participation.

ii) Income also has a positive effect on participation at the Olympic Games: If real GDP per capita increases by 100 US dollars participation increases by 8.6 percentage points and 7.3 percentage points for the Summer Games and Winter Games, respectively. Changes in income affect female participation more significantly, except for the Winter Games.

iii) The distance from the home country to the Olympic host nation had a detrimental effect on participantion numbers particularly especially for the Winter Games. The impact on female participation at the Winter Games was greater than for men.

iv) Home advantage is significant and has the expected positive effect: organizing Summer Games results in an increase in participation of about 23 percentage points. The impact on the Winter Games is much smaller (9.5 percentage points), but this is only significant at 10%. There is no significant impact of the home advantage on male participation at the Winter Games.

A final note is that the results are more reliable for the Summer Games because of the bigger sample size. The measure of fit (R^2) indicates that between 52% and 78% of the variation of participation is explained by the determinants in the model.

Success

In this paper, we modeled national Olympic participation as a function of income per capita, population, distance to the games and some country specific factors. Now we considered Olympic success in terms of winning medals. We took the national shares in medal totals o_m. We separated the medals by type: gold, silver, and bronze. Since participation is endogenous we use the estimated participation results from the previous section. As we illustrate below the data reveals that national medal success is dependent on participation.

We have modelled the share of medals (gold, silver, and bronze) at the Olympic Games o_m, with *m* = Gold, Silver, and Bronze, as a function of the participation share, income per capita and the home advantage:

$$o_{mit} = c_1 p_{it} + c_2 Y_{it} + c_3 H_{it} + c_i + e_{it}, \quad m = G, S, B, \qquad (2)$$

where e_{it} is a white noise residual. The country specific effects c_i represent factors that are constant over time but differ across countries. Countries that were successful at one Games probably carried their success over into the next Games as well.

Table 6 presents the results for the model with country-specific fixed effects for the Olympic Summer and Winter (these fixed effects are not reported). We model medal success conditional on the set of variables that explain participation using two-stage least squares. The main results are:

i) Success for both the Summer Games and the Winter Games is mainly driven by participation: one percentage point higher participation leads to about 0.6-0.7 percentage points more medals. For women we found only a weak effect of participation on winning silver and bronze medals.

ii) Income and home advantage do not affect success directly, except for the Winter Games were we find a direct effect for winning gold medals, and a weak effect (10% significance level) for winning silver medals. Gender differences are diverse: Men from wealthier countries win more gold medals, while women win more bronze medals.

iii) Home advantage is shown to be significant for winning bronze medals. Note that men win fewer bronze medals and women win more bronze through the home advantage effect. However, home advantage also affects success via participation.

Summary and conclusion

We modeled both participation and success at the pre-World War II editions of the Olympic Summer and Winter Games. We made a distinction between these and participation and success of both female and male athletes. Our main objective was to establish the core determinants of participation, and conditional on that medal success. Our paper illustrates that participation

is key to medal success. This has established for post War Games by other authors[19] and we have confirmed this was also the case for early Olympic Games. Participation nowadays is basically determined by selection procedures; during the early editions of the Modern Olympic Games real income mattered more.

Our paper has discovered the impact of demographic, economic and geographical conditions on participation and medal winning success at Olympic Games in the pre-war years. We have found that population size, real per capita income, distance to the hosting country, and the home advantage are the core determinants of both participation and success. Success was mainly determined by participation, and income, distance and the home advantage effect success mainly indirectly via participation.

Our paper illustrates a couple of developments. Firstly, larger, richer countries were able to dominate the Olympic Games during their first 40 years of existence. These countries sent athletes to the Olympic Summer and Winter Games and our findings illustrate that participation is key to success. Secondly, the same countries were also able to send female participants to the growing portfolio of women's events in the period of review. Because female medal productivity has been relatively high, this finding contributed to medal success. Thirdly, we have demonstrated that home advantage is important to participation. The fact that for instance the USA had very high participation and medal share in 1904 and at the Winter and Summer Games in 1932 is because distance mattered to foreign participants. Home advantage, the effect of the home crowd, knowledge of local conditions and even the possibility of 'hometown decisions' by officials impact of judges, were key factors in pre-War Games just as they have continued to be post 1945.

Notes

1 See e.g.: HILL, Christopher R.: *Olympic Politics: Athens to Atlanta 1896-1996*. Manchester 1996.

2 WALLECHINSKY, David & LOUCKY, Jamie: *The Complete Book of the Summer Olympics, Beijing 2008 Edition*. Aurum 2008.

3 YOUNG, David C.: "On The Source of the Olympic Credo", in: OLYMPIKA: *The International Journal of Olympic Studies*, 8(1994), 17-25.

4 JOHNSON, Daniel K.N. & ALI, Ayfer: "A tale of two seasons: participation and medal counts at the summer and winter Olympics", in: *Social Science Quarterly*, 85(2004), 974-993.

5 WALLECHINSKY & LOUCKY: *The Complete*, 2008

6 MADDISON, Agnus: *Contours of the World Economy: 1-2030 AD.* Oxford 2007.

MADDISON, Agnus: *Statistics on World Population, GDP and Per Capita GDP, 1-2008 AD*. Groningen 2010.

7 STERKEN, Elmar: "Growth Impact of Major Sporting Events", in: *European Sport Management Quarterly*, 6(2006), 375-389.

8 BALL, Donald W.: "Olympic Games Competition: Structural Correlates of National Success", in: *International Journal of Comparative Sociology*, 15(1972), 186-200.

LEVINE, Ned: "Why do Countries Win Olympic Medals? Some Structural Correlates of Olympic Games Success: 1972", in: *Sociology and Social Research,* 58(1974), 353-360.

GRIMES, A. Ray, KELLY, William J. & RUBIN, Paul H.: "A Socioeconomic Model of National Olympic Success", in: *Social Science Quarterly*, 55(1974), 777-782.

9 SHUGHART, William F. & TOLLISON, Robert D.: "Going for the Gold: Property Rights and Athletic Effort in Transitional Economies", in: *Kyklos*, 46(1993), 263-272.

JOHNSON & ALI: "A tale"

BERNARD, Andrew B. & BUSSE, Meghan R.: "Who Wins the Olympic Games: Economic Development and Medal Totals", in: *Review of Economics and Statistics,* 86(2004), 413-417.

10 See: COURNEYA, Kerry S. & CARRON, Albert V.: "Home Advantage in Sport Competitions: A Literature Review", in: *Journal of Sport and Exercise Psychology*, 14(1992), 13-27.

NEVILLE, Alan M. & HOLDER, Roger L.: "Home Advantage in Sport: An Overview of Studies on the Advantage of Playing at Home", in: *Sports Medicine*, 28(1999), 221-236.

11 WALLECHINSKY & LOUCKY: *The Complete,* 2008

12 WALLECHINSKY, David & LOUCKY, Jamie: *The Complete Book of the Winter Olympics, Turin 2006 Edition*. Wilmington, Del 2006.

WALLECHINSKY & LOUCKY: *The Complete*, 2008

13 See: www.olympic.org

14 MADDISON: *Statistics.*

15 See: www.populstat.info

16 See: www.cepii.fr/

17 BALMER, Nigel J., NEVILLE, Alan M. &WILLIAMS, Mark: "Home Advantage in the Winter Olympics: 1908-1998", in: *Journal of Sports Sciences*, 19(2001), 129-139.

18 REISS, Rolf-Dieter: *Approximate Distributions of Order Statistics*. Berlin 1989.

19 JOHNSON & ALI: "A tale"