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Popularity and visibility appraisals to compute improved Olympic medal rankings

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Abstract:	The ranking of countries in Olympic Games generates a great deal of interest among analysists, academics, and fans. This paper proposes an innovative approach to provide Olympic medals (gold, silver, and bronze) with different weights based on metrics of popularity and media visibility and create an alternative historical ranking. The analysis uses "Google Trends" and "Merit" appraisals to capture contents and news articles in the Internet that relates to the different types of metals. Figures on weekly relative search intensity in Google and contents in the Internet registered monthly, are used to track changes over time and thus to control for differences between Summer and Winter Olympic Games. The results show that gold medals gather far more attention than silver and bronze medals. By applying the estimated multiplying factors, we create an alternative historical ranking of countries that shows some relevant changes. The use of weights based on popularity and visibility has managerial implications and open new avenues for future research.

Popularity and visibility appraisals to compute improved Olympic medal rankings

1. Introduction

Evaluating the performance of countries in international sports events, such as the Olympic Games or the World Athletics Championships, is a major point of discussion among sports analysts, academics, and the general public. The current system to rank countries in the Olympic Games has been criticised due to the lack of appropriate weights to account for the type of metals and disciplines (Churilov & Flitman, 2006; del Corral et al., 2017; Lozano et al., 2002; Zhang et al., 2009; del Corral et al., 2017).

This paper proposes an innovative method to assess the achievements of countries in the Olympic Games and compute an alternative ranking. We propose two metrics based on media visibility and popularity to control for the relevance of the prizes (gold, silver, and bronze) and the differences between Summer and Winter Olympic Games. Our approach takes advantage of all the available information on the Internet, which has become the most important global tool to inform, influence, interact, and inspire others (Curran & Hesmondhalgh, 2019), also in sports (Korzynski & Paniagua, 2016).

"*If it is not on Google, it does not exist*." This statement by Jimmy Wales, co-founder of Wikipedia, represents the running gig of a generation that massively absorbs news and contents. On the Internet, sports fans can access international events results, updates, comments, posts, and discussions that often involve peers from around the globe. The Olympic Games are among the most relevant international sport events, where countries historically fight to obtain the maximum number of medals in the different disciplines, enhancing national pride (Grix & Carmichael, 2012; Van Hilvoorde et al., 2010).

The International Olympic Committee (IOC) elaborates the ranking of countries according to a winner-takes-it-all system that prioritizes the metal of the medals.[1] The gold-first ranking counts the number of gold medals to set up the table. If there are countries with the same number of gold medals, the number of silver medals is then counted to line up the countries and, if still needed, bronze medals go next. Prior research is often critical with this system and points towards several shortcomings.

First, under the current criterion, a country that only achieves one gold medal (and zero medals of either silver or bronze) will be ranked ahead of another country with zero gold medals and many silver and/or bronze medals. Therefore, several studies provide weights to the number of medals e.g., 3-gold; 2-silver; 1-bronze or 1-gold; 1-silver; 1-bronze, to measure success in the Olympics and elaborate alternative rankings (Churilov & Flitman, 2006; Lozano et al., 2002; Zhang et al., 2009). Second, the official rankings would be

[1] As stated in the Olympic Charter, the International Olympic Committee (IOC) provides the medal table for information only and does not aim to officially recognize winners. However, this table is used globally to assess the performance of countries and discuss the results in the media, Internet, and other platforms.

improved if accounting for differences between individual and team disciplines when measuring the level of success (del Corral et al., 2017).

Beyond the genuine concerns that research shares about the weights of medals, the impact that the disciplines have on the Internet and social media is yet to be considered.[2] By relying on appraisals of the general interest of fans, journalists and the general public, we provide the medals with different weights, even if the disciplines involve the same number of individuals; extending previous contributions to the literature (del Corral et al., 2017). We advocate that a more scientific criterion to define the appropriate weights may be based on the degree of attention granted to the different types of medals (gold, silver, and bronze), and distinguishing also between the Summer and Winter Olympic Games.

First, we present different metrics counting the number of online references and news that can be used to provide gold, silver, and bronze Olympic medals with different weights. Second, we use one of these metrics, i.e., Google Trends Web, to associate the different types of medals with weights based on their popularity and to create an alternative historical ranking that includes all previous Olympics Games. The underlying rationale behind this new way of ranking countries implies that medals that attract larger shares of attention must be given a greater value.

The rest of the paper is organized as follow. Section 2 reviews the related literature that deals with weights to Olympic medals. Then, Section 3 presents the data and explains in detail the methodology, while Section 4 shows the results, discusses the findings, and compares our ranking with the traditional measures of medal weights. Finally, Section 5 summarizes the main findings and describes some prospective results obtained when allowing for a distinctive treatment to be given to the different sport disciplines.

2. Literature Review

A number of papers use data on Olympic Games' medals (and their rankings) to analyse a variety of topics. For instance, del Corral et al. (2017) provide a detailed literature review and classify the research studies into two categories. First, papers that try to identify and measure the influence of a variety of factors, like population or GDP, on the countries' success in the Olympics. Secondly, a growing body of literature in which the aim is to evaluate the relative efficiencies of the nations that participate in the Olympic Games.

In addition to GDP and population, researchers explored other factors related to sport success in the Olympic Games, including welfare (Den Butter & Van Der Tak, 1995); socio-economic factors (Condon et al, 1999); ex-host effect (Hoffman et al, 2002); specialization (Tcha & Pershin, 2003); weather and climate conditions (Hoffman et al 2004; Johnson & Ali, 2004); number of athletes (Moosa & Smith, 2004); political regimes (Bernard & Busse, 2004; Rathke & Woitek, 2007); poverty and income distribution (Mitchell & Stewart,

[2] Rogers and Anagnostopoulos (2016) pioneer the idea of using the Internet to measure the interest of the different countries in the Olympics, sports, and healthy habits to create alternative tables.

2007); education and cultural traits (Andreff et al., 2008; Lui & Sen, 2008); public spending on recreation (Forrest et al. 2010); other macroeconomic indicators (Vagenas & Vlachokyriakou, 2012); infrastructures (Andreff, 2013); regional socioeconomic factors (Otamendi & Doncel, 2014); prior performance (Celik & Gius, 2014); geographic situation (Noland & Stahler, 2016), and income and host effect (Forrest et al., 2016) among others. Bernard & Busse (2004) compared the methodologies used to predict wins distribution of Olympics medals, concluding that the Tobit model was the better econometric strategy. Since then, a number of studies (Andreff et al., 2008; Forrest et al., 2010; Scelles et al., 2020, among others) estimate Tobit models to forecast national medal wins distribution.[3] More recently, Humphreys et al. (2018) estimate the willingness to pay for medals (obtained in the 2010 Winter Olympic Games) to evaluate the effectiveness of subsidies granted by the Canadian Government to athletes.

Furthermore, in the attempt for designing an objective system to rank countries' performance in the Olympic Games, nonparametric data envelopment analysis models (DEA) have become increasingly used to evaluate the relative efficiencies of participating nations (Lozano et al., 2002; Churilov & Flitman, 2006; Jablonsky, 2018). Besides, limitations inherent to conventional DEA models were addressed. Several DEA extension tools that allow refining the results and provide a number of complementary ways to achieve more reliable efficiency measures of Olympics success were developed (Lins et al., 2003; Churilov & Flitman, 2006; Li et al., 2008; Soares de Mello et al., 2008; Zhang et al. 2009; Wu et al., 2009 and 2010; Chiang et al., 2011; Benicio et al., 2013; Azzizi & Wang, 2013; Lei et al., 2015; Li et al., 2015).

Apart from the above-mentioned studies on efficiency, based on both conventional and modified DEA models, some attempts were made to estimate frontier production functions using parametric methods. In this context, Rathke & Woitek (2008) adopt a stochastic frontier analysis to isolate the effect of the different preferences (relative importance paid to sports in general or to certain disciplines where countries want to specialize themselves) on performance differences in the Olympic Games.

The papers typically use as a "proxy" variable of output efficiency, the number of medals (equivalent to assuming equal weights: 1-gold; 1-silver; 1-bronze or the weighted number of medals, where the most popular weights are: 3-gold; 2-silver; 1-bronze (Churilov & Flitman, 2006; Lozano et al., 2002; Zhang et al., 2009). Nevertheless, the shortcomings of these two systems are notorious. First, by simply counting the number of medals, we must assume that a gold medal is worth the same than a silver or bronze medal. Second

[3] Forrest et al. (2016) perform a comprehensive empirical study by estimating random effects Tobit models on data for 6 editions of the Olympic Games (1992–2012) and across 15 sport disciplines. They develop a disaggregate analysis of individual sports in the Olympic Games, to investigate if the number of medals of certain disciplines are more intensively affected than others by income or by hosting effect.

the weighted average calculation (3-gold; 2-silver; 1-bronze) might be an improvement but it does rely on arbitrary weights.[4]

Until recently, researchers did not start to calculate weights using different criteria by discipline and type of medal. Sitarz (2012) applies a more theoretical method based on the weighted mean value, where gold, silver and bronze are given weights: 11, 5 and 2, respectively. In this line, we propose to use the information available on the internet to calculate the weights of medals based on popularity and visibility.

3. Data Description and Methodological Approaches

In this paper we claim that the degree of interest in Olympic Games can be accurately measured by the intensity with which sports' fans look for contents in the Internet (as captured by Merit) or in the Google search engine (Google Trends).

On the one hand, to provide the different types of Olympic medals with weights, we adopt two approaches that may be alternative or complementary: Merit Estimations (ME) and Google Trends (GT). On the other hand, each of the approaches, either ME or GT, can be applied for measuring the degree of: (i) media visibility and (ii) popularity. We actually claim that the former aspect is accurately captured through the amount of news articles (News); while the latter can be approximated by counting the number of general contents in Internet or Google searches (Web).

Given the variety of available metrics and approaches, we benefit from the possibility of selecting or combining them for appraising the degree of interest shown by people to the Olympic medals.[5] In the empirical analyses, we propose using ME(News) and GT(News) as proxies for measuring the degree of visibility in the media; and ME(Web) and GT(Web) to evaluate popularity levels attached to each type of Olympic medal. In the following lines we give a more detailed description on these aspects.

3.1. Merit (ME) versus Google Trends (GT) Approach

We now describe how the two alternative (complementary) aforementioned approaches work. The first method follows the lines developed by MERIT (*Methodology for the Evaluation and Rating of Intangible Talent*), which computed appraisals based on popularity levels and degree of visibility in the media from the information reflected in the Internet.

[4] To our knowledge, del Corral et al. (2017) was pioneer in introducing in the medals' weighting procedure not only the metal, but also the number of participants involved in winning the respective medal; thereby implying that a basketball medal will receive greater value than medals of individual disciplines.

[5] Both approaches, Merit and Google Trends, allow the users to refine the searches by limiting them to the number of general searches (Web) or to the number of news articles (News). The implications of including different types of contents might be relevant for our analysis.

To obtain the raw data, we first define the appropriate search strings, using as keywords: “Olympics” OR “Olympic Games”; AND either: “gold medal”, or “silver medal”, or “bronze medal”. We claim that the number of internet searches and the content available are an accurate approximation of the interest that followers have in the Olympic Games. This information will allow us to establish differences among the different types of metals (gold, silver, and bronze) and weight also the disparities in the results for Summer and Winter Olympic Games. More detailed information on the MERIT approach is available at the home web page: www.meritsocialvalue.com

The second method relies on the comparative intensity with which Google users look for information in the Google searching engine. This approach, denoted as GT in this paper, yields similar – although not identical – results, and it is also useful for producing accurate assessments of Olympic Games’ achievements. In this case, the raw data delivered by Google Trends is always expressed with respect to a top reference value of 100, conveying values that range between 0 and 100 points. Actually, using normalised data is suitable for comparing the intensity with which Google users search for the contents (Cf.: Choi et al., 2012). Specifically, we registered weekly figures on relative search intensity for each type of metal, i.e., gold, silver, and bronze, which enable us to track changes over time.

Notice that, in processing the information, we rely merely on counting either the number of mentions or news articles, paying no attention to the actual content of the news articles or web pages found in the Internet or reported by Google. Even if Internet contents only represent part of the sport events’ visibility, the outstanding development of new media technologies and worldwide information access provide us with comparable measures of global attention.

3.2. Media Visibility versus Popularity

Once the two main approaches are described, it is time to introduce the two types of useful metrics we obtain from them. Later in this paper, the four resulting combinations will be used for evaluating the degree of attention drawn by the Olympic medals.

First, media visibility scores, aiming at measuring the degree of attention paid to each type of Olympic medal, are approximated by the relative number of news articles found either on the Internet or Google.

In the former case, MERIT appraisals are calculated by searching strings of keywords, in the way we exposed earlier. Actually, ME(News) comprises news articles from online journals and newspapers, as well as from a wide variety of media that pour their information into the Internet. In this case, we limit our search to news articles that mention each type of Olympic medal: gold, silver and bronze. Remind that ME(News) scores are calculated from relative numbers of news articles and, since they are based on

their comparative positioning, there is no need to account for the level of diffusion of the media or websites where the sport events are recalled. The latter approach, GT(News), aspires measuring the same aspect, but relying on the number of articles' searches made by users of the Google searching tool; expressed with respect to 100, in the way it was already explained.

Second, the metrics based on general contents and searches are meant to reflect the accumulated level of popularity associated to sport events or disciplines. To approximate the popularity levels, we look at the relative number of times that Olympic medals are mentioned on the Internet, ME(Web); or searched in Google, GT(Web). Again, the metrics obtained from the former approach, ME(Web), are the result of collecting the number of references made to each type of medal in a given period of time. The general interest of people is then measured through comparing the relative number of contents found in websites worldwide. Instead, the figures obtained from the latter approach, GT(Web), correspond to the number of Web searches – for the period 2010 to 2018 – delivered by Google Trends in the usual scale: with respect to a maximum reference value of 100. To download the information, we limited the periods in a way that the outcomes were given on weekly bases, which will permit a more refined analysis of the changes over time.

4. Results and Discussion

This section describes the procedures to calculate the different weights that, based on the different methods proposed here, should be given to the gold, silver and bronze metals; and to Summer and Winter Olympic medals. For the sake of robustness, we use several alternative approaches. More importantly, a variety of analysis and results are compared in order to select the most consistent approach with which to accomplish the simulation exercise of an alternative Olympics' ranking by countries.

4.1. Multiplying factors

As we mentioned already, the weights are calculated through applying two methods that produce four different metrics: ME(News), GT(News), ME(Web), and GT(Web).

Regardless of the chosen approach to obtain the weights that must be attached to each type of metal, we calculate the multiplying factors in a consistent way. Thus, the fact of comparing absolute values, like in the Merit approach, or values expressed relative to 100, like in Google Trends, is indifferent. In all four approaches what matters is obtaining the multiplying factor of one type of medals with respect to the reference group: bronze medals in our case. The resulting factors are then used as the weights for computing the improved ranking of countries.

In this section, we report the multiplying factors, or weights, attached to each of the three metal types of the medals awarded in the Olympic Games. While all metrics show the expected results (gold medals are more valuable than silver and bronze medals; and

silver medals more valuable than bronze medals) the factors across methods display no significant discrepancies except in one case.

Each of the four metrics registers figures for the three types of metals for every year. First, we sum up the results to obtain a value that reflects the interest for the complete period (2010-2018). Next, we divide the average interest value of gold by the average interest value of silver to create the multiplying factor. Columns (1), (2), (3), and (4) of Table 1 show the results of, respectively, ME(Web), GT(Web), ME(News), and GT(News).

Alike in the MERIT approach, we perform calculations separately to measure popularity, as captured through Google Trends, GT(Web); and media visibility, GT(News). Figures from Google Trends inform about the relative intensity of Google users when they search for either general contents, GT(Web) or news articles, GT(News).

Table 1. Multiplying Factor - Gold and Silver w.r.t. Bronze

	Popularity			**Visitibility**		
	MERIT Contents ME(Web)	Google Trends Web GT(Web)	**Average WEB**	MERIT Articles ME(News)	Google Trends News GT(News)	**Average NEWS**
	(1)	(2)	(1+2) / 2	(3)	(4)	(3+4) / 2
Gold w.r.t. Bronze	12.11	9.82	**10.97**	2.97	7.74	**5.36**
Silver w.r.t. Bronze	3.83	1.21	**2.52**	1.31	1.44	**1.38**
Bronze w.r.t. Bronze	1.00	1.00	**1.00**	1.00	1.00	**1.00**
Gold w.r.t. Silver	3.16	8.35	**5.63**	2.27	5.37	**3.82**

Firstly, our results support the current IOC ("winner takes it all") system, which concedes gold medals a radically decisive role in ranking the countries. Indeed, the prevalence of gold medals, relative to silver and bronze medals, is consistent with the empirical evidence concerning the degree of attention paid to each medal by the public. We find higher levels of interests for gold medals in all four metrics. For example, people show about ten-fold times more interest in gold than bronze medals; a figure that ranges between 9.8 to 12.1 depending whether one relies, respectively, on the number of searches made in Google – column (2) – or on the amount of Internet contents – column (1). We also find that the differences between silver and bronze medals are significantly smaller. However, the value of ME(News) is much lower, which demands conducting further analyses to understand the discrepancies found, especially concerning the results on the number of news articles registered by Google Trend, GT(News).

In any case, the last analysis suggests that the results obtained from figures based on Web metrics are more reliable and consistent than those obtained from News. Besides

and more importantly, popularity – rather than visibility – seems to be the right approach to be adopted for computing our new improved ranking of the countries' historical sport achievements in Olympic Games.(Appendix 2 reports information on all the Olympic Games since they started in 1896 in Athens).

4.2. Alternative ranking based on the Google Trends Web approach

Before we proceed to elaborate the historical ranking of Olympic medals, there is another important feature to be accounted for: measuring the discrepancies between medals obtained in Summer versus Winter Olympic Games.

We initially compute four alternative metrics to address the task of calculating the weights that should be attached to each type of Olympic medal. Nonetheless, only the two approaches related to Web contents are apropos for computing an historical ranking, since they collect the cumulative figures on popularity status, rather than constraining the outcomes to just News articles. Moreover, between the two methods based on Web figures – namely, ME(Web) and GT(Web) – the latter is preferred, since it allows for a more detailed examination over time. Table 2 summarizes the main results obtained for the period under analysis.

Table 2. Harmonised Google Trends WEB by Years – Multiplying Analysis

	GoogleTrends WEB Gold (1)	GoogleTrends WEB Silver (2)	GoogleTrends WEB Bronze (3)	GoogleTrends WEB TOTAL	(1)/(3)	(2)/(3)
2010	369.02	35.17	36.66	*440.86*	10.07	0.96
2011	178.21	25.10	20.77	*224.08*	8.58	1.21
2012	684.91	76.42	85.85	*847.17*	7.98	0.89
2013	150.00	17.08	14.46	*181.54*	10.37	1.18
2014	321.35	35.19	32.31	*388.85*	9.95	1.09
2015	173.67	23.09	16.73	*213.48*	10.38	1.38
2016	598.96	71.11	67.76	*737.83*	8.84	1.05
2017	222.51	28.48	22.00	*272.98*	10.12	1.29
2018	464.68	45.72	40.41	*550.81*	11.50	1.13
Average TOTAL	**351.48**	**39.71**	**37.44**	***428.62***	**9.39**	**1.06**
(A) Average without Olympics	181.10	23.44	18.49	*223.02*	9.79	1.27
(W) Average Winter Olympics	385.01	38.70	36.46	*460.17*	10.56	1.06
(S) Average SummerOlympics	641.93	73.76	76.80	*792.50*	8.36	0.96
2010 / (A)	2.04	1.50	1.98	*1.98*		
2014 / (A)	1.77	1.50	1.75	*1.74*		
2018 / (A)	2.57	1.95	2.19	*2.47*		
Winter (W) / (A)	***2.13***	***1.65***	***1.97***	***2.06***		
2012 / (A)	3.78	3.26	4.64	3.80		
2016 / (A)	3.31	3.03	3.66	3.31		
Summer (S) / (A)	***3.54***	***3.15***	***4.15***	***3.55***		
Summer wrt Winter (S) / (W)	**1.66**	**1.91**	**2.11**	**1.72**		

Nevertheless, to accomplish the matching procedure for assembling a dataset over the years, while obtaining weekly figures on GT(Web), we had to perform a harmonisation procedure. Even if the average results for the multiplying factors will be basically identical irrespective of harmonising or not the data, this additional analysis will enable us to homogeneously compare the outcomes over the years; and, hence, to obtain also the factor by which Olympic Summer medals multiply to Olympic Winter medals.

Moreover, the harmonization is necessary since, to obtain weekly figures from Google Trends, the data was collected separately per each year (from 2010 to 2018). But this procedure, delivered one different reference value (of 100) per year , thereby provoking that the reference values had different scales, which need to be re-scaled before carrying out comparisons over the years. Notice that the absolute figures in Table 2 are meaningless, as they have been distorted as the result of the harmonization procedure. Still, the relevant factor, which is the relative status of one type of medal with respect to the other, happens to be essentially equal. (For instance, the multiplying factor of gold with respect to bronze medals is now 9.79; which is virtually identical to the value 9.82 reported in Table 1).

In summary, in computing the new ranking, we propose accounting for the fact that the followers show usually different degrees of attention to Winter and Summer Olympic Games; as well as to the type of medals' metal. These are two major features that should not be neglected in appraising the "fair" weight given to each type of medals. Thus, the results reported in Table 2 are based on harmonised figures, which enable us to compare the three types of medals over time and depending on whether they were obtained in the Summer or Winter Olympic Games.

4.3. An alternative ranking of countries

The position of countries in the Olympic Games does heavily depend on the values and weights provided to the different types of metal. To challenge the usual ranking systems, either 1-1-1 or 3-2-1, and to create an alternative ranking of countries, we propose using the weights obtained from our approach, based on popularity status and media visibility records.

We actually rely on the average of the MERIT Web and Google Trends Web metrics to perform this analysis, taking into account just information from 2010. Although the content on the Internet only represents part of the sport events' interest, it delivers a reliable measure of the global attention that the different types of Olympic Games medals generate among the public. We show how the position of countries change when using our ranking as compared to the conventional ranking systems already mentioned.

Table 3 reports, in column (A), the improved ranking that results from applying our methodological proposal for estimating the "fair" weights associated to the mentioned

dimensions: the metal medals (Gold, Silver or Bronze) and the type of Olympic Games (Winter or Summer). Along with the new ranking, the table conveys the conventional IOC ranking, in column (C); as well as the one resulting from the 3-2-1 system. Some relevant changes are observed in the countries' ranking, as revealed by the table.

Table 3. Alternative Improved Olympic Medals Rankings

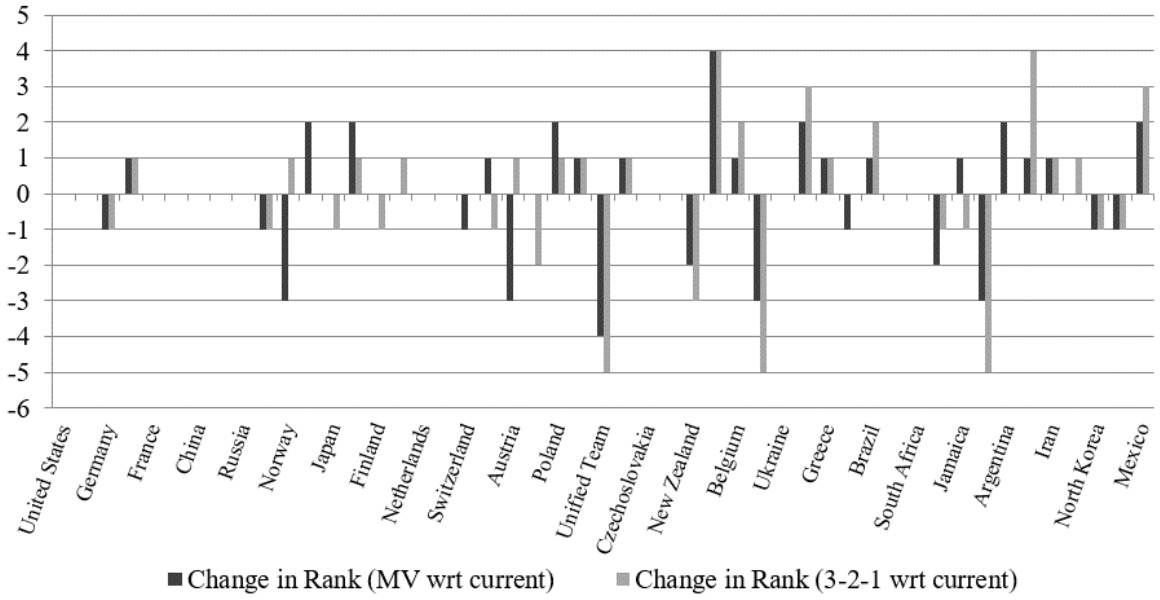
MV (A)	3-2-1 (B)	w-t-all (C)	IOC code Country	1-1-1 Total	3-2-1 Weight	MV Index	Change (C)-(B)	in Rank (C)-(A)
1	1	1	United States (USA)	2,827	5,986	100.00	0	0
2	2	2	Soviet Union (URS)	1,204	2,526	40.92	0	0
4	4	3	Germany (GER)	855	1,703	24.32	–1	–1
3	3	4	Great Britain (GBR)	880	1,727	27.39	+1	+1
5	5	5	France (FRA)	840	1,612	24.02	0	0
6	6	6	Italy (ITA)	701	1,407	21.98	0	0
7	7	7	China (CHN)	608	1,277	21.40	0	0
8	8	8	Sweden (SWE)	652	1,272	18.20	0	0
9	9	9	Russia (RUS)	546	1,100	16.82	0	0
11	11	10	East Germany (GDR)	519	1,068	16.62	–1	–1
14	10	11	Norway (NOR)	520	1,070	12.68	+1	–3
10	12	12	Hungary (HUN)	498	999	16.79	0	+2
13	14	13	Japan (JPN)	497	966	14.97	–1	0
12	13	14	Australia (AUS)	512	984	15.44	+1	+2
15	16	15	Finland (FIN)	470	906	12.52	–1	0
16	15	16	Canada (CAN)	501	941	11.66	+1	0
17	17	17	Netherlands (NED)	415	811	11.25	0	0
18	18	18	South Korea (KOR)	337	691	10.47	0	0
20	19	19	Switzerland (SUI)	345	676	8.58	0	–1
19	21	20	Romania (ROU)	307	580	9.18	–1	+1
24	20	21	Austria (AUT)	319	597	6.11	+1	–3
22	24	22	Cuba (CUB)	225	449	7.52	–2	0
21	22	23	Poland (POL)	306	546	7.94	+1	+2
23	23	24	West Germany (FRG)	243	459	6.62	+1	+1
29	30	25	Unified Team (EUN)	135	287	4.66	–5	–4
25	25	26	Bulgaria (BUL)	224	417	6.03	+1	+1
27	27	27	Czechoslovakia (TCH)	168	327	5.03	0	0
28	28	28	Spain (ESP)	154	310	4.83	0	0
31	32	29	New Zealand (NZL)	120	240	4.19	–3	–2
26	26	30	Denmark (DEN)	195	360	5.25	+4	+4

On one side, the UK overtakes Germany; while Hungary overtakes East Germany and Norway gets relegated three positions in the ranking. The Appendix 1 provides more extensive information on the relevant 152 of countries, along with the respective changes

in rank. To more easily recognise the importance of the changes observed in the countries' hierarchy concerning their sport achievements in Olympic Games, Figure 1 illustrates this issue.

On the other side, notice that a more careful examination of our raw data must still be done to corroborate the validity of the results and to evaluate to what extent they could be considered conclusive. Moreover, a more refined analysis by sport disciplines and type of medals seems necessary before we venture a definitive ranking of countries' sport achievements in the Olympic Games.

Figure 1. Countries' Olympic Medals Rank
Changes relative to the "winner-take-all" system

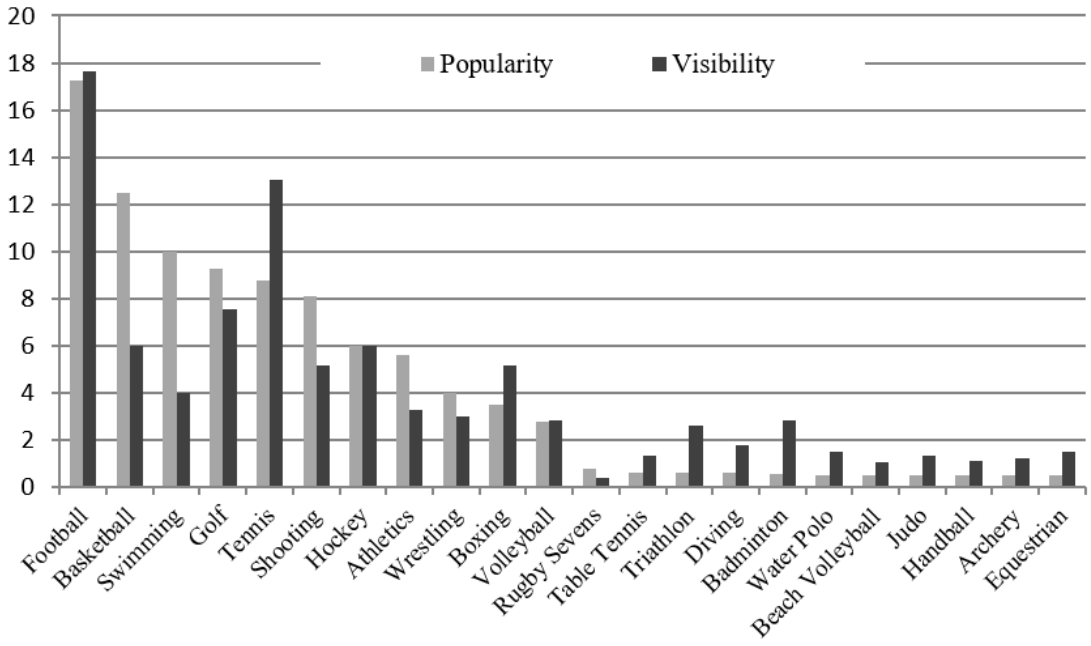


Finally, we present some prospective results concerning the different treatment that each sport discipline participating in the Olympic Games seems to demand; an exercise that can also be done applying the same innovative methodology described in this paper. However, such a comprehensive approach deserves a more refined analysis, which is left to future research.

To this aim, Figure 2 conveys the hierarchy of the most relevant Olympic sport disciplines, even if the results must not be taken as definitive. The comparative analysis of the degree of interest drawn by the different sports (as captured by popularity and media visibility appraisals) takes into account 39 Olympic disciplines: Football; Golf; Tennis; Shooting; Hockey; Basketball; Athletics; Boxing; Swimming; Sailing; Triathlon; Rowing; Volleyball; Diving; Fencing; Weightlifting; Badminton; Table Tennis; Wrestling; Equestrian; Judo; Handball; Water Polo; Archery; Beach Volleyball; Taekwondo; Modern Pentathlon; Rhythmic Gymnastics; Artistic Gymnastics; Cycling Track; Marathon Swimming; Rugby Sevens; Synchronised Swimming; Cycling Road; Canoe Sprint; Canoe Slalom; Cycling BMX; Cycling Mountain Bike; and Trampoline Gymnastics.

An important shortcoming associated to this approach is the fact that the values attached to sport disciplines may change over time. Of course, the discussion on the advantages and disadvantages of this approach deserves further examination, but this is also kept for future research efforts.

Figure 2. Hirerachy of Sport Disciplines in the Olympic Games
(Share of Popularity and Media Value in 2016)



4.3. Implications and limitations

Given our aim of homogeneously comparing the intensity with which consumers of sport spectacles manifest their interest on the various Olympic medals and disciplines, we always include the term "Olympic medal" into the searching strings. This procedure prevents the outcomes to be bias due to sport events not been directly related to the Olympic Games.

Another feature that demands adopting a differential treatment between types of medals concerns the distinct nature of Summer and Winter Olympic Games. We argue here about the importance – at least from a theoretical perspective – of accounting for the fact that Winter medals may have different importance than medals achieved in the Summer Olympic Games.

Notice that the two mentioned features are precisely the type of issues that can be addressed with the help of "Google Trends" records and the "Merit" approach. Moreover, we claim our approach to be able of procuring more accurate "proxy" variables to capture the countries' efficiency in Olympic sports in terms of popularity, outperforming the usual rankings. In summary, our methodological approach allowed us addressing two of the challenges confronted by earlier papers, seeking to assess the rank of countries in the Olympic Games and the issue of performance measurement.

Implicit to our approach is the acknowledgement that better sport performance and success will eventually be translated into strong reputation and social recognition. Hence, this procedure is actually able to comprehend sport accomplishments along with other features that people find attractive beyond mere sport achievements.

An important limitation of our analysis is that we only control for the share of attention of the types of metals. A more extensive approach needs to include the differences between disciplines for the same type of metals. In other words, future research needs to further specify the search, so that a gold medal in a highly visibly discipline, e.g., 100m-race, weights more than a gold medal in a low-visibly discipline. In our analysis, we only control for the different level of interests of the type of metals. Future research should also include the difference between men´s and women's events, as it might yield relevant results.

5. Conclusions

In this paper we develop a new procedure to evaluate countries' achievements in the Olympic Games. Our methodological approach uses information available on the internet and Google to provide the medals with more accurate weights (or factors) for gold, silver and bronze medals. as well as to distinguish between Summer and Winter Games.

Specifically, our method is based on comparative records on popularity and media visibility as way to capture the degree of worldwide attention generated by the Olympic medals. We use the contents on the Internet (as captured by MERIT) or accessible through the Google search engine (Google Trends). The options "web" and "news" allow us to measure popularity vs. visibility, respectively, and to incorporate alternative metrics to the analysis.

Our methodological proposal allows us to overcome the arbitrariness of the current systems for assigning weights to the different medals that have traditionally been used in the literature dealing with the evaluation of countries performance in Olympic Games. In particular, the implementation of this methodology implies progressing in two directions.

First, we refine the weights provided to the different types of metal as we rely on popularity records rather than arbitrary weights that characterizes the traditional rankings. In fact, we show that the position of some countries in the historical ranking of Olympic Games significantly changes if applying the weights based on the relative popularity. For example, in the top positions, Germany loses a position, to the benefit of the United Kingdom and Norway would fall three places in the ranking. In the lower end of the ranking, some extreme cases are found: Namibia and the Philippines would raise 24 and 18 positions, respectively. Second, our results provide researchers with new values that may be used as refined proxies of output in models that analyse both the

factors determining performance in the Olympics and the relative efficiencies of the participating nations.

Finally, in order to overcome some of the limitations of the method applied in this paper, as a future research agenda, we plan to further refine the most appropriate value that should be given to every medal category accounting also for the sport discipline. To this aim, we intend to apply the same methodology, based on popularity and media visibility figures, to calculate the appropriate weights, resulting from measuring the degree of public interest (as computed by the media attention), that must be granted to each sport discipline. Additional research efforts are in progress to obtain the appropriate weights for each sport discipline on the bases of the degree of media attention withdrawn with the focus on a particular edition of the Summer Olympic Games.

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Appendix 1

MV	3-2-1	w-t-all	IOC code	Summer			Winter			1-1-1	3-2-1	MV	Change	in Rank
(A)	(B)	(C)	Country	Gold	Silver	Bronze	Gold	Silver	Bronze	Total	Weight	Index	(C)-(B)	(C)-(A)
1	1	1	USA	1,022	795	705	105	110	90	2,827	5,986	100.00	0	0
2	2	2	URS	395	319	296	78	57	59	1,204	2,526	40.92	0	0
4	4	3	GER	191	194	230	92	88	60	855	1,703	24.32	–1	–1
3	3	4	GBR	263	295	291	11	4	16	880	1,727	27.39	+1	+1
5	5	5	FRA	212	241	263	36	35	53	840	1,612	24.02	0	0
6	6	6	ITA	206	178	193	40	36	48	701	1,407	21.98	0	0
7	7	7	CHN	224	167	155	13	28	21	608	1,277	21.40	0	0
8	8	8	SWE	145	170	179	57	46	55	652	1,272	18.20	0	0
9	9	9	RUS	149	124	153	47	38	35	546	1,100	16.82	0	0
11	11	10	GDR	153	129	127	39	36	35	519	1,068	16.62	–1	–1
14	10	11	NOR	56	49	47	132	125	111	520	1,070	12.68	+1	–3
10	12	12	HUN	175	147	169	1	2	4	498	999	16.79	0	+2
13	14	13	JPN	142	135	162	14	22	22	497	966	14.97	–1	0
12	13	14	AUS	147	163	187	5	5	5	512	984	15.44	+1	+2
15	16	15	FIN	101	85	117	43	63	61	470	906	12.52	–1	0
16	15	16	CAN	64	102	136	73	64	62	501	941	11.66	+1	0
17	17	17	NED	85	92	108	45	44	41	415	811	11.25	0	0
18	18	18	KOR	90	87	90	31	25	14	337	691	10.47	0	0
20	19	19	SUI	50	75	67	55	46	52	345	676	8.58	0	–1
19	21	20	ROU	89	95	122	0	0	1	307	580	9.18	–1	+1
24	20	21	AUT	18	33	36	64	81	87	319	597	6.11	+1	–3
22	24	22	CUB	78	68	79	0	0	0	225	449	7.52	–2	0
21	22	23	POL	68	83	133	7	7	8	306	546	7.94	+1	+2
23	23	24	FRG	56	67	81	11	15	13	243	459	6.62	+1	+1
29	30	25	EUN	45	38	29	9	6	8	135	287	4.66	–5	–4
25	25	26	BUL	51	87	80	1	2	3	224	417	6.03	+1	+1
27	27	27	TCH	49	49	45	2	8	15	168	327	5.03	0	0
28	28	28	ESP	45	64	41	1	0	3	154	310	4.83	0	0
31	32	29	NZL	46	27	44	0	1	2	120	240	4.19	–3	–2
26	26	30	DEN	45	74	75	0	1	0	195	360	5.25	+4	+4
30	29	31	BEL	40	53	55	1	2	3	154	291	4.40	+2	+1
35	37	32	TUR	39	24	28	0	0	0	91	193	3.48	–5	–3
33	33	33	UKR	35	30	56	3	1	4	129	236	3.69	0	0
32	31	34	EUA	28	54	36	8	6	5	137	269	3.75	+3	+2
34	34	35	GRE	33	43	40	0	0	0	116	225	3.51	+1	+1
37	36	36	KEN	31	38	33	0	0	0	102	202	3.21	0	–1
36	35	37	BRA	30	36	62	0	0	0	128	224	3.34	+2	+1
38	38	38	YUG	28	31	31	0	3	1	94	184	2.88	0	0
39	39	39	RSA	26	31	29	0	0	0	86	169	2.69	0	0
42	41	40	CZE	15	17	24	9	11	11	87	163	2.13	–1	–2
40	42	41	JAM	22	35	20	0	0	0	77	156	2.40	–1	+1
45	47	42	ETH	22	11	20	0	0	0	53	108	1.95	–5	–3
41	43	43	ARG	21	25	28	0	0	0	74	141	2.21	0	+2
43	40	44	BLR	12	27	39	8	5	5	96	168	2.11	+4	+1
44	44	45	IRI	19	22	28	0	0	0	69	129	2.01	+1	+1
46	45	46	KAZ	15	20	27	1	3	4	70	125	1.76	+1	0
48	48	47	PRK	16	16	22	0	1	1	56	105	1.64	–1	–1
49	49	48	CRO	11	10	12	4	6	1	44	90	1.31	–1	–1
47	46	49	MEX	13	24	32	0	0	0	69	119	1.65	+3	+2
50	50	50	EST	9	9	16	4	2	1	41	78	1.14	0	0
51	51	51	SVK	9	12	7	3	4	1	36	76	1.10	0	0
52	54	52	IRL	9	10	12	0	0	0	31	59	0.93	–2	0
53	55	53	THA	9	8	16	0	0	0	33	59	0.93	–2	0
55	60	54	IND	9	7	12	0	0	0	28	53	0.88	–6	–1
56	58	55	UZB	8	6	17	1	0	0	32	56	0.87	–3	–1
57	57	56	GEO	8	8	17	0	0	0	33	57	0.86	–1	–1
61	69	57	ZZX	8	5	4	0	0	0	17	38	0.70	–12	–4
60	53	58	SLO	5	8	10	2	5	10	40	67	0.77	+5	–2
58	56	59	INA	7	13	12	0	0	0	32	59	0.85	+3	+1
54	52	60	AZE	7	11	25	0	0	0	43	68	0.92	+8	+6
59	59	61	EGY	7	10	15	0	0	0	32	56	0.81	+2	+2
62	63	62	LTU	6	7	12	0	0	0	25	44	0.66	–1	0
64	66	63	MAR	6	5	12	0	0	0	23	40	0.62	–3	–1
68	72	64	BAH	6	2	6	0	0	0	14	28	0.52	–8	–4
63	62	65	COL	5	9	14	0	0	0	28	47	0.64	+3	+2
65	64	66	TPE	5	7	12	0	0	0	24	41	0.59	+2	+1
70	70	67	ALG	5	4	8	0	0	0	17	31	0.50	–3	–3
66	67	68	POR	4	8	12	0	0	0	24	40	0.54	+1	+2
72	77	69	TUN	4	2	7	0	0	0	13	23	0.38	–8	–3
67	61	70	LAT	3	11	5	0	4	4	27	48	0.52	+9	+3
69	65	71	NGR	3	10	12	0	0	0	25	41	0.50	+6	2
73	73	72	SRB	3	6	6	0	0	0	15	27	0.38	–1	–1
75	78	73	ANZ	3	4	5	0	0	0	12	22	0.33	–5	–2
79	81	74	ZIM	3	4	1	0	0	0	8	18	0.30	–7	–5

78	80	75	**PAK**	3	3	4	0	0	0	10	19	0.30	–5	–3
81	85	76	**DOM**	3	2	2	0	0	0	7	15	0.27	–9	–5
82	88	77	**CMR**	3	1	2	0	0	0	6	13	0.25	–11	–5
71	68	78	**MGL**	2	10	14	0	0	0	26	40	0.45	+10	+7
76	75	79	**CHI**	2	7	4	0	0	0	13	24	0.31	+4	+3
74	71	80	**TRI**	2	6	11	0	0	0	19	29	0.35	+9	+6
85	74	81	**OAR**	0	0	0	2	6	9	17	27	0.18	+7	–4
77	76	82	**ARM**	2	6	6	0	0	0	14	24	0.31	+6	+5
80	79	83	**VEN**	2	3	10	0	0	0	15	22	0.28	+4	+3
84	86	84	**UGA**	2	3	2	0	0	0	7	14	0.22	–2	0
91	84	85	**LIE**	0	0	0	2	2	6	10	16	0.13	+1	–6
83	83	86	**URU**	2	2	6	0	0	0	10	16	0.23	+3	+3
88	96	87	**BRN**	2	1	0	0	0	0	3	8	0.16	–9	–1
86	87	88	**RU1**	1	4	3	0	0	0	8	14	0.17	+1	+2
96	95	89	**LUX**	1	1	0	0	2	0	4	9	0.11	–6	–7
92	92	90	**PER**	1	3	0	0	0	0	4	9	0.13	–2	–2
93	93	91	**VIE**	1	3	0	0	0	0	4	9	0.13	–2	–2
89	89	92	**PUR**	1	2	6	0	0	0	9	13	0.16	+3	+3
94	94	93	**SIN**	1	2	2	0	0	0	5	9	0.13	–1	–1
90	91	94	**ISR**	1	1	7	0	0	0	9	12	0.15	+3	+4
97	98	95	**CRC**	1	1	2	0	0	0	4	7	0.11	–3	–2
98	99	96	**TJK**	1	1	2	0	0	0	4	7	0.11	–3	–2
99	101	97	**CIV**	1	1	1	0	0	0	3	6	0.10	–4	–2
100	102	98	**HKG**	1	1	1	0	0	0	3	6	0.10	–4	–2
101	103	99	**SYR**	1	1	1	0	0	0	3	6	0.10	–4	–2
102	107	100	**BDI**	1	1	0	0	0	0	2	5	0.09	–7	–2
103	108	101	**ECU**	1	1	0	0	0	0	2	5	0.09	–7	–2
104	109	102	**GRN**	1	1	0	0	0	0	2	5	0.09	–7	–2
105	110	103	**PAN**	1	0	2	0	0	0	3	5	0.09	–7	–2
106	114	104	**MOZ**	1	0	1	0	0	0	2	4	0.08	–10	–2
107	115	105	**SUR**	1	0	1	0	0	0	2	4	0.08	–10	–2
108	116	106	**UAE**	1	0	1	0	0	0	2	4	0.08	–10	–2
109	117	107	**IOA**	1	0	1	0	0	0	2	4	0.08	–10	–2
111	123	108	**FIJ**	1	0	0	0	0	0	1	3	0.07	–15	–3
112	124	109	**JOR**	1	0	0	0	0	0	1	3	0.07	–15	–3
113	125	110	**KOS**	1	0	0	0	0	0	1	3	0.07	–15	–3
87	82	111	**MAS**	0	7	4	0	0	0	11	18	0.17	+29	+24
110	97	112	**NAM**	0	4	0	0	0	0	4	8	0.08	+15	+2
95	90	113	**PHI**	0	3	7	0	0	0	10	13	0.11	+23	+18
114	100	114	**MDA**	0	2	3	0	0	0	5	7	0.06	+14	0
115	104	115	**ISL**	0	2	2	0	0	0	4	6	0.05	+11	0
116	105	116	**LIB**	0	2	2	0	0	0	4	6	0.05	+11	0
121	118	117	**SCG**	0	2	0	0	0	0	2	4	0.04	–1	–4
122	119	118	**SRI**	0	2	0	0	0	0	2	4	0.04	–1	–4
123	120	119	**TAN**	0	2	0	0	0	0	2	4	0.04	–1	–4
117	106	120	**QAT**	0	1	4	0	0	0	5	6	0.05	+14	+3
118	111	121	**BOH**	0	1	3	0	0	0	4	5	0.04	+10	+3
119	112	122	**GHA**	0	1	3	0	0	0	4	5	0.04	+10	+3
120	113	123	**KGZ**	0	1	3	0	0	0	4	5	0.04	+10	+3
124	121	124	**KSA**	0	1	2	0	0	0	3	4	0.04	+3	0
125	122	125	**IOP**	0	1	2	0	0	0	3	4	0.04	+3	0
126	126	126	**HAI**	0	1	1	0	0	0	2	3	0.03	0	0
127	127	127	**NIG**	0	1	1	0	0	0	2	3	0.03	0	0
128	128	128	**ZAM**	0	1	1	0	0	0	2	3	0.03	0	0
129	129	129	**BOT**	0	1	0	0	0	0	1	2	0.02	0	0
130	130	130	**CYP**	0	1	0	0	0	0	1	2	0.02	0	0
131	131	131	**GAB**	0	1	0	0	0	0	1	2	0.02	0	0
132	132	132	**GUA**	0	1	0	0	0	0	1	2	0.02	0	0
133	133	133	**MNE**	0	1	0	0	0	0	1	2	0.02	0	0
134	134	134	**AHO**	0	1	0	0	0	0	1	2	0.02	0	0
135	135	135	**PAR**	0	1	0	0	0	0	1	2	0.02	0	0
136	136	136	**SAM**	0	1	0	0	0	0	1	2	0.02	0	0
137	137	137	**SEN**	0	1	0	0	0	0	1	2	0.02	0	0
138	138	138	**SUD**	0	1	0	0	0	0	1	2	0.02	0	0
139	139	139	**TGA**	0	1	0	0	0	0	1	2	0.02	0	0
140	140	140	**ISV**	0	1	0	0	0	0	1	2	0.02	0	0
141	141	141	**AFG**	0	0	2	0	0	0	2	2	0.02	0	0
142	142	142	**BWI**	0	0	2	0	0	0	2	2	0.02	0	0
143	143	143	**KUW**	0	0	2	0	0	0	2	2	0.02	0	0
144	144	144	**BAR**	0	0	1	0	0	0	1	1	0.01	0	0
145	145	145	**BER**	0	0	1	0	0	0	1	1	0.01	0	0
146	146	146	**DJI**	0	0	1	0	0	0	1	1	0.01	0	0
147	147	147	**ERI**	0	0	1	0	0	0	1	1	0.01	0	0
148	148	148	**GUY**	0	0	1	0	0	0	1	1	0.01	0	0
149	149	149	**IRQ**	0	0	1	0	0	0	1	1	0.01	0	0
150	150	150	**MKD**	0	0	1	0	0	0	1	1	0.01	0	0
151	151	151	**MRI**	0	0	1	0	0	0	1	1	0.01	0	0
152	152	152	**TOG**	0	0	1	0	0	0	1	1	0.01	0	0

Appendix 2

* Cancelled due to the 1st or to the 2nd World War

	City	Country	Continent	Summer	Winter	Year	Opening Ceremony	Closing Ceremony
Summer	Athens	Greece	Europe	I		1896	April 6	April 15
Summer	Paris	France	Europe	II		1900	may-14	October 28
Summer	St. Louis	United States	North America	III		1904	July 1	November 23
Summer	London	United Kingdom	Europe	IV		1908	April 27	October 31
Summer	Stockholm	Sweden	Europe	V		1912	may-05	July 22
Summer	Berlin	Germany	Europe	VI		1916	Cancelled*	
Summer	Antwerp	Belgium	Europe	VII		1920	April 20	September 12
Winter	Chamonix	France	Europe		I	1924	January 25	February 5
Summer	Paris	France	Europe	VIII		1924	may-04	July 27
Winter	St. Moritz	Switzerland	Europe		II	1928	February 11	February 19
Summer	Amsterdam	Netherlands	Europe	IX		1928	may-17	August 12
Winter	Lake Placid	United States	North America		III	1932	February 4	February 15
Summer	Los Angeles	United States	North America	X		1932	July 30	August 14
Winter	Garmisch-Partenk.	Nazi Germany	Europe		IV	1936	February 6	February 16
Summer	Berlin	Nazi Germany	Europe	XI		1936	August 1	August 16
Winter	Sapporo	Empire of Japan	Asia		V	1940	Cancelled*	
Winter	Garmisch-Partenk.	Nazi Germany	Europe			1940	Cancelled*	
Summer	Tokyo	Empire of Japan	Asia	XII		1940	Cancelled*	
Winter	Helsinki	Finland	Europe			1940	Cancelled*	
Winter	Cortinad'Ampezzo	Italy	Europe		V	1944	Cancelled*	
Summer	London	United Kingdom	Europe	XIII		1944	Cancelled*	
Winter	St. Moritz	Switzerland	Europe		V	1948	January 30	February 8
Summer	London	United Kingdom	Europe	XIV		1948	July 29	August 14
Winter	Oslo	Norway	Europe		VI	1952	February 14	February 25
Summer	Helsinki	Finland	Europe	XV		1952	July 19	August 3
Winter	Cortinad'Ampezzo	Italy	Europe		VII	1956	January 26	February 5
Summer	Melbourne	Australia	Oceania	XVI		1956	November 22	December 8
Winter	Stockholm	Sweden	Europe			1956	June 10	June 17
Winter	Squaw Valley	United States	North America		VIII	1960	February 18	February 28
Summer	Rome	Italy	Europe	XVII		1960	August 25	September 11
Winter	Innsbruck	Austria	Europe		IX	1964	January 29	February 9
Summer	Tokyo	Japan	Asia	XVIII		1964	October 10	October 24
Winter	Grenoble	France	Europe		X	1968	February 6	February 18
Summer	Mexico City	Mexico	North America	XIX		1968	October 12	October 27
Winter	Sapporo	Japan	Asia		XI	1972	February 3	February 13
Summer	Munich	West Germany	Europe	XX		1972	August 26	September 11
Winter	Innsbruck	Austria	Europe		XII	1976	February 4	February 15
Summer	Montreal	Canada	North America	XXI		1976	July 17	August 1
Winter	Lake Placid	United States	North America		XIII	1980	February 13	February 24
Summer	Moscow	Soviet Union	Europe	XXII		1980	July 19	August 3
Winter	Sarajevo	Yugoslavia	Europe		XIV	1984	February 7	February 19
Summer	Los Angeles	United States	North America	XXIII		1984	July 28	August 12
Winter	Calgary	Canada	North America		XV	1988	February 13	February 28
Summer	Seoul	South Korea	Asia	XXIV		1988	September 17	October 2
Winter	Albertville	France	Europe		XVI	1992	February 8	February 23
Summer	Barcelona	Spain	Europe	XXV		1992	July 25	August 9
Winter	Lillehammer	Norway	Europe		XVII	1994	February 12	February 27
Summer	Atlanta	United States	North America	XXVI		1996	July 19	August 4
Winter	Nagano	Japan	Asia		XVIII	1998	February 7	February 22
Summer	Sydney	Australia	Oceania	XXVII		2000	September 15	October 1
Winter	Salt Lake City	United States	North America		XIX	2002	February 8	February 24
Summer	Athens	Greece	Europe	XXVIII		2004	August 13	August 29
Winter	Turin	Italy	Europe		XX	2006	February 10	February 26
Summer	Beijing	China	Asia	XXIX		2008	August 8	August 24
Winter	Vancouver	Canada	North America		XXI	2010	February 12	February 28
Summer	London	United Kingdom	Europe	XXX		2012	July 27	August 12
Winter	Sochi	Russia	Europe		XXII	2014	February 7	February 23
Summer	Rio de Janeiro	Brazil	South America	XXXI		2016	August 5	August 21
Winter	Pyeongchang	South Korea	Asia		XXIII	2018	February 9	February 25