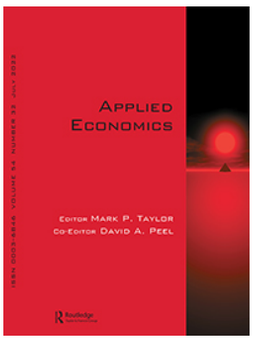

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How long does a medal win last? Survival analysis of the duration of Olympic success

Gergely Csurilla [a,b] and Imre Fertő [a,c]

[a]Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences Centre of Excellence, Budapest, Hungary; [b]Sport Economics and Decision Making Research Centre, Hungarian University of Sports Science, Budapest, Hungary; [c]Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

ABSTRACT

The aim of this article is to examine the factors that determine the durability of Olympic success at seven consecutive Summer Games between 1996 and 2021, employing survival analysis. It is assumed that factors similar to those that influence the durability of Olympic success also influence the likelihood of winning Olympic medals. We examine the durability of Olympic success at the level of sports for all medals, and for each type of medal. Our results suggest that a country can maintain its performance in a sport for an average of 2.1 Olympic Games. The Kaplan-Meier survival function shows that about 85% of spells fail after a single Games The GDP, host country, Communist past, the number of medals in a sport and the duration of preceding medal winning period are associated with successive medal-winning. Population size and the number of previous discontinuous medal wins decrease duration of Olympic success.

KEYWORDS

Survival analysis; medal winning; Summer Olympic Games; sports-level data; sports-fixed effect

JEL CLASSIFICATION

C41; L83; Z21

I. Introduction

Before all Olympic Games, speculation is rife concerning whether the favorite elite athletes can win again at their events and maintain their proven performance. In most sports, the Olympics is the ultimate competition, for which even qualifying requires sustained concentration and abstinence for several years. In most cases, a win is a one-time unrepeatable event; only a small number of athletes have collected medals in two different Olympic Games. The latter athletes are usually the main celebrities at the Olympics, their shoulders burdened with expectations.

Almost every sports fan in the world knows the name of Michael Phelps, the most successful Olympian of all time, who won a total of 28 medals in four consecutive Olympics. Probably a less well known record holder is a Hungarian fencer Áron Szilágyi, who won the Individual Men's Saber event in Tokyo 2021 for the third consecutive time; a feat no one had succeeded in doing before. The latter are among the few athletes who have been capable of winning medals in more than two Olympics successively.

Both records indicate the rarity of an athlete being capable of performing at the same level for multiple Olympic cycles. However, successive victories are more common at a national level; such winning countries usually target increasing their medal share in the following Olympics. Countries with international sporting success pursue an 'athlete production system' approach to maintaining ordinary medal counts in sports and reducing the risk to individuals (De Bosscher et al. 2010, 2008). Unexpected injuries or mental blocks could happen at any time to any athlete: successful countries strive to prevent such problems that may lead to the failure medals by preparing substitutes with similar capabilities to a similar level. In some sports, risk management is more achievable owing to the number of medals an athlete can potentially win (Csurilla et al. 2021). For example, in the modern pentathlon event there is no second chance for an athlete to win a medal in another event, unlike in swimming or athletics.

The determinants of countries' Olympic success have been investigated in the sport management and economics literature from many perspectives. The primary aim of these studies has been to

CONTACT Gergely Csurilla csurilla.gergely@krtk.hu Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences Centre of Excellence, Tóth Kálmán u. 4., Budapest 1097, Hungary

understand the factors that influence success at the Olympics, and to provide policy recommendations for countries seeking to increase their medal share. However, the long-term effect of these determinants is not known, as previous studies have not examined how medal winning can be maintained at the country level.

The aim of the present study is to investigate the duration of Olympic success and the factors that tend to influence the sustainability of national medal-winning performances at the Olympic Games. In contrast to the majority of studies on Olympic success, we use sports-level data for the estimation. This has several advantages. First, there is no country that always wins medals in all sports from one Olympic Games to another, thus the factors that determine countries' failures can be analyzed. Second, in contrast to country-level data, the use of sports-level data allow us take into account the impact of sports-level heterogeneity on Olympic success.

Survival analysis has been used before in the sports literature to estimate the duration of Olympic records (Gutierrez, Lozano, and Gonzalez 2011; Hollifield, Trevino, and Zarn 2012), the life-span of Olympic medalists (Clarke et al. 2012; Thieme and Fröhlich 2020), and sports sponsorships (Jensen and Cornwell 2017). However, survival analysis has not been used to assess the duration of Olympic success. Survival analysis gives information not only about the duration of Olympic success, but also the factors determining medal winning at the Olympic Games. We perform survival analysis for different outcome variables, including total medals, and different types of medals separately.

Information on the duration of success at the Olympics can be useful in several ways. First, it helps with understanding the nature of medal-winning. Is it normal that a country always obtains Olympic medals, or is this a rare, extraordinary event? Second, understanding the determinants of the span of Olympic success could help with creating guidance for countries' sport systems regarding how to formulate new strategies to maintain or increase medal winning. Knowing the determinants of successive Olympic success can help for countries targeting resources in the proper sports where winning is easier to sustain. Third, the analysis can also provide the International Olympic Committee with insights into how the Olympic Games can be transformed. What options are available if they want to break the monarchy of certain countries or, conversely, if they want to steer the Olympics toward more predictable success.

II. Literature review: Olympic success

The determinants of Olympic success have been investigated from many perspectives. Most studies have focused on the Summer Olympic Games (Bernard and Busse 2004; Forrest, Sanz, and Tena 2010; Forrest et al. 2017; Kovács, Gulyás, and Sterbenz 2017; Rewilak 2021; Scelles et al. 2020; Trivedi and Zimmer 2014; Vagenas and Vlachokyriakou 2012), with only a few studies having been published on the Winter Games (Johnson and Ali 2004; Weber et al. 2016).

There is an established consensus in the literature that the wealth of a country and population size are important drivers of national medal tallies (Bernard and Busse 2004; Kovács, Gulyás, and Sterbenz 2017; Trivedi and Zimmer 2014; Vagenas and Vlachokyriakou 2012). In developed countries, sport is much more a part of everyday life; consequently, more and better-qualified athletes can be produced (Bernard and Busse 2004; Forrest, Sanz, and Tena 2010). Nevertheless, in a recent study, Rewilak (2021) highlights, using a fully specified model, the fact that economic development, as proxied as Gross Domestic Product (GDP), can lose its significance.

Another important factor of Olympic success is hosting the event. Host countries tend to invest additional financial resources to ensure their athletes are adequately prepared to take advantage of a home field. Therefore, studies usually control for the host-country effect (Bernard and Busse 2004; Durączky and Bozsonyi 2020; Forrest, Sanz, and Tena 2010; Kovács, Gulyás, and Sterbenz 2017; Rewilak 2021; Scelles et al. 2020). Despite the different methodologies and samples, the host-country effect is found to have a positive impact on the Olympic success in all studies.

The former member states of the Soviet Bloc usually won more Olympic medals then their socio-economic situation explains (Bernard and

Busse 2004). Although the magnitude of soviet effect is falling, its statistical significance is still detectable (Rewilak 2021). We follow recent studies (Noland and Stahler 2016; Rewilak 2021) and employ a communist bloc dummy variable to the former countries of the Communist Bloc.

Three countries – namely China, Russia, and the U.S., – perform outstandingly well not only at the Olympic Games but also from an economic and social point of view. The lack of consideration of superpower countries may lead to misleading results. To handle this, Durászky and Bozsonyi (2020) employed a dummy variable to control for the possible impacts of superpower countries – the first authors to do so.

A previous study, applied also sport-level data, concluded that the higher the obtainable number of medals in a sport is, the lower the luck based noise factor will be (Csurilla et al. 2021). They define the noise factor as the unpredictability of sport results which is also related to the duration of success. Therefore, we employ a variable about the number of medals that can be won in a sport.

In recent decades, another approach has unfolded in the sports management literature concerning the factors that influence success in elite sport. De Bosscher, De Knop, and Heyndels (2003) classified the factors determining top-level success in sports into three levels: macro-, meso-, and micro. In a later study, the latter highlight the fact that impact of macro-level factors on elite sporting success (such as GDP and population) are shrinking, but the effect remains significant (De Bosscher et al. 2006). As none of the macro-level variables can be influenced by sports policies in the short term, national sports systems must play an important role in victories (De Bosscher et al. 2006). The authors also identified that sporting success can be maintained through increasing investment in the elite athlete production system (De Bosscher et al. 2008). Later, the authors published several studies on the topic that help determine the sports policy factors that lead to international sporting success (De Bosscher et al. 2008, 2010, 2015, 2016), the former which have attracted conceptual and methodological criticism (Henry et al. 2020).

We assume that macro factors influence not only medal-winning capability, but also the duration of medal winning. Thus, we use GDP, population, host country, and superpower dummies to explain the duration of Olympic success. We formulate the following research hypotheses:

H_{1A}: There is a positive relationship between a country's GDP and the duration of Olympic success

H_{1B}: There is a positive relationship between a country's population and the duration of Olympic success

H_{1C}: Hosting is positively associated with the duration of medal winning

H_{1D}: That being a former member state of the Soviet Bloc is positively associated with the duration of Olympic medal winning

H_{1E}: That being a superpower country is positively associated with the duration of Olympic medal winning

H_{1F}: There is a positive relationship between the number of medals that can be won in a sport and the duration of Olympic success

Although the duration of success (namely, medal-winning) has not yet been investigated in relation to the Olympic Games, a few studies have applied survival analysis. Gutierrez, Lozano, and Gonzalez (2011) and Hollifield, Trevino, and Zarn (2012) analyzed the duration of Olympic records. Gutierrez, Lozano, and Gonzalez (2011) focused only on athletic events, finding that the duration of Olympic athletics records is affected by the category of sporting event, the year of the record, the rank order of the record, improvements in relation to the previous Olympic record, and the magnitude of the gap over the contemporaneous world record. Hollifield, Trevino, and Zarn (2012) employed different covariates in their model, including the host dummy, GDP, and the population of the country of the record-setter. They found that Olympic-record -specific variables are the most important factors, whilst standard macroeconomic variables affect Olympic success.

Studies on the nature of Olympic records indicate that the breaking of records depends on several factors, but mainly on the characteristic of the

sporting event, and the year of the Olympic record. The longer a record has been held, the greater the probability of it being broken. Consequently, the duration of Olympic success tends to have the same characteristics. Most countries are not able to win medals from one Olympic Games to another in the same sport. Olympic sports also differ in terms of the component of luck (Csurilla et al. 2021), which highlights the difficulty of maintaining performance at the same level.

In countries that are not capable of performing at the same level at the Olympics, medal-winning duration tends to be short. Countries with a more developed elite sports system can maintain their medal-winning from one Olympics to another (De Bosscher et al. 2008). Consequently, we further hypothesize the following

H_2: There is a positive relationship between the duration of the preceding medal winning span, and later medal win duration

If a country cannot win medals successively, it is difficult to overcome this. In contrast, other countries can sustain medal winning from one Olympic Games to another (i.e. have less discontinuity). Based on this, we assume the following:

H_3: Medal win duration is negatively associated with the number of previous discontinuous medal wins

III. Data and methodology

Survival analysis

Duration analysis of Olympic success is estimated by the survival function, S(t), using the nonparametric Kaplan-Meier product-limit estimator (Cleves et al. 2010). We assume that a sample contains n independent observations denoted as $(t_i; c_i)$, where i = 1, 2, . . . , n, t_i is the survival time, and c_i is the censoring indicator variable C, which takes a value of 1 if a failure occurred, and 0 otherwise of observation i. It is assumed that there are m < n recorded times of failure. The rank-ordered survival times are denoted as $t_{(1)} < t_{(2)} < \ldots < t_{(m)}$, while n_j denotes the number of subjects at risk of failing at $t_{(j)}$, and d_j denotes the number of observed failures. The Kaplan-Meier estimator of the survival function is then

$$\hat{S}(t) = \prod_{t(i) < t} \frac{n - d_j}{n_j} \tag{1}$$

with the convention that $\hat{S}(t) = 1$ if $t < t_{(1)}$. Given that many observations are censored, it is noted that the Kaplan-Meier estimator is robust to censoring and uses information from both censored and non-censored observations.

Discrete time models

Beyond a descriptive analysis of the duration of Olympic success, we are interested in the factors explaining survival. Recent literature on the determinants of duration uses Cox proportional hazards models. However, over the last decade some papers have pointed out three problems inherent to the Cox model that reduce the efficiency of estimators (Hess and Persson 2011, 2012) which is relevant for our research question. First, the Cox model is a continuous-time models, while duration of Olympic success is observable in discrete of four yearly length. This may result in biased coefficients when the database refers to discrete-time intervals (the Olympic period in our case), and especially in samples with a high number of ties (numerous short-spell lengths). Second, Cox models do not control for unobserved heterogeneity (or frailty). Thus, results might not only be biased, but also spurious. The third issue is connected to the proportional hazards assumption. In other words, the impacts of explanatory variables on the hazard rate are assumed to be constant across duration time. This is unlikely to hold for the variables usually applied to investigate the duration of Olympic success. Incorrectly imposing proportionality will produce misleading estimates of covariate effects. Thus, we

estimate a discrete-time models logit model into which sport-country fixed effects are incorporated to control for unobservable heterogeneity.

Data

Data about the results of the Olympic Games were obtained from the Gracenote database. Gracenote is an entertainment data company that collects data about the Olympic Games, among other areas.

We collected data about seven Summer Olympic Games (1996–2021) for all sports to obtain more detailed information about countries' Olympic performance. During this period, there were no major political boycotts or changes which could have a major distorting effect on the results. The breakup of Yugoslavia (1996 Atlanta and 2000 Sydney) and Serbia and Montenegro (2004 Athens) were the only problematic issues during the period of analysis. However, the latter countries performed remarkably well at the Olympics, thus we decided to retain the data and associate it with Serbia (Serbia and Montenegro are the two successor countries, and medals were won mainly by Serbian athletes in individual sports). To create a panel structure, countries were grouped with sports events. In the dataset, the individual units are countries associated with specific sports (e.g. Australia – archery), and the time dimension is the year of the Olympic Games.

We create spells of wins to indicate continuous wins using the annual data about each country-sport pair. If a country in a sport continuously won medals from 1996 to 2021, this represents a spell of seven Olympic Games.

For the socioeconomic indicators, we employ data from the database of the World Bank. The Olympic Games is a four-yearly event, thus to obtain more detailed information about countries' economic and social situations we calculated four-yearly geometric means for the year of the Olympic games and the previous three years. This method eliminates bias due to data fluctuations or erroneous data.

IV. Results and discussion

We aim to explore the duration of Olympic medal-winning. First, we undertake descriptive analysis of Olympic medal-winning over the period 1996–2021 with sport-country-level data. Table 1 shows the descriptive statistics of winning spells. With no regard to the type of medals, the average winning span of a country in a sport is 2.1 Olympics. The results of countries within the first spell are slightly higher, with a mean of 2.3. In terms of medals, gold has the longest duration in both cases, followed by bronze, and then silver.

The distributions of the number of spells are quite similar in all cases (Figure 1). About 75% of the countries have one winning spell in a sport, and about 25% have two spells. In a few rare events there are four spells for a country in a sport. This

Table 1. Descriptive statistics of spells.

	Obs	Mean	Std. Dev.	Min	Max
			Total medal		
total sample	1421	2.125	1.754	1	7
first spell	1012	2.337	1.947	1	7
			Gold medal		
total sample	767	1.664	1.310	1	7
first spell	577	1.729	1.421	1	7
			Silver medal		
total sample	964	1.521	1.155	1	7
first spell	689	1.574	1.286	1	7
			Bronz medal		
total sample	1060	1.583	1.170	1	7
first spell	754	1.598	1.257	1	7

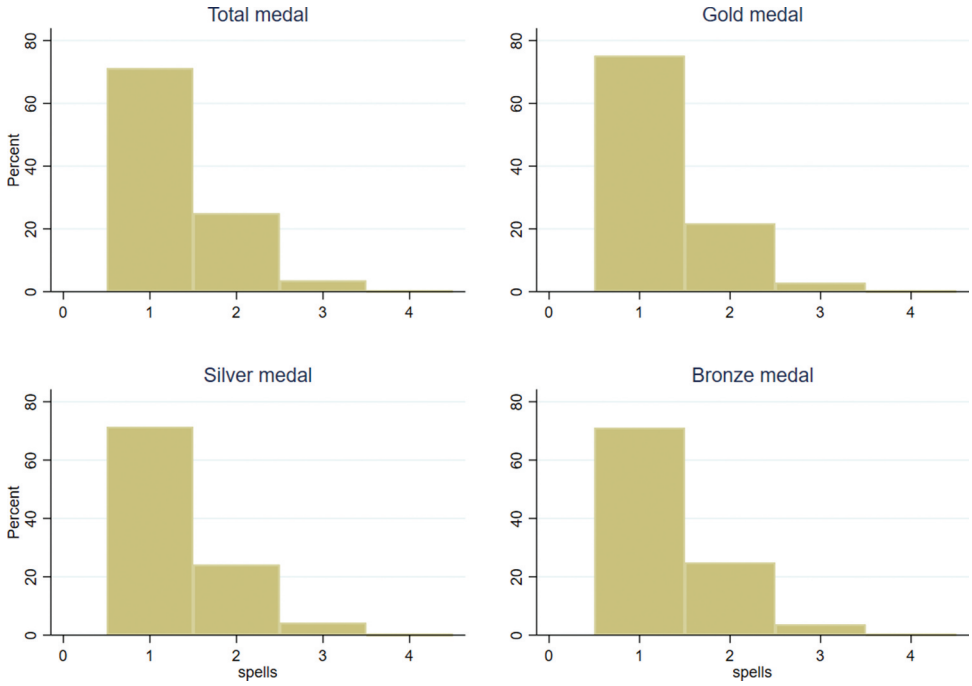

Figure 1. Distribution of number of spells.

indicates that if a country wins a medal at an Olympic Games, then does not at the next, and then wins again, this a rather unusual phenomenon.

Figure 2 presents the distribution of Olympic success by type of medals. More than 50% of medal wins last for a single year, and wins are

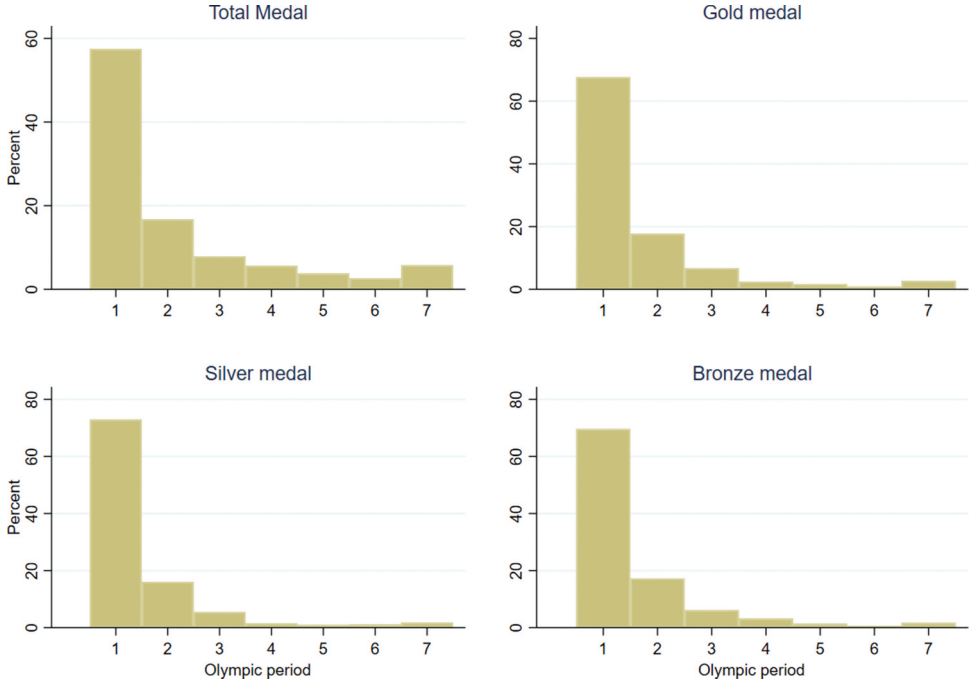

Figure 2. Duration of Olympic success.

sustained for seven Olympic cycles in only about 5% of cases. Countries that can win consecutive Olympic medals in sports for longer are the most successful nations (probably the superpowers), or those that have an effective 'athlete production system' (De Bosscher et al. 2008) that can prepare more potential athletes with a chance at the podium to minimize the risk arising to individuals.

To describe Olympic medal win duration in a more detailed way, we use the Kaplan-Meier survival function. Figure 3 shows the empirical survival functions for Olympic medals by total and type. The x-axis plots the observed spell length, and the y-axis plots the fraction of observations whose observed spell of wins exceeds a given length. The Kaplan-Meier estimates indicate that, after a year, about 85% of spells fail; only a minority are sustained. The estimations highlight the rapid turnover of Olympic victories, and the difficulty of sequentially winning in one Olympic Games and then another.

We estimated discrete-time logit models to explore the determinants of duration of success at the Olympic Games. We used three different model specifications. First, we add the number of medals that can be won in a sport into the model (1). With this method, sport-country random effects are incorporated to control for unobservable heterogeneity. Second, instead of medals a sport fixed effect was applied to control for obtainable medals in sports (3). Third, we interacted the number of medals can be won in a sport with the total number of medals in a given Olympic Games (3). Table 2 shows the results of estimations with different models and outcome variables. The full estimations with the fixed effects are presented in Appendix.

The estimation results are similar for all model specifications (1,2,3). This demonstrates the robustness of our method. GDP has a negative and significant effect in all estimations. The results indicate that GDP plays an essential role in reducing the probability of failing at the Olympic Games. This is in line with the finds of previous studies that investigated the determinants of success at the Olympics. Moreover, GDP is an important determinant of duration of victory as well. GDP affects silver medal-winning most, followed by gold and bronze.

Although population is significantly associated with most outcome variables, it also positively affects the possibility of failure. This finding implies that the population size of a country influences the continuity of Olympic medal-winning in a negative direction. One potential explanation is that there

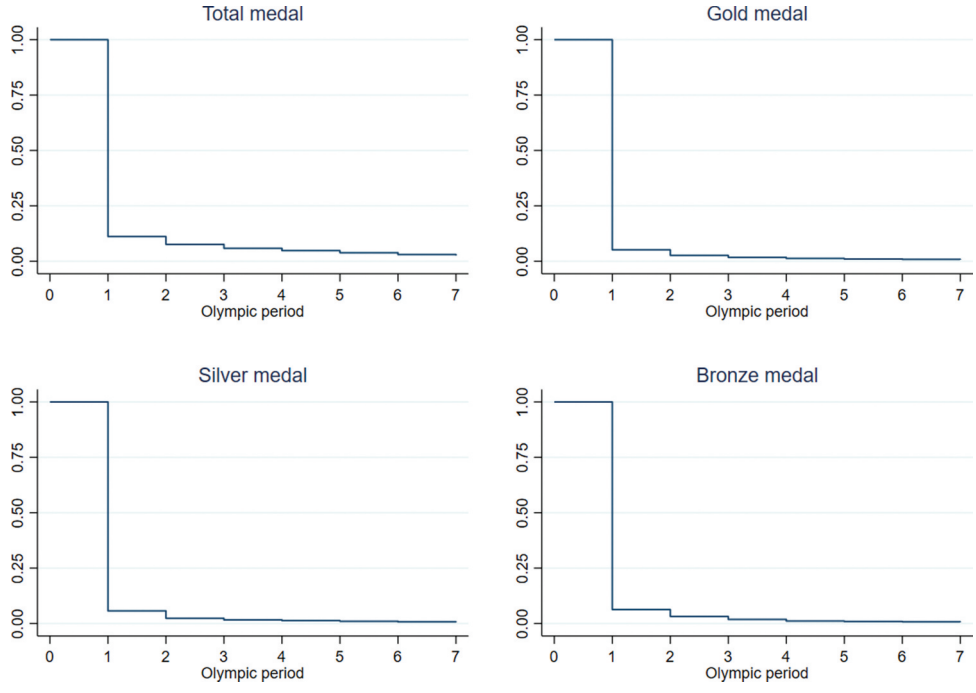

Figure 3. Kaplan-Meier survival estimates.

Table 2. Estimation for the full sample.

	1				2				3			
	Gold	Silver	Bronze	Total	Gold	Silver	Bronze	Total	Gold	Silver	Bronze	Total
lnGDP	−0.751***	−0.805***	−0.704***	−0.690***	−0.739***	−0.827***	−0.740***	−0.689***	−0.743***	−0.822***	−0.744***	−0.703***
lnPOP	0.288***	0.269***	0.191***	0.238***	0.288***	0.290***	0.232***	0.259***	0.285***	0.284***	0.229***	0.259***
HOST	−1.098***	−0.826***	−0.600***	−1.088***	−1.135***	−0.882***	−0.658***	−1.065***	−1.102***	−0.834***	−0.609***	−1.061***
Super	0.028	0.195	0.461**	0.102	0.039	0.166	0.398**	0.145	0.017	0.141	0.374**	0.058
Communist bloc	−1.026***	−1.347***	−1.277***	−1.113***	−1.010***	−1.316***	−1.236***	−1.067***	−1.011***	−1.307***	−1.241***	−1.083***
Medal_sport	−14.777***	−14.991***	−12.304***	−11.227***								
length_t-1	−1.275***	−1.294***	−1.318***	−1.113***	−1.278***	−1.294***	−1.287***	−1.093***	−1.274***	−1.292***	−1.280***	−1.105***
spell_t-1	0.825***	1.183***	1.110***	0.827***	0.783***	1.176***	1.039***	0.706***	0.807***	1.186***	1.055***	0.781***
Sport FE					Yes	Yes	Yes	Yes				
Medal & sport interaction									Yes	Yes	Yes	Yes
constant	19.408***	21.056***	19.330***	17.648***	19.784***	21.387***	19.623***	17.582***	19.491***	21.115***	20.355***	17.993***
N	17,469	17,469	17,469	17,469	18,500	18,430	18,500	18,500	17,469	17,457	17,469	17,469
log-likelihood	−2.7e + 03	−3.1e + 03	−3.5e + 03	−4.2e + 03	−2.6e + 03	−3.1e + 03	−3.4e + 03	−4.3e + 03	−2.6e + 03	−3.1e + 03	−3.4e + 03	−4.1e + 03
chi2	1351.704	1202.308	1305.656	2391.404	1646.843	1375.900	1666.150	2871.875	1650.292	1333.107	1636.597	2688.143
Wald p value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

* $p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

are other populous countries besides post-Soviet states and superpower countries that win medals only occasionally at the Olympic Games, such as India, Pakistan, and Nigeria. This result contrasts somewhat with the findings of previous studies. It has been assumed that the distribution of athletic talent with Olympic medal-winning capability is equal across countries (De Bosscher et al. 2006), and that population size is correlated with the number of Olympic medals (Bernard and Busse 2004; Johnson and Ali 2004; Kovács, Gulyás, and Sterbenz 2017; Rewilak 2021; Scelles et al. 2020; Trivedi and Zimmer 2014; Vagenas and Vlachokyriakou 2012). Our result suggests that the population is less important than investment in terms of Olympic success; consequently, the distribution of sporting talent is not equal throughout the world. It reinforces the view that sport is a more integrated part of schooling and everyday life in wealthier countries, which also have the financial capacity to invest in sports developments (Bernard and Busse 2004).

Being the host of the Olympic Games prolongs medal-winning survival: the coefficients of the host dummy are significant with all outcome variables. Hosting has the largest impact on gold medals, followed by silver and bronze. In contrast to the population variable, hosting plays an important role not only in terms of the total amount of medals but also in relation to the longevity of medal winning.

The dummy that captures the outstanding performance and socio-economic situation of superpower countries affects the duration of Olympic success in the case of bronze medals. The Communist Bloc dummy also contains China and Russia, probably it takes away the effect of the superpower dummy in the case of total, gold and silver medals. The coefficients of the communist dummy are statistically significant in all cases with all model specification. Being a member of the Soviet bloc still adds to the duration of Olympic success.

There is a positive relationship between the number of medals that can be won in a sport and the duration of Olympic success. In sports with more obtainable medals, countries are more likely to sustain their Olympic success. The negative and significant effect of the lagged coefficient of length indicates that previous medal win duration is correlated to the later duration of Olympic victory, increasing the probability of surviving from Olympics to Olympics. In contrast, the lagged effect of the spell decreases the probability of surviving. The more that a country's previous medal winning spell in a sport is discontinuous, the greater the probability it will fail to win at successive Olympics.

We undertook a robustness test on the analysis. As reported in Table 3, we followed the same procedure as in Table 2; however, instead of the full sample, we utilized data about the first spells. The results remain similar; there is only one difference that should be highlighted. With the data for the first spell, the coefficient of super countries remains significant in the case of silver medals. The results of the robustness test with different samples indicates that the positive effect on medal-winning duration caused by the outstanding Olympic success of superpower countries still exists when it comes to obtaining medals.

V. Conclusion

We investigate the duration of success at the Olympic Games, and the determinants that influence the length of victory. The determinants of Olympic medal winning are described in an extended literature; however, the duration of wins has not been examined before. We attempt to fill this gap in the literature here.

Our sample analysis shows that the average winning span of a country in a sport is 2.1 Olympics. Furthermore, more than 50% of medal wins last for a single year, while only about 10% of wins are sustained for seven Olympic cycles. Consequently, consecutive winning for a country in any sport is usually an occasional event, and only a small number of countries can maintain their performance from one Olympic Games to another. The estimates of the Kaplan-Meier survival function confirm this conclusion: about 85% of spells fail after a single Olympic Games, and only a minority survive in the longer term.

Table 3. Estimation for the first spell.

	1				2				3			
	gold	silver	bronze	total	gold	silver	bronze	total	gold	silver	bronze	total
lnGDP	−0.536***	−0.547***	−0.451***	−0.391***	−0.533***	−0.562***	−0.485***	−0.400***	−0.532***	−0.562***	−0.485***	−0.398***
lnPOP	0.216***	0.173***	0.133***	0.133***	0.215***	0.183***	0.165***	0.150***	0.212***	0.181***	0.162***	0.145***
HOST	−1.184***	−0.840***	−0.789***	−1.081***	−1.221***	−0.873***	−0.853***	−1.110***	−1.186***	−0.829***	−0.811***	−1.096***
Super	0.069	0.270*	0.196	0.119	0.110	0.298*	0.148	0.138	0.096	0.286*	0.139	0.105
Communist bloc	−0.733***	−0.841***	−0.772***	−0.622***	−0.754***	−0.855***	−0.790***	−0.640***	−0.751***	−0.850***	−0.793***	−0.637***
Medal_sport	−9.451***	−9.708***	−6.862***	−5.567***								
length_t-1	−1.469***	−1.587***	−1.629***	−1.273***	−1.505***	−1.618***	−1.639***	−1.284***	−1.497***	−1.615***	−1.635***	−1.294***
spell_t-1	0.876***	1.436***	1.479***	0.855***	0.957***	1.510***	1.553***	0.846***	0.968***	1.526***	1.576***	0.888***
Sport FE					Yes	Yes	Yes	Yes				
Medal & sport interaction									Yes	Yes	Yes	Yes
constant	14.555***	15.379***	13.242***	11.299***	15.220***	15.932***	13.917***	11.934***	16.458***	17.254***	16.040***	13.783***
N	17,192	17,090	17,008	16,828	18,223	18,051	18,039	17,859	17,192	17,078	17,008	16,828
log-likelihood	−2.1e + 03	−2.4e + 03	−2.6e + 03	−3.2e + 03	−2.1e + 03	−2.4e + 03	−2.6e + 03	−3.2e + 03	−2.0e + 03	−2.3e + 03	−2.5e + 03	−3.0e + 03
chi2	1162.766	941.869	1119.563	2214.182	1455.356	1230.473	1348.644	2511.238	1524.232	1226.136	1373.495	2492.443
Wald p value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

* $p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

To explore the factors that affect the duration of victory, we applied a discrete-time models logit model. Our estimations show that GDP, host dummy, Communist Bloc dummy, the number of medals can be won in a sport and the duration of the preceding medal winning spell are associated with successive medal winning in relation to any type of outcome variable. These five indicators play an essential role in reducing the probability of failing at the Olympic Games. The superpower dummy affects the duration of Olympic success only in the case of bronze medals.

One of the main findings of our paper is the positive and significant effect of population size, which is found to damage the continuity of Olympic victory for a country in any sport. This result questions the previously popular assumption that sporting talent associated with Olympic medal capability is equal across the world. Based on our findings, we argue that there is inequality in Olympic talent; the economic situation is more decisive in terms of the emergence of talented athletes.

Finally, we find that if the preceding medal-winning spell of a country in a sport is discontinuous, then smaller the probability of later successive victories.

Some limitations of our study are worth mentioning. First, we use country-sport level data about seven Summer Olympic Games, which has obvious shortcomings compared to a dataset with a longer period. Additional data about the Olympic Games could generate more reliable patterns and estimates. However, due to political changes, data about previous Olympics could not be properly linked to those of the current countries, so this would pose additional problems. Second, the probability of winning is different in sports, as there is more luck involved in some sports than others (Csurilla et al. 2021). This fact presumably affects the duration of success, and the determinants as well.

Finally, we formulate some implications for policy makers. Countries that aim to maintain consecutive Olympic medal wins should invest in sporting staff and facilities to ensure that adequate conditions for their sporting talents exist, through which they can fulfil their potential. With expenditure on staff, talent with Olympic podium potential can be earlier identified and prepared in a proper way. The effectiveness of talent management plays a more determining role in the duration of (successive) Olympic success than population size. Furthermore, hosting the Olympic Games may also be a crucial factor in terms of the continuity of medal wins. Bidding for the event requires considerable expenditure that is not available to all countries. Nevertheless, as demand for Olympic medals is not decreasing, hosting may be seen as an additional, albeit expensive, means of obtaining more medals. Lastly, countries for successive Olympic success should target sports where the number of medals that can be won are higher. If there is a second chance to win, the winning streak is easier to maintain.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Gergely Csurilla http://orcid.org/0000-0001-5325-9612
Imre Fertő http://orcid.org/0000-0002-3742-5964

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to commercial restrictions.

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Appendix

Table A1. Estimation for the full sample – full estimation.

	2				3			
	gold	silver	bronze	total	gold	silver	bronze	total
Archery					35.253	21.613	−42.517	3.261
Artistic Swimming	1.123	0.893	0.402	0.359	250.193	184.230	−25.113	64.538
Athletics	−2.769***	−2.129***	−1.508***	−1.877***	−16.146***	−12.833***	−14.293***	−13.024***
BMX	−0.212	1.678*	0.875	0.283	−334.909	−1.943	−324.441	−420.801**
Badminton	−0.245	0.141	0.227	0.163	14.621	24.463	−20.398	14.708
Baseball	−0.725	0.195	0.350	−0.411	−242.320	−5.003	−217.174	−304.274
Basketball	1.182	0.109	0.104	−0.069	257.524	59.384	−72.358	−5.490
Basketbal 3 × 3	−0.070		1.076	0.399	−273.496		−253.638	−331.852*
Beach	−0.314	0.796*	0.171	0.079	24.583	172.634*	−61.147	24.229
Boxing	−1.601***	−1.254***	−1.586***	−1.498***	−22.994*	−19.818*	−42.915***	−29.697***
Canoe – Slalom	−1.097**	−0.625	−0.396	−0.265	−50.562	−29.818	−77.981	−19.863
Canoe – Sprint	−1.491***	−1.245***	−0.938***	−1.006***	−28.036	−26.300*	−40.105***	−26.230**
Cycling – Road	−1.079**	−0.094	0.016	−0.453	−51.919	14.447	−43.693	−34.292
Cycling -Track	−1.675***	−0.966**	−0.953***	−1.083***	−36.736*	−22.290	−43.640***	−32.051**
Diving	−0.458	−0.146	−0.426	−0.124	−0.740	4.048	−39.283*	−3.020
Equestrian – Dressage	−0.132	0.541	0.385	0.888*	51.438	129.252	−26.902	155.902
Equestrian- Eventing	−0.448	0.118	0.491	0.155	−0.203	62.323	−7.885	37.672
Equestrian – Jumping	−0.676	0.353	0.352	−0.247	−37.547	101.400	−30.846	−30.052
Fencing	−1.384***	−0.707*	−0.399	−0.340	−29.594	−13.532	−30.022*	−10.002
Football	−0.882	0.042	0.281	−0.568	−71.271	48.611	−44.240	−88.296
Golf	0.520	1.162*	1.703***	0.644	−16.309	60.180	15.742	−83.235
Gymnastic – Artistic	−1.751***	−0.751**	−0.453	−0.695**	−29.971**	−10.947	−23.156*	−15.221
Gymnastic- Rhythmic	0.398	0.218	0.092	−0.208	140.357	75.498	−73.403	−22.470
Gymnastic -Trampolining	−0.929	0.119	0.585	−0.284	−78.040	55.979	4.085	−42.929
Handball	−0.811	−0.193	0.072	−0.768*	−59.713	10.579	−77.096	−122.572
Hockey	−1.132*	−0.596	−0.223	−0.395	−109.635	−53.226	−124.536	−57.668
Judo	−1.647***	−0.962***	−1.367***	−1.249***	−20.825*	−11.960	−33.099***	−21.280***
Karate	−1.071*	0.094	−0.366	−0.804**	−94.070***	−61.405**	−114.447***	−128.992***
Modern	−0.695	0.021	0.173	−0.529	−41.503	45.388	−61.812	−79.914
Mountain	−0.584	0.173	0.268	−0.239	−21.752	68.255	−45.333	−35.365
Open	−0.476	0.544	0.610	−0.191	−62.933	73.421	−51.064	−92.934
Rowing	−1.893***	−1.121***	−1.026***	−0.851**	−33.370**	−20.130	−36.479***	−19.454*
Rugby	−0.715	0.383	0.395	−0.517	−237.786	−83.542	−220.326	−317.773**
Sailing	−1.717***	−1.150***	−0.844***	−1.004***	−39.909**	−27.879	−43.271***	−30.510**
Shooting	−1.836***	−1.226***	−0.805**	−1.310***	−29.250**	−20.100*	−28.571***	−27.525***
Skateboarding	0.587	1.632**	1.346**	0.959**	−69.430	3.901	−102.214	−100.306
Softball	−0.153	0.332	0.469	0.296	−23.347	30.686	−165.914	−163.578
Sport Climbing	0.373	1.601**	1.615**	0.725	−178.920	−2.843	−137.736	−253.613*
Surfing	0.066	1.010	1.232*	0.352	−250.507	−118.321	−222.398	−346.526**
Swimming	−1.808***	−1.188***	−0.781**	−0.935***	−13.490**	−9.100	−13.250**	−9.049**
Table	1.047	0.518	0.828*	0.736*	113.785*	62.110	20.761	62.007
Taekwondo	−1.593***	−1.259***	−1.315***	−1.551***	−36.686*	−31.130	−61.221***	−49.970***
Tennis	−1.264**	−0.518	−0.274	−0.658**	−57.110	−18.244	−57.233	−44.466
Triathlon	−0.894*	0.116	0.304	−0.355	−66.309	58.539	−39.001	−48.890
Volleyball	−0.701	0.072	0.086	−0.226	−40.888	56.834	−75.590	−25.517
Water	−1.204*	−0.224	0.035	−0.989**	−125.283	7.004	−84.708	−157.558
Weightlifting	−1.860***	−1.364***	−1.166***	−1.425***	−30.934**	−23.397*	−38.058***	−30.788***
Wrestling freestyle	−1.437***	−1.370***	−1.472***	−1.369***	−21.669	−23.955*	−47.605***	−31.985***
Wrestling Greco-Roman	−1.608***	−1.291***	−1.247***	−1.334***	−44.729*	−39.927*	−70.677***	−51.794***

Table A2. Estimation for the first spell – full estimation.

	2				3			
	gold	silver	bronze	total	gold	silver	bronze	total
Archery					−95.778	−101.470	−160.938***	−141.271***
Artistic Swimming	0.956	0.074	0.012	−0.222	−50.574	−200.615	−334.490**	−326.856***
Athletics	−2.003***	−1.631***	−1.046***	−1.346***	−22.339***	−20.226***	−21.579***	−21.806***
BMX	−0.996*	−0.335	0.163	−0.803*	−423.152***	−330.465**	−374.807**	−491.631***
Badminton	0.507	0.412	0.507	−0.135	−47.675	−59.755	−103.805*	−125.677***
Baseball	−0.681	−0.098	0.071	−0.421	−744.918**	−589.264*	−783.876***	−880.516***
Basketball	1.043	−0.255	−0.163	−0.541	−37.121	−253.787*	−362.817***	−380.987***
Basketbal 3 × 3	−0.403		0.421	−0.490	−612.870***		−623.082***	−781.963***
Beach	0.106	0.421	−0.030	−0.393	−181.026	−140.249	−342.011***	−353.594***
Boxing	−0.933*	−1.059***	−1.301***	−1.323***	−42.991**	−47.015***	−67.409***	−62.387***
Canoe – Slalom	−0.722	−0.501	−0.377	−0.522	−156.790**	−146.860**	−199.842***	−189.790***
Canoe – Sprint	−1.334***	−1.001***	−0.716**	−0.912***	−69.077***	−62.272***	−75.330***	−73.337***
Cycling – Road	−0.860*	−0.379	−0.211	−0.366	−170.721**	−137.333**	−187.869***	−178.394***
Cycling -Track	−1.229***	−0.738*	−0.706**	−1.081***	−72.599***	−61.513**	−81.314***	−84.354***
Diving	−0.487	−0.185	−0.204	−0.136	−69.842*	−60.921*	−93.257***	−79.156***
Equestrian – Dressage	−0.067	0.195	0.491	0.281	−213.806	−179.054	−260.299*	−246.371**
Equestrian- Eventing	−0.395	0.040	0.149	0.031	−266.934*	−207.010	−310.193**	−288.478**
Equestrian – Jumping	−0.887*	0.396	0.021	−0.326	−342.304**	−150.695	−330.592**	−344.273***
Fencing	−0.957*	−0.323	−0.065	−0.621*	−69.008**	−50.858*	−67.778***	−76.390***
Football	−0.849	−0.363	−0.108	−0.655*	−335.708**	−270.893**	−353.393***	−399.350***
Golf	0.220	0.530	1.043*	−0.260	−351.164**	−309.585*	−358.208**	−539.158***
Gymnastic – Artistic	−1.167**	−0.562	−0.595*	−0.753**	−55.158***	−42.964**	−61.530***	−58.880***
Gymnastic- Rhythmic	0.302	0.371	0.262	0.200	−147.124	−154.561	−297.075**	−260.092**
Gymnastic -Trampolining	−1.069*	−0.418	0.080	−0.952**	−373.442**	−281.301**	−323.730**	−446.404***
Handball	−0.531	−0.352	0.021	−0.618*	−287.402*	−267.607*	−336.306**	−392.972***
Hockey	−0.878	−0.439	−0.305	−0.787*	−340.376**	−281.651**	−385.255***	−418.603***
Judo	−1.300***	−0.886**	−0.940***	−1.127***	−43.556***	−37.662***	−51.925***	−50.522***
Karate	−1.185**	−0.425	−0.777**	−1.394***	−149.336***	−124.383***	−170.884***	−195.965***
Modern	−0.705	−0.456	−0.066	−0.876***	−315.621**	−285.528**	−347.627***	−433.158***
Mountain	−0.747	−0.005	0.187	−0.461	−318.625**	−214.305	−310.151**	−368.266***
Open	−0.535	−0.086	0.130	−0.792**	−348.579**	−287.171**	−383.828***	−491.952***
Rowing	−1.209**	−0.894**	−0.696**	−0.733**	−56.499***	−51.121***	−64.097***	−58.990***
Rugby	−0.833	−0.216	−0.050	−1.142**	−536.868***	−440.882**	−551.263***	−717.971***
Sailing	−1.280***	−1.052***	−0.596**	−0.615*	−77.972***	−72.560***	−82.450***	−74.483***
Shooting	−1.532***	−1.022***	−0.698**	−1.172***	−56.710***	−48.131***	−56.971***	−61.574***
Skateboarding	0.240	0.854	0.631	−0.031	−247.918**	−198.403**	−294.839***	−340.047***
Softball	−0.052	−0.175	0.143	−0.072	−508.745	−629.207**	−743.401***	−878.909***
Sport Climbing	0.083	0.711	0.891	−0.223	−523.661**	−422.671**	−533.717***	−726.184***
Surfing	−0.253	0.370	0.563	−0.513	−586.601***	−489.264**	−596.409***	−784.796***
Swimming	−1.359***	−0.929**	−0.406	−0.867***	−25.635***	−22.107***	−24.656***	−26.483***
Table	0.897	0.256	0.717	0.318	−28.795	−80.357	−107.539*	−115.399**
Taekwondo	−1.455***	−1.218***	−1.184***	−1.615***	−86.247***	−79.888***	−105.367***	−110.067***
Tennis	−1.039**	−0.504	−0.384	−0.811**	−159.831***	−126.736**	−171.799***	−184.354***
Triathlon	−0.979*	−0.455	−0.096	−0.816**	−321.822**	−253.839**	−314.027***	−383.960***
Volleyball	−0.661	−0.125	−0.356	−0.521	−308.571**	−232.644	−392.239***	−371.066***
Water	−1.306**	−0.275	−0.308	−0.819*	−410.269***	−259.646*	−385.877***	−426.761***
Weightlifting	−1.476***	−1.271***	−1.050***	−1.314***	−58.623***	−55.465***	−68.402***	−67.755***
Wrestling freestyle	−0.919*	−0.874**	−1.190***	−1.153***	−45.174**	−47.367***	−74.496***	−67.236***
Wrestling Greco-Roman	−1.213**	−1.082***	−1.016***	−1.057***	−94.205***	−92.545***	−119.817***	−110.923***