Macroeconomics of international sporting success: how to win medals?

The literature on the determinants of sports performance is antiquated (from the 1950s) and multidisciplinary. Historians, geographers, physicians, sociologists, demographers, lawyers and economists have mobilised their tools and concepts: the length of time the practices have been in use and their social and spatial diffusion, the climate, the diet and the physical characteristics of the athlete, race, religion, the population, the political system and the per capita income.

Since the 1970s, econometric analysis has made it possible to improve our knowledge of the explanatory variables of Olympic medal wins according to the nations involved. It should be remembered that, although the IOC considers the Olympic Games to be a competition between athletes, the media's ranking of countries according to the number of medals won is a major geopolitical issue.

In addition to the three variables traditionally taken into account in modelling Olympic success - Gross Domestic Product (GDP) per capita, number of inhabitants and political regime - new variables were tested: the advantage of the organising country, the regional-cultural dimension and public spending on sport. However, other unobserved variables should be included to refine the analysis (notably doping).

The great imbalance in global sporting performance

A primary observation of the unequal access to sports performances can be made with a complete assessment of the distribution of medals according to the countries participating in the Olympic Games, a quadrennial multidisciplinary event and central indicator of sporting success [Bourg and Gouguet, 2007]. A historical and geographical reading of the results over the period from 1896 to 2018, i.e., 51 editions of summer and winter Olympic Games, reveals a very large imbalance in the Olympic podium achievements.

Developing countries have an average medal-winning 'productivity' more than five times lower than developed countries: 56 medals per country compared to 309. The values of this medal concentration ratio for low-income countries (10 medals on average per country, 1% of all medals), lower-middle-income countries (32 medals, 4% of all medals) and upper-middle-income countries (105 medals, 24% of all medals) reflect the magnitude of the disparities within developing countries (grouping of countries by level of development selected by the World Bank in 2019).

Success in sport is therefore largely reserved for high-income countries: 45 countries in this group won 71% of the Olympic medals (out of a total of 18,882 gold, silver and bronze medals), while 98 developing countries won only 29% and, 78 countries - almost all of them developing - did not win any medals. Only a few high-income countries participating in the Olympic Games did not win a single medal, demography being a major handicap for them: Brunei, Monaco, Oman in particular. These data show a close relationship between economic development and sporting performance.

The economic and demographic variables

The pioneering work of Donald Ball [1972] and Ned Levine [1974] studied the role of population and GDP per capita. GDP is an aggregate whose level is correlated with the wealth and quality of facilities, the country's ability to prepare competitive athletes for the Olympic Games with high-performance equipment, highly qualified technical staff, a medical system at the cutting edge of innovation and massive public and private funding of elite sport.

However, throughout the history of the Olympic Games a very high GDP alone has not guaranteed a large medal haul. Singapore (83rd in the world ranking of countries according to the number of Olympic podiums), Luxembourg (89th), Hong Kong (99th) and Kuwait (103rd) are marginal in terms of Olympic success, but are at the top of the list in terms of wealth on the planet, in the absence of political and budgetary choices in favour of top-level sport.

Population size is a limiting factor for small nations and nothing more than a resource for others to exploit. To develop a sporting elite, a country must have at least one million inhabitants. However, more than a quarter of the nations entered in the Olympic Games have a demographic size below this threshold. A calculation of the elasticity of the number of medals in relation to the population has shown that all things being equal, a country with average characteristics could win 16 more medals in one edition of the Summer Olympics if its number of inhabitants doubled [Blais-Morisset, Boucher and Fortin, 2017].

A large population is a necessary, but not sufficient, condition for winning titles. India, Pakistan, Bangladesh and Vietnam together account for 24% of the world's population and only 0.2% of the medals. Of course, a country with a large population will have a large pool of potential talent and will be able to allocate its fixed costs more profitably: from the 2000 Summer Olympics to the 2016 Summer Olympics, China has always been in the top three in the medal standings by nation, along with the United States, and Russia or Great Britain.

The political variables

The political regime helps to explain the distribution of tasks between nations. For this purpose, it is necessary to specify whether the country is democratic, liberal, communist, a market economy, one-party, a planned economy, or a post-communist country in transition to a more democratic and market-oriented system. Communist or formerly communist countries generally win more, or much more, than their national wealth or population size would predict.

The former USSR was, and Russia is, despite an average GDP per capita, a leading sports power (2nd in the world medal rankings). In the context of the Cold War during the years 1970 to 1990, the communist countries had a clear advantage over the capitalist countries. Indeed, these countries were able to mobilise resources centrally and concentrate them on a priority objective: the financing of Olympic disciplines and the production of medals. From 1976 to 2004, between 22.6% and 35.8% of developed countries with a liberal democracy won at least one medal. This percentage is between 90% and 100% for communist countries and between 33% and 100% for ex-communist countries in transition since 1992 [Andreff, Andreff and Poupaux, 2008].

The impact of the amount of public spending on medal wins has been the subject of an econometric study that confirms the importance of state action [Blais-Morisset, Boucher and Fortin, 2017]. Public funding reflects a country's desire to showcase itself during the Olympic Games for the dual purpose of geopolitical prestige and national cohesion. In such a way, the UK invested 340 million pounds to prepare for the 2012 Olympics, which was four times more than the amount spent on physical education in schools. The results were convincing as the British finished third in the world after the United States and China with 65 medals. Australia, for its part, spent 240 million euros on its Olympic elite, even though it has three times fewer inhabitants than Great Britain. The Australians ranked 10th in the world with 35 medals, ranking higher than in terms of demography (55th) or GDP (20th).

According to the specifications of the model used by Blais-Morisset, Boucher and Fortin [2017], and all things being equal, a country with average characteristics would have to invest between 56 and 74 million euros (holding constant the investment of competing nations) to gain an additional medal four years later. In other words, if France wants to reach the announced goal of 80 medals at the 2024 Paris Olympics [Andreff, Scelles, Bonnal, Andreff and Favard, 2019], it would have to increase the public budget dedicated to the preparation of its Olympic elite by about 1.6 billion euros over four years in order to win 25 more medals than in 2016 (42), this figure takes into account the benefit of being the organising country (+30% on average of podiums, i.e. 13 medals).

The sporting and societal variables

The 'host country effect' lies in the impact of the mobilisation of the nation hosting the event: increased funding for the preparation of its athletes, constant support from supporters and the national media, motivation increased tenfold by the patriotic enthusiasm, knowledge of the competition venues, familiarity with the climate, less stress due to transport and acclimatisation, and the absence of geographical, time and cultural differences. Stephen Clarke [2000] has determined that, on average, for the twenty-four editions of the Summer Olympics from 1896 to 1996, the organising countries increased their number of medals by almost 30%. For the next five editions of the Olympics, from 2000 to 2016, the expectation of further gains was 29%.

This 'home advantage' variable, therefore, has a significant influence on the overall performance of the host country, although there are considerable differences between countries: +53% for China in 2008 (Beijing) compared to 2004, +33% for Great Britain in 2012 (London) compared to 2008, +29% for Australia in 2000 (Sydney) compared to 1996, +21% for Greece in 2004 (Athens) compared to 2000, +8% for Brazil in 2016 (Rio) compared to 2012. The consequences of the increase in the number of medals awarded over the years have been neutralised to allow comparisons over time: from 921 medals in 2000 to 974 medals in 2016.

Some research with econometric models for individual winter sports has shown that the home advantage of athletes at the Olympics or World Championships results in an average 51% improvement in performance: 11 percentage points from public support and 40 points from their knowledge of the facility [Chun and Soo Park, 2021].

The regional-cultural dimension was introduced by Madeleine Andreff, Wladimir Andreff and Sandrine Poupaux [2008] to capture the effect of sporting culture by grouping countries with similar sporting specialities into nine major regions of the world. At the 1976 Olympic Games, the medals were distributed as follows: 53.6% for Eastern Europe, 19.9% for North America, 18% for Western Europe, 5.9% for Asia, i.e. 97.4% of the total for these four regions; the Middle and Near East, South America and Oceania shared the rest (North Africa and Sub-Saharan Africa did not obtain any medals). For the 2004 Olympic Games, the distribution was as follows: 26.3% for Eastern Europe, 26% for Western Europe, 16.6% for Asia, 16.4% for North America, i.e., a total of 87.3%; the other regions of the world took advantage of the decline of the former communist countries after the collapse of the Soviet bloc and its satellite countries to increase their shares (5.8% for Oceania, 3.1% for Sub-Saharan Africa and 2.7% for South America.

Learnings

As soon as a country has a certain level of wealth, demographic resources and political will, sporting success can be achieved. The United States is the most successful nation with 2,827 Olympic medals from 1896 to 2018, far ahead of the former USSR and Russia with 1,885 medals and Germany with 1,235 medals. These variables are good indicators of sporting success. For example, population and GDP per capita together explain 40% of medal wins [Levine, 1974]. But population alone cannot account for the distribution of podiums by nation.

A model of the distribution of medals at the 2008 Beijing Olympics, built with about thirty economic, social and political variables, was tested on the Olympics from 1976 to 2004 to determine the importance of each variable. Ex-post, this medal econometrics correctly predicted the results of 70% of the countries analysed at the 2008 Olympics, i.e., the number of medals obtained was 95% within the confidence interval (medals predicted minus medals won). The amount and forms of public support seem to guarantee sustainable medal gains that are much higher than those expected from an estimate based solely on economic and demographic indicators [Andreff, Andreff and Poupaux, 2008].

The amount of government spending on elite sports appears to be a better indicator of Olympic performance than GDP per capita, which remains statistically significant. Therefore, the national sports budget variable represents a relevant public policy instrument to achieve more ambitious podium targets. Indeed, the elasticity of the number of medals obtained by a country at the Summer Olympics relative to the public investments it has made varies between 0.23 and 0.38 depending on the specifications used [Blais-Morisset, Boucher and Fortin, 2017].

Predictive models are better at explaining the hierarchy of performance between nations in multi-disciplinary events such as the Olympics, than in the World Cup or the Euros, for example. At the summer Olympics, a thousand medals are at stake. In football, there is only one competition and only one winner. The number and repetition of competitions (38) allow a balance to be struck at the Olympics, with possibilities to redress failure in certain sports. Furthermore, the role of the State does not seem to be a significant variable in football, given the poor results recorded by China despite massive investment in the sport.

Further thoughts

Certain research has shown that the variables used are insufficient and can be combined in complex ways. Therefore, the approach to the macroeconomics of Olympic medals could be enriched by seeking to identify the explanatory power of two new variables. The first of these is doping, a variable that is a very important priority, but not observed [Andreff, Andreff and Poupaux, 2008]. Medical assistance for sports performance is a structural fact of contemporary competitive sport. If doping - legal or not, detectable or not, known or not - is consubstantial with high-level sport, the question of its unequal impact on performance arises. The effectiveness of the substances and methods used, masking products or innovations in the pharmacopoeia to circumvent the anti-doping rules does not have the same impact depending on the athletes, the countries, and the financial, scientific or legal resources mobilised.

The past (in a cold war context) or present (in a soft power logic) organisation of real state doping, differentiates the capacities to obtain medals in favour of the athletes 'benefiting' from such a 'preparation' (see the examples of the former USSR, the former GDR and Russia). The influence of this undetermined variable, due to the lack of a database, must be evaluated. Doping can create a decisive advantage in that the final difference recorded at the end of the competition is infinitesimal (less than 1%), even though the use of doping devices can improve results by 3 to 10% depending on the discipline.

The ranking of countries according to the number of medals obtained at the Sochi Winter Olympics (2014) partially illustrates the impact of a massive public-doping policy. Thus, a predictive model of podium wins based on socio-economic variables (without taking doping into account) attributed 24 medals and 4th place in the world rankings to Russia [Andreff, 2013]. Ex-post, the country hosting the Olympic Games won 33 medals (38% more than forecast) and ranked 1st in the world. After the detection and punishment of doping athletes (disqualification), Russia retained 22 medals and was demoted to 5th place in the world rankings.

A second variable is worth looking at, that of the results of the Olympic Games edition that immediately follows the one organised by the host country. For the Summer Olympics from 2000 to 2016, there was a significant increase in the number of medals compared to the edition that preceded the hosting of the Olympics, i.e., eight years earlier:+35% for Great Britain(2016/2004),+34% for China (2012/2004), +10% for Australia(2004/1996). Greece is the only exception with a 79% drop(2008/2000), which can be explained by the consequences of the investment cost for the 2004 Games, which

was uncontrolled and beyond the country's budgetary capacity, as well as by the consequences of the serious economic crisis that affected Greece afterwards. This 'post-Olympic Games' effect can be explained by the fact that the athletes taking part in this post host country Olympic Games are largely the same as those who benefited from exceptional public and private support four years earlier.

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