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POLICY BRIEF

20-6 What Might Have Been: Globalization on the Medal Stand at the Tokyo Olympics

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The Summer Olympic Games are the most globalized sporting event on earth. At the 2016 Rio Games, half a million spectators watched as more than 11,000 athletes—nearly half of them women—from more than 200 countries went head to head in sporting disciplines from aquatics to wrestling. Billions more followed through the media. Similar numbers were expected to watch the Tokyo Games in July.

Until now, the Summer Games had been postponed only three times—in 1916, 1940, and 1944—all because of world wars. So, the announcement that in response to the COVID-19 pandemic, the 2020 Tokyo Games would be postponed by a year is significant, implicit testimony to the destructiveness of the pandemic.

What was expected to be revealed in Tokyo was a continuation in the evolution of the Games away from the aristocratic European milieu where the modern Olympic movement began. As poverty has been reduced and incomes across the global economy converged, participation in the Games has broadened and the pattern of medaling has become more pluralistic, particularly in sports with low barriers to entry in terms of facilities and equipment (figure 1).[1]

This Policy Brief presents forecasts of medal counts at the 2020 Tokyo Summer Games had they had gone on as scheduled, setting aside possible complications arising from the coronavirus pandemic. The forecasts are not just a depiction of what might have been. They establish a benchmark that can be used when the Games are eventually held, to examine the impact of the uneven incidence of the pandemic globally.

The models indicate that the United States would have won the most medals. And thanks to an increase in the total number of medals awarded, its total was expected to rise. The rest of the world was forecast to continue to catch up,

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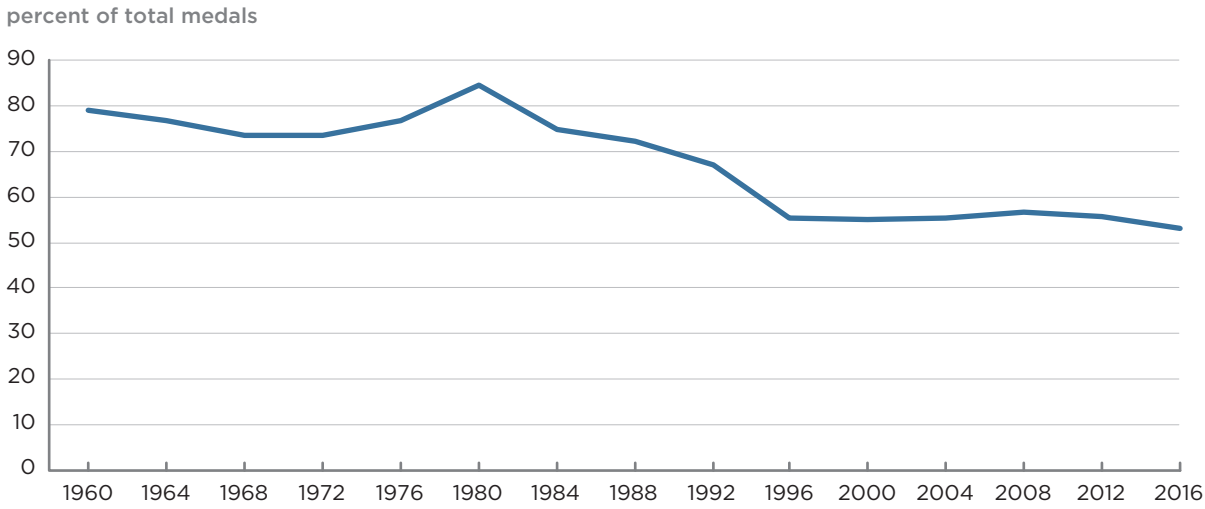
1 See, for example, Bernhard and Busse (2004); Johnson and Ali (2004); Klein (2004); Pfau (2006); Lui and Suen (2008); Leeds and Leeds (2012); Andreff (2013), Lowen, Deaner, and Schmitt (2014); Otamendi and Doncel (2014); Noland and Stahler (2015a, 2015b); Leeds (2019); Otamendi, Doncel, and Martín-Gutiérrez (2020); and Scelles et al. (2020).

Figure 1
Percent of total medals won by top 10 National Olympic Committees at the Summer Olympics, 1960–2016



Note: The composition of the top 10 National Olympic Committees changes depending on the year.
Source: International Olympic Committee.

however. The number of countries winning medals was forecast to rise, and the US medal share was expected to fall slightly. Both phenomena are projected to be particularly acute in women's competitions. Japan was expected to get a boost from hosting the Games and see its medal total increase.

These models did a good job of forecasting medal counts at the 2016 Rio Games when evaluated ex post (Noland 2016b). How they hold up in the post-pandemic world remains to be seen.

STATISTICAL MODELING

The forecasts are constructed using multivariate regressions that take into account real GDP per capita, population size, status as the current host, status as the host of the previous summer games, membership in the Communist bloc, average years of schooling, women's educational attainment, dummies for doping and boycotts, and distance from the Equator (see appendix A).

There is some evidence of changes in the importance of these determinants over time (the importance of membership in the Communist bloc has faded since the end of the Cold War and the importance of per capita income has declined in "low-entry" disciplines such as track and field and boxing, to give two examples). There is also evidence of differences in the importance of these factors in men's and women's competitions.[2]

2 There is also some evidence that Asian countries fare better in certain culturally linked disciplines (table tennis) and weight-stratified events (judo) (Noland and Stahler 2016).

That said, a number of confounding factors pose challenges for forecasting. One issue is that athletes from developing countries increasingly train in the United States and Europe. This access to facilities and coaching may explain the waning impact of per capita income on outcomes in some disciplines.

A second is that national identity is becoming an increasingly fluid concept. Athletes with eligibility to compete for multiple National Olympic Committees (NOCs), because of mixed national ancestry, sometimes choose their affiliations based on the likelihood of making the delegation. "Transfers of allegiance" accelerated after the 1990s (Jansen, Oonk, and Engbersen 2018). Gulf countries have actively recruited world-class athletes to become citizens. Qatar is the most brazen: Of the 39 athletes who competed for Qatar at the Rio Games, at least 23 were from other countries (17 countries in all). Allegiance transfers can affect medaling, but the numbers remain relatively small; with a few notable exceptions, such as the Kenyan-American runner Bernard Lagat, these athletes tend to be more marginal competitors. The impact of nationality switching is likely to weaken the statistical relationships over time, but it would not be expected to have a big impact on medal counts.

The same cannot be said about the impact of the use of performance-enhancing drugs (PEDs). Doping has long been part of the Olympic Games: The first recorded use of a PED was at the 1904 St. Louis Games, when American Thomas Hicks was given two doses of strychnine en route to winning the marathon. Concerns over doping intensified after Danish cyclist Knut Jensen died after suffering a heatstroke at the 1960 Rome Games after overdosing on Ronicol, a peripheral vasodilator known to enhance blood circulation. PEDs appear to be most effective in sports relying on power, such as weightlifting, sprinting, and swimming, and endurance sports (such as cycling and distance running).

A low point in this regard was the confirmation, following German unification, of long-held suspicions about the comprehensive system of doping administered by the East German authorities. This effort, involving more than 10,000 athletes, appears to have had a particularly significant impact on women's competitions, both because the drugs have a greater physiological impact on women, and due to the comparatively thin depth of competition in women's contests (Noland and Stahler 2015b). More recently, the World Anti-Doping Authority (WADA) uncovered a Russian state-supported program that included systematic falsification of testing samples. This discovery led to the banning of the Russian NOC at the 2016 Games, though many Russian athletes were allowed to compete on an "unaffiliated" basis (Noland 2016c; WADA 2020).[3]

There is evidence that other types of public policy interventions can have an impact on medaling. Great Britain's overperformance in Rio, where it avoided the slump that often occurs after hosting the Games, may have been a function of its targeting niche competitions for state support such as rowing and equestrian. The United States also overperformed in Rio, with the bulk of the unexpected

3 WADA and the Russian Anti-Doping Agency are in the midst of a legal dispute. Whether Russia will be able to compete in the 2020 Tokyo Olympics as a country or whether Russian athletes will be allowed to compete as "unaffiliated" athletes, as they did in Rio, has yet to be determined. For the purpose of this exercise, no special treatment was imposed on Russia. Tables 1 and 2 assume that Russian athletes perform for the Russian NOC.

medals going to women. Researchers have hypothesized that the continued strong performance of American women is connected to Title IX, a federal law that forbids gender-based discrimination in federally funded activities.[4]

Another issue is the impact of home field advantage. Normally, the host of the Games experiences a statistically significant performance boost, though Brazil performed woefully in Rio. That shortfall was anticipated: The country was in chaos, and Brazil is historically weak in judged events, such as gymnastics, where the impact of host advantage is greatest (Balmer, Nevill, and Williams 2003; Noland and Stahler 2015a; Noland 2016b, 2016c).[5] It is an open question as to whether the home field advantage will reemerge in Tokyo: Japan may be well placed to benefit from "home cooking" in gymnastics, where its women's and men's teams are currently ranked third and fifth in the world, respectively.

At this time, it is impossible to assess how the epidemic may affect the Games. It is possible that the Games could be played without spectators. Whether home field advantage would still obtain under that circumstance is not clear.

MEDAL FORECASTS

Table 1 presents the forecasts of rankings and medal counts at the 2020 Tokyo Olympics for the top 20 NOCs as well as the performance of the top 20 NOCs in 2016. In general, the number of medals each 2016 top 20 NOC is forecasted to win in 2020 increases. The total number of medals to be awarded in Tokyo is expected to be 10 percent higher than the number awarded in Rio, because of the addition of new competitions.[6]

Two forecast techniques are used. Column A in table 1 reports the forecasted number of medals on the basis of a model of overall outcomes; column B reports the forecasted number of medals aggregated from models of men's, women's, and mixed events estimated separately. The cross-national rankings are quite similar: The United States is predicted to earn the most medals, followed by China and Great Britain. Japan is expected to benefit from the home-field advantage and jump to fourth place. Without its home-field advantage, Brazil drops out of the top 20 ranking. Kenya is also forecast to fall out of the top 20.

In contrast to the trend toward greater cross-country dispersion in medaling shown in figure 1, the figures in table 1 show that the most successful countries increase their medal hauls. Two phenomena appear to be at work. First, there is a bit of the rich getting richer: Per capita income has not converged unconditionally, and in absolute terms there is a widening disparity of per capita incomes across NOCs. Second, the models are not good at capturing bolts of lightning: 17 NOCs that won at least one medal in Rio are forecasted not to win any in Tokyo. (Only one NOC—Hong Kong—which won no medals in Rio is

4 Not all interventions are successful: After a disappointing experience at Rio, Australia's Sports Commission abandoned its "winning edge" strategy.

5 Figure skating is another example of a discipline where the host advantage has been pronounced.

6 There will be 339 events in Tokyo 2020, according to the International Olympic Committee. There were 306 events at the Rio 2016 Olympics.

Table 1
Actual (2016) and predicted (2020) number of medals won by top 20 National Olympic Committees

2016			(A) 2020 total			(B) 2020 men + women + mixed		
Rank	*National Olympic Committee*	*Number of medals*	*Rank*	*National Olympic Committee*	*Number of medals*	*Rank*	*National Olympic Committee*	*Number of medals*
1	United States	121	1	United States	131	1	United States	137
2	China	70	2	China	83	2	China	85
3	Great Britain	67	3	Great Britain	74	3	Great Britain	77
4	Russia	56	4	Japan	66	4	Japan	66
5	France	42	5	Russia	62	5	Russia	63
5	Germany	42	6	Germany	49	6	Germany	57
7	Japan	41	7	France	47	7	France	50
8	Australia	29	8	Italy	32	8	Australia	34
9	Italy	28	8	Australia	32	9	Italy	32
10	Canada	22	10	Canada	28	10	Canada	31
11	South Korea	21	11	South Korea	27	11	South Korea	28
12	Netherlands	19	12	Netherlands	22	12	Netherlands	22
12	Brazil	19	13	Azerbaijan	21	13	Spain	21
14	New Zealand	18	13	Spain	21	13	Azerbaijan	21
14	Kazakhstan	18	15	Kazakhstan	20	15	Kazakhstan	19
14	Azerbaijan	18	16	New Zealand	16	16	Poland	16
17	Spain	17	16	Denmark	16	17	Uzbekistan	15
18	Denmark	15	18	Hungary	15	18	Denmark	14
18	Hungary	15	18	Uzbekistan	15	18	Hungary	14
20	Uzbekistan	13	18	Poland	15	18	Sweden	14
20	Kenya	13						

Source: Authors' calculations (see appendix A).

predicted to medal in Tokyo based on table 1 column A forecasts.) Those medals are implicitly reallocated, increasing the share of medals of NOCs that are already forecast to win at least one medal. However, if lightning strikes again, Tokyo will yield a new group of NOCs winning a medal or two, and the totals of the leaders will fall commensurately.

This observation points to the fact that given the estimated parameters of the models, some countries consistently perform unexpectedly well in some disciplines (Kenya in distance running and Jamaica in sprinting spring to mind) while others (such as India) tend to chronically underperform. To take account of what amounts to an unobservable variable, table 2 presents results in which the forecasts are constructed using the marginal change in the explanatory variable and the observed outcomes at Rio 2016 as the base.

The results from the marginal change models show less dispersion than the results in table 1, hewing more closely to the actual results observed in 2016. The United States, China, and Great Britain continue to lead the way, but their forecast medal totals are lower. The only top 20 NOC that experiences an increase in the number of medals of more than 10 percent is host country Japan. The others lose medal share relative to the rest of the world, reproducing the gradual pluralization of the medal winning depicted in figure 1.[7] And unlike in table 1, Kenya cracks the top 20.

At the 2016 Rio Olympics, the United States exceeded expectations, with women accounting for the bulk of the unexpected medaling (Noland 2016b). Table 2 suggests that the rest of the world is expected to gain ground on the American women in Tokyo, in part driven by a relative increase in female educational attainment. Although fewer Americans on the medal stand may disappoint American fans, the underlying change manifested in the outcome is socially desirable.

A perennial question is whether China can catch the United States. The model forecasts suggest that it will not do so in 2020, although it has been hypothesized that time zone proximity may be an advantage in competition, which would help China (Do and Galvez 2012).

7 In contrast to table 1, the forecasts in column A of table 2 imply that more than 30 NOCs that did not win any medals in 2016 are expected to win at least one medal in 2020. This effect tends to depress the shares allocated to the incumbent medal-earning NOCs. One explanation is that marginal forecasts (table 2) do not incorporate relatively large negative constants estimated by the models whereas nonmarginal forecasts (table 1) do.

Table 2
Changes in forecast results between 2016 and 2020

2016			(A) 2020 total			(B) 2020 men + women + mixed		
Rank	*National Olympic Committee*	*Number of medals*	*Rank*	*National Olympic Committee*	*Number of medals*	*Rank*	*National Olympic Committee*	*Number of medals*
1	United States	121	1	United States	125	1	United States	123
2	China	70	2	China	73	2	China	70
3	Great Britain	67	3	Great Britain	69	3	Great Britain	68
4	Russia	56	4	Japan	59	4	Russia	55
5	France	42	5	Russia	58	5	Japan	53
5	Germany	42	6	Germany	43	6	Germany	47
7	Japan	41	7	France	43	7	France	44
8	Australia	29	8	Australia	30	8	Australia	30
9	Italy	28	9	Italy	29	9	Italy	27
10	Canada	22	10	Canada	23	10	Canada	23
11	South Korea	21	11	South Korea	22	11	South Korea	21
12	Netherlands	19	12	Netherlands	20	12	Netherlands	19
12	Brazil	19	13	Kazakhstan	19	13	New Zealand	18
14	New Zealand	18	14	New Zealand	19	13	Kazakhstan	18
14	Kazakhstan	18	15	Azerbaijan	18	15	Spain	17
14	Azerbaijan	18	16	Spain	18	15	Azerbaijan	17
17	Spain	17	17	Hungary	16	17	Hungary	15
18	Denmark	15	18	Denmark	16	17	Denmark	15
18	Hungary	15	19	Kenya	14	19	Brazil	14
20	Uzbekistan	13	20	Uzbekistan	13	20	Kenya	13
20	Kenya	13						

Source: Authors' calculations (see appendix A).

CONCLUSIONS

Results from Olympic competitions reflect the underlying changes in the world economy over the past 60 years, particularly in disciplines in which entry barriers created by facilities and equipment are low. If the Tokyo Games had gone on as scheduled and, as in Rio, most Russian athletes had been allowed to compete (either under the Russian flag or as "unaffiliated" athletes), the preferred forecasts in table 2 imply that a continued pluralization of medal winners would have occurred. More than 30 countries that did not medal in Rio might have appeared on the stand in Tokyo. The United States was likely to remain at the top of the leaderboard, albeit with a smaller share of the medal count. The rest of the world would have continued to catch up, particularly in women's competitions. As host, Japan would have likely experienced a transitory uptick in medals.

But the Games are not being played in 2020, and if they are held with a one-year postponement as envisioned, they may be occurring under conditions very different from what was expected only months ago. The pandemic is likely to have uneven effects on countries around the globe. The forecasts in this paper depict a world that might have been. They establish a benchmark for evaluating the impact of the pandemic on the competitions when the Games are eventually held.

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APPENDIX A
DATA AND METHODOLOGY

The paper largely adopts the methodologies used in Noland (2016a). It produces four forecasts of the number of medals each NOC would win at the Tokyo 2020 Olympics, shown in columns A and B of table 1 and table 2. Column A of table 1 forecasts the total number of medals. Column B of table 1 is the summation of separate forecasts for men, women, and mixed teams. Table 2 also has the forecasts of the total number of medals (column A) and the summation of forecasts for men, women, and mix teams (column B), but it uses a different methodology from Table 1.

The unbalanced panel data consists of 208 NOCs and covers 15 Olympic Summer Games. Each forecast column in the two tables results from six Tobit models using this dataset. The first three models use data for 1960–2016; the last three models focus on 1992–2016.

The first model regresses the share of medals on the natural log of real GDP per capita in 1990 dollars; the natural log of population; average years of schooling for people 15–64; status as a current or preceding host of the Olympic Summer Games; a Communist country dummy; distance from the Equator; a doping dummy; a boycott dummy (Moscow 1980, Los Angeles 1984); an East Germany dummy; a Russia 2012 dummy; and dummies for each Summer Games.

The second model adds the lagged share of medals to the specification of the first model. The third model has the same specification as the first model but is estimated using a random-effects Tobit model. The fourth, fifth, and sixth models have the same specification as the first, second, and third models but use data that span a shorter period of time. All models are left-censored at 0 and right-censored at 1. Robust standard errors are used except in the random-effects Tobit models.

The Granger-Ramanathan (1984) method, which combines forecasts, is used to select which of the six models to use and determine the weights of the selected models. For the total and men's models, the second and the fifth models are selected. Only the fifth model is used for women's models.[8]

Using 2020 data and the combined forecast model, the paper predicts how many medals each NOC would win at the Tokyo 2020 Olympics. When the prediction produces a negative share, it is treated as winning zero medals.

Because of missing data, some NOCs, including 15 that won at least one medal in 2016, were dropped from the forecasting process. We used naive forecasts for these NOCs, assuming that in 2020 they would obtain the same share of medals they won in 2016. At the end, we scaled the forecasts (including the naive forecasts) so that the sum of all the forecasted shares would add up to 1.

Column B of table 1 separately forecasts the number of medals for men, women, and mixed teams. For men and women, we repeat the process described above, using the share of men's/women's medals and men's/women's average

8 In the total model, 72 percent of the weight is given to the fifth model. For the men's model, 67 percent of the weight is on the fifth model.

years of schooling attained. For mixed medals, we make a naive forecast that the share would stay the same as in 2016. At the end, we add the number of men's, women's, and mixed medals to produce the aggregate number in column B.

Columns A and B in table 2 use the same models and specifications as columns A and B of table 1, respectively. The difference is that in table 2 we use the share of medals in 2016 as the base. We add the effect of the changes in independent variables from 2016 to 2020 to the base using the parameters from the estimated models in table 1. Regarding real GDP per capita, for example, we forecast how much the changes in the natural log of real GDP per capita from 2016 to 2020 would increase or decrease the number of medals that each NOC won in 2016. As in table 1, column B of table 2 predicts the number of medals awarded to men, women, and mixed teams separately. We select the same models to yield a combined model, as in table 1 (the second and the fifth models for the total and men's forecasts and the fifth model for women's forecasts).

The data come from the following sources:

- The number of medals awarded between 1960 and 2016, by NOC and gender, comes from the International Olympic Committee.
- Real GDP per capita in 1990 dollars for 1960–2016 comes from the Madison Project database 2018. For countries not included in that database, such as East and West Germany, the data come from Noland (2016a).
- Real GDP per capita for 2020 was calculated using 2016–20 GDP per capita based on current prices growth rate from the *World Economic Outlook* (October 2019).
- Average years of schooling attainment (for men, women, and both) in 2015 and 2020 come from Barro and Lee (2015). Data for 2015 data were used for 2016. Average years of schooling attainment before 2015 data come from Noland (2016a).

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