Journal of Sports Economics
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Journal of Sports Economics published online 29 April 2014
DOI: 10.1177/1527002514531791

The online version of this article can be found at:
http://jse.sagepub.com/content/early/2014/04/28/1527002514531791

Published by:
SAGE
http://www.sagepublications.com

On behalf of:
The North American Association of Sports Economists

Article

Journal of Sports Economics
1-26

DOI: 10.1177/1527002514531791
jse.sagepub.com

Guys and Gals Going for Gold: The Role of Women's Empowerment in Olympic Success

Aaron Lowen[1], Robert O. Deaner[2], and Erika Schmitt[3]

Abstract

We test the hypothesis that women's empowerment correlates with women's international athletic success. Greater gender equality (measured using the Gender Inequality Index) is associated with higher participation and medal counts in the Summer Olympic Games from 1996 through 2012. This relationship persists even after controlling for previously identified nation-level predictors of Olympic success and across alternative measures of success (such as shares of the total, percentage within each country, and medals per athlete). These results provide direct evidence for the long-standing claim that girls' and women's international athletic achievement is linked to women's empowerment.

Keywords

gender equality, athletic performance, Gender Inequality Index, Olympics, Title IX, sex differences

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Introduction

The empowerment of women is often associated with improved outcomes for children and increased economic growth and development (Bucciarelli, Muratore, Odoardi, & Pagliari, 2011; Duflo, 2012; Klasen & Lamanna, 2009; Rees & Riezman, 2012; Scanlan, 2010). This empowerment is likely determined by a variety of social and political structures, including the participation of women in political decision making and legal structures protecting individual property rights. Some authors have hypothesized that one of these structures is athletic opportunity for girls and women (Brake, 2010; Brown & Connolly, 2010; Cahn, 1994; Diekman & Eagly, 2000; Hargreaves, 1994; Hogshead-Makar & Zimbalist, 2007; Kietlinski, 2011).

Quantitative evidence for the association between women's empowerment and athletic opportunities is now emerging. Within U.S. states, for example, as the sex difference in high school sports participation decreases, the proportion of college-educated residents rises (Stevenson, 2007), and increases in girls' high school sports participation predict later increases in women's educational and labor force attainment (Stevenson, 2010). Similarly, across 50 societies in the Human Relations Area Files, the sex difference in the number of sports is larger in patriarchal societies,[1] where women generally enjoy less control of resources and political influence (Deaner & Smith, 2012).

Some scholars and policy makers have further hypothesized that the association between women's empowerment and athletic achievement holds at the highest sporting levels. For instance, the U.S. women's 1998 World Cup soccer victory was widely regarded as a triumph for the education reform known as Title IX, which bars sex discrimination in access to athletic opportunities in federally funded educational institutions in the United States (Longman, 2000; Zirin, 2008). Similar claims have been made regarding national success at the Olympic Games (Brake, 2010; Brown & Connolly, 2010; Cahn, 1994; Hargreaves, 1994; Kietlinski, 2011). For example, the U.S. media noted that, for the first time, the 2012 Summer Olympics featured more U.S. female than male participants and attributed this to Title IX legislation (Brennan, 2012; Hersh, 2012). This legislation was a unique and powerful step in formalizing equal access to social resources, but cannot account for the large shift in women's participation in the Olympics, which has been an international phenomenon since the beginning of the modern Olympic era. Figure 1 shows the increasing percentages of Olympic athletes who are women and the number of Olympic events that include women, both of which have increased from nearly zero in 1900 to nearly half in 2012.

The present article tests the commonly assumed but not rigorously tested hypothesis that women's empowerment correlates with women's international athletic success. Specifically, we investigate the relationship between nation-level gender equality and success of both men and women in elite international athletic competition. We measure women's empowerment in each nation using the Gender Inequality Index (GII; Human Development Report Office, 2011), and athletic success by

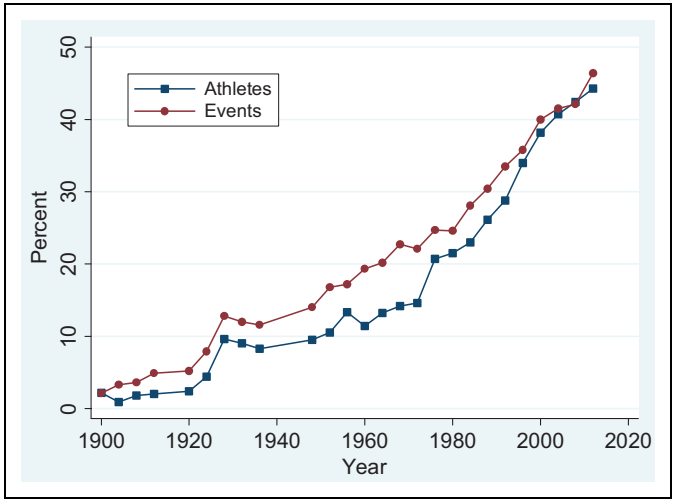

Figure 1. Female Olympic success: Female participation over time.

the number of participants and the number of medals won in the Summer Olympics. Our chief question is whether the GII predicts women's Olympic success even after controlling for previously documented predictors of Olympic success.

There are many sports that could be used to investigate the relationship between women's empowerment and elite international performance, but we use national success at the Summer Olympics to document the relationship. First, unlike any single sport, athletes from almost all countries and territories in the world participate. The 2012 Olympics had athletes from over 200 distinct National Olympic Committees (International Olympic Committee [IOC], 2013a). Thus, the Summer Olympics should allow inclusive, meaningful, and relatively accurate estimates of national athletic success. Second, the Olympics recognize a wider variety of elite performances (e.g., events with medalists) than in any other elite international sporting context, hosting over 300 distinct events (IOC, 2012b). Third, the number of Olympic events offered for women has steadily increased and now approaches the number offered for men (see Figure 1). For example, in the 2012 Olympics, 46.4% of the events were for women and 44.3% of the athletes were women (IOC, 2012a; OlyMADMen, 2012). Similarly, approximately 43.4% of the individual medals and 46.4% of the team medals were awarded to women (author computation). Fourth, the Olympics receive wide recognition by the global public. The 2012 Olympics, for example, generated over 100,000 hours of coverage spread over more than 500 television channels across the globe. These broadcasts reached an estimated 3.6 billion viewers in 220 countries and territories (IOC, 2013b). In addition, the Olympics are one of the few elite sporting contexts where female athletes receive media coverage that is reasonably similar to that of males (Billings, Angelini, & Duke, 2010), suggesting

that prestige is similar. Therefore, the Summer Olympics allow for more meaningful comparisons of male and female elite athletic success within and across nations than any other sporting context.

We expand on the substantial academic literature that predicts measures of Olympic success at the country level. Recent work has provided sophisticated analyses of macro-level economic and policy data and is summarized in Table 1 (work before 2000 is summarized in Baimbridge, 1998).[2] In general, population size, measures of income (gross domestic product [GDP] or gross national product [GNP]), government structure (typically whether each government had a centrally planned economy), being the host of the Games, and past Olympic success predict the number of medals won. We add to this literature by predicting multiple measures of Olympic success in the presence of a commonly accepted measure of gender equality, which has policy implications related not just to sport, but economic development.

The article most relevant to ours in this regard is Johnson and Ali (2004). Like other research, they model the total medal counts by country. Unlike other research, they also model the number of athletes sent by each country. They find that larger countries send more athletes and, at the Summer Games, tend to win more medals. Higher income is also associated with more participants and more medals. Consistent with the research discussed previously, they find that single-party and communist regimes do not send more athletes than republics and parliamentary democracies but do win more medals. Finally, they find that host nations are represented by more participants and win more medals.

Unlike other studies, Johnson and Ali (2004) separated their results by sex, allowing the possibility of meaningful variation in sex differences. They find the relationships between country size (population) and wealth (GDP per capita) and the number of athletes differ somewhat for men and women. They essentially find that female participation has increased over time, mostly driven by shifts in larger countries. They do not, however, consider the determinants of winning medals by sex nor do they consider empowerment-related variables that might underlie the differences in participation or medals by sex.

We find that greater gender equality is consistently and significantly associated with both higher Olympic participation and winning medals, even after controlling for population, GDP, host nation status, and other previously investigated predictors of Olympic success. This relationship persists whether participants and medals are measured in absolute numbers, shares of the total, percentage within each country, or in medals won per athlete. Although women experience larger positive effects from gender equality, greater equality is also associated with greater success for male athletes. Further, we find the new result that male athletes generally do less well in countries that are more unequal, even after controlling for variables such as GDP.

Our analysis does not include controls for country-level policy variables such as investment in physical education or Olympic training, because standardized measures do not exist. However, there is consensus that the United States has made

Table 1. Summary of Recent Literature.

Paper	Statistical Techniques	Olympics Included	Dependent Variable(s)	Independent Variable(s)
Baimbridge (1998)	OLS	Summers, 1896-1996	Proportion of countries winning at least one medal	Competitors per event and per country, government structure, boycotts, and time trend
Hoffman, Ging, and Ramasamy (2002)	OLS	Summer, 2000	Number of medals won	GNP, population, government structure, host status, and climate
Bernard and Busse (2004)	Tobit	Summers, 1960-1996	Share of medals won	GDP, population, host status, government structure, lagged medal shares, boycotts, and year dummies
Johnson and Ali (2004)	OLS, ordered Probit, Poisson, Heckman selection	All Games, 1952-2000	Number of participants and number of medals won	GDP, population, host status, government structure, geographic proximity to host, climate, and time trend
Lui and Suen (2008)	Tobit, Poisson, negative binomial	Summers, 1952-2004	Number of medals won and medals won per capita	GDP, population, life expectancy, education, host status, year dummies, and lagged medal winnings
Forrest, Sanz, and Tena (2010)	Tobit	All Games, 1992-2004	Share of medals won	GDP, government structure, current and future host status, lagged medal winnings, public spending on recreation, and subjective adjustments
Van Tuyckom and Joreskog (2012)	Structural equation modeling	Summers, 1984 and 2004	Medals won per capita	Three measures of political development, five measures of social development, and five measures of economic development, length of IOC membership, population size, and climate

Note. OLS = ordinary least squares; GDP = gross domestic product; GNP = gross national product; IOC = International Olympic Committee.

exceptional investments in girls' and women's athletics (Brake, 2010; Brown & Connolly, 2010). As a first step in investigating this issue, we explore whether U.S. women had exceptional success, given the country's other characteristics (e.g., population and GDP), and find little evidence they are disproportionally successful compared to other countries or U.S. men.

Data and Method

We test whether nations with greater gender equality yield greater women's athletic success. Our first measure of women's athletic success is participation of women in the Olympics, a good measure of success because most Olympic events have difficult qualification standards (see Johnson & Ali, 2004). Our second measure of success is the extent to which athletes win medals. We use Panel Tobit regression with random effects by country, where the number of medals won and the number of athletes sent have lower bounds of zero.

We analyze data from the Summer Olympic Games held in 1996, 2000, 2004, 2008, and 2012. Data on medals won were collected from the *New York Times* (2008) and the website of the International Olympic Committee (2012b). Because individual athletes can enter more than one event, we use the number of medals instead of the number of medalists. A number of events allow men and women to compete directly (such as equestrian events) or as a mixed pair (such as badminton). These events constitute less than 5% of the medals in the Olympic Games and were omitted from this study.

Many of the articles summarized in Table 1 used the share of the medals awarded in each year instead of the absolute number of medals. This approach accommodates the increasing number of medals awarded in each year and the omission of some medal-winning countries because other information on those countries was not available for all independent variables used. To address such concerns, we use several measures of success: the absolute number of participants and medals, the share of total participants and medals, the percentage of female participants and medals won by women for each country, and the number of medals won per participant. This final measure is an attempt to identify the country-level determinants of athletic success that converts participants into medal winners. Summary statistics for all variables are included in Table 2, with a correlation matrix of the variables measuring country characteristics in Table 3.

Participation data were obtained from OlyMADMen, a private organization specializing in the collection and dissemination of Olympic data (Sports Reference LLC, 2012). This participation data reflected smaller numbers than those reported by *The Guardian* (the first 50 nations yielded a correlation of .96) and the IOC (The Guardian, 2012; Official site, 2012). OlyMADMen provided participation data to the IOC and remains more accurate, as it is continually updated and only includes athletes who actually competed.

Table 2. Summary Statistics.

Variable	*N*	*M*	*SD*	Minimum	Maximum
GII	636	42.63	19.59	3.910	86.81221
Host	636	0.0079	0.0884	0	1
Polity2	636	4.280	6.149	−10	10
MuslimPct	636	23.46	36.03	0.1	99.86
GDP	636	274.4	1074.1	0.1280	11940.5
Population	636	45.75	154.0	0.7290	1350.4
Male participants	636	44.62	63.54	0	375
Female participants	636	30.10	52.30	0	289
Male medals	636	3.664	8.444	0	60
Female medals	636	2.621	7.182	0	58
Male conversion	634	4.074	6.177	0	33.33
Female conversion	615	4.010	10.22	0	100

Note. GDP = gross domestic product; GII = Gender Inequality Index.

Table 3. Correlations Among Country Characteristics (Significance Level in Parentheses).

	GII	Host	Polity2	MuslimPct	GDP
Host	−0.0971				
	(0.0134)				
Polity2	−0.4560	0.0407			
	(0.0000)	(0.2521)			
MuslimPct	0.3608	−0.0526	−0.5018		
	(0.0000)	(0.1347)	(0.0000)		
GDP	−0.2304	0.2013	0.1608	−0.1242	
	(0.0000)	(0.0000)	(0.0000)	(0.0005)	
Population	−0.0134	0.1709	−0.0169	−0.0408	0.3195
	(0.7338)	(0.0000)	(0.6349)	(0.2466)	(0.0000)

Note. GDP = gross domestic product; GII = Gender Inequality Index.

Following the relevant literature, our control variables include each country's GDP in billions of current US$ (*GDP*) and population in millions (*Population*) in the year of each Olympic Games. The data were gathered from The World Bank Group (2012). Missing years were estimated using linear interpolation, and 2012 GDP and population data, not available at the time of the writing, were estimated through a linear extension of 2010 and 2011 data. The dummy variable *Host* indicates the current host of the Games with the value 1, with the others receiving a 0.

We also use data on the political structure of each country in each year of the Games. This measure serves as a proxy for whether a country has centralized control that could demonstrate its power by creating Olympic success. We use Marshall, Jaggers, and Gurr's (2011) *Polity2* score, which comes from a transparent and rigorous assessment of every country with a population over 500,000 people for every

year since 1800. *Polity2* contains scores from 10 (indicating a full democracy) to −10 (indicating a full autocracy). Following their recommendation, we classified scores from −10 to −6 as autocracies, −5 to +5 as anocracies, and scores above 5 to be democracies.

Our critical independent variable is the GII (Human Development Report Office, 2011), a measure of women's advancement in a country. The GII replaces the Gender Development Index and Gender Empowerment Measures, more directly measuring the extent to which social achievements and empowerment differ by sex within countries. The GII is based on reproductive health (maternal mortality and adolescent fertility), empowerment (parliamentary representation and secondary education attainment), and the labor force participation rate. Scores range from 0 (gender equality) to 100 (gender inequality). Thus, higher GII values correspond to more unequal distribution of social achievement, while lower GII values correspond to more equal distributions.

Permanyer (2013) provides a careful discussion of the design choices used in creating the GII and trade-offs made when using it. In particular, Permanyer notes the labor force participation rate is used instead of earned income or income shares because those variables are not consistently or accurately gathered by many governments and so are not widely available or reliable measures of equality in the labor market. The author notes GII is an imperfect measure, using a complicated aggregation function that combines both absolute and relative performance measures. Most relevant to our analysis, these problems may cause poor measurement of women's outcomes in low-income countries, where poor health outcomes are confounded by low income. Second, the use of relative education and economic outcome measures may hide declines in women's outcomes when both men and women experience worse outcomes simultaneously. Our use of the GII is also driven by necessity, as we are not aware of any measures of underlying attitudes toward gender empowerment that are widely accepted, globally implemented, and resource based.

Finally, we included the percentage of the population that was Muslim (*MuslimPct*) according to the Pew Research Center (2011). Data were available for 1990 and 2010, and we used linear interpolation to estimate the intervening and following years.

Results

We examine the determinants of multiple measures of Olympic success. We first consider the absolute number of male and female participants and medal winners. We then analyze the share of total participants and medals won to accommodate the slightly changing number of participants and medals. Third, we examine the percentage of athletes from each country who are female and the percentage of medals won by females from each country. Finally, we consider the determinants of a "conversion," or the number of medals won per participant. In each analysis, we include the

independent variables discussed previously (*GII*, *Host*, *Polity2*, and *MuslimPct*) and three formulations of Gross Domestic Product[3] (*GDP*) and *Population* (linear, logged, and quadratic). Additional analyses were conducted, including using the components of GII, interacting GII and GDP, separating individual and team medals, and including a time trend, with results available from the authors.[4] When discussing the magnitude of effects on GII, we will focus on 10-point changes in the variable. Examples of 10-point differences in GII in 2012 include New Zealand (20.3) versus the United States (30.3) and (approximately) the United States versus Algeria (40.7).

We do not have data on country-level policy variables such as investment in physical education or Olympic training, but U.S. women benefited from direct governmental support in the form of Title IX. We discuss the effects of this legislation subsequently.

Number of Participants and Medals

Table 4 contains the regression results from predicting the number of participants. Our results support previous research in that larger, wealthier, and host countries send more athletes to the Games. Results from the quadratic models indicate diminishing marginal returns to both *GDP* and *Population*. Our results differ from previous research by finding that government regime (*Polity2*) is insignificant, but our data are entirely post-Soviet, whereas most previous research used at least some data from the Soviet era. Countries with a higher percentage of Muslim citizens send fewer athletes of both sexes, on average, in every formulation. The size of the effect is larger for men than for women, but, given that women constitute less than half the participants, this is to be expected. Finally, countries with more gender inequality (*GII* values closer to 100) send fewer female participants than countries with more gender equality (*GII* values closer to 0). This result holds for all three functional forms of GDP and population, with estimates ranging from two to six fewer athletes for a 10-point increase in inequality. In two of the three formulations, *GII* is only significant for women, indicating women's empowerment does not significantly affect male participation but does increase the participation of women.

We next analyze the determinants of the number of medals won, noting that the number of medals won is strongly related to the number of participants sent ($\rho = .8774$ in 2012). We return to this issue subsequently. Results presented in Table 5 indicate that the delegations of larger, wealthier, and host countries win more Olympic medals. As with the number of participants, government structure is insignificant and countries with higher percentages of Muslims win fewer medals for both sexes. In the linear and quadratic models, athletes in countries with more gender inequality win significantly fewer medals: about 1 medal for men and 1.5 medals for women, given a 10-point change in GII. The relationship is not different from zero in the log model.

Table 4. Number of Participants, by Sex.

	Males	Females	Males	Females	Males	Females
GII	0.0277‘	−0.581***	0.0531	−0.565***	0.381***	−0.194*
	(0.28)	(−7.23)	(0.52)	(−7.03)	(3.11)	(−1.72)
Host	126.2***	103.7***	118.7***	104.1***	121.3***	96.03***
	(21.38)	(21.60)	(18.69)	(20.53)	(20.48)	(18.95)
Polity2	−0.195	−0.0486	−0.217	−0.122	−0.371	−0.234
	(−0.79)	(−0.25)	(−0.88)	(−0.62)	(−1.49)	(−1.11)
MuslimPct	−0.430***	−0.205***	−0.408***	−0.221***	−0.518***	−0.330***
	(−3.91)	(−2.96)	(−4.04)	(−3.30)	(−5.08)	(−4.51)
GDP	0.0137***	0.0227***	0.0335***	0.0246***		
	(5.01)	(12.16)	(6.00)	(6.36)		
Population	0.0473*	0.0451***	0.136**	0.231***		
	(1.83)	(2.69)	(2.24)	(5.46)		
GDP^2			−0.00000157***	−0.000000222		
			(−3.89)	(−0.73)		
$Population^2$			−0.0000866**	−0.000143***		
			(−2.06)	(−4.75)		
Ln(GDP)					9.519***	9.915***
					(4.00)	(5.42)
Ln(Pop)					7.002**	6.823***
					(2.20)	(2.78)
Constant	45.59***	49.74***	39.10***	44.87***	−9.250	−4.208
	(6.60)	(10.15)	(5.73)	(8.96)	(−0.86)	(−0.50)
σ_u	48.65***	29.45***	43.99***	28.40***	44.42***	30.95***
Constant	(14.79)	(15.92)	(14.11)	(15.68)	(14.25)	(16.04)
σ_e	11.64***	9.542***	11.77***	9.425***	11.86***	10.14***
Constant	(30.64)	(30.69)	(30.20)	(30.55)	(30.28)	(30.76)
N	636	636	636	636	636	636

Note. GDP = gross domestic product; GII = Gender Inequality Index. *t* statistics in parentheses.
*$p < .1$, **$p < .05$, ***$p < .01$.

Table 5. Number of Medals Won, by Sex.

	Males	Females	Males	Females	Males	Females
GII	−0.116***	−0.136***	−0.109***	−0.148***	−0.0125	−0.0832
	(−3.03)	(−3.54)	(−2.85)	(−3.73)	(−0.23)	(−1.22)
Host	13.96***	7.837***	12.05***	8.612***	12.66***	6.448***
	(6.97)	(4.54)	(5.75)	(4.70)	(6.25)	(3.09)
Polity2	0.0289	−0.0174	−0.0325	−0.0239	−0.0452	−0.134
	(0.28)	(−0.16)	(−0.33)	(−0.22)	(−0.43)	(−1.06)
MuslimPct	−0.0413*	−0.0643**	−0.0461**	−0.0660**	−0.0721***	−0.111***
	(−1.78)	(−2.52)	(−2.11)	(−2.56)	(−2.95)	(−3.73)
GDP	0.00395***	0.00533***	0.00741***	0.00399***		
	(6.52)	(8.90)	(5.64)	(3.16)		
Population	0.0109**	0.0154***	0.0564***	0.0240		
	(2.33)	(3.35)	(3.85)	(1.58)		
GDP^2			−0.000000369***	0.000000116		
			(−3.33)	(1.13)		
$Population^2$			−0.0000396***	−0.00000575		
			(−3.53)	(−0.50)		
Ln(GDP)					2.638***	2.707***
					(3.90)	(3.10)
Ln(Pop)					1.262	2.417**
					(1.53)	(2.39)
Constant	2.670	0.757	1.439	1.287	−11.57***	−14.55***
	(1.35)	(0.36)	(0.72)	(0.61)	(−3.56)	(−3.58)
σ_u	7.680***	7.496***	7.043***	7.471***	7.944***	7.310***
Constant	(10.77)	(9.73)	(10.83)	(9.68)	(11.22)	(9.93)
σ_e	4.001***	3.440***	3.949***	3.432***	4.057***	4.169***
Constant	(19.15)	(17.07)	(19.08)	(16.84)	(18.93)	(17.09)
N	636	636	636	636	636	636

Note. GDP = gross domestic product; GII = Gender Inequality Index. *t* statistics in parentheses.
*$p < .1$, **$p < .05$, ***$p < .01$.

Shares of Participants and Medals

Analyzing the shares of participants and medals won accommodates the changing number of participants and available medals. For example, the number of female athletes has increased from 3,512 in 1996 to 4,664 in 2012, and the number of events including women has increased from 97 to 140 over the same time period. Table 6 shows that, once again, larger, wealthier, and host countries send relatively larger delegations of both male and female athletes, although with diminishing returns to population and GDP in the quadratic model. Government structure is still insignificant except for marginal statistical significance and miniscule economic significance for men in one formulation. In every case, the percentage of the population that is Muslim has a negative and significant effect. *GII* has inconsistent significance, with 10-point greater GII (inequality) resulting in a lower share of the total female athletes of about 0.08% (linear and quadratic models) or a higher share of male athletes of about 0.5% (log model) of the more than 10,000 athletes.

Table 7 contains regression results for the share of medals won. These parallel the results above: Wealthier, larger, and host countries win a larger share of the medals (with diminishing returns to population and GDP), government structure is not statistically significant, and countries with a larger percentage of Muslim citizens win a smaller share of medals. In quadratic models, more unequal countries win a smaller share of medals for both men and women (0.3% and 0.4%, respectively, for a 10-point change in GII) and no effect in the log model.

An important result in the analysis of the share of medals won comes in the relative magnitudes of the coefficient on *GII* for men versus women. In particular, more sex-based inequality leads to bigger losses for women than for men.

Percentage of Participants and Medals

Table 8 contains the regression results from predicting the percentage of athletes who are female from each country. Similarly, Table 9 contains results for predicting each country's percentage of medals that were won by female athletes. Both tables present results based on all countries in our data set (columns 1, 2, and 3) and on the subset of countries which won at least five medals in the given year (columns 4, 5, and 6). In both sets of countries, and for all formulations, higher values of the *GII* are significantly associated with lower percentages of female athletes sent to the Olympics (about 2–4% for a 10-point increase in inequality). Larger countries tend to send more female athletes, as seen in the log form for the full data set and all formulations among countries who won five or more medals. The percentage of a country's medals won by women is not significantly associated with the GII in most models but is marginally statistically significant in the quadratic model for all countries and the log model for countries winning five or more medals. The percentage of medals is significantly determined by the percentage of the population that is Muslim. These results should be interpreted with caution, as it is based only on countries who won at least one medal, eliminating over half of the participating countries.

Table 6. Shares of Participants, by Sex.

	Males	Females	Males	Females	Males	Females
GII	−0.00177	−0.00803***	−0.00110	−0.00806***	0.00490***	−0.00159
	(−1.21)	(−3.83)	(−0.75)	(−3.83)	(2.62)	(−0.60)
Host	2.076***	2.488***	1.955***	2.517***	1.950***	2.444***
	(23.99)	(20.54)	(21.14)	(19.61)	(21.62)	(20.82)
Polity2	−0.00314	−0.0000600	−0.00348	−0.00222	−0.00633*	−0.00379
	(−0.87)	(−0.01)	(−0.96)	(−0.45)	(−1.66)	(−0.76)
MuslimPct	−0.00593***	−0.00797***	−0.00571***	−0.00806***	−0.00774***	−0.00985***
	(−3.57)	(−3.88)	(−3.65)	(−4.37)	(−4.91)	(−5.15)
GDP	0.000349***	0.000139**	0.000642***	0.000276**		
	(8.95)	(2.36)	(8.04)	(2.36)		
Population	0.000620	0.00155***	0.00181**	0.00786***		
	(1.59)	(3.18)	(1.98)	(6.97)		
GDP^2			−2.38e-08***	−8.87e-09		
			(−4.09)	(−1.07)		
$Population^2$			−0.0000118*	−0.00000480***		
			(−1.92)	(−5.99)		
Ln(GDP)					0.196***	0.127***
					(5.55)	(2.73)
Ln(Pop)					0.0868*	0.250***
					(1.78)	(3.99)
Constant	0.791***	1.110***	0.688***	0.938***	−0.171	−0.0273
	(7.61)	(8.21)	(6.61)	(7.12)	(−1.04)	(−0.13)
σ_u	0.741***	0.893***	0.690***	0.785***	0.689***	0.824***
Constant	(15.48)	(13.76)	(15.11)	(13.36)	(14.98)	(15.12)
σ_e	0.171***	0.238***	0.171***	0.238***	0.181***	0.235***
Constant	(31.06)	(29.06)	(30.85)	(28.78)	(30.77)	(30.12)
N	636	636	636	636	636	636

Note. GDP = gross domestic product; GII = Gender Inequality Index. *t* statistics in parentheses.
*$p < .1$, **$p < .05$, ***$p < .01$.

Table 7. Shares of Medals Won, by Sex.

	Males	Females	Males	Females	Males	Females
GII	−0.0270***	−0.0350***	−0.0257***	−0.0381***	−0.00764	−0.0139
	(−3.53)	(−3.15)	(−3.28)	(−3.29)	(−0.68)	(−0.73)
Host	2.965***	2.352***	2.611***	2.421***	2.668***	1.990***
	(7.09)	(4.69)	(5.93)	(4.50)	(6.00)	(3.53)
Polity2	0.00207	−0.00545	−0.00838	−0.0137	−0.0140	−0.0354
	(0.10)	(−0.18)	(−0.41)	(−0.44)	(−0.62)	(−1.02)
MuslimPct	−0.00736	−0.0203***	−0.00831*	−0.0213***	−0.0141***	−0.0337***
	(−1.58)	(−2.78)	(−1.86)	(−2.89)	(−2.78)	(−3.97)
GDP	0.000996***	0.00128***	0.00160***	0.00118***		
	(8.23)	(7.98)	(5.82)	(3.29)		
Population	0.00205**	0.00457***	0.00969***	0.0108**		
	(2.18)	(3.56)	(3.19)	(2.52)		
GDP^2			−6.60e-08***	3.17e-09		
			(−2.85)	(0.11)		
$Population^2$			−0.00000667***	−0.00000490		
			(−2.87)	(−1.50)		
Ln(GDP)					0.582***	0.760***
					(4.08)	(3.16)
Ln(Pop)					0.248	0.657**
					(1.44)	(2.34)
Constant	0.624	0.205	0.402	0.257	−2.315***	−4.320***
	(1.56)	(0.35)	(0.99)	(0.42)	(−3.40)	(−3.79)
σ_u	1.530***	2.083***	1.435***	2.040***	1.596***	2.093***
Constant	(11.13)	(9.77)	(10.87)	(9.61)	(11.31)	(9.88)
σ_e	0.838***	1.001***	0.832***	1.010***	0.890***	1.126***
Constant	(19.54)	(17.22)	(19.28)	(16.95)	(19.26)	(16.83)
N	636	636	636	636	636	636

Note. GDP = gross domestic product; GII = Gender Inequality Index. *t* statistics in parentheses.
*$p < .1$, **$p < .05$, ***$p < .01$.

Table 8. Percentage of Participants Who Were Female.

	All Nations	All Nations	All Nations	5+ Medals	5+ Medals	5+ Medals
GII	−0.192***	−0.199***	−0.447***	−0.200**	−0.330***	−0.410***
	(−3.25)	(−3.17)	(−5.36)	(−2.09)	(−2.71)	(−2.73)
Host	0.528	1.016	1.718	−0.402	1.069	0.117
	(0.08)	(0.15)	(0.27)	(−0.12)	(0.32)	(0.04)
Polity2	0.291*	0.281	0.298*	0.315	0.266	0.185
	(1.67)	(1.58)	(1.75)	(1.16)	(0.91)	(0.63)
MuslimPct	−0.0312	−0.0330	−0.0288	−0.0993*	−0.0866	−0.101
	(−0.97)	(−1.01)	(−0.91)	(−1.75)	(−1.39)	(−1.57)
GDP	0.000503	−0.000303		0.000118	−0.00284	
	(0.50)	(−0.10)		(0.20)	(−1.48)	
Population	0.0105	0.0207		0.0182***	0.0781**	
	(1.48)	(0.72)		(2.93)	(2.33)	
GDP^2		6.30e-08			0.000000194	
		(0.24)			(1.22)	
$Population^2$		−0.00000797			−0.0000440*	
		(−0.35)			(−1.77)	
Ln(GDP)			−4.177***			−1.727
			(−4.21)			(−1.02)
Ln(Pop)			5.626***			4.202**
			(4.79)			(2.00)
Constant	42.36***	42.65***	53.75***	43.05***	45.58***	46.23***
	(13.68)	(12.99)	(11.25)	(11.61)	(11.01)	(7.06)
σ_u	10.08***	10.13***	9.743***	5.464***	6.352***	6.781***
Constant	(9.74)	(9.67)	(9.73)	(3.83)	(4.07)	(4.51)
σ_e	12.99***	12.97***	12.86***	6.722***	6.370***	6.441***
Constant	(29.24)	(29.16)	(29.36)	(12.25)	(11.83)	(12.29)
N	636	636	636	143	143	143

Note. GDP = gross domestic product; GII = Gender Inequality Index. *t* statistics in parentheses.
*$p < .1$, **$p < .05$, ***$p < .01$.

Table 9. Percentage of Medals Won by Females.

	All Nations	All Nations	All Nations	5+ Medals	5+ Medals	5+ Medals
GII	−0.429	−0.554*	−0.500	−0.135	−0.173	−0.402*
	(−1.45)	(−1.79)	(−1.21)	(−0.91)	(−0.99)	(−1.93)
Host	2.032	3.071	0.113	0.131	1.378	1.414
	(0.15)	(0.21)	(0.01)	(0.02)	(0.19)	(0.20)
Polity2	−0.524	−0.902	−0.622	0.682	0.698	0.543
	(−0.60)	(−1.02)	(−0.72)	(1.33)	(1.32)	(1.13)
MuslimPct	−0.423**	−0.470**	−0.449**	−0.255**	−0.251**	−0.265***
	(−2.21)	(−2.47)	(−2.46)	(−2.43)	(−2.38)	(−2.58)
GDP	0.00248	0.000615		0.000105	−0.00224	
	(0.70)	(0.07)		(0.10)	(−0.63)	
Population	0.0145	0.215*		0.0227**	0.0314	
	(0.53)	(1.95)		(2.01)	(0.53)	
GDP^2		−7.61e-08			0.000000216	
		(−0.10)			(0.73)	
$Population^2$		−0.000164*			−0.00000487	
		(−1.89)			(−0.11)	
Ln(GDP)			0.692			−3.249
			(0.13)			(−1.18)
Ln(Pop)			10.25			6.739**
			(1.63)			(2.03)
Constant	43.04***	45.01***	16.94	36.46***	37.86***	41.24***
	(3.11)	(3.17)	(0.77)	(5.30)	(5.22)	(4.01)
σ_u	41.54***	40.60***	38.50***	9.044***	9.129***	8.664***
Constant	(7.56)	(7.49)	(7.38)	(4.36)	(4.37)	(4.17)
σ_e	27.96***	27.96***	28.02***	14.42***	14.36***	14.48***
Constant	(15.63)	(15.57)	(15.58)	(13.56)	(13.52)	(13.54)
N	298	298	298	143	143	143

Note. GDP = gross domestic product; GII = Gender Inequality Index. *t* statistics in parentheses.
*$p < .1$, **$p < .05$, ***$p < .01$.

Conversion Rates of Participants Into Medals

Interpreting our results on the number of medals won is complicated because an athlete must receive support and training as well as actually participate in the Olympics to win a medal. Simply put, countries that send many athletes have more opportunities to win medals. Thus, we analyze medal counts conditional upon the number of participants. Table 10 examines the relative effectiveness of Olympic athletes from each country, where effectiveness is measured by the number of medals per 100 athletes sent to the Games. These results contain the most powerful argument for the role of gender empowerment in women's international athletic success. Depending on the specification, larger and wealthier countries are weakly more likely to have an athlete win a medal, but many of the coefficients are either

Table 10. Conversion of Participants into Medals, by Sex.

	Male	Female	Male	Female	Male	Female
GII	−0.252***	−0.435***	−0.271***	−0.478***	−0.195***	−0.375**
	(−5.72)	(−4.02)	(−5.92)	(−4.23)	(−3.13)	(−2.36)
Host	−0.174	1.377	−0.171	0.850	−0.363	−0.0750
	(−0.04)	(0.17)	(−0.04)	(0.10)	(−0.09)	(−0.01)
Polity2	0.0560	−0.112	−0.0325	−0.349	−0.0284	−0.265
	(0.40)	(−0.32)	(−0.23)	(−1.00)	(−0.21)	(−0.81)
MuslimPct	−0.000540	−0.117*	−0.0126	−0.146**	−0.0190	−0.142**
	(−0.02)	(−1.74)	(−0.50)	(−2.19)	(−0.76)	(−2.28)
GDP	0.00130*	0.00264*	0.00122	0.00326		
	(1.91)	(1.69)	(0.65)	(0.78)		
Population	0.0126**	0.0169	0.0674***	0.143***		
	(2.57)	(1.46)	(3.36)	(2.97)		
GDP^2			−8.83e-08	−0.000000278		
			(−0.52)	(−0.74)		
$Population^2$			−0.0000454***	−0.000105***		
			(−2.88)	(−2.76)		
Ln(GDP)					1.337*	1.818
					(1.76)	(0.92)
Ln(Pop)					1.253	4.805**
					(1.40)	(2.07)
Constant	7.022***	3.610	7.330***	4.239	−1.364	−14.27
	(3.08)	(0.65)	(3.14)	(0.75)	(−0.38)	(−1.62)
σ_u	7.103***	16.56***	6.658***	15.44***	6.686***	13.87***
Constant	(8.94)	(7.76)	(8.66)	(7.55)	(8.65)	(7.28)
σ_e	7.941***	16.58***	7.982***	16.74***	7.988***	16.88***
Constant	(19.90)	(18.06)	(19.79)	(17.91)	(19.76)	(17.86)
N	634	615	634	615	634	615

Note. GDP = gross domestic product; GII = Gender Inequality Index. *t* statistics in parentheses.
*$p < .1$, **$p < .05$, ***$p < .01$.

insignificant or marginally significant. This indicates a much weaker effect from wealth and population than might be expected. Host status and government structure are both insignificant for all formulations. The result for host status contradicts claims of "home field advantage" or "referee preference," possibly reflecting host countries sending more, and hence more marginal, athletes. The percentage of the population that is Muslim is marginally statistically significant for women but insignificant for men, indicating a systematic difference in the success of men and women from countries with different proportions of Muslim citizens.

The most critical result is the high level of significance and negative sign on *GII* for all formulations, which indicates that higher gender inequality reduces the number of medals won by both men (two to three medals per 100 athletes for a 10-point change in GII) and women (four to five medals), with the reduction for women being about twice than that of men. This indicates that more unequal countries are at a disadvantage for all athletes, but the disadvantage for women is far greater than that for men.

Sport in the United States: Title IX

In 1972, the U.S. government passed the education reform known as Title IX, which banned sex discrimination in federally funded educational institutions. One effect of Title IX has been improved access to athletic opportunities for women (Brake, 2010; Brown & Connolly, 2010). Title IX has also been credited with improved elite athletic performance by U.S. women, including their 1998 World Cup soccer victory (Longman, 2000; Zirin, 2008) and success at the Olympic Games (Brake, 2010; Brown & Connolly, 2010; Cahn, 1994; Hargreaves, 1994; Kietlinski, 2011). The U.S. media noted that the 2012 Summer Olympics featured more U.S. female participants than U.S. male participants and have connected the event to the 40th anniversary of Title IX, calling the U.S. female athletes "Team Title IX" (Brennan, 2012; Hersh, 2012).

Figure 2 identifies the United States with a hollow square, indicating the country has a higher percentage of female athletes than would be predicted by a simple regression of percentage of female athletes against *GII*. However, after controlling for country characteristics, U.S. women have shown less success in terms of participation and medals won relative to predictions from the quadratic model. Table 11 contains the actual and predicted values for U.S. participation and medal data over the study period, controlling for the independent variables listed previously (GDP, GDP squared, population, population squared, GII, etc.).

The table shows that more U.S. men and fewer U.S. women participated in the Summer Olympics than were predicted for a country with its characteristics. The men won about as many medals and women won fewer medals than predicted (although this is to be expected, given the lower number of participants). Analyzing shares of athletes gives a different result, with U.S. men having about the same share of participants and women more than predicted, given the U.S.'s characteristics. The

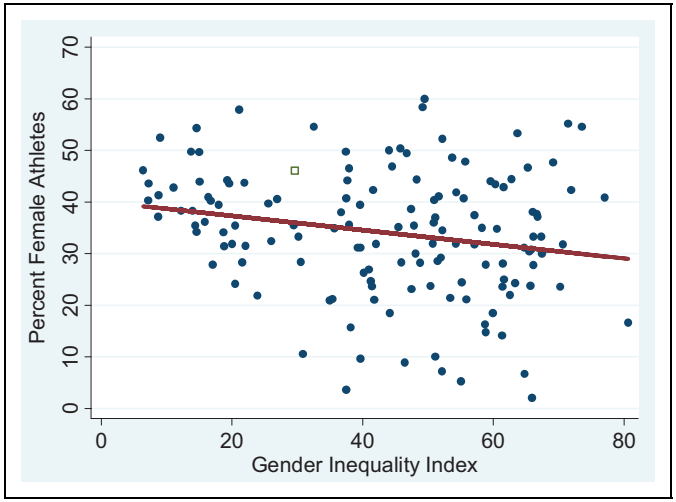

Figure 2. Female Olympic success: Percentage of athletes who are female by Gender Inequality Index, country averages, 1996–2012.
Note. the United States is indicated by a hollow square.

share of medals won, however, shows both U.S. men and women performing at or below expectations, with the statistically insignificant exception of female athletes winning a larger share of medals than expected in 2012. The data show substantial change over the period of analysis for the percentage of U.S. participants who are female and the percentage of U.S. medals won by females, although the percentages are not statistically significantly different from predictions. The conversion of participants into medals for each sex yields similar results, with the gap between predictions and outcomes closing for women, although none of the differences are statistically significant.

In sum, the results provide mixed evidence regarding the success of U.S. women in the Olympics. While they were at or below expectation for almost all measures, given their country's characteristics, U.S. women improved in several of them and may eventually show unusual success.

Discussion and Conclusion

We examine the relationship between women's advancement and international athletic success in the Summer Olympic Games. Our primary result is empirical confirmation that greater gender equality is consistently and significantly associated with improvements in two measures of Olympic success, athlete participation and medal counts. These improvements persisted after controlling for population, GDP,

Table 11. Success of U.S. Women at the Olympics Against Predictions, 1996-2012 (Predictions in Parentheses Below Actual Values).

	1996	2000	2004	2008	2012
Male participants	375	333***	279	307*	262
	(356.8)	(247.1)	(248.9)	(248.3)	(248.1)
Female participants	271***	253***	254***	282***	269***
	(372.8)	(302.9)	(322.2)	(340.8)	(347.6)
Male medals	60	51	55	53	45
	(58.4)	(47.8)	(47.9)	(47.7)	(47.5)
Female medals	36***	35***	40***	53*	58
	(52.5)	(53.7)	(59.6)	(65.5)	(67.6)
Share male participants	5.8**	5.3	4.7	5.1	4.6
	(6.7)	(5.0)	(5.2)	(5.3)	(5.3)
Share female participants	8.1***	6.5***	6.1***	6.3***	5.9**
	(6.6)	(4.4)	(4.5)	(4.6)	(4.7)
Share male medals	11.7	10.0	10.7	10.0	11.5
	(13.1)	(11.1)	(11.4)	(11.6)	(11.6)
Share female medals	12.6	9.8**	10.7**	13.4	17.0
	(14.0)	(13.6)	(14.8)	(16.0)	(16.4)
Percentage of female participants	42.0	43.2	47.7	47.9	50.7
	(47.6)	(47.9)	(48.8)	(50.3)	(50.5)
Percentage of female medals	37.5	40.7	42.1	50.0	56.3
	(68.8)	(65.5)	(65.3)	(66.8)	(66.7)
Male conversion rate	16.0	15.3	19.7	17.3	17.2
	(18.0)	(17.8)	(17.3)	(17.7)	(17.4)
Female conversion rate	13.3	13.8	15.7	18.8	21.6
	(26.6)	(23.4)	(21.5)	(20.9)	(19.9)

*, **, ***denote significance levels at 10%, 5%, and 1%.

host nation status, and other previously identified predictors of Olympic success, and regardless of whether measured in absolute numbers, shares of the total, percentage within each country, or in medals won per athlete. We see some fragility in the significance of the coefficient estimates when comparing quadratic and logged forms for GDP and population, but the fragility is reduced when considering expanded models.

While women experience larger negative effects from gender inequality, the data also show higher levels of inequality are associated with less success for both male and female athletes. In particular, the data confirm the anticipated result that countries with more gender inequality send delegations with a higher proportion of male athletes to the Summer Olympics. More interesting is that these male athletes typically win fewer medals, even after other controls are included. To our knowledge, this is the first time this finding has been reported, and no previous study predicted it. The potential mechanisms underlying this relationship are not obvious, but we note that GDP, government structure, and percentage of Muslim population have already been included as controls. One possibility is that societies that incorporate women in the workforce more equitably tend to generate more resources. This is in line with the work in economic development that connects women's empowerment to improved economic growth. This additional growth would create resources in a way that is not necessarily captured in GDP data, including expanded opportunities for recreational and personal pursuits such as elite athletic training and competition. Increased access to these activities would be shared by both men and women, improving the sporting performance of both groups. These results are important because they provide direct evidence for the long-standing claim that girls' and women's international athletic achievement is linked to women's empowerment (Brake, 2010; Brown & Connolly, 2010; Cahn, 1994; Deaner & Smith, 2012; Hargreaves, 1994; Kietlinski, 2011; Stevenson, 2007, 2010). We emphasize, however, that the data at hand cannot provide conclusive insight into the mechanisms leading to this association. In particular, we know of no exogenous changes that alter women's empowerment or international athletic achievement in a way that allow for a controlled test of the relationship.

Our work has implications for public policy for sport, women's empowerment, and economic development. Our confirmation of the relationship between women's elite athletic performance and gender equality even after controlling for so many independent variables, and the panel nature of the data indicates a significant and persistent relationship beyond mere correlation with variables such as GDP. As mentioned previously, however, we do not have access to data that would allow us to test causality. Duflo's (2012) examination of the existing evidence on women's empowerment and social outcomes concludes that the relationships are not necessarily self-perpetuating but require multiple supporting political and social structures to strengthen over time. The potential of sport as one possible venue for public policy to support women and foster economic growth has been established here and should not be underestimated.

Country-level public policies with regard to female participation in athletics may strengthen the visibility and acceptance of female athletes (particularly in highly unequal societies), but a rigorous analysis of individual country policies is beyond the scope of this article. The one piece of legislation considered, the U.S.'s Title IX, does not appear to have positioned their female athletes' participation or medals beyond what would be expected for a country of that size and wealth. That said, our overall results support the claim that increased athletic opportunities are one component of broader social, cultural, and political trends that may support the empowerment of women.

Our results must be interpreted cautiously, given the rules and structure of Olympic competition and limitations of the data. First, Olympic rules typically limit countries to three or fewer athletes per event, which weakens the link between country characteristics and athletic success. For example, a large proportion of the world's best marathoners are Kenyan, yet only three men and three women may represent Kenya in that event. Second, the IOC changes the roster of Olympic events over time in ways that may favor one sex or category of country (e.g., wealthier countries). For example, cricket and baseball are both popular internationally but are not currently included in the Olympic program. Third, existing data do not allow for controls of modulating variables such as the level of interest in sports and physical fitness of a population, general physical fitness, or infrastructure and support for athletics and fitness across age levels. These measures may help explain differences within and across countries in terms of athletic success for both men and women (participation and Olympic medals won).

Acknowledgment

The authors thank Dr. Bill Mallon for generously providing Olympic participation and medal data.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Notes

1. Deaner and Smith (2012) define patriarchal societies as those exhibiting patrilocality (married couples live near the husband's family) and patrilineality (titles and property move through males).
2. This summary omits articles using a technique called data envelopment analysis, a benchmarking procedure used to assess performance and set targets. The analysis differs

substantially from trying to predict medal counts and provides few insights on Olympic participation and medals by sex. Wu, Zhou, and Liang (2010) and Morton (2002) summarize the relevant articles.

3. Per capita gross domestic product (GDP) was tried in place of GDP but did not result in qualitatively different conclusions and so is omitted from this article. Results are available on request from the authors.
4. The coefficient estimates on Gender Inequality Index (GII) occasionally differ between the quadratic and log models for each dependent variable. In some cases, the coefficients differ in significance as well as magnitude. Additional analyses were conducted, including using the components of GII rather than GII itself, including an interaction between GII and GDP, analyzing individual and team medals separately, and including a time trend. All results are available from the authors on request.

   When using the constituent variables in place of the Index, there were few changes in either the magnitude or significance of the other independent variables with the exception of the percentage of the population that is Muslim, which largely either remains or becomes insignificant.

   For the interaction term, the only place that the change made a substantial change was for the number of participants sent, where a positive and significant coefficient on the interaction terms indicated that men benefit more from inequality in richer countries than in poor ones. In the logged setting, the coefficient on GII for female athletes shows that it is less damaging to be discriminated against in a rich country than a poor one in the context of elite performance in international sport.

   Separating individual and team medal counts yields more negative and statistically significant coefficient estimates on GII. In most cases, the differing results for GII across functional form shrink or vanish. This is particularly true for team medals, in which GII is now significant for all models.

   Finally, when adding a time trend, coefficients on GII are more consistently significant and negative across all tables, models, and sexes, except for the percentage of female participants and medals, which went from negative and significant to insignificant or remained insignificant. Coefficients on percentage of Muslim either did not change or become less significant in many of the tables. Despite the stronger results for negative and significant GII, the coefficient on the time trend was also consistently negative and significant. This is to be expected, as increasing population and equality tend to increase measures of Olympic success. As suggested by other results, the time trend was positively associated with a higher percentage of participants who are female while still having a negative, significant coefficient on GII.

   In each additional analysis, the results typically support a negative and significant coefficient on GII, more so than those presented here.

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