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On the determinants of sporting success – A note on the Olympic Games

Eike Emrich
Saarland University

Markus Klein
Saarland University

Werner Pitsch
Saarland University

Christian Pierdzioch
Helmut-Schmidt-University

Abstract

We analyzed whether, in democratic open societies, economic and demographic conditions allow sporting success at the aggregate level to be predicted. Theoretical considerations led to the hypothesis that the population size and gross domestic product (GDP) per capita should be important determinants of sporting success. Using regression analysis, we analyzed the influence of population size and GDP per capita on sporting success in Olympic Summer and Winter Games (1992 – 2010). Regarding the Olympic summer games, we found that the most powerful predictor is population size. In contrast, GDP per capita seems to play an important role as a predictor of sporting success with respect to the Olympic winter games.

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Contact: Eike Emrich - e.emrich@mx.uni-saarland.de, Markus Klein - ma.klein@mx.uni-saarland.de, Werner Pitsch - we.pitsch@mx.uni-saarland.de, Christian Pierdzioch - c.pierdzioch@hsu-hh.de.
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1 Introduction

Many contemporary societies systematically attempt to select and promote high-performance sporting elites. While the means different societies use to form sporting elites are similar, institutional structures and promotional programmes are quite different across societies, reflecting different cultural norms and political structures.[1] Institutions and promotional programmes can be located between the two extremes of a laissez-faire system and a rigid organizational system of sports promotion. A laissez-faire system implies that athletes are providers of sporting performance on an open market, while extensive state protection characterizes a rigid organizational system of sports promotion.[2] A laissez-faire system of sports promotion often develops in democratic open societies (see Popper, 1945), whereas closed societies often tend to enforce a rigid, dirigiste, and centrally-planned system of sports promotion.

History has witnessed that rigid systems of sports promotion have been characteristic of the sports systems of totalitarian societies. A non-exhaustive list of examples includes the rigid sports systems of the former Soviet Union, the German Democratic Republic, China, and North Korea. This historical record does not mean, however, that a totalitarian society is a necessary precondition for a rigid promotional system. Yet, a totalitarian society, seems to provide at least better initial conditions than a democratic society for rigid promotional systems to unfold. A combination of a totalitarian society with a rigid, centralistic system of sports promotion implies that individual athletes are being controlled, that they are delegated to specific training sites, that they train along the lines specified in long-term training concepts, that their performance is being tested on a regular basis, and that they are sorted out eventually in case their performance does not match with what is expected of them according to centrally specified plans.

Although democratic open societies with highly developed civil liberties may also opt for a centralistic rather than a laissez-faire system of sports promotion, open societies must always publicly legitimize the type and extent of their sports promotion. Moreover, in an open society, individual athletes can try to maximize their utility, implying that they may use their time for activities that promise the greatest subjective utility. As a consequence, such athletes will decide to do sports only if the extra utility of such an activity exceeds the utility that they can derive from other activities. In contrast to a rigid, centrally-planned system of sports promotion, an open society thus faces to a much more significant extent the problem to sort out those cultural, social, political, and demographic conditions that determine why athletes do sports and why they are successful.

Our research,aims at identifying those conditions that, in a cross-section of open societies, help to predict, at the aggregate level, sporting success at the Olympic Games. We present estimation results for the summer and winter Olympics. Most recent studies (Bernhard and Busse 2004, Hoffmann et al. 2004, Maennig and Wellbrock 2008, Li et al. 2009) only consider summer Olympics. Pfau (2006), in contrast, only considers winter Olympics. Johnson and Ali (2004) present results for both summer and winter Olympics, but their sample ends in 2000.[3] Our sample period runs from 1996 to 2010. We show that a simple unified framework can be useful to trace out the determinants of medal counts at both Olympic summer and Olympic winter games.

[1] For political influence on sports in English-speaking countries in general, see Houlihan (1997). For political influence as a determinant of sporting success, see de Bosscher et al. (2006).

[2] Concerning the latter, athletes are so called “state amateurs” [Staatsamateure], see Holzweißig (1981).

[3] The sample period studied by Johnson and Ali (2000) runs from 1952 to 2000. Such a long sample period has the advantage that many data are available to study the determinants of Olympic success. A potential disadvantage is that care should be exercised to asses the stability of the parameters of the regression model being studied (Maennig and Wellbrock 2004).

We organize the remainder of this research follows. In Section 2, we build on earlier literature to setup a theoretical foundation for our empirical research. In Section 3, we describe our empirical research. In Section 4, we offer some concluding remarks.

2 Theoretical foundation

The influence of cultural, social, economic, and demographic conditions on sporting success has been studied for many years. A list of early studies on this subject includes the research by Jokl et al. (1956), Ball (1972), Novikov and Maximenko (1972), Seppänen (1972), Grimes et al. (1974), Levine (1974), Kiviaho and Mäkelä (1978). More recent studies are Colwell (1984), Gärtner (1989), Seppänen (1989), Baimbridge (1998), Condon et al. (1999), Lamprecht and Stamm (2001), Hoffmann et al. (2002), Johnson and Ali (2004), Bernard and Busse (2004), Hoffmann et al. (2004), Campbell et al. (2005), Pfau (2006), Schmid et al. (2006), Maennig and Wellbrock (2008), Shibli and Bingham (2008), Li et al. (2009), and Bryant (2011). Despite much significant research on the subject, however, a consistent picture concerning the determinants of sporting success has not yet emerged.[4] At least the following reasons are likely to have contributed to the scattering of research results reported in earlier literature:

Firstly, researchers have measured sporting success in different ways. For example, researchers have measured sporting success by counting gold medals only, medals (gold, silver and bronze medals) in a medal table, and by linear transformation (1st place: 10 points, 10th place: 1 point) (see Pitsch et al., 2001). The most common form of measuring the collective sporting performance is based on counting the number of medals (gold, silver and bronze medals) in a medal table for every country participating in the Olympic Games. Secondly, researchers have used different explanatory variables and different scales for the same explanatory variable (see Schmid et al., 2006). This scattering of explanatory variables may reflect to a certain degree a lack of full-fledged theoretical foundation of empirical research. Thirdly, researchers have estimated different statistical models on data differing with respect to the sample period, Olympic Games (summer games, winter games) and with respect to the sample of countries being analysed (all countries participating in the Olympic Games, only those with medal rankings, etc.). Finally, many researchers have studied only the bivariate correlations of sporting success and its potential determinants.

Given the diversity of findings reported and methods used in earlier literature, it is important that we are precise and explicit with regard to the theoretical foundation we used to organize our empirical research. Furthermore, given the significant diversity of explanatory variables considered in earlier literature, we shall focus on those explanatory variables that are likely to be key determinants of sporting success. Those key determinants should help to build a parsimonious empirical model that helps to explain a large proportion of the cross-country variability of sporting success across open societies. Accordingly, we took four key aspects into consideration to lay the theoretical foundation for our empirical research: population size and economic prosperity, geographical country size, and the proportion of the population living in big cities.

Population size increases the likelihood that persons with specific genetic conditions and sports talent originate from a population. Population size may also proxy for the size of a sports market and the possibility of athletes to attract media attention. The size of a sports market and media attention, in turn, are likely to have a positive effect on the financial income an athlete can derive from sporting success. If athletes can transform sporting success

[4] In addition to research on collective sporting success of nations at the international level, much research has been done to shed light on the determinants of sporting success in professional team sports (see Dawson, Dobson, and Gerrard, 2000; Dobson and Goddard, 2010; Garcia-del-Barrio and Szymanski, 2006).

into a high financial income the interest of young adults in sports is likely to increase, which should eventually lead to a better exploitation of the population of young adults.

Population size also matters insofar as a larger population ceteris paribus lowers the likelihood that individual athletes qualify for a competition. For example, if an athlete wishes to participate in the Olympic Games, he must beat, at the national level, those who compete with him for a strictly limited number of positions. The number of competitors and thus competitive pressure should depend on population size. The resulting highly competitive selection process should imply that, in open societies, athletes from larger countries (as measured in terms of population size) are more successful in an international competition like the Olympic Games.

Another aspect that may matter for sporting success is economic prosperity. In a rich country, a larger proportion of its population can afford doing sports. Furthermore, in a rich country, the proportion of daily working time which must be used for ensuring one's physical subsistence is likely to decrease, making it possible for a large proportion of the population to do sports. Economic prosperity is also likely to raise the likelihood that athletes can derive a significant amount of financial income from sporting success.[5]

Country size may also matter for medal counts. First, for all kinds of sports that depend on natural and climatic conditions (e.g., sailing, downhill skiing), the probability that a sport discipline can be practiced may increase in the diversity of environmental and climatic conditions and, thus, in country size. Second, the number of athletes a country can send to the Olympic Games depends on the number of different sports disciplines which are practiced at an elite level, implying that country size may matter for Olympic success .

Furthermore, the supply of expensive sports infrastructure like marinas and ski lifts is likely to depend one expected “capacity utilization” and, thus, on demand conditions. Demand conditions, in turn, should be correlated with the number of athletes that practice a certain sports discipline. Sports organizations such as associations and clubs, but also private and other public sports providers, only provide a broad variety of sports facilities if a sufficient number of athletes is interested in using the various sports facilities. A large proportion of the population living in big cities, therefore, may increase the probability that politicians and sports clubs are willing to supply such facilities, which could have a positive effect on how many different types of sports facilities are being available in a region or country. A broad availability of a large variety of sports facilities could also increase the likelihood that athletes are successful in many Olympic disciplines. As a result, success at Olympic Games may depend on the proportion of the overall population that lives in big cities.

[5] One could also imagine that the distribution of economic prosperity and income across a countries population matters for sporting success because, for example, the proportion of the population earning an income belonging to the lower quartile of the income distribution perhaps cannot afford doing sports. Furthermore, one could imagine that the distribution of income across young adults (or their parents) matters in this respect. Given a lack of data availability, we did not consider the distribution of income in our empirical analysis.

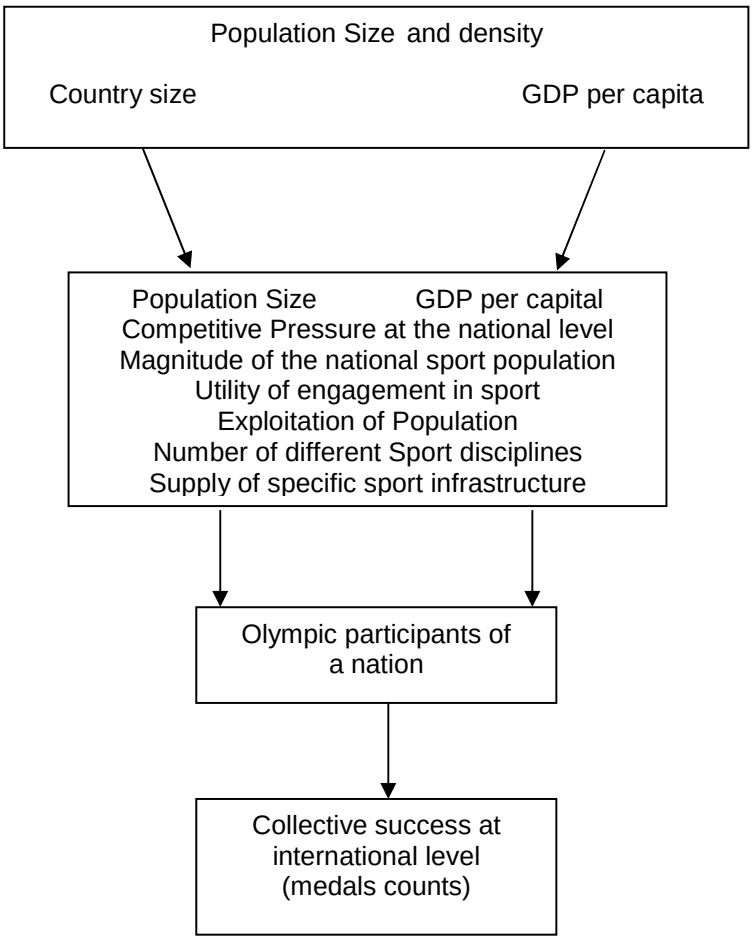

Figure 1: Structure of the model of collective athletic success in open societies.

To sum up, Figure 1 illustrates the structure of the model of collective athletic success discussed above. We emphasize that our model only applies to open societies.[6] Our empirical research strategy, thus, is to explain as much as possible of the cross-country variance of success at Olympic Games by means of a parsimonious regression model that features only a small number of explanatory variables.

3 Empirical analysis

In order to select a sample of countries that meet the criteria of an open and liberal society, we used the Freedom House Index,[7] which is based on the annual "Freedom in the World survey". This annual survey measures freedom – defined as the opportunity to act

[6] Previous studies (Bernhard and Busse 2004, Maennig and Wellbrock 2008, among others) typically cover a large cross-section of countries, including open societies, planned societies, and (post-)socialist societies. In order to account for potential differences across types of societies, researchers extend their empirical models to incorporate dummy variables. Differences between open societies and other types of societies are multidimensional, however, implying that a dummy variable is a "catch all" variable that captures in a stylized way the various differences. Because the economic and sociological interpretation of such a "catch all" dummy variable is difficult, we explicitly model only the medal winnings of open societies.

[7] Source: Freedom House. Freedom in The World - Edition 2009 - Methodology. Accessed on 15th May 2010 at: http://www.freedomhouse.org/template.cfm?page=351&ana_page= 333&year=2009. The fact that e.g. North

Table 1: Estimation results

	Summer Olympics 1996 (n = 27)				Winter Olympics 1998 (n = 15)			
R^2_{adj}	0.723							
	B	SE (B)	β	p	B	SE (B)	β	p
Constant	**0.505**	**0.233**		**0.040**				
Population size	**0.700**	**0.086**	**0.857**	**<0.001**				
GDP per capita								

	Summer Olympics 2000 (n = 37)				Winter Olympics 2002 (n = 16)			
R^2_{adj}	0.522				0.352			
	B	SE (B)	β	p	B	SE (B)	β	p
Constant	**0.529**	**0.238**		**0.033**	-3.474	1.804		0.075
Population size	**0.583**	**0.092**	**0.732**	**<0.001**				
GDP per capita					**1.810**	**0.598**	**0.629**	**0.009**

	Summer Olympics 2004 (n = 34)				Winter Olympics 2006 (n = 17)			
R^2_{adj}	0.543				0.489			
	B	SE (B)	β	p	B	SE (B)	β	p
Constant	-0.244	0.484		0.618	**-3.555**	**1.309**		**0.015**
Population size	**0.571**	**0.094**	**0.713**	**<0.001**				
GDP per capita	**0.320**	**0.153**	**0.246**	**0.045**	**1.772**	**0.427**	**0.720**	**<0.001**

	Summer Olympics 2008 (n = 39)				Winter Olympics 2010 (n = 18)			
R^2_{adj}	0.470				0.284			
	B	SE (B)	β	p	B	SE (B)	β	p
Constant	-0.947	0.695		0.181	-3.36	1.975		0.109
Population size	**0.521**	**0.101**	**0.617**	**<0.001**				
GDP per capita	**0.514**	**0.233**	**0.263**	**0.034**	**1.596**	**0.589**	**0.579**	**0.020**

Note: This table summarizes statistically significant results for the presented determinants only. Results for country size and the proportion of the population living in big cities are not shown because they were not significant. The adjusted R^2 was calculated for the whole model including all four explanatory variables. B = estimated coefficient. SE = standard error. β = standardized coefficient, n = number of observations. p = p value.

spontaneously in a variety of fields outside the control of the government and other centres of potential domination – according to two broad categories: political rights and civil liberties. For the purpose of our empirical analysis, we selected those countries that showed the two highest levels of civil liberties during a period of time of four years up to an including an Olympic year. We focused on the Summer Olympics of 1996, 2000, 2004, and 2008, and the Winter Olympics of 1998, 2002, 2006, and 2010. We measured the sporting success of countries in terms of the total number of medals (gold, silver, and bronze medals, see however, Shibli and Bingham 2008).[8] the data source for the number of medals were the web page of IOC (www.olympic.org) and Wikipedia (http://www.wikipedia.org).

We retrieved data on the explanatory variable population size and economic prosperity (as measured in terms of GDP per capita) from the Penn World Tables (Version 6.3; Heston et al., 2006) and, to include the Olympic Games of 2004 and the Winter Games of 2006 in

Korea also met this inclusion criterion indicates however that the measurement of indicators on which the Freedom House Index is based can be prone to errors.

[8] We also analysed the sporting success of those nations which are classified as nations with restricted liberties according to the Freedom House Index, but did not find any significant influence of the explanatory variables on collective sporting success (results are not reported). Weighing medals (gold medal: 3 pt, silver medal: 2 pt, bronze medal: 1 pt) led to very similar results (results are available from the authors upon request).

our empirical analysis, the CIA World Factbook from 2002 to 2007.[9] We retrieved data on the proportion of the population living in cities also from the CIA World Factbook. We measured the four explanatory variables in terms of logs.[10]

Population size is significant in the case of the four Summer Olympics. It is never significant in the cases of the Winter Olympics. This result confirms results found by Johnson and Ali (2004) that GDP per capita is more important for the Winter Olympics than for the Summer Olympics, and that population size is less important for medals won in the Winter Olympics.[11] Economic prosperity as measured in terms of GDP per capita is significant in the cases of the Summer Olympics 2004 and 2008, and in the cases of the Winter Olympics, with the Winter Olympics 1998 being an exception.[12] The proportion of the population living in big cities as well as country size are always insignificant. Despite the parsimony of the estimated model, measured in terms of the number of explanatory variables being considered, it explains a large part of the cross-country variability of sporting success (measured in terms of the adjusted R^2).[13]

Figures 2 and 3 illustrate the explanatory power of our regression model. The figures also illustrate that the explanatory power of our regression equations is higher in the case of the Summer Olympics than in the case of the Winter Olympics. The comparatively lower explanatory power of our model in the case of the Winter Olympics suggests that other (unobserved) factors are more important for explaining sporting success in Winter Olympics than in Summer Olympics. One possibility, for example, is that geographical and climate conditions matter more for sporting success in Winter Olympics. Another possibility is that the strong influence of GDP per capita in the case of the Winter Olympics reflects a strong dependence on specific and costly sports facilities in winter sports. Such specific and costly sports facilities are only accessible to a relatively small proportion of the population (Flatau and Emrich, 2011: 100 ff), which explains why population size per se does not matter in winter sports. In contrast, only a small number of the sports practised at the Summer Olympics require access to specific sports facilities, implying that a large proportion of a countries population can do summer sports at low costs.

[9] Source: CIA World Factbook, accessed on 15th May 2010 at https://www.cia.gov/library/publications/the-world-factbook/index.html

[10] We found weak correlations among the explanatory variables (r_{max}=0.393; r_{min}=-0.299), implying that collinearity is not an issue. Because Maennig and Wellbrock (2008) find that parameters linking Olympic success to socio-economic explanatory variables may not be stable over time, we did not estimate a panel data model but decided to estimate our regression model for every Olympics separately. In order to control for a potential endogeneity problem, we lagged the explanatory variables (4 years). Notwithstanding, one should be aware of a potential endogeneity prolbem when interpreting our results in terms of a causal nexus connecting medal counts and the explanatory variables.

[11] Johnson and Ali (2004, 974) even find that less populous nations perform somewhat better in the Winter Olympics. They also consider squared population size as an explanatory variable. Pfau (2006) finds an insignificant effect of GDP per capita on medal counts at winter Olympics, and only a weakly significant effect of population size. We also tested whether the coefficient of population size is unitary. The test did not show any significant results.

[12] Bernhard and Busse (2004) find a significant effect of population size and GDP per capita on medal winnings at summer Olympics. Johnson and Ali (2004) also find a significant effect of GDP per capita, where they also consider squared GDP per capita as an explanatory variable. Hoffmann et al. (2004) find a significant effect on medal counts of GNP as a proportion of world GNP, where they study only the Sydney Games.

[13] Including data on the "degree of civil liberties" as a further explanatory variable in our regression equations reduced the explanatory power of the regression equations.

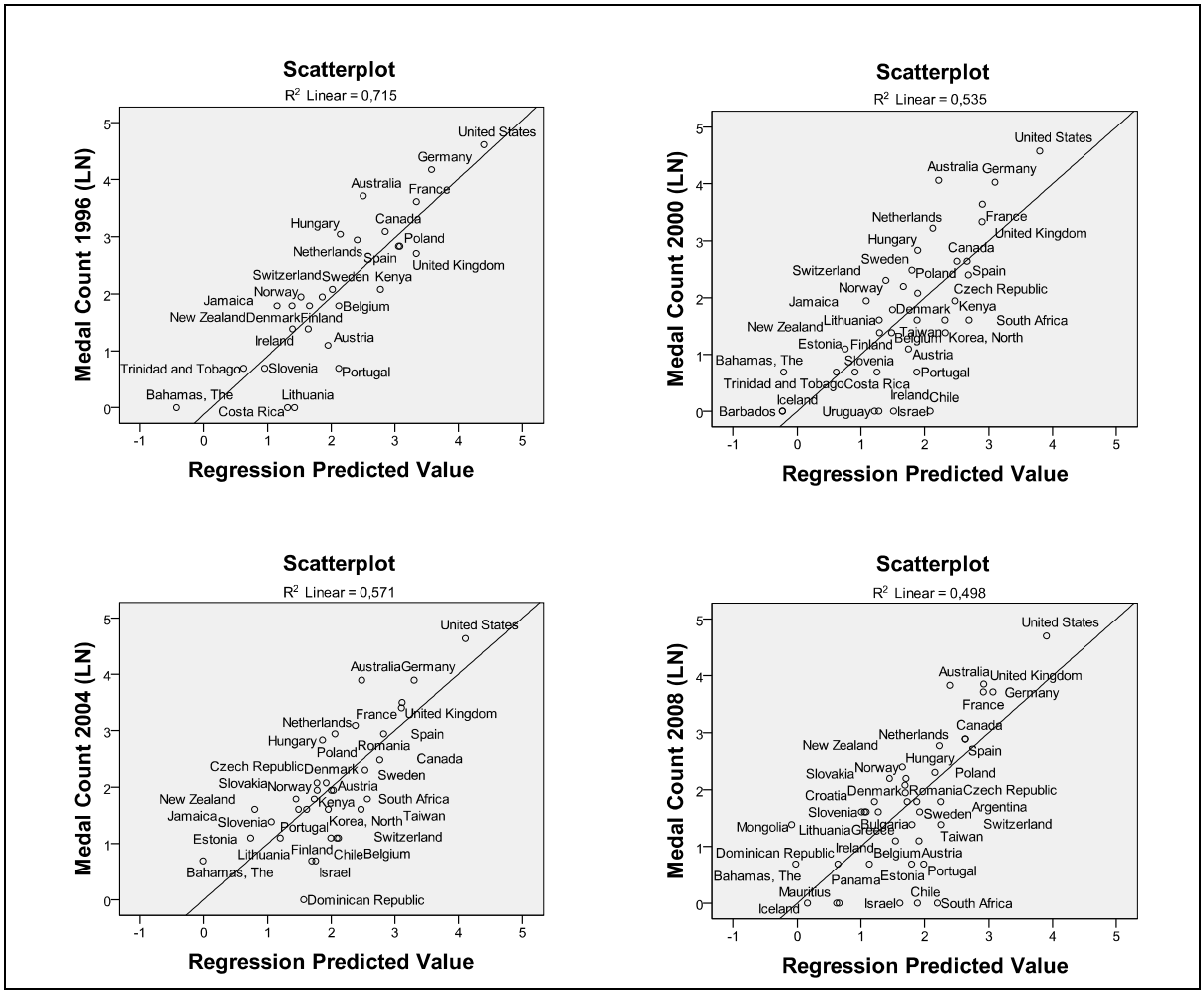

Figure 2: Comparison between predicted (standardized) and actual number of medals (logarithmic value) at the Summer Olympics, 1996 to 2008 (points on the line indicate a perfect correspondence)

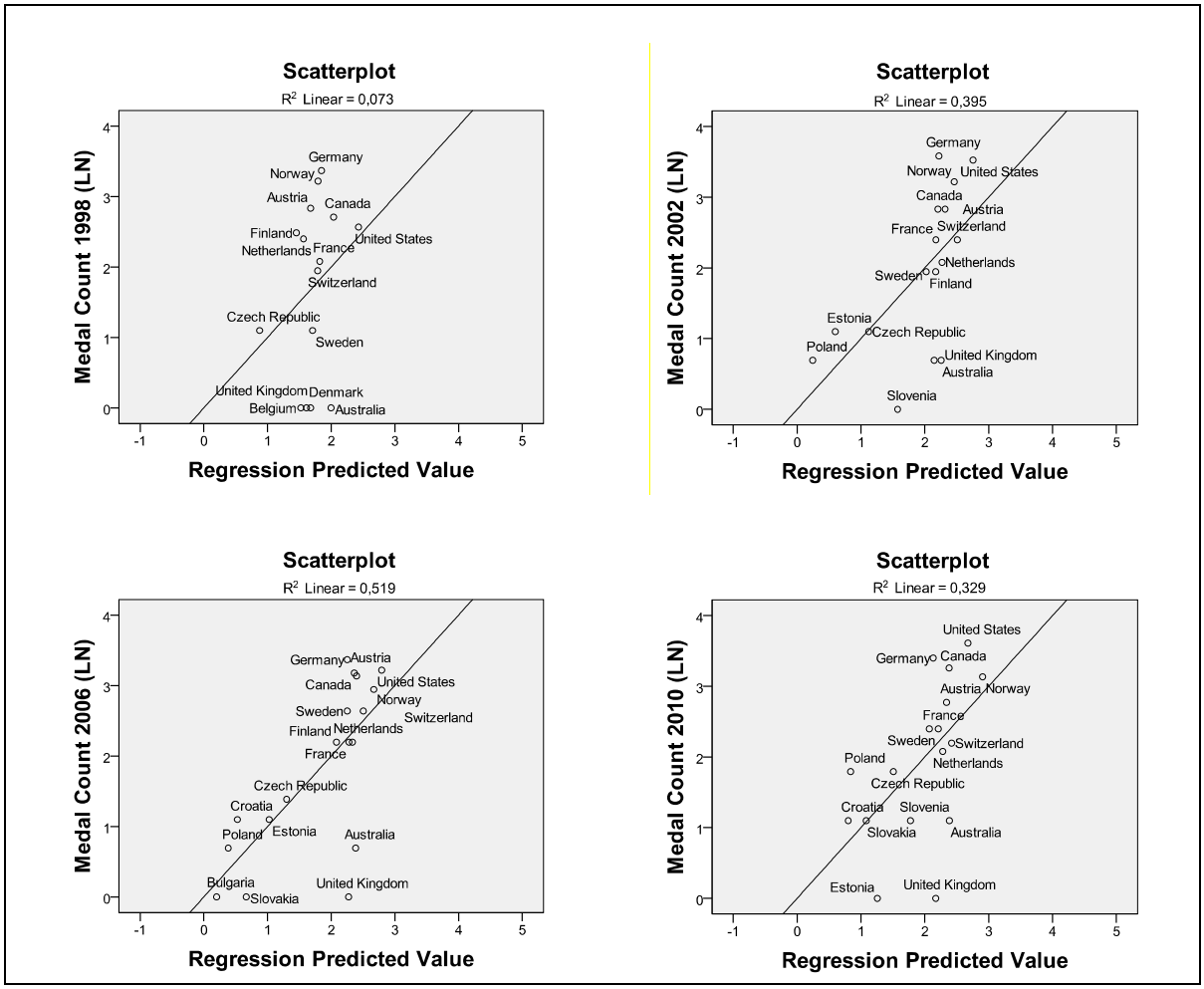

Figure 3: Comparison between predicted (standardized) and actual number of medals (logarithmic value) at the Winter Olympics, 2002 to 2010

4 Concluding remarks

Our results can be interpreted to show that the production of sporting success needs not only production sites and markets in which sport is in demand, but talented people, whether as producers or consumers. People and sporting talents cannot be produced like goods. Talented athletes are proving a particularly scarce ressource, in particular with respect to the Olympic summer games. For sporting success, athletes must be trained, the training and the competitions must be organized, sport facilities and scientific support for controlling and timing of the training process are needed, and so on. These elements of a high performance sport support system in open societies are expensive, and our results indicate that economic prosperity may matter in particular with regard to sport success in the Olympic winter games. In sum, it is important to analyze both population size and economic prosperity as preconditions for sport success, confirming results of earlier studies. Country size and the proportion of the population living in big cities have been found to be insignificant. While our results do not imply that the variables we have considered in our empirical analysis are the only variables that help to explain sporting success, our variables explain a substantial proportion of the cross-country variability of sporting success of open societies.

It is important to reiterate that, as compared to earlier studies, we restricted our analysis to open societies. This restriction was motivated by our theoretical model, which only is applicable to open societies. In future research, we plan to apply our empirical model to incorporate both open and closed societies. Such an extension will necessitate a careful extension of the theoretical underpinnings of our empirical research. In addition, it is most

unlikely that the simple ordinary least squares techniques that we applied to derive our empirical results for open societies also is applicable to study a broader cross-section of countries. A broader cross-section of countries typically features many countries that did not win Olympic medals at all. Bernhard and Busse (2004) use a Tobit estimator to account for such "zero counts".

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