Sport Management Review 15 (2012) 211–217

Contents lists available at ScienceDirect

Sport Management Review

journal homepage: www.elsevier.com/locate/smr

Olympic medals and demo-economic factors: Novel predictors, the ex-host effect, the exact role of team size, and the "population-GDP" model revisited

George Vagenas *, Eleni Vlachokyriakou

Dept. of Physical Education and Sport Science, National and Kapodistrian University of Athens, 41 Olgas, Dafne, Attiki 17237, Greece

ARTICLE INFO

Article history:
Received 20 February 2011
Received in revised form 26 June 2011
Accepted 18 July 2011

Keywords:
Olympic medals
Demo-economic predictors
Log-linear regression models
Ex-host effect
Olympic team size
GDP-free models

ABSTRACT

The present study revisited the problem of estimating Olympic success by critical demo-economic indicators. The sample consisted of the 75 winner countries at the Athens 2004 Olympic Games (not previously analyzed). Medal totals were log-linearly regressed on land, population, GDP, urban population, inflation, growth rate, unemployment, labor force, health expenditures, ex-host, and team size. Multiple regression assumptions were tested with proper diagnostics including collinearity. Olympic team size was the best single predictors of Olympic medals ($R^2 = 0.690$, $p < 0.001$), and as an alternative criterion variable was significantly regressed on population, growth rate, health expenditure, and unemployment ($R^2 = 0.563$, $p < 0.001$). Medal totals were significantly regressed on population, ex-host, health expenditure, growth rate, and unemployment ($R^2 = 0.541$, $p < 0.001$). The classical population-GDP model extracted only 28% of the variance in total medals ($R^2 = 0.277$, $p < 0.001$), and this was slightly improved when combined with unemployment ($R^2 = 0.365$, $p < 0.001$). It appears that the size of the Olympic team plays the role of transmitting the composite impact of a country's size and economy to the end-phase of Olympic success. Winning Olympic medals depends on the combined potential of population, wealth, growth rate, unemployment, ex-host, and social-sport expenditures. Larger and wealthier countries win more medals by "producing" larger Olympic teams as a result of possessing more athletic talents and better support for social and sport related activities.

1. Introduction

The demographic and economic determinants of Olympic success have been investigated over the last four decades by researchers and analysts from diverse fields. Olympic medal counts were routinely analyzed in relation to critical aspects of the political, social, economic, and demographic profiles of the participating countries for both explanatory and predictive purposes (i.e. Hoffmann, Ging, & Ramasany, 2004). Early analysis correlated non-parametrically medal indexes to selected dichotomies reflecting political and economic systems (i.e. Ball, 1972), while the first prediction models were tested in an attempt to explain total Olympic medals by the linear combination of GDP with the dichotomy of socialist vs. non-socialist economy, land area (Levine, 1972), and population (Grimes, Kelly, & Rubin, 1974). Subsequent studies explored primarily population-GDP based specifications, enhanced their models with the additive contribution of other potential factors, examined several editions of the games, and applied more sophisticated statistical methods.

* Corresponding author. Tel.: +30 2107276164, fax: +30 2107276192.
E-mail address: gvagenas@phed.uoa.gr (G. Vagenas).

1441-3523/$ – see front matter © 2011 Published by Elsevier Ltd on behalf of Sport Management Association of Australia and New Zealand.
doi:10.1016/j.smr.2011.07.001

Artificial neural network techniques contrasted to ordinary and weighted least squares regressions were utilized for the concurrent assessment of many candidate correlates of medal counts from the Atlanta 1996 Games and verified the validity of land area, population, and per capita GDP as prime predictors of Olympic success (Condon, Golden, & Wasil, 1999). Logarithmic functions of population and GDP estimates combined with the previous Olympic medals and the positive effect of the home – neighboring advantage were combined into successful specifications of total and gold medal counts from all summer Games between 1952 and 2000 (Johnson & Ali, 2002, 2004). Similarly, total Olympic medals were correlated with population-based estimates of proportions in athletic talents and, then, log-linearly regressed on the population-GDP pair of predictors along with home advantage and the Soviet influence (Bernard & Busse, 2004). These two later factors were examined in a series of more inclusive analyses of all Games between London 1948 and Sydney 2000, and the resulting models combined certain indicators of climatic conditions with population and GDP (Hoffman, Ging, & Ramasany, 2002, 2004). In that respect, Western and Eastern block countries were compared on their Olympic efficiency by applying a theoretical model to estimate the added cost for each additional athlete and medal, thus confirming by econometric analysis the best way of planning an optimal level of Olympic medals ''production'' (Tcha, 2004).

Lozano, Villa, Guerrero, and Cortes (2002) estimated best athletes' performance for future prediction of Olympic success by using countries that won at least one medal in all Games from Los Angeles 1984 to Sydney 2000. The approach was rather complex in terms of the number of potential predictors tested, with this being indicative of the difficulty inherent to correctly specifying optimal econometric models (Studenmund, 2001, pp. 157–242). As too complex regression models tend to increase variances in the coefficients and the predictions, while oversimplified ones suffer from biased coefficients and predictions (Myers, 1990, pp. 178–180), the main methodological problem in this area has been the determination of optimal specifications. When a large number of candidate correlates of Olympic success are explored, some of them end-up to simply be distal covariates of minor or no relevance, as for example correlates such as expected life span, death rate, number of airports, and total railway length found in study (Condon et al., 1999). On the other hand, there are cases of studies in which oversimplified models of Olympic success are proposed with only two predictors (population & GDP), as for example the multiplicative function of Morton (2002) and the ordered-logit model of Andreff (2001), or even with solely one predictor (GNP), as the simplest ever published model proposed by Nevill and Stead (2003).

According to theory developed by Shughart and Tollison (1993) the problem of Olympic success is a pure economic one that requires a certain balance between expected profit (number of Olympic medals) and cost (i.e. sport financing). Therefore, a better interpretability of the phenomenon under study may result from theory-based macroeconomic specifications (Studenmund, 2001, p. 167, 171) of moderate complexity (Stevens, 1996, p. 78), as for example the one proposed by Andreff, Andreff, and Poupaux (2008), which successfully combined population and GDP per capita, with the political regime, the host effect, and the cultural differences of countries across regions worldwide. Accordingly, certain substantive improvements are tenable in this field of research if some theoretically relevant but so far untested correlates of Olympic success are incorporated into novel specifications. For example, economic growth (Alexander, 1997; Barro, 1991; Moldan & Billharz, 1995), labor force (Alexander, 1997; Maddison, 1995), inflation (Grier & Tullock, 1989; Levine & Renet, 1992; Osborne, 2006; Pollin & Zhu, 2006), unemployment (Alexander, 1997; Benerjee, Marcellino, & Masten, 2005), and health expenditure, as an essential element of social and developmental investments (Alexander, 1997; Barro, 1991; Gupta & Sommers, 1999), had not yet been examined, despite their critical role in the structure of national economies and in international economics (Alexander, 1997; World Bank, 1998).

In addition, the exact role of Olympic team size had not been fully determined statistically and interpretably, while certain originality is secured by using data from the Athens 2004 Olympics, since no study has yet examined this edition of the Games. Moreover, there is margin for methodological improvement by testing for potential collinearity in the proposed specifications (i.e. population with land), as this inherent problem of multiple regression leads, among other things, to inflated standard errors of the estimated coefficients and in turn to unstable prediction models (Aczel & Sounderpardian, 2009, p. 536; Pedhazud, 1997, p. 295; Stevens, 1996, p. 76; Studenmund, 2001, pp. 248 and 252). In light of these novel perspectives the present study aimed at investigating the correlational structure of Olympics success (medals) by exploring the combination of traditional and novel demo-economic predictors, analyzing the exact role of Olympic team size, testing novel specifications of optimal fitting and minimum multi-collinearity, and revisiting the traditional ''population-GDP'' solution for comparative purposes.

2. Methods

The sample consisted of the 75 countries that won at least one Olympic medal in the Athens 2004 Games. Only the medal winner countries were analyzed and this secured certain statistical requirements regarding raw data transformation (e.g. when 0 medals are reported) and the presence of outliers (Condon et al., 1999; Grimes et al., 1974; Morton, 2002).

Olympic success was assessed by the total number of medals won by each country (Ball, 1972; Bernard & Busse, 2004; Grimes et al. 1974; Shughart & Tollison, 1993). A total of 929 medals were shared in these Games (301 gold, 301 silver, 327 bronze). Medal tallies (gold, silver, bronze, total) per country were collected from sources available by the International Olympic Committee, the NBC, and the official book of Olympic Games. The countries that have hosted the Games were also identified and a dichotomy was added to reflect this effect.

Valid data available in World Bank and United Nations sources were collected for each participant country on selected national demographic and economic indicators for the year preceding the Games, according to relevant studies (Ball, 1972;