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The Economic Factors Analysis in Olympic Game

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Abstract. In recent years, our country economic development tendency was encouraging, and the speed of catching up with developed countries is faster and faster. Athletics sports result is better than other countries at 29 Olympic Games hold in Beijing. Rapid economic growth is clearly to promote the development of sports. This paper will establish a multiple regression model by gold medals and weighted total medals to analyze the economic factors which affect the Olympic medals.

Keywords: economic factors, Olympic medal.

1. Introduction

Chinese sports delegation made 51 gold MEDALS and 100 MEDALS in Beijing Olympic Games in 2008. It is the first time for China to get No.1 instead of America. It is the best achievement to China since we take part in the Olympic Games. It is also a surmounting for China to advance to the modern Olympics movement powerful nation. It is affirmation to the Chinese sports development and also a great contribution to modern Olympics movement by Chinese nation. We break the record that the gold or medal is zero in many projects. This result has roused the national spirit enormously, and unfolded Chinese's sports strength to the common people. At the same time, we can not help but consider what factors are promoting our grow behind this achievement? What factors associated with the strength of a country's sports competition? This article in view of this fact is going to analyze the contact between national sports scores and various factors by multiple regression model. The Olympic Games' event is numerous and there do not have the direct absolute index to weight country result. Then the medal number may show the question to a certain extent. This paper will establish a multiple regression model by gold medals and weighted total medals to analyze the economic factors which affect the Olympic medals.

2. The choice of data and economic factors

We first check the information on the 2008 Beijing Olympic Games, reorganizes as follows:

Table 1 medals won situation of 2008

country	gold	silver	bronze	Total medals
China	51	21	28	100
America	36	38	36	110
England	19	13	15	47
Germany	16	10	15	41
Australia	14	15	17	46
South Korea	13	10	8	31
Japan	9	10	10	25
Italia	8	11	10	28
France	7	16	17	40
Ukraine	7	5	15	27
The Dutch	7	5	4	16
Spain	5	10	3	18
Canada	3	9	6	18
Brazil	3	4	8	15
New Zealand	3	1	5	9

Table 2 Independent variables and observation

country	05-08 Average annual GDP growth rate（%）	05-08 Per capita GDP growth rate（%）	05-08 Industrial production total index	08 Industrial production index	08 Agricultural production index	08Per capita agricultural production index
China	11	10.4	834.4	244.4	122.1	114.2
America	2.1	2.2	502.7	129.2	107.3	103
England	2.1	2	409.2	103.1	97.9	96.7
Germany	1.9	-0.1	465.4	117.4	102.8	102.4
Australia	3.0	2.7	476	120.2	90.9	87.4
South Korea	4.1	2.5	692.7	194.3	92.2	90.1
Japan	1.4	2.5	402.8	106	97.8	97.2
Italia	0.8	0.3	421.2	104.8	95.4	95.7
France	1.7	1	463.8	116.4	100	98.1
Ukraine	5	10.2	573.5	166.9	116.1	119.8
The Dutch	2.8	-1.4	438.3	110.2	93	91.1
Spain	3.0	2	477.8	122	103.4	102.5
Canada	2.2	1.1	490.8	128.4	101.8	98.7
Brazil	2.2	-1.4	464	124	125.4	119.3
New Zealand	3.9	1.8	443	114.6	114.2	110.8

As we all know, economy is the primary factor to influence the development of competitive sports. So we first consider the country's gross domestic product. The Olympic Games are held every four years, so we calculate four years' GNP sum between two Olympics. But during the computation, we find the gross national product and various countries' Olympic Games result have no linear relationship nearly. So we decide to use gross national product's average annual rate of growth and the industry and agriculture produces and another 12 factors as independent variable to analyze. We chose 15 countries to have a discussion.

In the table, industrial output index is on the base of 2000. 08 agricultural production index, 08 per capita agricultural production index is the base of total output value for 2000 index. The data of population density and health and social work personnel quantity is from 2007.

Human Development Index is a measure of human development which is the average achievements in three aspects of a comprehensive index: Health and longevity of life (with birth life expectancy to represent); Knowledge using adult literacy rate and large middle and primary school to represent); A decent living standards (with measured at purchasing power parity method to calculate the per capita GDP to represent). On this basis, we use the weighted average method to calculate the index of the three areas, then average the three indexes.

Education index is one of the three component indexes which published by the United Nations development program. It measured by adult literacy rate (2/3 weight) and elementary school, high school, college comprehensive enrollment rate (1/3 weight).

Renewal table 2

country	05-08Per capita medical expenses average (dollars)	05-08Medical expenditure's GDPaverage （%）	08Humanistic development index （%）	08Education index （%）	Population density (people/km2)	Health and social workers
China	63	5.8	75.5	84	141	530
America	5274	14.6	94.4	97	32	1783.4
England	2031	7.7	93.9	99	252	346.2
Germany	2631	10.9	93	96	236	439.8
Australia	1995	9.5	95.5	99	3	109.8
South Korea	577	5	90.1	97	491	74.5
Japan	2827	7.9	93.7	94	351	579
Italia	1737	8.5	93.4	95	202	157.5
France	2348	9.7	94	97	112	314.3
Ukraine	40	4.7	76.6	95	80	135.9
The Dutch	2298	8.8	94.9	99	483	131
Spain	1192	7.6	93.3	97	90	122.9
Canada	2222	9.6	94.9	97	4	184.6
Brazil	266	7.9	79.2	89	22	332.7
New Zealand	1255	8.5	93.3	99	15	20.4

Note: the Data is from the national bureau of the People's Republic of China's official web.

3. Method uses

Table 3

country	x_1	x_2	x_3	x_4	x_5	x_6
China	11	10.4	834.4	244.4	122.1	114.2
America	2.1	2.2	502.7	129.2	107.3	103
England	2.1	2	409.2	103.1	97.9	96.7
Germany	1.9	-0.1	465.4	117.4	102.8	102.4
Australia	3.0	2.7	476	120.2	90.9	87.4
South Korea	4.1	2.5	692.7	194.3	92.2	90.1
Japan	1.4	2.5	402.8	106	97.8	97.2
Italia	0.8	0.3	421.2	104.8	95.4	95.7
France	1.7	1	463.8	116.4	100	98.1
Ukraine	5	10.2	573.5	166.9	116.1	119.8
The Dutch	2.8	-1.4	438.3	110.2	93	91.1
Spain	3.0	2	477.8	122	103.4	102.5
Canada	2.2	1.1	490.8	128.4	101.8	98.7
Brazil	2.2	-1.4	464	124	125.4	119.3
New Zealand	3.9	1.8	443	114.6	114.2	110.8

This article analyzes the contact between medals and economic factors by multiple linear regression analysis. China is a developing nation of the world, we should pay attention to various aspects when the economic takes off. Sports is one hand which can also show our new look and comprehensive national strength. And the main objective of sports statistics is to establish the core index of the statistical data every year which can reflect the basic condition of Chinese sports industry development.. At the same time, make sound

the index system of sports industry development which can be accurate, comprehensive and systematic reflected by special investigation or economic census. People constantly describe, analyze, control and forecast the quantity relationship in market economy by regression forecast. This method will surely make great contribution to the development of physical culture.

We take a group of economic factor as independent variables to reorganize the above material.

Renewal table 3

country	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	y
China	63	5.8	75.5	84	141	530	100
America	5274	14.6	94.4	97	32	1783.4	110
England	2031	7.7	93.9	99	252	346.2	47
Germany	2631	10.9	93	96	236	439.8	41
Australia	1995	9.5	95.5	99	3	109.8	46
South Korea	577	5	90.1	97	491	74.5	31
Japan	2827	7.9	93.7	94	351	579	25
Italia	1737	8.5	93.4	95	202	157.5	28
France	2348	9.7	94	97	112	314.3	40
Ukraine	40	4.7	76.6	95	80	135.9	27
The Dutch	2298	8.8	94.9	99	483	131	16
Spain	1192	7.6	93.3	97	90	122.9	18
Canada	2222	9.6	94.9	97	4	184.6	18
Brazil	266	7.9	79.2	89	22	332.7	15
New Zealand	1255	8.5	93.3	99	15	20.4	9

4. Analysis

We first analyze the number of gold medals as the achievement of a country in the game and synthesizes 2 and 3. The result computed by mathematica is:

Table 4

Dependent variable	independent	Regression equation	R^2	t	F
y_1	x_1	y_1 =8.1144+0.7682 x_1	0.6482	3.8252	10.809
y_2	x_2	y_2 =8.2924+0.8885 x_2	0.5218	2.1969	8.33
y_3	x_3	y_3 =-6.0074+0.0336 x_3	0.6232	1.8243	9.328
y_4	x_4	y_4 =-1.4935+0.0913 x_4	0.1352	1.5818	2.502
y_5	x_5	y_5 =7.7017+0.028 x_5	0.4096	3.1325	7.56
y_6	x_6	y_6 =12.1411-0.0142 x_6	0.548	-2.0651	9.238
y_7	x_7	y_7 =5.6450+0.0033 x_7	0.543	2.1510	4.627
y_8	x_8	y_8 =-2.6133+1.6328 x_8	0.619	1.8450	8.045
y_9	x_9	y_9 =13.7681-0.0349 x_9	0.4023	-3.1060	1.24
y_{10}	x_{10}	y_{10} =67.4741-0.5980 x_{10}	0.3884	-2.0859	3.179
y_{11}	x_{11}	y_{11}=10.2226+0.0032 x_{11}	0.38181	2.1703	2.901
y_{12}	x_{12}	y_{12} =-4.4494+0.1204 x_{12}	0.1622	0.0975	3.098

$$t_{0.05}(13) = 1.7709.$$

Because of $|t_4| < t_{0.05}(13)$, $|t_{12}| < t_{0.05}(13)$, so x_4 and x_{12} can be deleted.

The results showed that 08 industrial production index and health and social workers had not through significant test, and x_1, x_2, x_3, x_5, x_7, x_8, are all through significant test. That means they have the remarkable linear relationship with the sports result. And x_1, x_7 is more remarkable. To industry, x_3 is more remarkable than x_4. x_8 is more remarkable than x_7.

Then we Construct the multiple regression equation of the dependent variable with all variables. We get the result:

$$y = 123.5794 - 1.1028x_1 + 2.5504x_2 + 0.2464x_3 - 1.1660x_4 + 0.7791x_5 - 0.9498x_6$$
$$+0.0052x_7 + 0.9257x_8 - 1.0869x_9 - 0.5222x_{10} + 0.0191x_{11} + 0.4837x_{12}$$

$R^2 = 0.9525, F = 8.357$.

We can see that the data 95.25% can be explained by the model at the confidence for 0.95 circumstances. But, the regression coefficients of x_1 is negative. So when x_1 is larger, the scores of the country at the Olympics will decline. It's of course not true. The model is not established.

Then we removed x_4 and x_{12}, there is another model:

$$y = 131.9158 + 1.7627x_1 + 0.4786x_2 + 0.0230x_3 - 0.4360x_5 + 0.1849x_6$$
$$+0.0044x_7 + 2.0633x_8 + 0.0421x_9 - 1.4858x_{10} + 0.0090x_{11}$$
$$t_1 = 3.6566, \quad t_2 = 2.4379, \quad t_3 = 3.8033, \quad t_5 = -4.8298, \quad t_6 = 3.4656$$
$$, \quad t_7 = 2.2432, \quad t_8 = 4.9616, \quad t_9 = -3.0754, \quad t_{10} = -2.4671, \quad t_{11} = 2.5771$$
$$F_{0.05}(10,4) = 5.96, t_{0.05}(4) = 2.1318, R^2 = 0.9093, F = 7.021.$$

Table 5

Dependent variable	independent	Regression equation	R^2	t	F
y_1	x_1	$y_1 = 74.6637 + 2.7601\,x_1$	0.6406	4.4031	9.625
y_2	x_2	$y_2 = 72.4508 + 4.2596\,x_2$	0.5605	2.7735	5.984
y_3	x_3	$y_3 = -16.6557 + 0.2023\,x_3$	0.6194	3.4726	8.169
y_4	x_4	$y_4 = 15.2371 + 0.5153\,x_4$	0.08212	1.1965	0.732
y_5	x_5	$y_5 = 122.4668 - 0.3646\,x_5$	0.6355	-6.2388	7.702
y_6	x_6	$y_6 = 153.6866 - 0.6749\,x_6$	0.5134	-5.4285	8.36
y_7	x_7	$y_7 = 39.5925 + 0.0291\,x_7$	0.5323	2.8216	7.961
y_8	x_8	$y_8 = -37.5334 + 14.9221\,x_8$	0.6254	2.3394	8.473
y_9	x_9	$y_9 = 14.3998 + 0.7804\,x_9$	0.4718	4.3290	10.82
y_{10}	x_{10}	$y_{10} = 317.4820 - 2.4595\,x_{10}$	0.5216	-3.6022	3.626
y_{11}	x_{11}	$y_{11} = 80.4106 + 0.0250\,x_{11}$	0.2052	2.1814	3.29
y_{12}	x_{12}	$y_{12} = -4.5841 + 0.7043\,x_{12}$	0.059	1.3768	0.96

We can see from the table, $t_i > t_{0.05}(4)$ $i = 1,2,3,5,\cdots 11$. All variables passed the test of significance and $F > F_{0.05}(10,4)$. The model is right. Then we know when x_1 is positive it means average growth rate of

GDP increases, at the same time, sports result rise. It's the same to $x_2, x_3, x_6, x_7, x_8, x_{11}$. But the situation is opposite to x_5、 x_9、 x_{10}. That's because we don't have enough money to develop sports when having invested too much in agriculture and the humanities education. So this model is better than last one.

Then we analyze the weighted total medals as the achievement of a country in the game.

According to gold, silver and bronze medals, we give out different weight. Gold is 5, silver is 2, bronze is 1. We get the formula: $y = 5a + 2b + c$.

a, b, c is the number of medal.

$$t_{0.05}(13) = 1.7709.$$

Because of $|t_4| < t_{0.05}(13)$, $|t_{12}| < t_{0.05}(13)$, so x_4 and x_{12} can be deleted.

The results showed that 08 industrial production index and health and social workers had not through significant test, and x_1, x_2, x_3, x_5, x_7, x_8 ,are all through significant test. That means they have the remarkable linear relationship with the sports result. And x_1, x_7 is more remarkable. To industry, x_3 is more remarkable than x_4. x_8 is more remarkable than x_7.

Then we Construct the multiple regression equation of the dependent variable with all variables. We get the result:

$$y = 779.3938 - 4.3290x_1 + 17.8181x_2 + 2.3057x_3 - 7.8838x_4 + 5.0331x_5 - 6.6917x_6 + 0.0320x_7 + 19.8394x_8 - 8.2939x_9 - 2.0801x_{10} + 0.1640x_{11} + 0.7533x_{12}.$$

$$R^2 = 0.9612, F = 10.31.$$

We can see that the data 96.12% can be explained by the model at the confidence for 0.95 circumstances. But the regression coefficients of x_1 is negative. So when x_1 is larger, the scores of the country at the Olympics will decline. It's of course not true. The model is not established.

Then we removed x_4 and x_{12}, there is another model:

$$y = 901.5606 + 13.6437x_1 + 2.5568x_2 + 0.1472x_3 - 3.7648x_5 + 1.4065x_6 + 0.0254x_7 + 22.5628x_8 - 1.2511x_9 - 8.5788x_{10} + 0.1064x_{11}.$$

$$t_1 = 4.2827, \quad t_2 = 3.3471, \quad t_3 = 2.7141, \quad t_5 = -2.0628, \quad t_6 = 3.5255, \quad t_7 = 4.0682, \quad t_8 = 3.5598, \quad t_9 = -2.3324, \quad t_{10} = -2.1132, \quad t_{11} = 3.0090.$$

$$F_{0.05}(10,4) = 5.96, t_{0.05}(4) = 2.1318, R^2 = 0.9214, F = 8.202.$$

We can see from the table, $t_i > t_{0.05}(4)$ $i = 1, 2, 3, 5, \cdots 11$. All variables passed the test of significance and $F > F_{0.05}(10,4)$. The model is right. Then we know when x_1 is positive it means average growth rate of GDP increases, at the same time, sports result rise. It's the same to $x_2, x_3, x_6, x_7, x_8, x_{11}$. But the situation is opposite to x_5、 x_9、 x_{10}. That's because we don't have enough money to develop sports when having invested too much in agriculture and the humanities education. So this model is better than last one.

5. Conclusions

We can get the result after our analysis:

1. The predominant factor which affects a country's Olympic Games result are:

(1) Before Olympic Games, the growth rate of national product average in three years;

(2) The proportion that a country's spending on health care sharing of GDP in two Olympic Games period:

(3) education index of a country.

2. Olympic Games result is being related with the following factor:

(1) Before Olympic Games, the growth rate of national product average in three years;

(2) Before Olympic Games, the growth rate of per capita GDP in three years;

(3) Industrial total index in two Olympic Games period;

(4) per capita agricultural index in that year;

(5) The proportion that a country's spending on health care sharing of GDP in two Olympic Games period:

(6) Population density.

Negatively correlated with the following factors:

Agriculture Index in that year;

Human Development Index;

Education index

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