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Coefficient of efficient countries' effect on inefficient countries in 2012 Olympic Games with the use of linear programming

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ABSTRACT

Olympic is the biggest sporting event that takes place only once every four years. Therefore, surveying the qualitative assessment of the inefficient countries according to the effect's amount of 100% productivity countries cause the improvement of these teams. Analysis data evolvement (linear programming) is used for determination of impact amount of 100% productivity countries on inefficient countries. This comparison causes countries know their real opponents and do especial programming for compete with these teams in the future. On the other hand, they take model from these effective countries for creating changes in their inputs and outputs. This survey shows what countries have the most impact on the other countries' inefficiencies. Indeed, units' impact coefficient provides an improvement samples for inefficient units. Gathering inputs and outputs of the first 25 countries of the Olympic standing and analysis the data evolvement, results show that some inefficient countries are affected by the most effective countries. It means that they place at operational and qualitative level and increasing their productivity level, they should use the programs of these countries. Moreover, some inefficient countries place in less qualitative level since the impact amount of efficient countries on these countries were much less. This does not mean that the main competitors of these teams are ones except efficient countries and their comparison have no benefit and they should take samples for improvement from countries that place at low level of the table.

Keywords: leaner programming, data envelopment analysis, productivity, Olympic, Input, output.

INTRODUCTION

The Olympic Games are greatest Games in world. Olympic Games countries the first actually happened in 1896. Since then all countries can participate of the Olympic Games every four years. These Games are deemed very important for political and economic countries. As customary a ranking of countries was made using gold, silver and bronze medals, in that order. This method is the so-called lexicographic method (Barba-Romero and Pomerol 1997), which is widely used for many other Games, for example, the Olympic Games [2]. The lexicographic is very easy to understand. First we classify countries by their gold medals, of course the more the better. When a tie is found we use the number of silver medals. If a new tie is found, we use the bronze medals to untie. Unfortunately this method over-values the gold medal, as a country with one gold medal is in a better position than one that has, say, 20 silver medals. The same thing occurs when comparing silver and bronze medals. This characteristic may be as an unfair for many. As a consequence many researchers have proposed methods for better ranking the countries taking into account other features [20].

Ranking from operational view shows that what countries have good operation comparing to others. From managerial aspect, surveying the impact of efficient countries on inefficient countries is important because this comparison enable us to measure the qualitative level of the countries to have more efficient and careful

programming. For example, if an efficient country has no impact on inefficient country, the inefficient country should not use the programs of the mentioned country since finally no benefit will be gained.

One of the most important methods for evaluation units is data envelopment analysis (DEA). In this method, a finite number of inputs and outputs is determined for each decision unit and from this data, they can determine the performance. Efficiency means that the ratio of total of inputs to outputs. If the value of a unit is 1, in this case the efficiency of this unit 100%.DEA method is as follows:

CCR and BCC Model

Several methods have been developed to measure productivity which can be divided into two main categories: parametric and nonparametric [6]. First-parametric methods are used only for units have an outlet, secondly, this method should be considered to function as a default. The nonparametric approach considers no function as a default. In fact, it is tried to obtain an empirical function through observations. One of the most important nonparametric methods to evaluate the performance of Decision Making Units is using the envelopment data analysis which has a multiple usage in assessing the productivity and efficiency of economic units and upgrading them. Farrell (1957) presented the nonparametric methods for determining productivity for the first time. Charles Cooper and Rhodes were developed a new method as generalization of Farrell's work in 1978. In this method observed units can be compared by several inputs and outputs. For this purpose, the input and output factor should have a weight in order that Inputs and outputs of each units rhythmic. The productivity per unit is calculated from the equation(1):

$$P = \frac{U^T Y}{V^T X} \qquad (1)$$

In this equation, P is the value productivity, U is the output weights, Y is the output value, T represents the vector sum, V is the input weights and X is input values of input weights.

DEA models are divided to two sub-models that the ratio of efficiency to scale is constant in the first and it is variance in the second.

This model is mathematically equivalent to the deficit model of (1) , X_0 is input vector, Y_O the output vector and θ variable indicating the efficiency of the desired unit replying to the efficient problem. If the ratio of efficiency to scale is not constant.

Determination the amount of observations' influence on DEA radial models

There are several methods for determination the amount of observations in DEA models. For example, some samples can be fined in DEA models of Method of Wilson for radial models that are provided via Charnz and Benker.

$$\begin{aligned} Min \quad & \theta_{op} \\ s.t \quad & \sum_{j\in J} \lambda_j X_{ij} \le \theta_{op} X_{iO} \qquad i = 1,\dots,n \\ & \sum_{j\in J} \lambda_j Y_{ij} \ge Y_{ro} \qquad r = 1,\dots s \qquad (2) \\ & \sum_{j\in J} \lambda_j = 1 \\ & X_j, Y_j \ge 0 \\ & \theta \quad free \quad J = \{1,..,n\} - \{p\} \end{aligned}$$

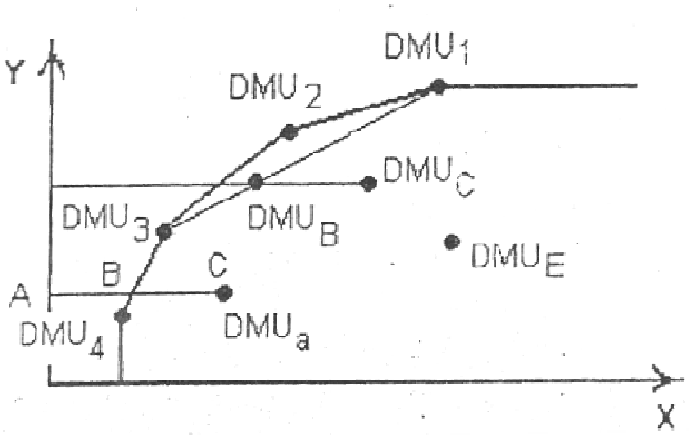
We conclude from above discussions that the impact amount of (DMU_p) Efficient Decision Making on Inefficient Decision Making (DMU_o) is gained via formula (3).

$$I_{op} = \frac{1 - \theta^*_{op}}{1 - \theta^*_o} \qquad (3)$$

That always $I_{op} \in [0,1]$. If $I_{op} = 1$ we conclude efficient DMU_p has no effect on inefficient DMU_o. In other words, DMU_p does not belong to the reference of DMU_o and in this manner, we have $\theta^*_{op} = \theta^*_o$. According to picture (1), if we delete DMU_2 from observations' set, since DMU_2 does not belong to the reference of

DMU_a , therefore, DMU_2 has no effect on the efficiency of DMU_a According to picture (1), we have $\theta_a^* = \theta_{a2}^* = \frac{AB}{AC}$. If $I_{op} = 0$, then DMU_p has the maximum impact on DMU_O. In other words, deletion of DMU_p causes the efficiency of DMU_o . As you can see in picture (1), DMU_2 has the maximum influence on DMU_B .

If DMU_o and DMU_l both are inefficient and $I_{op} < I_{lp}$, therefore, the impact amount of DMU_p on DMU_o is more than DMU_l. In picture (1), we have $I_{c2} > I_{B2}$, therefore, the impact of DMU_2 on the efficiency of DMU_B s more than DMU_c .



Picture (1): Comparison the impact amount of DMU_c and DMU_B toward DMU_2

1. Efficiency rank of DMU_E that is compared in classic model of BCC with weak boundaris more than its efficiency rank in the amended model. The impact amount in the amended model of BCC for DMU_E that is compared with weak boundary is more that impact amount in classic model of BCC.
2.

MATERIALS AND METHODS

This research is analysis. For each of the countries three inputs (population - the number of athletes in each country - the results of the previous period) and also an output (Total Medals by applying a factor of ten for gold, 2 for silver and one for bronze as coefficients) was considered. In order to determine the input and output, for each of the medals, gold, silver and bronze, fair coefficients is considered [2]. As countries rank in alphabetical Olympic table does not change. Therefore, these coefficients can be most fair coefficients[20]. For analysis data used of DEA and EMS software.

Table (1) shows, the inputs and outputs (raw data). In the first column, the name of 25 countries staging the 2012 Olympics is given, The second column contains the country's populations (Population in million) The third column, contain a number of athletes.The fourth column, the total medals for countries in pre game, with coefficients 10 for gold, 2 for silver and one for bronze. The last column is the total medals of this period (2012), which is considered as an output or performance:

Table1: input and output

Input-output countries	I_1	I_2	I_3	O	Efficiency
United States	360*	530	472	547	1
China	1040	396	580	457	1
Great Britain	62	542	231	343	1
Russia	142	436	300	324	0/89
South Korea	53	245	158	153	0/79
Germany	84	391	195	162	0/56
France	65	330	119	144	0/66
Italy	60	284	110	109	0/54
Hungary	11	157	42	93	1

Australia	22	410	187	114	0/65
Japan	130	293	112	115	0/50
Kazakhstan	16	114	35	77	1
Netherlands	17	178	84	80	0/64
Ukraine	49	240	95	79	0/44
New Zeland	5	185	37	69	1
Cuba	12	110	53	62	0/84
Iran	75	53	14	63	1
Jamaica	3	50	68	52	1
Czech Republic	11	133	36	49	0/88
North Korea	24	51	32	42	1
Spain	47	282	73	54	0/39
Brazil	190	295	46	49	0/31
South Africa	50	125	11	35	1
Ethiopia	80	35	44	35	1
Croatia	5	108	31	34	1

*****Population in million*

RESULTS AND DISCUSSION

For determining the efficiency and ranking of units, Anderson and Peterson model was used also Jahanshahloo et al (2007) have done a research with the subject of reviewing the evaluating methods and presented a new method for ranking educational units. Efficient units are ranked through presented model. In order to analysis the sensitivity of departments with the 100% of productivity the method used in Aslani research has used with the title of efficient models sensitivity and inefficiency with the ratio of efficiency to variant scale. Also, Aslani et al (2008) did a research on diffusion coefficient in DEA models with the ratio of efficiency to constant and variant scales; this study was used to determine the diffusion coefficient of models. Evaluation of countries based on the model (4):

$$\begin{aligned} &\max \quad U^t y_p + u_0 \\ &s.t: \quad V^t x_p = 1 \\ &\quad U^t y_j - V^t x_j + u_0 \le 0 \qquad j = 1,....,n \\ &u_r, v_i \ge 0 \end{aligned} \tag{4}$$

Table 1 shows that the America - China - Great Britain - Iran - New Zealand - Hungary - Kazakhstan - Jamaica - North Korea - Croatia - Ethiopia - South Africa are efficient in terms of performance. Thus, in the ranked table will be in the top part of Other countries. Iran is 100% productivity That expected. Probably at the top of the table (Table efficiency) will be. DEA method has some problems, including the fact that some countries which are basically inefficient, evaluated by this method 100% productivity. To identify such units, the DEA model should be modified. To revising model and In addition to the finding efficient strong - weak, etc, we used The model presented in the PHD thesis Daneshvar (2002)(A modification of the basic DEA models using Faced analysis) . These units in produce possibility set (convex area which determined by the input and output) are on weak border. Weak boundaries may be modified. In fact, we need to change the weak boundaries (5).

$$\begin{aligned} &u_0^+ = Max \quad u_0 \\ &s.t: \quad V^t x_p = 1 \\ &\quad U^t y_j + u_0 = 1 \\ &\quad U^t y_j - V^t x_j + u_0 \le 0 \qquad (5) \\ &\quad U, V, u_0 \ge 0 \end{aligned}$$

$$u_0^- = Min \quad u_0$$
$$s.t: \ V^t x_p = 1$$
$$U^t y_j + u_0 = 1$$
$$U^t y_j - V^t x_j + u_0 \le 0 \qquad (6)$$
$$U, V, u_0 \ge 0$$

To determine the brand of efficiency (strong efficiency, weak efficiency, etc) and also for modify the model, we use model(5 and 6):

Table2: Data for revise models

Country	u_0^-	u_0^+	Return to scale	Efficiency
United States	-0/34	-0/004	Decreasing	Strong
China	-0/71	-0/004	Decreasing	Strong
Great Britain	-5/6	-0/02	Decreasing	Strong
Hungary	-0/71	0/49	Fix	Strong
Kazakhstan	-0/25	0/69	Fix	Strong
New Zealand	-1/87	0/9	Fix	Strong
Iran	-2/48	1	Fix	Weak and strong frontier
Jamaica	-2/18	1	Fix	Weak and strong frontier
North Korea	0/36	1	increasing	Weak and strong frontier
South Africa	-0/62	1	Fix	Weak and strong frontier
Ethiopia	0/35	1	increasing	Weak and strong frontier
Croatia	0/66	1	increasing	Weak and strong frontier

According to table 3 when A and B be positive[4] If so, returns to scale, would be increasing and if both negative return to scale, would be decreasing also if one negative and other be positive ,return to scale, would be fix. America – china – British – Hungary – kazagestan and newzeland are a strong efficient country and other efficient countries, are in weak and strong frontier [4].

Inefficient countries, rating on the basis of their performance, But since all efficient countries have efficient performance of 1 (100% efficiency) Accordingly, there is no possibility of their ranking, we are using Anderson Peterson method for ranking:

$$\max \quad U^t y_p$$
$$s.t: \ V^t x_p = 1$$
$$U^t y_j - V^t x_j \le 0 \qquad p \ne j = 1,....,n \qquad (7)$$
$$u_r, v_i \ge \varepsilon$$

$$AP - Model$$

$$Min \quad 1 + w_a$$
$$s.t \quad \sum_{j=1}^{n} \lambda_j X_{ij} \le x_{ia} + w_a \qquad i = 1,...,m \qquad JAM - Model$$
$$\sum_{j=1}^{n} \lambda_j Y_{rj} \ge y_{ra} \qquad (8)$$
$$\lambda_j \ge 0$$

because of the Anderson-Peterson problems Sometimes we use the JAM method.

The final result show in table(3):

Table 3: Efficiency Ranking

Efficiency Ranking	country	Olympic Ranking
1	Iran	17
2	Jamaica	18
3	New Zealand	15
4	Kazakhstan	12
5	North Korea	20
6	United States	1
7	China	2
8	Great Britain	3
9	Hungary	9
10	South Africa	23
11	Ethiopia	24
12	Croatia	25
13	Russia	4
14	Czech Republic	19
15	Cuba	16
16	South Korea	5
17	France	7
18	Australia	10
19	Netherlands	13
20	Germany	6
21	Italy	8
22	Japan	11
23	Ukraine	14
24	Spain	21
25	Brazil	22

Deleting efficient countries from game tables the efficiency of inefficient countries changes. Its results are in tables (5) and (4):

Table 4: efficiency without efficient country

Inefficient country	Efficiency without America	Efficiency without Chin	Efficiency without British	Efficiency without Hungay	Efficiency without Kazagestan	Efficiency without New zeland	Efficiency without Iran	Efficiency without Jamaieka	Efficiency without North korea	Efficiency without South africa	Efficiency without Etiopi	Efficiency without Croacia
Russia	1	0/8924	1	0/8924	0/8924	0/8924	0/8924	0/9096	0/8924	0/8924	0/8924	0/8924
South Korea	0/8422	0/7960	0/8928	0/796	0/7978	0/796	0/796	0/8564	0/797	0/796	0/796	0/796
Germany	0/5852	0/5633	0/6057	0/5633	0/5671	0/5633	0/5633	0/5698	0/5633	0/5633	0/5633	0/5633
France	0/6631	0/6631	0/7589	0/6843	0/6631	0/6631	0/6926	0/6631	0/6631	0/6631	0/6631	0/6631
Italy	0/5495	0/5416	0/5440	0/5416	0/5502	0/5416	0/5525	0/5416	0/5416	0/5416	0/5416	0/5416
Australia	0/6528	0/6528	1	0/6528	0/6528	0/6947	0/6528	0/6528	0/6528	0/6528	0/6528	0/6528
Japan	0/5041	0/5024	0/5615	0/5024	0/5031	0/5024	0/5762	0/5024	0/5024	0/5024	0/5024	0/5024
Netherlands	0/6483	0/6483	0/6513	0/69	0/6545	0/6483	0/6483	0/7429	0/6483	0/6483	0/6483	0/6483
Ukraine	0/4542	0/4492	0/4492	0/4492	0/4674	0/4492	0/4554	0/4587	0/4492	0/4492	0/4492	0/4492
Cuba	0/8435	0/8435	0/8435	0/8435	0/8729	0/8435	0/8435	1	0/8437	0/8435	0/8435	0/8753
Czech Republic	0/8852	0/8852	0/8852	0/8852	0/9005	0/8882	0/8852	0/8852	0/8852	0/8911	0/8852	1
Spain	0/3991	0/3991	0/3991	0/3991	0/4126	0/3991	0/3993	0/3991	0/3991	0/4104	0/3991	0/4241
Brazil	0/3158	0/3158	0/3158	0/3158	0/3158	0/3158	0/4446	0/3158	0/3168	0/3496	0/3158	0/3158

Table5: Impact coefficient

Inefficient Country	$I_{iAmerica}$	I_{iCHina}	$I_{iBritish}$	$I_{iHungry}$	$I_{iKazage}$	I_{iNewzl}	I_{iIran}	$I_{iJamaik}$	$I_{iNorthk}$	$I_{iSafrica}$	$I_{iEtiopi}$	$I_{ICorovasia}$
Russia	0	1	0	1	1	1	1	0/8401	1	1	1	1
South Korea	0/7735	1	0/9962	1	0/9911	1	1	0/7529	0/9986	1	1	1
Germany	0/4148	1	0/9029	1	0/5671	1	1	0/9851	1	1	1	1
France	1	1	0/7156	0/9370	0/9912	1	0/9124	1	1	1	1	1
Italy	0/9728	1	0/9947	1	0/9812	1	0/9762	1	1	1	1	1
Australia	1	1	0	1	1	0/8793	1	1	1	1	1	1
Japan	0/9965	1	0/8812	1	0/9985	1	0/8516	1	1	1	1	1
Netherlands	1	1	0/9775	0/9859	0/9686	1	1	0/7207	1	1	1	1
Ukraine	0/9909	1	1	1	0/9718	1	0/9887	0/9841	1	1	1	1
Cuba	1	1	1	1	0/8121	1	1	0	0/9987	1	1	0/8313
Czech Republic	1	1	1	1	0/8403	09442	1	1	1	0/9197	1	0
Spain	1	1	1	1	0/9775	1	0/9996	1	1	0/9811	1	0/9583
Brazil	1	1	1	1	1	1	0/8117	1	0/9985	0/9505	1	1

Table 5 shows that United States has no influence on inefficiency of France, Australia, Netherlands, Cuba, Czech Republic, Spain and Brazil but it has the most impact on Russia. Indeed, if we delete America form games' table, Russia will be effective. Britain has the most impact on Australia and Russia. Iran effects Brazil most. Moreover, Croatia has the most impact on Czech. Results show that Russia should measure its situation with two big rivals means America and China since both has the most influence on Russia. Therefore, Russia should have more programming for better operation on its Chinese and American rivals. Also, it should take modeling from America and China for creating changes in managerial and sport infrastructures. The influence of America and China on Russia is documented via game tables (conformation of Russia athletes with Chinese and American rivals). These three countries faced each other in these rivals in the most competitions and the amount of Russia failures against China and America has a lot of effects on Russia' productivity. Therefore, the conditions of Russia are compared with America and China. Indeed, Russia is an inefficient country that states at the level of countries that places at the top of the table.

Results show that South Korea is compared with the most effective countries. It means that the primarily situations and results of South Korea is better than the other inefficient countries and it will have an acceptable rank between inefficient countries. South Korea is a country that has a harsh competition with the most countries that are placed in the top of the table. Meanwhile, Brazil has the least affected by these countries and is compared with less efficient countries. Therefore, it is at the end of ranking table. It means that this country has the most competition with countries in the lower ranks of 25 and should do more changes in its structure to compete with 25 countries in terms of quality. In fact, Brazil is not at the level of these 25 countries in terms of quality and operation and having modeling from the top teams of the table has no effect on the operation' s improvement of this country in the future.

CONCLUSION

Olympic is finished and just results, happiness, sorrows and lessons of this era remain. In this period of the biggest sporty event, all participated countries made their top athletes ready to show the real style of their sport to the world. What we seen was the result of 4 years of programming in these countries. What we will see in the future will be the programming of these countries, too. Good results gain by a good and strong programming. Careful and scientific programming for the next period is the most important duty of sporty organizations related to a country. A careful and efficient comparison as well as modeling form the first class teams will have a glorious future for the sport of countries. Comparison of inefficient countries with efficient countries can be useful; this comparison shows what countries placed in the same level of inputs and outputs with other countries. For example, Russia is a country

that competes with China and America in high level and these are America and China that cause Russia does not be too efficient in operation. Therefore, Russia can programming for the next four years for its preparatory meetings with these rivals or another teams that their game styles are similar to China and America teams. Moreover, it should use the methods of two mentioned countries in creating sporty infrastructures. It can reach the sporty budget of its teams to the level of these teams and use America and China managerial methods in all fields. Iran has the most effect on Brazil inefficiency. It means that Brazil should use Iran's programs for improvement. Iran is a country that places in a high level in some sports like wresting, weightlifting, martial sports and etc. therefore, Brazil should pattern most of its programs in these sports and use Iran technical and managerial structures for improvement its teams' quality. South Korea has a harsh competition with the most countries at top level of the table and it has a lot of choices for programming in the future. Results shows that within inefficient countries, Russia, South Korea, Italy, Japan and France are placed at the high quality level of the table, respectively' and Brazil placed in the lower level in comparison with others.

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