Performance Evaluation Prevailingly Concerning The Disease Burden In Albania And Other Southeastern European Countries, Using DEA

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***Abstract* - This study intends to discover, using performance evaluation, the opportunities that exist to improve the prevailing attitudes of the health issues in Albania in comparison with the Southeastern Europe countries. The study estimates some essential and critical indicators which connect the total disease burden in Albania and in the Southeastern Europe countries in the time period 1995-2013 with the economic development progress and the access of funding in health policies. The study takes data from DALY values (Disability Adjusted Life Years), the indicator used in the global burden of disease study, used for the first time in 1990. The identification of the "inputs" and "outputs" in this process is fundamental. In the selection of the indicators that are referred to as inputs and outputs, firstly is "discovered" the "strength" relation of the reciprocal impact using the correlation coefficient from the statistical model and afterwards DEA is used as method and methodology for the evaluation of performance. Any performance evaluation is conditioned by the intentions of estimation to identify the best practices. In the production possibility set (PPS) and evaluation of the Outputs possible expansion maximization and contraction of DMU Input level without avoiding the given PPS set, some virtual DMUs are included connected to the respective DMU, which calls for a more detailed "investigation" of its performance evaluation that rivals with more detailed performance improvement goals**.

Keywords—Daly, correlation coefficient, DEA performance, Virtual DMU

I. INTRODUCTION

The information about Albanian and Southeastern European populations, given together with the respective indicators, is based on the data of the most reliable and acceptable resources of the international institutions like GBD, WHO, etc. During the 45 years of the communist regime, Albania was one of the most isolated and poor countries of Europe and, therefore, reliability of the data given may be accepted with much reserve. Despite the changes in the positive side regarding statistical information handling, even now still there is a need for a more rigorous evidence of health data recording and adequacy in the health policies.

Life expectancy at birth in Albania is increased in the last 20 years for both genders, from 69 years old in 1990 (67 for males and 71 for females) to 74 years old in 2012 (73 for males and 75 for females) (WHO, World Health Statistics, 2014), even though the figure reached remains the lowest in the Southeastern European countries.

The evaluations for the global disease burden regarding life expectancy and life expectancy at birth in Albania in 2010 are respectively, (72,0 and 62,5) for males and (68 and 67) for females, which approximate the ones of Macedonia, but are lower than the other Southeastern European countries.

One of the most important indicators for the total disease burden in a population is the so called DALY value (per 100 thousand inhabitants). Disability adjusted life years (DALY), is used for the first time in 1990 in the global burden of disease (GBD). DALY harmonizes the life years lost because of the untimely death and the life years lost for the disease duration. By the beginning of the '90s the Albanian economy fall in a collapse and after that the free market economy system was established, therefore the study is deemed to envelope the period of time 1995-2013. The social-cultural-economic reforms performed during the transition process were carried out likewise in the other former Eastern and Central European communist countries, but the pass of development in Albania has had fluctuations. The

1997 turmoil in Albania caused a general loss of as much as 40% of the country GDP at that time. The relatively poor economic conditions in Albania have fostered population emigration. According to the census of October 1st, 2011, the population of Albania was 2.8 million inhabitants with the average age of 35.5 years. Mortality level for the age of under 5 years old (death number for 1000 live births) in Albania in 2013 compared to the other Southeastern European countries is higher (IGME Report 2010-2014 UN inter-Agency Group for child Mortality Estimation). The figures mentioned and the responsible risk factors for the disease burden in Albania are mostly related to the food diet, as the gravest factor, and the life style, but they certainly call for further study. The risk factor related to the food diet in 2010 was 38% of the general mortality level in Albania. Disease burden attributed to all life style factors in Albania in 2010 is 19501.7 (daily value) per 100 thousand inhabitants or 71.2% of the life style in total. Considering the figures for the disease burden and the risk factor, we will examine the relation between the economic development progress and the adjusted life years during the period 1995-2013.

II. *Methodology*

1 Definition of input-output factors

Selection of input-output factors is related to the objectives and manageable data lay out. Within the managing data system and founded on a diagnostic-reasoning, an intercausal-reasoning is performed which is based on the joint causes that take to a conclusion. So, we are referring to the data which may be evaluated as inputs and that their <<contraction>> will bring (in our case <<require>>) the support of those that will be evaluated as outputs. In a first impression it looks like we are getting farther from the traditional way of their designation, but we will be referring to the real life and to the goals and objectives requirements satisfaction. If we have fixed and settled the objectives, we immediately decide on the evaluation criteria and input-output factors selection. We are looking for disease reduction based on the support enlargement in order to make possible this reduction. To support the diagnostic reasoning, from the statistical model make estimation for the correlation coefficient of their relation <<contraction>>. Preliminary, I present the table containing some data from the economic development progress, support value accesses, disease burden indicators, and the adjusted disability life years (DALYvalues).(Number of males (M),Number of Females (F), Average(AVG))

Table 1.

No.	Country	Age standardized disability adjusted life years (2010) (per 100 thousand inhabitants) averagely for both genders.	DALY value for neonatal diseases (per 100 thousa-nd inhabit-ants)	Stand ard-ized disability adjusted life years (disease burden in children 1-4 years old)	Gross Domestic Product / per capita per year in US$ (the average for the period 1995-2013)	Total expenditu reper capita in the health system (in US$, according to each respective year rate of exchange . 995-2013).	Total expenditu re per capita in the health system (in US$ adjusted for the average of buying power, 1995-2013)	Tatale expenditure on health (THE) as % of GDP for the period 1995-2013	Private expenditu-re on health as % of Total expenditure on health, for the period 1995-2013
1	Albania	AVG 26793.8 F 22841.9 M 30745.2	753.8	13688.1	AVG2428 Min649.3 Max4456	AVG 142 Min49 Max240	AVG 361 Min214 Max539	AVG 6,4% Min5.5% Max9.6%	55.6%
2	Bosnia and Herzego--vina	AVG 23489.7 F 20376.1 M 26603.2	726.1	5908.1	AVG2729 Min568 Max4830	AVG 246 Min51 Max449	AVG 537 Min124 Max934	AVG 8.75% Min7.5% Max10.2%	40%
3	Greece	AVG 19699.7 F 17220.4 M 22179.0	325.0	3813.3	AVG18983 Min11094 Max30699	AVG 1734 Min918 Max2924	AVG 2108 Min1264 Max3029	AVG 9.4% Min7.9% Max10.2%	34.9%
4	Serbia	AVG 24063.9 F 20738.4 M 27389.3	493.4	5098.5	AVG3517 Min1420 Max6485	AVG 325 Min64 Max672	AVG 745 Min301 Max1242	AVG 8.4% Min6.7% Max10.7%	30.56%
5	Croatia	AVG 23835 F 19984.8 M 27685.7	484.1	5132.9	AVG9489.6 Min4733 Max16126	AVG 693 Min304 Max1259	AVG 1087 Min548 Max1637	AVG 7.2% Min5.5% Max8.4%	14.1%
6	Montene--gro	AVG25901.2 F 23021.3 M 28781.0	762.4	6292.4	AVG3937 Min1904 Max7331	AVG 281 Min102 Max502	AVG 683 Min426 Max980	AVG 7.1% Min6.5% Max8.9%	32%
7	Slovenia	AVG20760.7 F17470.3 M24051.0	338.7	4804.1	AVG17585 Min10227 Max27249	AVG 1454 Min 785 Max2298	AVG 1879 Min970 Max2618	AVG 8.3% Min7.5% Max9.4%	16%
8	TFYR of Macedo---nia	AVG25782.2 F22840.3 M28724.1	890.4	6238.5	AVG3065 Min1807 Max4948	AVG 234 Min141 Max314	AVG 610 Min416 Max497	AVG 7.9% Min6.4% Max10%	37.7%
AVG		23790	596.7	6372	7716.7	638.6	1001	7.93%	32.6%

***Data source**: World health Organization (Global Health Expenditure Database) visited on January 30, 2016 and GBD, National Health Report (Public Health Institution, Tirana 2014).*

In order to see the <<strength>> of the reciprocal relation between the economic development progress and the disease burden, disability adjusted life years according to DALY value, from the statistical model we make estimation of the Pearson correlation coefficient. r = $\frac{\sum_{i=1}^{n} x_i y_i - \frac{\sum x_i \sum y_i}{n}}{\sqrt{(\sum_{i=1}^{n} x_i^2 - \frac{(\sum x_i)^2}{n})(\sum_{i=1}^{n} y_i^2 - \frac{(\sum y_i)^2}{n})}}$ (We use this formula, as the volume of the selections number is relatively small).

By examining the values for the respective variables accepted as x_i(total expenses per capita in the health system (in US$, based on the rate of exchange of each respective year, 1995-2013)) and y_i respectively and accepted separately for each column (disability adjusted life years (2010) averagely age standardized (per 100 thousand inhabitants) for both genders; DALY value for neonatal diseases (per 100 thousand inhabitants); Standardized disability adjusted life years (disease burden in children 1-4 years old)). (For example see the table below:)

Table 2 :

No.	x_i	x_i^2	y_i	y_i^2	$x_i y_i$
1	142	20164	753.8	568214.44	107039.6
2	246	60516	726.1	527221.21	179358.6
3	1734	3006756	325.0	105625.0	563550
4	325	105625	493.4	243443.56	106355
5	693	480246	484.1	234352.81	335481.3
6	281	78961	762.4	581253.76	214234.4
7	1454	2114116	338.7	114717.69	492468.8
8	234	54756	890.4	792812.16	208353.6
$\sum$	$\sum x_i$ = 5109	$\sum x_i^2$ =5921143	$\sum y_i$ =4773.9	$\sum y_i^2$ =3167640.63	$\sum x_i y_i$ =2206842.3

$\sum x_i \cdot \sum y_i$ = 24389855.1 ;

$$r = \frac{\sum_{i=1}^{n} x_i y_i - \frac{\sum x_i \sum y_i}{n}}{\sqrt{(\sum_{i=1}^{n} x_i^2 - \frac{(\sum x_i)^2}{n})(\sum_{i=1}^{n} y_i^2 - \frac{(\sum y_i)^2}{n})}} =$$

$$= \frac{2206842.3 - \frac{24389855.1}{8}}{\sqrt{(5921143 - \frac{26101881}{8})(3167640 - \frac{22790121.21}{8})}} =$$

$$= -0{,}914 \quad (|r| = |-0{,}914| \approx 1)$$

(Minus sign indicates that the variables X and Y do not change in the same direction.)

For the existence of coorelative connection is formulated the hypothesis:

H_0 : r = 0

H_a : r ≠ 0

Control of the hypothesis is done with the criterion T = r $\sqrt{\frac{n-2}{1-r^2}}$. It is not difficult to conclude that the null hypothesis (H_0) is rejected and is accepted the alternative hypothesis (H_α). Control of the hypothesis can be done quickly using the table with the name "Critical values of the coefficient of correlation of Pearson" .So we can operate and for the others coorelative connections,where it is observable that $|r| \approx 1$. So we can easily estimete and accept the input and output variables below.

Input 1 – Age standardized disability adjusted life years (2010) (per 100 thousand inhabitants) averagely for both genders.

Inputi 2- DALY value for neonatal diseases (per 100 thousand inhabitants)

Inputi 3- Standardized disability adjusted life years (disease burden in children 1-4 years old)

Outputi 1- Gross Domestic Product / per capita per year in US$ (the average for the period 1995-2013)

Outputi 2- Total expenditure per capita in the health system (in US$, according to each respective year rate of exchange. 1995-2013).

Outputi 3- Total expenditure per capita in the health system (in US$ adjusted for the average of buying power, 1995-2013)

As far as the performance consideration and evaluation, its fundamental indication is the efficiency concept, a concept derived from the engineering and physics sciences and that is connected with the relation between the inputs and outputs. In the processes real life we cannot expect a pure proportional separate relation that would know beforehand these coefficients (or as they may be called differently <<weights>>) that any input or output has apriori in the construction of their components. For this reason, the ratio of the weighted sum of outputs to the weighted sum of inputs is studied without the apriori assumption of the weights preliminary knowledge.

DEA approach developed by Charnes Cooper and Rhodes [7] presents such a method. The initial concept of efficiency in literature is connected to the name of Wilfredo Pareto in his book [4] about the welfare policy that is related to the evaluation of public policies, which in substance emphasizes that a social policy may be justified if it makes some people better without making the others worse. For this reason this definition is often known as the economic efficiency. Koopmans definition [3] emphasizes that a possible point in the production area is called efficient anytime that an increase in one of its coordinates may be attained only with the cost of reduction of another coordinate... [2].

Charnes, Cooper and Rhodes gave the definition of efficiency expansion that is known as 'Extended Pareto-Koopmans definition', which is : " A DMU is fully efficient if and only if it is not possible to improve any input or output without worsening some other input or output".The difficulty of the "absolute" efficiency estimation accepts the relative efficiency that in the contestability of the decision making units does not apriorily assume the weights that are related to the relative importance of the inputs and outputs. Charnes A,Cooper WW, Rhodes E in their article [7] gave the methods for the efficiency evaluation of DMUs related to the public programs intended to improve events planning and control. The coefficient of the efficiency value is taken from maximizing the ratio of the weighted sum of outputs to the weighted sum of inputs with the condition that the similar ratios for any DMU are less than or equal to 1. Expressed in mathematical form, the model is written:

$\max \sum_{r=1}^{s} \mu_r y_{r0}$

s.t $\frac{\sum_{r=1}^{s} \mu_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1$, j=1,2,…,n

$\sum_{i=1}^{m} v_i x_{i0} = 1$

$\mu_r, v_i \geq \varepsilon$, r=1,2,…,s, i=1,2,…,m

$\varepsilon > 0$("Non-Archimedean").

Multiplying both sides of the first constraints with its denominator (which is accepted to be positive by its definition) which is known also as the linearization of the oriented input formulization, we have:

$\max \sum_{r=1}^{s} \mu_r y_{r0}$

s.t $\sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0$, j=1,2,…,n

$\sum_{i=1}^{m} v_i x_{i0} = 1$

$\mu_r, v_i \geq \varepsilon$, r = 1,2,…,s, i=1,2,…,m

$\varepsilon > 0$ ("Non-Archimedean")

In matrix form the following models are given:

<<Multiplier CCR >> (CCR_M-I) Model

$\max E_{fI} = \mu^T y_0$

s.t $\mu^T Y - v^T X \leq 0$

$v^T x_0 = 1$

μ,u$\geq \varepsilon$ 1

$\varepsilon > 0$ ("Non-Archimedean")

(CCR_E- I) Envelopment Model

$\min \xi_I = \theta - \varepsilon(1^T s^+ + 1^T s^-)$

s.t $Y\lambda - s^+ = y_0$

$X\lambda - \theta x_0 + s^- = 0$

$\lambda, s^-, s^+ \geq 0$

$\varepsilon > 0$ ("Non-Archimedean")

The above models are referred by using the assumption of constant returns to scale (CRS).
(s^- and s^+ are slacks variable vectors that represent input contranctions and output expansions.The nonzero slacks and/or the value of $E_{fo} < 1$ identify the sources and amounts of inefficiency in each input and output of the DMU being evaluated.)

<<Multiplier BCC>> (BCC_M-I) Model

$\max E_{fI} = \mu^T y_0$ + u

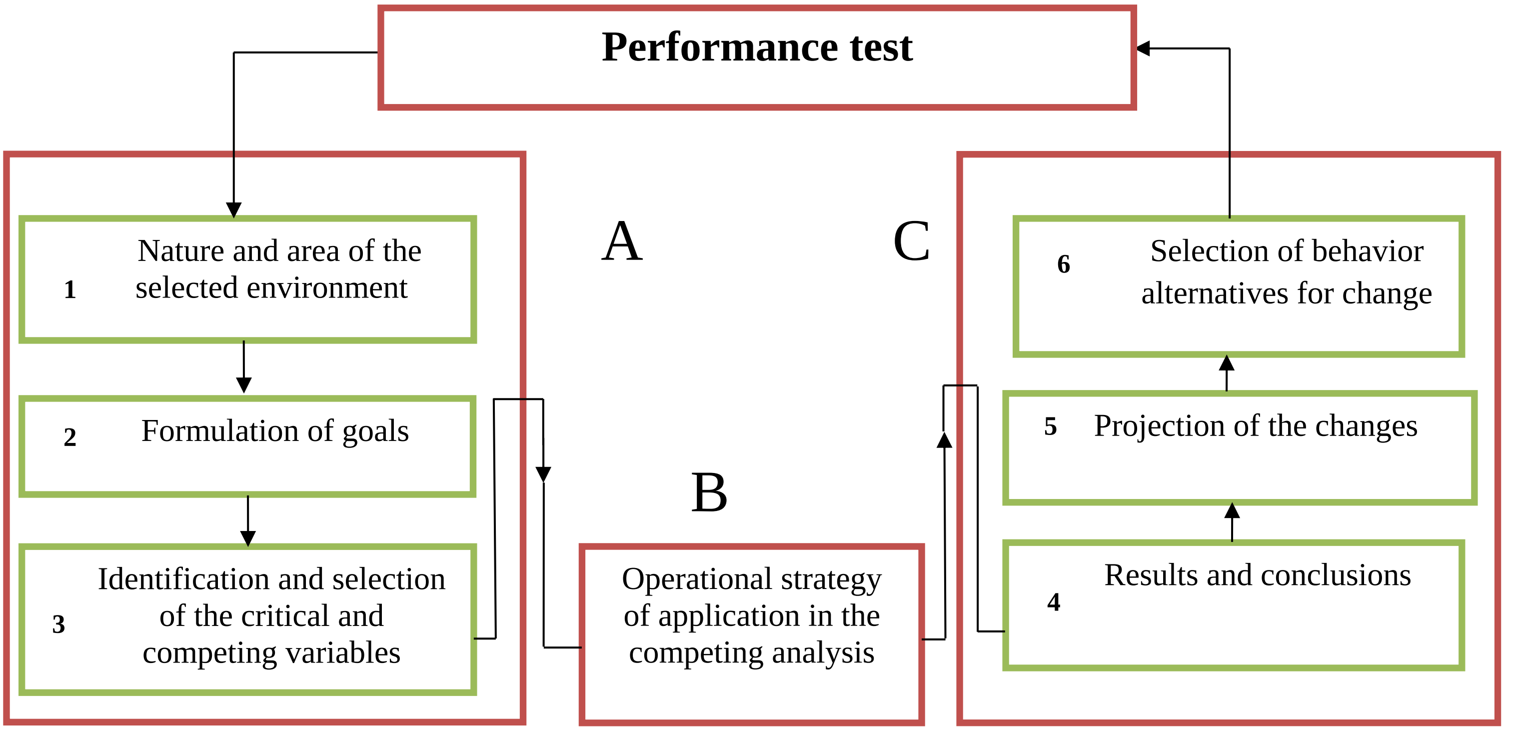
s.t $\mu^T Y - v^T X + u1^T \leq 0$

$v^T x_0 = 1$

μ,u$\geq \varepsilon$ 1

$\varepsilon > 0$ ("Non-Archimedean")

So, a DMU_0 is CCR efficient (either for the oriented input or oriented output) if $\exists \varepsilon > 0$, such as for the optimum values $E_{fI}^* = E_{fO}^* = \xi_I^* = \xi_O^*$=1, otherwise DM$U_0$ is inefficient. The units with the efficiency values equal to 1 define that that is called the efficient limit where no reduction in inputs may be made as this DMU is located in the efficient limit (although we may have DMU with the efficient value = 1, which may have weak efficiency that different authors specify as having the efficiency value = 1, but that are related to a referring DMU that calls for a further study.
The scale efficiency is defined by
$S_e = \frac{C\_E_{f0}}{V\_E_{f0}}$.
Regarding the control of a performance test evaluation, the following table should be kept in mind (which includes the block A, B, C):



(Compiled by the author)

Based on the preliminary estimation made above for the definition of inputs and outputs, some virtual DMUs that are related to DMU_1 should be added. For a more sensitive analysis of the health evaluation performance problem in Albania,(For example if the coefficient of health expenditure is the average of the countries of Eastern Europe to 7.9% from 6.4%) the efficiencies will be calculated. The number of DMUs is not less than twice of the amount of input – output variables.

Table 3:

No.	DMU	I_1	I_2	I_3	O_1	O_2	O_3	E_{fI}	V_E_{fI}	Scale input efficiency
1	DMU$_1$	26793.8	753.8	13688.1	2428	142	361	0.12591	0.72523	0.17125
2	DMU$_2$	23489.7	726.1	5908.1	2729	246	537	0.21364	0.83865	0.25474
3	DMU$_3$	19699.7	325.0	3813.3	18983	1734	2108	1.00000	1.00000	1.00000
4	DMU$_4$	24063.9	493.4	5098.5	3517	325	745	0.28932	0.81864	0.35342
5	DMU$_5$	23835.0	484.1	5132.9	9489.6	693	1087	0.42619	0.82650	0.51566
6	DMU$_6$	25901.2	762.4	6292.4	3937	281	683	0.24643	0.76057	0.32401
7	DMU$_7$	20760.7	338.7	4804.1	17585	1454	1879	0.88889	0.95955	0.92636
8	DMU$_8$	25782.2	890.4	6238.5	3065	234	610	0.22111	0.76408	0.28938
9	DMU$_{1a}$	26793.8	596.7	13688.1	2428	192	361	0.12591	0.73523	0.17125
10	DMU$_{1b}$	23790.0	753.8	13688.1	2428	192	361	0.14181	0.82807	0.17125
11	DMU$_{1c}$	26793.8	753.8	6372.0	2428	192	361	0.12591	0.73523	0.17125
12	DMU$_{1d}$	23790.0	753.8	6372.0	3135	192	361	0.14181	0.82807	0.17125
13	DMU$_{1e}$	23790.0	596.7	6372.0	3135	247	361	0.14181	0.82807	0.17125

III. Conclusions

Considering the efficiency evaluation conclusions and based on the selected nature and environment in Albania and Southeastern European countries, one could easily draw the following conclusions.
Albania is listed in the end of the efficiency ranking list, which is an appeal for the policy makers in Albania. It also is an appeal for the European institutions to prevailingly follow health problems of the population in the region. Planning of the lowest percentage of budget funding for the health system during the 20 years is 6,4% of the GDP when the average of the Southeastern European countries is 7,9% of the GDP. Private expenses, as a percentage of the average total expenses during the period was 55,6% (the governmental ones were 44,4%), while the average of the private expenses in the Southeastern European countries comparing to the total is 32,6%. Slovenia has the highest percentage of the budget funding planning with 8,3%. Slovenia also has the non-private expenses compared to the total in the amount of 84%. Such planning with a better prevalence shows also Greece, Croatia and then Serbia. These indicators have also conditioned monitoring and management of the population burden of disease with a prevailing estimation. Considering the value of the average efficiency, Greece and Slovenia result to be above those values, while Croatia has an approximate value. The other five countries have an average of $\overline{E_f}$ = 0,219282. Albania has the biggest deviation from the average value also. Lack of funding in fulfilling the health system needs shows that there are consequences in the risks of disease burden and disability adjusted life years. Only some indicators were referred in this study, but other indicators may be used that may call for other studies. The results show that a more integrated approach is needed to face the population health problems. Use of DEA for specific problems and in specific sectors in the health system allows one to create an evaluation and a judgment that will serve both the continuous monitoring from the national institutions and the supervision by other organs.

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