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Review of Meta-Frontier Efficiency of the Health Systems in the World

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Abstract: The object of this study is to determine health efficiency by stochastic frontier analysis method in the form of Meta-frontier model in 135 Countries in 2002, 2007 and 2012. It should be mentioned that in Meta-frontier Method, technical efficiency of those countries is studied that are divided into 4 groups based on HDI. Based on hypotheses testing, Meta-frontier model is confirmed. According to obtained results, first group, the group including countries with high HDI has highest meta-technology ratio. In general, meta-technology ratio in 4 groups has been reduced over the time. In the other words, efficiency of countries has been decreased in regard with effect of health efficiency. The results of this study indicate that the effect of health expenditure on healthy life expectancy is positive and also the average years of education for a number of countries have positive effect on life expectancy and have no significant effect for a number of countries.

Key words: Health, efficiency, meta-frontier, function, Technical Gap (TGR), stochastic frontier analysis

INTRODUCTION

Health is one of the main and fundamental human welfare and happiness resources and one of the most valuable divine capitals and gifts. Health is one of the most important prerequisites to find job and income. Societies which have failed to achieve goals of public health have no stability and the societies would not be safe environment. Supplying health for people is one of the most important issues and it is in responsibilities of the government. Today, majority of societies consider health as a fundamental need of life. Hence, even in countries with capitalism system such as the US, despite to free economic system, the government interferes in sectors of public services such as education, communications, transportation and health system. As human factor has special role in process of economic growth and development of states, human investment and improve the quality of labor force is one of the main fields and ways to enhance productivity and to accelerate economic growth of the societies. Improvement of quality of human resources can be achieved through e\enhancement of health level of labor force (Amini and Hejazi, 2007).

Numerous studies have been conducted in field of identification of the effect of different factors on economic growth and ultimately, physical capital, human capital and labor force have been introduced as the most important factors. According to investigation of experiences of different countries, many economic scholars believe that function and importance of physical has been gradually decreased and consideration of human capital has been enhanced as key factor for economic development. As education and health are the main dimensions of hum capital, investment in human capital can refer to investment in activities such as education and healthcare which can lead to enhancement of productivity in labor market (Emadzadeh *et al*., 2009). Moreover, economists have considered health as a capital product that can affect production. Hence, it is in close relationship with comprehensive advancement and development such as economic growth and development. People of healthy society take action with more motivation and happier than others and direct and indirect costs resulting in reduction of national income and development would be decreased on the other hand. Hence, all societies pay specific attention to enhancement of health indices today. As health can affect growth, improvement of efficiency in health system can increase effect of the system on growth. Accordingly, this study aims in determining health efficiency using meta-frontier approach among studied countries, so that position of optimal function of countries in field of health could be specified. This can indicate economic behavior in this field and as a result, more effectiveness within the economic growth.

Organization of this study is as follows: in second section, relevant literature is presented including theoretical framework, literature and definitions; third section is associated with methodology including presentation of meta-frontier function model; fourth section described obtained results and findings and final section presented conclusion and suggestions gained by testing the hypotheses.

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Literature review: Importance of health as a fundamental right for living is clear to everyone. In fact, health is a kind of ability to make human life valuable. In other words, health is wealth. The expenditure inn y country spending on health affairs can determine health level of the society. Statistical evidences show that contribution of health and medical costs is different from total GDP in different countries. For instance, it includes 10-15% of GDP in the developed countries; about 8% in less developed countries; about 3-6% in developing countries and about 3% of GDP in poor countries (world health reports).

Life expectancy index indicates quality of life and is under impact of social plans, healthcare, mental relaxation and healthy eating. Growth of the index can demonstrate quality of using health costs in a country, i.e., if healthcare costs are sufficient and efficiency of using the resources is in high level, it is expected that the relevant indices of health level could be improved (Rezvani and Mansurian, 2008).

Schultz, father of theory of human capital, believed that role of improvement of quality of labor force achieved through investment in human capitals as one of the determinant factors for growth has been forgotten in traditional analyses on factors affecting economic growth. When talking about improvement of labor force, the issue would not be limited to training, skill and experience but also health of people should be also considered as a factor to accumulate human capital.

Grossman (1972), in chapter 5 of his book "health demand; theoretical and experimental study" has introduced health production function based on the assumption that in families, many products have multipurpose uses and hence, households have combined production function. Grossman has considered health production function as a function of inputs such as food, entertainment, housing, smoke, drinks and sweets and fatty foods in form of market and investment commodities and factors affecting consumer utility. Evans *et al.* (2001) have conducted a study using data of 191 countries during 1993-1997 to investigate health level of people in form of the average healthy life expectancy as production of health system in every country and have considered it as a function of 3 variables of health expenditure, average education levels and Chi square of the variable. Obtained results from the study showed that increase in health system resources isimportant for the poor countries and improvement of efficiency of existing resources can lead to creation of important advantages in most countries. Thornton (2002) has conducted a study to present new evidence of effect of economic, social and environmental factors on health status in different states of America using cross-sectional data of 1990. The study has considered age-adjusted mortality rate as product of health as a function of variable of costs of health care; taking of socio-economic variables (such as income and education), taking lifestyle factors (such as smoking and alcohol consumption and marital status), taking environmental factors (such as urbanization, crime and industrial) and taking control variables (instrumental variables) and has estim ted the approach using method of two-stage least squares. Obtained results from the study showed that overuse of healthcare services has had insignificant effect on mortality rate. However, factors reflecting economic and social conditions and lifestyle have been more effective determinants in field of mortality rate.

Hollingsworth and Wildman have conducted a study using 5-year panel data of 140 countries during 1993-1997 using parametric and non-parametric methods of Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) to estimate efficiency of health system of countries in frame of adjusted life expectancy based on compliance of Disability-Adjusted Life Expectancy (DALE) with health per capita expenditure, average education levels and population of adults of every country. Obtained results from estimating the model in 3 modes of all countries, OECD countries and non-OECD countries indicate that efficiency has been changed over the time and because of changeability of range of estimated efficiency in non-OECD countries compared to OECD countries, different models should be applied to estimate efficiency in 2 groups of countries. Self and Grabowski (2003) have conducted a study that the primary emphasisof this paper is on seeking some justification for the worldwide phenomenon of increasing government involvement in health-care. The Disability-Adjusted-health-Expectancy (DALE) rankings of countries by Murray *et al.* (2000), ranked wealthier countries with a typically large public sector involvement in health-care, higher on the list. Contrary to the possible implications for this ranking, this study finds that the comparatively higher DALE in wealthier countries is not a result of greater public health expenditures. In the middle income and less developed countries, however, there is some evidence of effective public involvement in health-care.

Data Envelopment Analysis (DEA) as an approach to find the efficient solutions, described by Mobin *et al.* (2015) and Li *et al.* (2016) has been also applied in the literature. Worthington (2004) has conducted a study using 3 approaches of Definite Frontier Analysis (DFA), stochastic frontier analysis and mathematical planning including data envelopment analysis to achieve health efficiency using Malmquist Index in frame of a one to

multiproduct production process. Obtained results from the study indicated that efficiency of profit organizations is higher than non-profit organizations in public sector. Moreover, efficiency is in significant correlation with size of institute whether the institute is hospital or and academy. Hence, efficiency of healthcare institutions has been enhanced over the time. Kumbhakar has conducted a study in deal with estimating efficiency of world health systems using panel data on World Health Organization (WHO) 191 member countries during 1993-1997. The Stochastic Frontier (SF) approach is used for this purpose. We evaluate absolute efficiency as well as rankings and their sensitivity across alternative model specifications using both output-maximizing and cost-minimizing frameworks. We also compare productivity of health service (among countries) derived from the output-maximizing and cost-minimizing models. Obtained results from the studyindicate that inconsistency is confirmed in inefficiency and disruption in both groups; although efficiency of most countries is maximization of health production is higher than health cost minimization. Moreover, results showed that efficiency rankings of countries vary substantially depending on whether the goal of healthcare provision is output maximization or health cost minimization. The result indicates that efficiency results are sensitive to the modeling method. On the other hand, comparing calculated productivity through ratio of adjusted life expectancy based on inability to pay health costs in both models indicates higher productivity of less developed countries compared to developed countries which is resulted from higher health expenditures of developed countries. Moreover, because of using a single production function for all countries, average productivity estimated through production function is lower than calculated average by cost function. Javadipoor (1999) has conducted a study to analyze effect of health expenditure on economic growth using cross-country studies using Solo 's developed model and statistical data of 33 developing countries. Obtained results from this study indicated that in addition to physical and human capital, health capital can also have positive effect on economic growth, entered in model as health expenditure variable. Zibaei and Jafari (2008) have conducted a study to differentiate regional differences in milk production technology using meta-frontier d\function and using data derived from 726 questionnaires and have found that the gap between the best producer and other ones is in minimum level in Yazd and in maximum level in Isfahan. Moreover, obtained results from estimation of meta-frontier production function and calculation of technology gap showed that Tehran and Yazd have better technical performance than other studied provinces. Lotfalipour (2011) have investigated effect of health indices on economic growth during 1982-1987 for Iran. Obtained results from this study showed that lifeexpectancy and health costs can increase rate of per capita income, respectively to 0.16 and 0.22%. Ranjbar and Torkian (2014) have conducted a study to determine economic, social and environmental factors affecting technical efficiency of health production function among 43 member countries of Islamic conference organization using stochastic frontier regression during 1998-2007. Statistical results of the study showed direct effect of factors including GDP, GDP and health expenditure percentage of GDP, food production, social factors and population literacy rate on health production function. However, social factor of fertility rate of adolescent mothers and environmental factors of urban population have negative effect on health production function. Moreover, obtained results from efficiency indicated that from the studied factors, increase in economic factors, vaccination of children and environmental factor have led to enhancement of technical efficiency of health production and increase in economic factor compared to age dependence and social factor of globalization have led to reduction of the efficiency. The declining effect of globalization can be because of lack of proper culture of using technologies and new social relations resulted from formation of the process in these countries.

Therefore, according to wide range studies in this field and obtained results from definition of each index following hypotheses are presented due to the research objective based on a review of meta-frontier efficiency of health systems in the world:

- The surveyed countries are similar in terms of health
- Health expenditures have no significant effect on health production of selected countries
- Average education levels of students have no significant effect on health production of studied countries. 4) Average health production technology gap is same in the studied countries
- Average health production is absolutely efficient in all studied countries in terms of technology

MATERIALS AND METHODS

In this section, applied model in this study to determine meta-frontier efficiency of health systems in international level is introduced to answer presented hypotheses. As applied model in this study is meta-frontier model based on inefficiency during the study is related to study of Battese and Coelli (1995), here

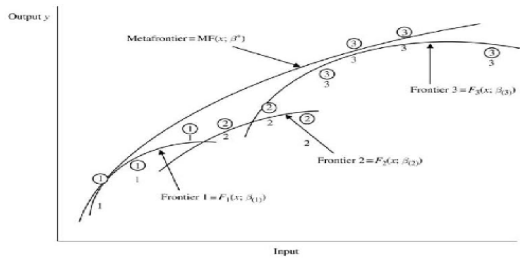

Fig. 1: Diagram of meta-frontier and frontier functions in different levels of technology (Battese *et al*., 2004)

meta-frontier model of Battese *et al.* (2004) has been introduced. Meta-frontier function shows production function with specific form which is not in subgroup of radical functions determined for stochastic frontier model of the studied regions. Battese *et al.* (2004) have presented a wide literature with the purpose of introducing a stochastic meta-frontier model in which a different mechanism derived from different regional fronts is considered to create meta-frontier data. Moreover, it is assumed that the meta-front is a uniform function in push form for frontier functions of different regions so that, the diagram in Fig. 1 has illustrated meta-frontier function according to Battese *et al.* (2004).

Here, it is assumed that production units produce product (y) using only one input (x) and different levels of technology. Some units work with technology 1, some of them use technology 2 and some others work with technology 3. Therefore, a frontier function can be determined for each level of technology. Considering health production function of each j group, the equation would be as follows: according to Battese *et al.* (2004):

$$Y_{it(j)} = f\left(x_{it(j),}\beta_{(j)}\right)e^{vit(j)-Uit(j)}, \quad i = 1, 2, ..., Nj, t = 1, 2, ..., T, j = 1, 2, ..., R \tag{1}$$

$$Y_{it} = f\left(x_{it},\beta_{(j)}\right)e^{vit(j)-Uit(j)} \tag{2}$$

where, X_{it} vector includes variables including health expenditures and average schooling. Moreover, v refers to random error and u refers to inefficiency:

$$v \sim N\left(0,\sigma_v^2\right)$$
$$u \sim \left|N\left(\mu,\sigma_u^2\right)\right| \tag{7}$$
$$U_{it(j)=\exp[-\eta(t-T)]u_{i(j)}}$$

According to Battese *et al.* (2004), meta-frontier health production function is calculated as follows:

$$Y_{it}^* \equiv f\left(x_{it},\beta^*\right) = e^{xit\beta^*}, i = 1,2,...,$$
$$N = \sum_{j=i}^{R} N_j; t = 1,2,...,T \tag{4}$$

where, values of B parameters through maximization of the target function are obtained as follows:

$$X_{it}\beta \geq x_{it}\beta(j)$$

Accordingly, technical efficiency of heath production of countries (TE_{it}) compared to TGR and TE_{it} is obtained as follows:

$$TE_{it}\frac{Y_{it}}{e^{x_{it}\beta_{(j)}+V_{it(j)}}} = e^{-U_{it(j)}},\ TGR_{it} = \frac{e^{x_{it}\beta_{(j)}}}{e^{x_{it}\beta^*}},$$
$$TE_{it}^*\frac{Y_{it}}{e^{x_{it}\beta^*+V_{it(j)}}} \tag{5}$$

Moreover, according to the equation, meta-frontier efficiency refers to multiplication of group efficiency of countries in Technology Gap Ratio (TGR).

$$TE_{it}^* = TE_{it} \times TGR_{it} \tag{6}$$

According to Kumbhakar, applied model in this study is introduced in form of a translog health production function, in which adjusted life expectancy variable (HALE) is based on inability year, Health Expenditures (HE) and average eduxation year (ED), U inefficiency and V random error:

$$LnDALE = 0.5B5lnHElnED$$

In this survey-analytical study, research area includes 135 countries divided to 4 groups according to Human Development Index (HDI) (details in appendix). Time scope of this study is considered in 5 year during 1998-2012, year 2002, 2007 and 2012 due to existence of dependent variable. For other variables, average of 5 year ending to these years is considered. In order to derive data, world systems including World Health Organization (WHO) and world development indicators have been applied.

RESULTS AND DISCUSSION

Data analysis: According to HDI, studied countries have been divided to 4 groups including very high HDI, high HDI, average HDI and low HDI. As 4 modes of presence

Table 1: T-testing combined hypotheses related to parameters γ in c and μ

Mode	H_0	H_1	$\Sigma^4_{i=1}\log L(H_0)$	$\Sigma^4_{i=1}\log L(H_1)$	Maximum like lihood	Result
1	$\gamma = \mu = \eta = 0$	$\gamma \neq 0, \mu = \eta = 0$	89/528	15/609	52/160	Rejected H0
2	$\gamma \neq 0, \mu = \eta = 0$	$\gamma, \eta \neq 0, \mu = 0$	15/609	46/679	61/140	Rejected H0
3	$\gamma = \mu \neq 0, \eta = 0$	$\gamma = \mu, \eta \neq 0$	97/611	42/699	92/39	Rejected H0
4	$\gamma = \eta \neq 0, \mu = 0$	$\gamma, \mu, \eta \neq 0$	46/679	42699	92/39	Rejected H0
5	$\gamma \neq 0, \mu = \eta = 0$	$\gamma = \mu, \eta \neq 0$	15/609	42/699	53/180	Rejected H0
6	$\gamma = \mu \eta = 0$	$\gamma = \mu, \eta \neq 0$	89/528	42/699	04/341	Rejected H0

Table 2: Testing likelihood ratio to assess possibility of existence of meta-frontier function result LR statistics Df = 2×30

H0	logL(peoled)	$\Sigma^4_{i=1}\log L(H_1)$	Df = 2×30	LR statistics	Result
Sameness of 4 groups	551.32	966.42	43.77	296.2	Rejected H0

Table 3:Testing combined hypotheses related to B parameters

H_0	Ln (H_0)	Ln (H_1)	LR test	Critical value 2%	Result
B2 = B4 = B5 = 0	510.43	528.90	37.14	21.03	H0 rejected
B1 = B3 = B5 = 0	482..72	528.90	92.36	21.03	H0 rejected

or absence of a, c and i parameters could be considered for fitness of 4 groups of countries, testing combined hypotheses for all groups are presented in Table 1 to assess type of distribution of inefficiencies. According to Table 1, firstly presence or absence of parameter γ is determined which can specify stochastic frontier nature of model. According to obtained results from Table 1 in row 1, the statistics (160.52) is higher than X^2 of the table with df off 4-9.49. As a result, hypothesis based on stochastic frontier nature of pattern is rejected. According to obtained results, each group is estimated separately. Also, rows 2 and 3 confirm variability of efficiency over the time under both distribution conditions of normal and semi-normal distribution for inefficiency. Row 4 has confirmed normality of inefficiency distribution under variable efficiency conditions over the time. Finally, rows 5 and 6 refer to reconfirmation of testing hypotheses in rows 1-4.

Here, it should be determined that whether determination of health efficiency in studied countries through selected model (stochastic frontier model) with inefficiency with normal and variable distribution overtime under homogeneous technological conditions and a common frontier for all countries or it is better to use heterogeneous technological conditions that is presence of common frontiers, along with a common meta-front. Obtained results from testing the hypothesis are presented in Table 2.

It has been observed that the statistics of likelihood ratio is more than statistics in table. As a result, H0 based on sameness of technology of 4 groups is rejected. Hence, accuracy of using a meta-frontier function for 4 groups is confirmed in p-value of 5%. In other words, 4 studied groups have independent frontiers and a meta-frontier could be considered for them. Obtained results from validation of 4 groups and meta-frontier function in condition of existence of variable inefficiency over the time with discontinuous normal distribution are presented in Table 3 in appendix.

Table 4: Mean traction in 4 studied groups

Elasticity to	Group 1	Group 2	Group 3	Group 4	Meta-frontier
Mean HE	5.66	11.52	2.73	0.21	0.42
Mean ED	0.05	-0.048	-0.047	0.019	0.08

Assessing the effect of studied variables: In this study, to assess the effect of variables of health expenditure and average education levels on health production function, likelihood ratio test is applied to test the hypotheses and obtained results are presented in Table 4

Hypothesis 1, mentions that explanatory variables of ln (ED), (ln(ED))2/2 and ln(ED)/2×ln(HE)/2 have not significant effect on DALE dependent variable simultaneously. According to Table 4, the mentioned hypothesis is rejected in confidence level of 5% (maximum error level of 5%). It means that common effects of explanatory variables of health expenditures and average education levels have significant effect on health production in studied countries. Hypothesis 2 mentions that explanatory variables of ln (HE), (In (he))2 /2 and ln (ED)/2×ln (HE)/2 have no significant effect on dependent variable of DALE at the same time. It means that variable of average education level has no effect on health production in studied countries. Obtained results from the test of likelihood in Table 3 indicate rejection of both H0 and H1 indicating effectiveness of both variables of HE and ED on health production in studied countries.

Elasticity calculation: According to obtained results from assessment of effectiveness of variables of ED and HE to investigate quality of the relations, average elasticity for life expectancy has been estimated along with health compared to mean value of variables affecting both groups and meta-frontier using the equations presented in previous sections. The results have been presented in Table 5.

In Table 5, average elasticity of health production function compared to health expenditure is estimated based on relevant variables in Groups 1-4. Clearly with 1% increase in mean HE, life expectancy is increased,

Table 5: Mean group efficiency, technology gap and meta-frontier efficiency

Year	Name	2002	2007	2012	Average	SD	Min.	Max.	Growth rate
Group 1	MTR	0.995726	0.99483408	0.994125623	0.9949	0.005	0.67449	1	-0.000160795
	TE (%)	0.997	0.997	0.967	0.9878	0.018034623	0.9671	09997	-0.003313004
	TE* (%)	0.995408	0.99152876	0.961369899	0.98276877	0.018633178	0.9613699	0.995408	-0.003473266
Group 2	MTR	0.829594	0.80177951	0.779024447	0.80347	0.040	0.7198	0.89624	-0.00626962
	TE (%)	0.962	0.967	0.972	0.967	0.005181929	0.962	0.972	0.001071513
	TE* (%)	0.797767	0.77548612	0.757203505	0.77681878	0.020314415	0.7572035	0.797767	-0.005204824
Group 3	MTR	0.960377	0.95487537	0.943290303	0.95285	0.036	0.86483	1	-0.001793571
	TE (%)	0.879	0.916	0.942	0.912	0.031959252	0.879	0.942	0.007015144
	TE* (%)	0.843926	0.87450306	0.888931124	0.86912013	0.022980273	0.84392619	0.888931	0.005208991
Group 4	MTR	0.961607	0.94209289	0.928009732	0.9439	0.042	0.77869	1	-0.003550014
	TE (%)	0.748	0.823	0.879	0.817	0.065853514	0.748	0.879	0.016298164
	TE* (%)	0.718896	0.77569545	0.815515659	0.77003558	0.048558042	0.71889578	0.815516	0.012690291

Table 6: Similarity test of TGR of health production in 4 groups

Groups	Confidence level	MTR	Test result
1	0.98<MTR<1.01	0.9949	
2	0.725 <MTR<0.882	0.80347	Health production
3	0.883 <MTR<1.023	0.95285	technology of 4
4	0.862 <MTR<1.026	0.9439	groups is not similar

respectively to 5.66, 11.52, 2.73 and 0.21%. Moreover, average elasticity of health production function compared to mean ED based on mean value of relevant variables in Groups 1-4 indicates that with 1% increase in mean education levels in Groups 1 and 4, healthy life expectancy would be increased, respectively to 0.05 and 0.019%; although a decline of 0.048 and 0.047 is observed in regard with Groups 2 and 3. Mean value of meta-technology (technology gap) ratio, mean group and meta-frontier efficiency during the study have been reported in Table 6.

In Table 5, MTR refers to meta-frontier technology gap; TE refers to in-group efficiency of each group and TE* refers to meta-frontier efficiency obtained from multiplying MTR in frontier efficiency of countries. According to obtained results, following items are gained: Fig. 2 Mean MTR of 4 studied groups.

Clearly, Group 1, group including countries with very high HDI has highest MTR. Moreover, MTR is decreased in all 4 groups over the time. In other words, performance of countries is decreased in field of health efficiency. Group 2 including high HDI is in lowest level in terms of technology gap referring to weak performance of this group in field of health efficiency.

Figure 3 show that first group has had negative growth rate during the study. Group 2-4 have positive growth rate; although growth rate of mean efficiency in Group 4 is more than two other Groups 3 Mean percent of meta-frontier efficiency of 4 groups According to Fig. 4, it could be observed that in terms of meta-frontier efficiency, Group 1 is in first position; Group 3 is in second position and Group 2 is in last position. Moreover, growth rate is positive in Groups 3 and 4; although the growth rate is negative in Groups 1 and 2.

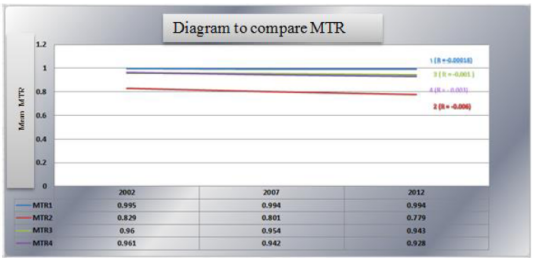

Fig. 2: Comparison MTR of 4 groups

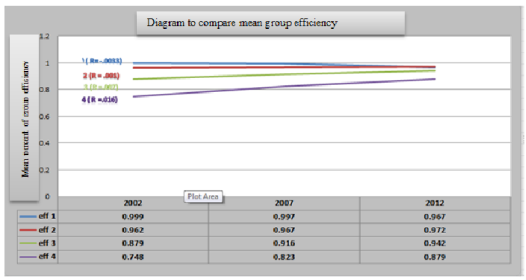

Fig. 3: Comparison mean percent of group efficiency

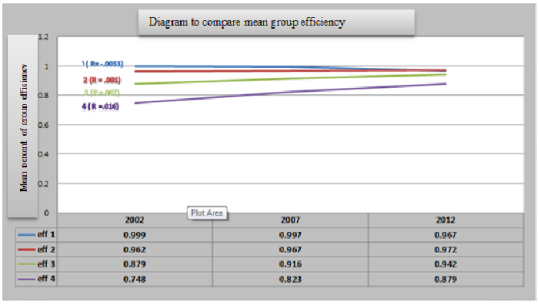

Fig. 4: Comparinf meta-frontier efficiency of 4 groups

Assessment of similarity of TGR of health production in 4 studied groups: In this part, to assess similarity of Technology Gap (TGR) of 4 groups, confidence level of MTR is estimated using estimated values of MTR and standard deviation related to it in Table 7 and 8 is estimated for each group using Eq. 9 in error level of 5%.

Table 4: Results of model fitness

Coefficients	Group 1	Group 2	Group 3	Group 4	Combined	Meta-frontier
B0	2.62 (3.69)	1.87	3.20 (7.75)	3.49 (10.30)	3.30 (36.62)	3.76
B1	0.14 (1.49)	0.10 (1.39)	0.14 (2.16)	0.24 (1.80)	0.09 (3.52)	0.04
B2	0.74 (1.77)	1.84 (4.69)	0.51 (1.24)	-0.02 (-0.07)	0.41 (7.04)	0.01
B3	0.01 (0.46)	-0.02 (-1.56)	-0.01 (-0.76)	-0.07 (-1.57)	0.01 (-0.61)	0.01
B4	-0.12 (-0.67)	-0.92 (-4.86)	-0.26 (-1.09)	-0.05 (-0.29)	-0.15 (-2.87)	-0.04
62	0.01 (3.56)	0.01 (0.49)	0.03 (1.87)	0.01 (3.31)	0.03 (5.866)	
ϒ	0.93 (38.86)	0.94 (8.26)	0.96 (35.77)	0.67 (6.03)	0.95 (68.89)	
μ	-2.35 (-4.49)	0.16 (2.41)	0.41 (8.47)	0.42 (5.61)	0.28 (12.32)	
Loglikelihood	249.49	235.02	126.06	88.85	551.32	

*values in parentheses are relevant t-values

Table 8: DIvision of countries to 4 groups

Group 1	Group 2	Group 3	Group 4
Norway	Uruguay	Maldives	Nepal
Australia	Romania	Mongolia	Pakistan
Switzerland	Russian	Federation	IndonesiaKenya
Netherlands	Bulgaria	Botswana	Swaziland
United States	Barbados	Egypt, Arab Rep	Myanmar
Germany	Malaysia	Paraguay	Rwanda
New Zealand	Mauritius	Gabon	Cameroon
Canada	Trinidad and Tobago	Bolivia	emen,Rep.
Singapore	Panama	El Salvador	PapuaNewGuinea
Denmark	Venezuela,RB	Philippines	Mauritania
Ireland	Costa Rica	South Africa	Lesotho
Sweden	Turkey	SyrianArab	RepublicSenegal
Iceland	Kazakhstan	Iraq	Uganda
United Kingdom	Mexico	Guyana	Benin
Japan	Sri Lanka	Vietnam	Sudan
Israel	Iran, Islamic Rep.	Guatemala	Togo
France	Jordan	Kyrgyz Republic	Haiti
Austria	Serbia	Namibia	Afghanistan
Belgium	Brazil	Honduras	Cote d'Ivoire
Luxembourg	Peru	Morocco	Gambia,The
Finland	Ukraine	Nicaragua	Malawi
Slovenia	Belize	Tajikistan	Liberia
Italy	Armenia	India	Mali
Spain	Fiji	Cambodia	Mozambique
CzechRepublic	Thailand	Ghana	Burundi
Greece	Tunisia	Lao PDR	Sierra Leone
Brunei Darussalam	China	Congo, Dem.. Rep	Central African Republic
Qatar	Algeria	Zambia	Niger
Cyprus	Dominica	Bangladesh	
Estonia	Albania		
Saudi Arabia	Jamaica		
Poland	Colombia		
Slovak Republic	Ecuador		
Malta	Tonga		
United Arab Emirates			
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Hungary			
Bahrain			
Cuba			
Kuwait			
Croatia			
Latvia			
Argentina			

In order to investigate similarity of technology gap in 4 studied groups, confidence levels of groups are measured two by two. Obviously, Group 2 has no common frontier with other groups. Hence, because of lack of common frontier of 4 confidence intervals, the final result refers to difference in technology gap of health production among 4 groups.

Assessment of perfect efficiency of health production in 4 studied groups: According to existing relationships to assess perfection of efficiency, confidence intervals are formed for all countries in 4 groups. According to obtained results, the confidence interval is obtained to 1 for no country and this refers to inefficiency among the countries.

CONCLUSION

In hypothesis 1 was mentioned that studied groups are similar in terms of health production. According to obtained results, H0 based on homogeneity of countries in terms of health production is rejected. Hence, it could be found that the frontier between groups is different. According to the difference among frontiers of 4 groups, a meta-frontier could be defined for them. In hypothesis 2, it was mentioned that health expenditure has no effect on health production of selected countries. According to test results of the hypothesis in 4 groups at the same time, H0 based on no effect of HE on lifeexpectancy index is rejected and this refers to effect of HE on healthy life expectancy. Moreover, obtained results show that there is positive relationship between health expenditure and life expectancy and this indicates that increase in expenditures in field of health can increase life expectancy. In hypothesis 3, it was mentioned that average education levels of students has no effect on health production of studied countries. According to results of testing the hypothesis in all groups at the same time, H0 based on no effect of average education levels on life expectancy is rejected in error level of 5%. Therefore, it could be mentioned that education levels can affect life expectancy in these 4 groups. In hypothesis 4, it was mentioned that health production technology is same among studied countries. According to obtained results and lack of commonness of 4 groups it could be found that health production technology gap is different among the 4 groups. Obtained results show that Group 1 (group with very high HDI) has highest MTR and highest

group efficiency and meta-frontier efficiency than other group. In hypothesis 5, it was mentioned that health production is perfectly efficient in all studied countries in technical terms. To test the hypothesis for all countries in all groups, it could be mentioned according to estimations that the efficiency is perfect when all confidence intervals are equal to 1. However, according to obtained results, confidence range of no country is obtained to 1 which indicates that all countries with perfect efficiency have confidence interval. As when the technical efficiency is not perfect, meta-frontier efficiency is also imperfect, group efficiency is tested. Obtained results from the study show that there is positive correlation between health expenditure and life expectancy in 4 groups and this shows that increase in expenditure consumed in field of health production can lead to increase in life expectancy. Moreover, there is significant correlation between education level and life expectancy in Groups 2 and 4, which refers to increase in life expectancy as a result of increase in education level. However, it was observed that there is no significant correlation between education level and life expectancy in Groups 1 and 3. Moreover, according to obtained results from MTR and group efficiencies, it was found that Group 1 (with very high HDI) has highest MTR and highest group and meta-frontier efficiency among the groups. In regard with division of countries to HDI, Iran has possessed Group 2 that includes countries with high HDI. Accordingly, both studied variables have been effective in enhancement of life expectancy in Group 2. As a result, in order to enhance life expectancy level in Iran, investments should be done in two health and education sectors to achieve desirable efficiency level.

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