# CONSIDERATIONS REGARDING THE ECONOMIC MODELS FOR THE EVALUATION OF HEALTH

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Abstract: Defining and understanding the concept of „health" is established as an essential step in today's world. The notion falls under the influence of numerous factors, mostly of economic nature, that determine the achievement of an optimum in terms of the actual purpose, namely health. In order to asses the economic value of health some specific economic models have been outlined, and they aim to appraise the monetary and non monetary values of health. By considering health a commodity, the economic models of health try to mathematically determine medical and non medical outcomes using methods derived from microeconomics, such as: cost-benefit analysis, cost-efficiency analysis, cost-utility analysis and the cost minimization model. These models employ their own set of particular indicators and although results frequently vary, pointing out the obvious limitations of each method, the answers they offer policy makers and individuals alike, become points of action for all parties involved and fundamentals for any future decision in the fields of health and healthcare. This paper aims to highlight the causes that have led to the need for developing economic evaluation models of health and also to assess the benefits, disadvantages and limitations of each model.

**JEL classification: I1, I11, I18**

**Key words: health evaluation, economic models for health, health outcomes, monetary value of health**

## INTRODUCTION

Considering health „an evolutionary process that requires quantification"[1], all elements that influence health lead to certain outcomes: „health related outcomes" and/or „economic outcomes".

Health outcomes reflect either the recovery of health status or certain conditions which generate long term physical impairment (loss or abnormality of anatomical, physiological or psychological features), disability (functional limitations described as a discrepancy between the actual physical and psychological capacity of an individual and the actual ability to perform certain activities) or disability (the effect of the existence of disability and need to adapt to it, translated by the social disadvantage faced by the individual).

[1] Satpathy, S.K., Bansa, R.D. – Health Economics: concepts and conceptual problems, Health and Population - Perspectives & Issues no. 5(1):23-33, New Dehli, 1982, p. 25

From an economic perspective, health can only be quantified as the monetary value of health outcomes measured by indicators which reflect a mathematical correlation between health status and ones' future ability to generate income. In this sense, economic concepts applied to healthcare define notions such as resources, cost, health spending, capital and recurrent expenditure, depreciation, cost of illness, effectiveness and efficiency. Based on these elements, the need to develop specific economic models for assessing the economic performance of health have emerged and they serve as a basis for all health policy decisions, especially those concerned with the allocation of financial resources.

## ECONOMIC MODELS FOR HEALTH EVALUATION

Having been first used in 1844 by Jules Dupuit[2] only to become an instrument of economic and financial evaluation in healthcare in 1993[3], the **cost-benefit analysis** attributes monetary value to all health and life improvements obtained through the use of medical goods and/or services. In monetary terms, the benefits (negative or positive) refer to either a reduction of the individual income as a result of damaged health or to the total amount a person is willing to allocate in order to preserve ones' health. From a mathematical point of view, the final individual benefit can be expressed as:

$$\mathbf{NB(x)=EB(x)-EC(x),}$$

*NB- final benefit;*
*EB- expected benefit;*
*EC- expected costs;*
*X- chosen alternative from $M_x$={X} – set of all available alternatives.*

In theory, this approach is simple and appropriate, since the terms of the equation can be easily identified as they depend on individual preferance (eg. a certain medical procedure) and individual levels of income. If we are to extend the scope of formula to a specific population, the need for restrictions emerges due to the fact that without them the results would vary randomly. In order to illustrate the previous statement we make the following assumptions:

(1) P = {P1 ... Pn}, the crowd of people accessing a range of health care services;
(2) (2) Mx = {M1 ... Mm}, the set of possibilities, namely health services available;
(3) $m \geq n$;
(4) B = {B1 ... Bz}, the set of benefits obtained through the use of medical services included in Mx;
(5) $B_1 \neq B_2$ **…..** $\neq B_z$, because the benefit is either considered as a reduction of individual income due to deteriorating health or the total of the amount which a person is willing to allocate to preserve health;
(6) the cost of any given medical service M will be identical to any element of the set P.

[2] Dupuit, J.- De la mesure de l'utilité des travaux publics-, Annales des ponts et chaussées, II Series, 8, 1844
[3] Jamison, D.T. et al. - Disease Control Priorities in Developing Countries-, World Bank, Washington D.C., USA, 1993, p. 263

For a certain M the individual net benefit will vary from $P_1$ to $P_n$:

$$\mathbf{NB_{P1}=EB_{\{Mx\}}-EC_{\{Mx\}},\ldots\ NB_{Pn}=EB_{\{Mx\}}-EC_{\{Mx\}}}$$

**or**

$$\mathbf{NB_P=\{\ NB_{P1}\ldots\ NB_{Pn}\}}$$

In other words, for any element of the set P, the net individual benefits deriving form a certain M will be different as one M leads to different losses or gains. Continuing with the assumption that any element of the set P will not opt for the same element of the set Mx, it can be concluded that the total net benefits set has the following form:

$$\mathbf{NB_P=\{\ NB_{P1}\neq\ NB_{P2}\neq\ \ldots\ldots\ldots NB_{Pn-1}\neq\ NB_{Pn}\ \}}$$

It appears therefore that, in the absence of restrictive conditions, the individual results obtained by calculating the net benefit can not be compared within a given population because the benefit obtained by the use of a particular medical service is not identical for all individuals, as depends on the level of income, or otherwise on the gain or loss resulting from particular options. Considering the monetary gain as a proportion of total individual income, it is clear that proportionality does not automatically lead to an equivalence between the amounts representing benefits.

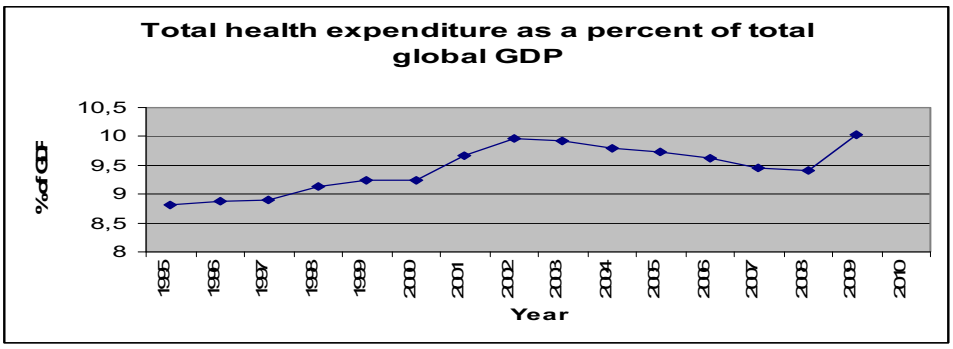
In order to balance the limitations of the previous equation, namely the difficulty of aggregating individual benefits and costs, the cost-benefit analysis has been extended at macroeconomic level:

$$\mathbf{TNSB_{Mx}=ETSB_{Mx}-ETSC_{Mx},}$$

*TNSB – total net social benefit;*
*ETSB – expected total social benefit;*
*ETSC - expected total social costs.*

For a better interpretation of the result, we believe that an appropriate equalization could be the fallowing: the expected total social costs is equivalent to the „Total health expenditure as a percent of total global GDP" (Chart 1), the set Mx is equivalent to all basic medical services packages that can be provided to persons covered under a health insurance system (social or private), the expected total social benefit is equivalent to „Life expectancy" (Chart. 2), and the total net social benefit is equivalent to the „Global GDP per capita" (Chart 3). Under these cirmustances, the total net social benefit would be expected to increase with positive offset between the expected total social benefit and the expected total social costs.

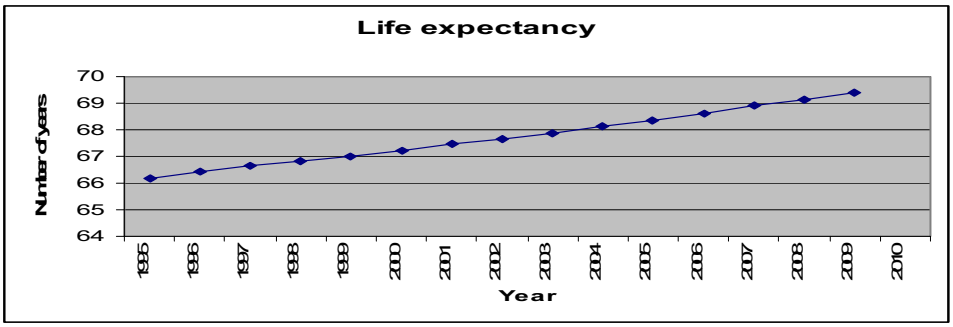
**Chart 1 Total health expenditure as a percent of total global GDP (1995-2010)**




*Source: the author's contribution based on available World Bank data*

According to Chart 1, during the 1995-2010 period, there is an increase in the level of total health expenditure as a percentage of global GDP, from 8.8% in 1995 to 10.0% in 2010. Despite the upward trend, the variation is non-linear and the downward growth rate between 2002-2008 is mainly due to the effects of various financial crises that affected Latin America and Asia between 1996-2002 and the entire global economy after 2007. In addition, during the same period Health ODA (Official Development Assistance for Health[4]) was quite limited, being directed to only 23 countries[5] which were considered to be poor. Thus low developed and developing countries faced insufficient health funding, usually reflected in the reduction of overall health expenditure.

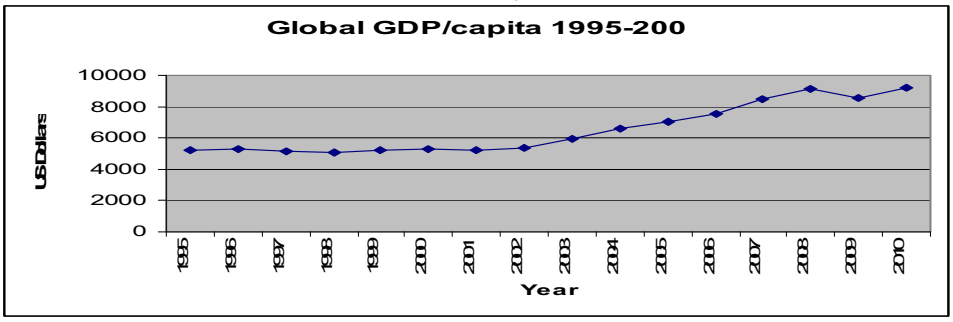
**Chart 2 Life expectancy (1995-2010)**




*Source: the author's contribution based on available World Bank data*

Chart 2 indicates a continuous increase in life expectancy at global level from about 66.5 years in 1995 to 69.4 years in 2010. By comparing the information of the upward trend of both indicators it stands out that the increase in life expectancy is not entirely the result of increased health expenditure.

**Chart 3 Global GDP/capita 1995-2010 (US Dollars)**




*Source: the author's contribution based on available World Bank data*

[4] World Health Organization –Recent Trends in Official Development Assistance to Health, p. 3, http://www.oecd.org/dataoecd/1/11/37461859.pdf

[5] World Health Organization –Health Amid a Financial Crisis: A Complex Diagnosis, Bulletin of the World Health Organization, Volume 87, p. 4-5

Should Global GDP/capita be taken into account (Chart 3) for the same period of time, a linear growth trend is noticed, from 5222.1 USD/capita in 1995 to 9216.0 USD/capita in 2010, with a minimum point of 5199.4 USD/capita in 2001.

The analysis of the three graphs show that all indicators are on a upward trend without a linear correlation. Thus, during 2002-2008 the total expenditure on health shows a decrease, while life expectancy and GDP/capita increase. Although there is a confirmation of the cost-benefit analysis, the occuring variations highlights the possible existence of other factors of influence one or all variables of the equation. Under these circumstances it is necessary to identify the role of certain factors such as social policy guidelines, level of education, living environment, etc. on life expectancy and also the impact of other additional elements of cost on the total health expenditures as a percentage of GDP.

Ultimately the cost-benefit analysis shows its limitations when it comes to correctly identifying all factors of influence and any additional social elements that affect the benefits.

The **cost-effectiveness analysis**, extended by Shepard, D.S. and Thompson, M.D. to the medical field in 1979[6], aims to compare the cost of a particular intervention in the health sector with its expected gains. The concept of effectiveness defines the capacity of a certain economic or medical intervention to generate positive results. Health sector interventions refer to any activity which uses human, financial or any other kind of resources with the purpose to improve health. Expected gains take the form of risk reduction associated with a health problem, reduction of either the severity of a certain condition or its duration, including the elimination of the risk of disability or death and is expressed in monetary terms as the increase of income due to improvements in health. In most cases, the comparison is done by calculating a ratio (R) between two or more alternatives, according to the formula:

$$R = \frac{C_1 - C_2}{E_1 - E_2},$$

*C – the cost of an alternative intervention;*
*E – expected gain of an alternative intervention.*

Frequently, the model calls for a specific indicator, DALY (Disability-Ajusted Life Years[7]), introduced in the field of health economics in 1993 by the World Health Organization. This indicator is used to determine the number of years of living in a particular health condition, resulting from the benefit of a particular treatment or medical procedure.

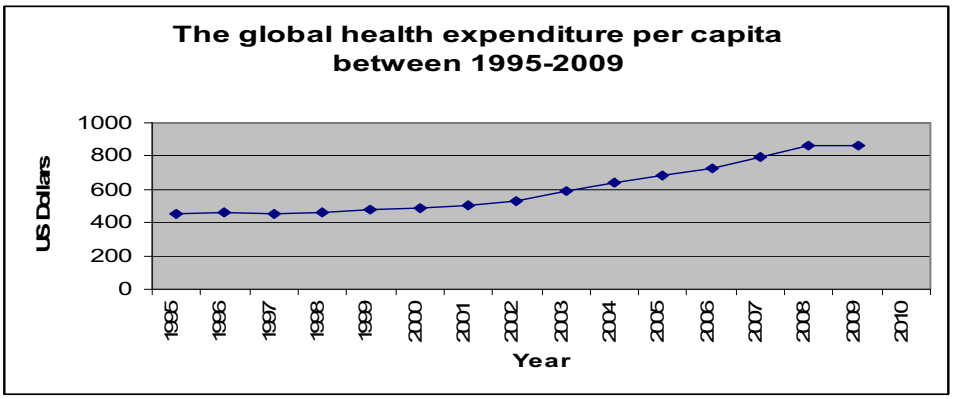
DALY= YLLSLE+YLDSLE unde,

*YLL – Years of Life Lost due to a medical condition;*
*YLD – Years lived with Disability;*
*SLE- standard life expectancy: 80 years for men, 82,5 for women.*

[6] Shepard, D.S., Thompson, M.S. – First principles of cost-effectivness in health, Public Health Reports, vol. 94, 1979, p. 535-543
[7] Zweifel, P., Breyer F., Kifmann, M. – Health Economics, Springer-Verlag, Berlin Heidelberg, Germany, 2009, p. 25

In order to clearly illustrate the cost-effectiveness model, we equate the cost with „The global health expenditure per capita" (Chart 4) and the expected gain with „Death rate due to illness/1000 inhabitants"(Chart.5).

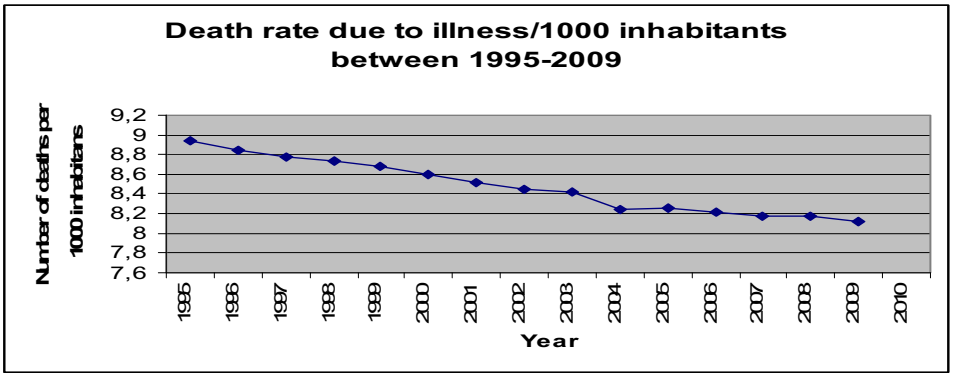
**Chart 4 The global health expenditure per capita between 1995-2009 (US Dollars)**




*Source: the author's contribution based on available World Bank data*

According to Chart 4 there is an increase in the level of total health expenditure per capita 1995-2009, from 456.9 USD/capita in 1995 to 686.0 USD/capita in 2005 and 863.6 USD/capita in 2010. This trend can be justified in terms of increasing GDP/capita over the same period of time (according to Chart 3), without it being reflected by the total health expenditure at global level which also records times of downward trend (Chart. 1).

**Chart 5 Death rate due to illness/1000 inhabitants between 1995-2009**




*Source: the author's contribution based on available World Bank data*

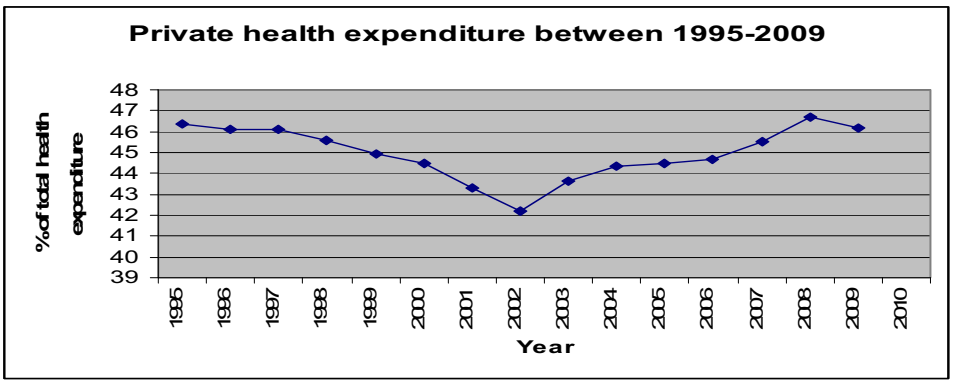
Considering the expected earnings as a decline in deaths per 1000 people worldwide, between 1995 and 2009 we find an inversed correlation between the number of deaths due to illness and health expenditure per capita, which shows that the annual supplement of funds allocated to health is likely to lead to the reduction of deaths from medical causes.

From the perspective of the cost-effectiveness analysis we can point out that the expenditure (cost) directly determines the expected profit increase (decrease risk of

death). However, we consider the statements of Jamison, D.T. and Breman, J.G. as notable as they believe that „an enhanced life expectancy through the use of medical services is not a guarantee to the improvement in the quality of life”[8]. Based on this argument, we consider that the authors highlight the main limitation of any economic model for healthcare evaluation, which is the proper identification and quantification of costs which are not always readily available and usually depend on the personal situation of the population for which the analysis is being conducted. Under these circumstances there is a risk of accidental failure of the model thorough those elements which are able to influence the results.

In order to test the cost-effectiveness model, it is necessary to consider an additional indicator „Out-of-pocket payments as proportion of total health expenditure” (Graph 6) which shows that over 40% of funds allocated to healthcare come from personal resources which usually represent fee-per-service payments. The change of the indicator closely fallows the variation of „GDP/capita” and it might be due to periods of global economic recession.

**Graph 6 Private health expenditure between 1995-2009 (% of total health expenditure)**




*Source: the author's contribution based on available World Bank data*

Under these circumstances it is found that the level of achieved utility depends greatly on the peoples's ability to allocate additional resources. Simultaneously, if individuals tend to allocate more funds to healthcare that could indicate a poor perception of their health status. Also, by extending the reasoning we can say that the use of cost-effectiveness analysis on a health insurance system will lead to results that are more likey to reffer to the level of coverage rather than to individual health effects (eg. improvement of health of the insured and extended coverage is not sufficient to ensure an increase in the quality of life). Depending on the envisaged objectives of a certain health policy orientation, efficiency could be seen in the number of insured and not necessarily as quality of care. In addition, health policy decisions based on cost-effectiveness analysis could disregard the situation of persons to whom they are addressed. The potential introduction of new medical technologies may contribute to the improvement of health, but patients may choose not to access it due to insufficient financial resources.

[8] Jamison, D. T., Breman, J. G. - Disease control priorities in developing countries, second edition, Oxford University Press, World Bank, 2006, p. 39

Another technique taken from the field of microeconomics, the **cost-utility analysis**, has become increasingly popular in recent years due to its widespread use by the World Health Organization for reports on health status and perceived satisfaction on existing health systems. Cost-utility analysis results are used as reference for future health policy approaches worldwide. This model weights the number of years gained from the use of certain medical procedures with the quality of life. The indicator that assesses the quality of life is the QALY (Quality Ajusted Life Years), which in mathematical terms appears as the product remaining life expectancy and quality of life years gained as a result of medical treatment.

Cost-utility for two alternatives, through QALY implies three steps:

(1) assesment of life expectancy in a particular health status;

(2) Identification of a utility index (UI) that takes values on a scale from 0 to 1 by probing the population concerned:

QALY= UI x remaining life expectancy

(3) Cost-utility ratio (R):

$$R=\frac{Cost_1 - Cost_0}{QALY_1 - QALY_0},$$

*Cost $_1$- the cost of the new medical procedure;*
*Cost $_0$- the cost of the old medical procedure;*
*QALY$_1$- the QALY of the new medical procedure;*
*QALY$_0$- the QALY of the old medical procedure.*

Considering an empirical model, we assume there are two available alternatives for treating the same condition which, without treatment has a survival perspective of 10 years. Alternative (1) helps extend the life with another 10 years and guarantees during this period, a state of satisfactory health (UI = 0.5). Alternative (2) provides only a state of optimal health (UI = 1) without additional extension of life.

QALY will take the following values:

(1) $QALY_1 = UI_1$x life expectancy with treatment =
= 0.5 x (10 years without treatment + 10 years life gain due to the treatment) =
=0.5 x 20 = 1 QALY;

(2) $QALY_2 = UI_2$ x life expectancy with treatment=
= 1 x 10 years (because alternative (2) only improves health status without extending life expectancy) = 1 QALY.

According to the model, both alternatives, although totally different, lead to apparently identical results, even if individual perception upon health and life are different. Unlike the previous analysis, cost-utility model is deeply subjective, finding its most common use in the pharmaceutical industry. The applicability of the model to a health system or health insurance system is limited because health policies and financial allocation are not based on individual perceptions.

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The fourth model, **cost-minimization analysis** aims to identify, measure and compare the costs of two or more medical interventions or health policy decisions, noting that the results/benefits are equivalent. The best alternative is one that bears the lowest cost while producing similar benefits. The starting point of this method refers to the identification and measurement of costs for a considered alternative or procedure.

In general terms, cost identification implies the calculation of the total cost of a particular condition or individual preference, and the acknoledgement of the effect that the total cost has on the economy. Thus, the total cost borne by society as a whole is composed of direct medical costs (all costs imposed by medical providers for services rendered and goods delivered, including medical staff salaries), non-medical direct costs (the costs imposed on any member of staff, including patients and other economic sectors other than the medical sector) and indirect costs (costs that are not directly related to the volume of services provided, and include management costs, heating, electricity, security, etc. and the opportunity cost incurred by patients).

This classification differs from any general economic approaches and leads to a more difficult understanding of the elements considered, particularly the indirect costs and their effects on the economy. Although at present, the literature has not yet fully substantiated cost terminology, saying that „these issues are still subjects of debate”[9], a general classification is given by microeconomy[10]. From this perspective, the costs are fixed, semi-fixed (non-proportional with volume of activity), semi-variable and variable, direct or indirect.

In terms of the source of financing costs are[11]: costs borne by the health sector (capital costs, personnel costs, cost of material and medical equipment), costs borne by patients and third parties (the cost of medicines and sanitary materials, co-payments, required contributions to private or social health insurance schemes) and costs incurred by other sectors (reduction of available resources due to additional allocations to the medical field).

All these types of costs requires a commnon measurement unit to ensure their comparability. To the extent to which a specific cost could be assigned a monetary value, there tangible costs (waiges, the value of material resources, contributions, etc.) and intangible costs (activities and psycho-emotional states generated by the degradation of health status).

The examination of costs in terms of typology, source of existance and source of financing entail broader implications for the alternative ways used to provide health care services or individual health programs. The relevance of the results of this model is limited by the need to express all the factors of influence in monetary terms and depends to a large extent on the perception of decision maker, who may accept or not the postulate of identical benefits. Moreover, optimal results can not be achieved through cost-minimization in the absence of specialized studies who to that two or more alternatives bear the same result.

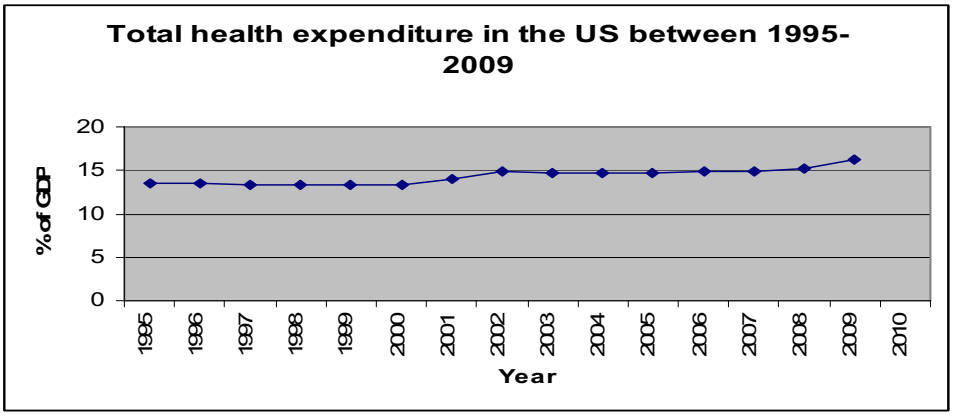
The main disadvantage of using this model are most evident when it is applied to a health insurance model. The optimal alternative may cost effective but it may

[9] Zweifel, P. et. al. op. cit., p. 314
[10] Pîrvu, Gh., Gruescu, R. – Microeconomie – Ed. Sitech, Craiova, 2009, p. 174
[11] Scîntee, G. – Elemente de economie sanitară - extras, p. 314, www.univermed-cdgm.ro/dwl/cap8.pdf

trigger disadvantages such as limiting the access to health services or a reduction of the basic health package.

In this regard we could consider the United States of America, which bears the largest health expenditure in the world but has yet failed to include the entire population in a health insurance scheme. As a percentage of GDP, health expenditure in the U.S. has now reached 17.6%, 1/6 of total federal expenditure[12], the most important global resource allocation (Chart 7). In relation to total health expenditure, public health expenditure increased from 38% in 2008 to 54% in 2009 despite the global economic recession and the decrease int he number of insured by 6.3 million[13].

**Graph 7 Total health expenditure in the US between 1995-2009 (% GDP)**




*Source: the author's contribution based on available World Bank data*

The immediate effect of this reduction was felt by service providers and medical supplies as a need to reduce total costs by 2.7% in 2009, of which 4.3% reduction in fundinf for research and 1.1% reduction in the resources allocated for the procurement of medical equipment. Consequently drug costs increased by 5.3%, compared to 2008 while the total cost of hospital services increased by 5.1% in 2009 compared with an increase of only 4.2% in 2008. Under the influence of these issues a complete reform of the american health insurance system has been set up. The reorientation of the american health policy betrays an attempt to control the costs and aims not necessarily save money, but to provide access to health care services for a larger number of people while accepting the fact that the anual growth rate of medical spending can not be lowered to more than 6.6%[14] (according to the American Hospital Association).

## CONCLUSIONS

[12] U.S. Department of Human Services, Centeres for Medicare and Medicaid, http://www.cms.gov/

[13] Murphy T. - Health insurers weather storms heading into 2010, Associated Press; 2009 sg.us.biz.yahoo.com/ap/091105/us_earns_managed_care.html?.v=2, p. 10

[14] American Hospital Association – The economic crisis: ongoing monitoring of impact on hospitals, Chicago, 2010, p. 18
http://www.aha.org/aha/trendwatch/2009/09noveconimpsurvresults.pdf, p. 18

Usually, the decision-making process in healthcare involves complex information bases and the action of many decision makers. The limitations of all cost analysis models entail the need for a specific language when assessing the costs and benefits of certain alternatives, because the mear existance of various interventions is based on the contribution of different specialists. In this respect, economists will be particularly concerned by the quality of models and the number of working hypotheses formulated, while professionals with medical training will focus on the results of clinical trials. All economic evaluation models above have both advantages and disadvantages depending on the situation in which they are applied. Without saying that the disadvantages are likely to lead to limiting or eliminating the use of one of the models of analysis, support is needed in order to correlate results between the different aproaches and it is important to emphasize the generic limitations of each model:

- the results obtained following the application of economic valuation models can not be generalized at nation or world level as the results bear cultural and regional differences;
- it is difficult to asses the distribution of cost and benefits among various social categories;
- the benefits obtained from theoretical aproach are often higher than those obtained by applying a certain model to a population;
- the use of economic evaluation techniques often generate significant indirect costs;
- the economic evaluation is based on data collection. If this data is not reliable, the results of economic evaluation would certainly be irrelevant.

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