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GDP Alternatives and their Correlations[1]

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ABSTRACT: In our study we wanted to find an answer to the question whether we can find sustainable countries if we compare the values of different composite indicators? The target of our study is to examine the possibilities as well as the limits of the application alternative composite indicators. Our study focuses on what kind of relations the indicators are in and to what extent they can substitute the GDP and what kind of morals can be indicated for Hungary. The basic question of our research is how possible is to group countries clearly based on the values of alternative indicators. In this study were examined three composite indicators (HDI, HPI, EPI) and the ecological footprint and GDP trends. In the first phase of our research we revealed that these indicators can be observed in pairs to linear relationship, the Pearson's correlation index values are shown in the correlation matrix. Based on our analysis two indicators independent of each other and also independent of the GDP, these are the HPI and the EPI. The classification of countries was performed using cluster analysis. Based on the three-cluster model is determined a specific path of development in Latin America and useful experience for Hungary.

KEYWORDS

HDI, HPI, EPI, Ecological Footprint, Latin America

"The social sciences also work with models and often with mathematical models. However, the social scientists have never thought that there is a need for this due to the fact that the „book" of the society (or let us say the economy) was written based on the language of mathematics."

-Mérő L.[2]

I. INTRODUCTION

What you can measure – you can improve! - Says the common wisdom. However, the one who said this might not have been so wise. As the fact is true

1 "This research was supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP 4.2.4. A/1-11-1-2012-0001 'National Excellence Program'."

2 Hungarian mathematician, psychologist.

in most cases, but the meaning is easily distorted to this: *What you want to improve, measure first!* Most important things in life are felt, but not measurable. Still, there is a strong need in our positivist world to measure the quality of life and sustainability, to translate them into heavily measurable and numerical categories. We often feel that not the citizens of the richest countries are the happiest and severe problems can be found in the developed countries despite the economic development. However, the economic crisis queries the success of the model resting on conventional market operation as well as private ownership and the values of those communal characteristics, which previously have not belonged to the features of successful countries, are rising. In Central Europe, including Hungary, the economical aims as well as the exemplary developmental way must be reassessed. The influences of the economic crisis beginning in 2008 can be experienced even today (Csiszárik-Kocsir 2012, Kerekes 2012); the most significant crisis of the new Millennium has unusual effect on every participant of the macroeconomy. The public budget was hard hit by the financeability of the public debt and the economic crisis has meant significant events for the enterprises and for the household, for instance the rise in the price of loan costs and the decline of consumption as well as investments[3], which can ultimately be recognised as the damaging factor of the welfare (Csiszárik-Kocsir 2011). Due to the impact of the economic crisis, the professional interest toward the reform of macroeconomic indicators has increased and since the report of Stiglitz – Sen – Fitoussi (Stiglitz et al. 2009) dealing with the limits of the GDP index, the accepted opinion is that the present clearing of accounts system cannot be maintained, which appears not only in the theories and research findings of alternative economists (Kerekes 2011) but also in the decision making of economic policy. In recent years, several assessments and criticisms have been published about the research of Stiglitz, mainly as a result of social studies (Tsai M. 2011).

Even from the beginning, the measuring experiments and their standpoints presented considerable variety, the basis of the measurements was the industrial achievement in England and mainly the agricultural performance in France. The contemporary measuring system based on GDP started to be established in the 1930s and its difficulties came out even in the first years: „In 1931 a group of governmental and private experts was called for congressional audition in order to provide answers to basic issues in connection with economy. It came to light that they were not able to do this: the latest facts and figures had reference to 1929 and they were also incomplete. In 1932, in the last year of Hoover administration, the senate called upon the Ministry of Commerce to conduct an overall estimation about the national income. Soon after, a young economist, Simon Kuznets was commissioned by the ministry to develop the unified system of the national clearing of accounts. This became the prototype of the today called GDP. Simon Kuznets had serious reservations about the clearing of accounts system of the national economy aided by him. In his first report of 1934 to the congress, he tried to draw the nation's attention to the limits of the new system. » Hardly can we conclude about the welfare of a nation from the measure of national income determined above«– drawing his conclusions. (…) Simon Kuznets rejected the most leading economic priori conceptual schema. When an economy starts to increase, as he claimed, the parts of that economy must increase as well. The economists ought to attempt to conduct the measure of more and varied items. In his book of *The New Republic,* 1962, Kuznets set down in writing that there is a need for the basic reconsideration of the

3 The effects of these phenomena can be significantly felt in the construction industry, where state programs may have remarkable positive effects on the long run (Szabó 2014).

national clearing of accounts. » We need to pay attention to the distinction between the quantity and the quality of increase, between the costs and the yields and the differences between the long and short term considerations« according to Kuznets. » The targets of the 'larger' increase must be determined specifically, in other words, what should be increased and for what reason (Cobb et al. 1995)." The situation has not changed for a long time: „After the GDP was welcomed completely in the United States, the calculation system of the national economy represented above was accepted globally. In the previous forty years this system had not been modified at all while the mankind and the face of the Earth transformed to some extent which had not been experienced before. Only just some of the dynamic changes constitute the conquest as well as the exhaustion of the environment, the denial of the existence of the subsystem of the economy and the incorporation of other social factors (family, politics, public administration) by the economy, the huge population explosion and the incredible financial differentiation" (Dabóczi 1998). The development of national accounts was set in many ways due to the concerns related to environmental problems caused by the increasing economy from the 1970s (Lawn 2007). It should also be noted that this development approach had a powerful impact on land use sustainability gained more attention than ever (Lazányi 1999 and 2005, Hetesi 2008, Kerekes 2012). This case stimulates scientific study of the urban structures and the scientific debate on the sustainability of these areas (Pintér 2011). The researchers have developed several indicators in the past decades as a result of the improvement of additional GDP or substituting alternative indicators. One of the most completed overview of the findings of recent years can be found in the article of Bleys (2012). The author is not willing to determine the exact number of alternative indicators however, Brent Bleys presents almost 200 indicators and its various clustering opportunities. The study of Vačkář D. (2012) is outstanding related to the examinations aiming at exploring the connections among the indicators in which the correlation matrix of 27 alternative indicators was prepared. Detailed analysis about the relation among the GDP, the ecological footprint and happiness can be read in the article of Kocsis (2010), in which the influences and consequences of the varied developmental ways are outlined for Hungary. The environmental sustainability would often requires the decrease of the GDP per capita in the so-called developed countries among the possible and positive future prospects. The various indicators are important at global level, but we think that it could be also at macro regional level too, for example the interpretation of the indicators could be also important in the cohesion policy of the EU. Also the local actors (civil organisations, firms, etc.) can contribute to the success of the cohesion policy (Reisinger 2012), so they can also contribute to the utilizations of the indicators in a wide range of the actors.

II. MATERIAL AND METHODS

In our study we examined the indicators belonging to the group of alternative indicators of substituting the GDP. We took into consideration two factors when we selected the indicators, we were in search of such indexes which can evaluate at least two pillars (environmental, economic and social) of sustainability and they are available in most countries. Below we are presenting the components of the examined alternative indicators:

i). Human Development Index (HDI)

The Human Development Index (HDI), an overall complex index including four indicators and three dimensions, evaluates the developmental level of

certain countries with the combination of GNI per capita, life time expected by birth, combined gross school enrolment and the index of adult literacy. The HDI index is the member of a four-member index-family (HDI, IHDI, GII and MPI) of the United Nations Development Programme-UNDP. In 2010, an overall reform of indexes was accomplished which can be recognised in their renaming and content change. Although it is characteristic of every indicator that they provide more precise picture about the welfare of a country comparing with the GDP, none of the indexes contain direct data about the state of the environment. The HDI index ensures wide variety of possibilities of comparisons, detailed HDI data of 187 countries can be downloaded from the homepage of the UNDP. The values of indexes can be from 0 to 1. The higher the value of the indicator is, the better the case is.

ii). Environmental Performance Index (EPI)

The researchers of the Universities of Yale and Columbia with the scientists of the EU created together the Environmental Performance Index which is the successor of the Environmental Sustainability Index. The index of 2010 divides altogether 163 countries based on 25 performance indicators, which are listed into 10 categories including environment, public health and the health of the ecosystem. Among the indexes the DALY (Disability-Adjusted Life Year Index) index appears with 25%. These indicators show how close the governments are in order to set up a comprehensive environmental package of measures. In the database the data of 132 countries can be found. The values of indexes can be from 0 to 100. The higher the value of the indicator is, the better the case is.

iii). Happy Planet Index (HPI)

The HPI (Happy Planet Index) measured by the New Economic Foundation (NEF) includes 3 factors: expected life time, ecological footprint and satisfaction with the life, in other words, it complements the ecological footprint with objective and subjective factors determining the people's quality of life. The database of the Happy Planet Index (HPI) contains the data of 151 countries. The values of indexes can be from 0 to 100. The higher the value of the indicator is, the better the case is.

iv). Ecological footprint (EF)

The Ecological Footprint means how much productive field is needed for a human society to maintain itself and to process the manufactured waste beside given technological development. The measurement unit of the Ecological Footprint is the global hectare/person (gha). Footprint tendencies show the impossibility of sustaining long term economic growth. We have long been aware of the overconsumption of developed countries, but the 'under-consumption' of lesser developed countries used to compensate for this. Even in 1960, bio-capacity – the output from biologically valuable land - was 2-3 times greater than that consumed per person globally.

According to the opinion of the European Commission, the ecological footprint and the carbon-dioxide footprint are together those environmental indexes, which can fill the role of an overall environmental index however, its circle of application is restricted. We can download the ecological footprint data of 142 countries from the homepage of the Global Footprint Network and estimations about further 9 countries can be found in the database including the calculation of the Happy Planet Index. The most widespread criticism against the Ecological Footprint Index is that it does not contain neither the social factors nor people's satisfaction. This index is not suitable for catching all the aspects of sustainability although it is often

mentioned among the sustainability indicators. However, this criticism is irrelevant since the creators of the ecological footprint have never claimed that for instance it would be a composite indicator, such as the HDI or ESI which include more pillars of sustainability. The Ecological Footprint gives information about the application of hypothetic area, it does not promise anything more or less (Csutora 2011a).The Ecological Footprint is applied on more levels from the beginning of measurement by its creators (Rees-Wackernagel 1996). Besides global evaluation, they also use national, regional, settling and individual EF indicators in order to compare the spatial demands of the consumption with the disposable biological capacity. The general recognition of this index differs considerably in the different application areas while the global EF is considered to be the best index of the „sustainability"(Stiglitz et al. 2009) its spatial application is criticised from more sides.[4] For this reason the national use of Ecological Footprint must be treated with increased caution. The values of this indicator are more than 0 although it does not have a top limit. The smaller the value of the index is, the more favourable the case is.

By selecting the methodology of our examination, we relied upon the research of Mostafa (2010) to a large extent. We have uncovered if linear relation can be observed among the alternative indicators in pairs.[5] We conducted our analyses with the help of the software package of IBM SPSS20 and reclined upon the data analysis manual of Sajtos – Mitev (2007) in case of selecting the methods and assessing the results. The basic question of our study if it is possible to group the countries based on their ecological footprint structure. We accomplished the grouping of countries as well as regions with the help of cluster analysis. In the first phase of our study we revealed if linear connection can be noticed among the alternative indicators in pairs. We conducted the examination with the data of those 126 countries whose all indicator values included in the calculation are available. We indicated the values of the correlation index of Pearson in a correlation matrix. Since the cluster analysis is sensitive to the presence of outliers, in the second phase of our research we checked the prominent data with average linkage method and excluded these values from our study. From the point of the assessment of the findings, it is significant that we did not exclude the prominent values of single data however those creating one member team during the examination, so after the elimination we continued the study with the data of 122 countries. We set two conditions, which mean that we take it as a relevant division: (1) the spreading within the cluster is smaller than the spreading of the whole mass as it refers to the fact that we managed to establish homogeneous group according to the examined factor, (2) if the findings of at least two examinations are similar.

III. THE RESULTS OF OUR FIRST EXAMINATION

Based on the values of the correlation coefficient of Pearson (Table 1.), there is close connection between certain indicators (these are indicated by the highlighted cells). Two indicators, the HPI and the EPI can be considered independent from GDP and all the other indexes. As a result of this, besides these two indicators, the GDP or any other indicators can be included in the cluster analysis

4 Van den Bergh, J.C.M.J.; Verbruggen, H. (1999) Spatial sustainability, trade and indicators: an evaluation of the ecological footprint, Ecological Economics29 pp. 61–72. and McDonald, G. W., Patterson, M. G. (2004): Ecological Footprints and interdependencies of New Zealand regions (analysis), Ecological Economics 50 pp. 49-67.

5 The availability of the above-mentioned database applied by the calculations can be found in the reference list by indicators.

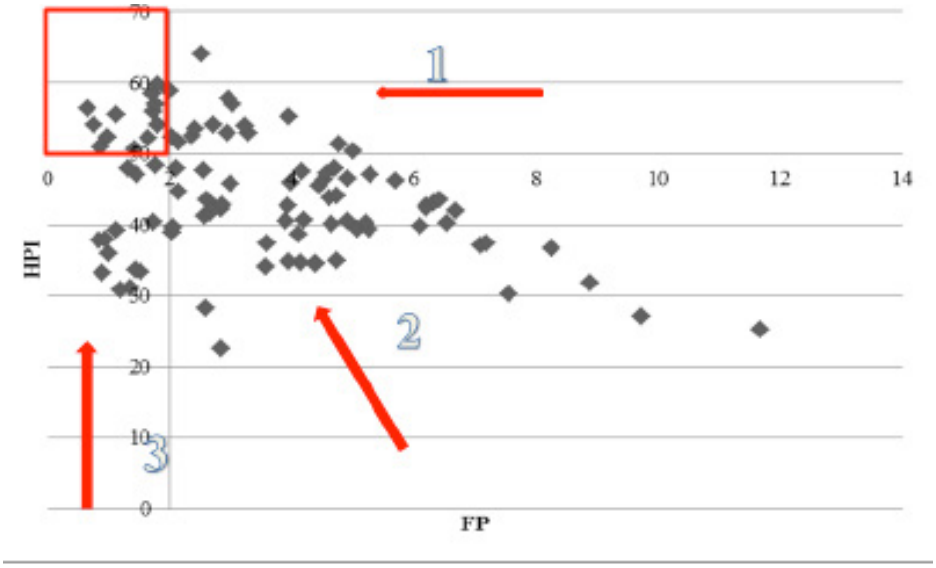

Figure 1: The relation between the ecological footprint and the HPI

without the deformation of the findings. The other essential aspect of the assessment of the findings is that the close connection between the Ecological Footprint and the GDP can question the suitability of the Ecological Footprint.

n=92	HDI	FP	HPI	EPI	GDP
HDI	1	0.744	0.145	0.535	0.758
FP		1.00	-0.336	0.377	0.909
HPI			1.00	0.174	-0.189
EPI				1.00	0.484
GDP					1.00

Table 1.: The correlation coefficient of Pearson

In the estimation of Vačkář D (2012) the value of the correlation coefficient is 0,289 between the ecological footprint and the EPI which confirms that only weak-medium relation can be noticed between the two indicators. According to the study of Csutora (2011b), the correlation is 0,356 between the ESI (the predecessor of the EPI) and the ecological footprint. Our research confirms the hypothesis that the likely relationship between the economic development and the extent of the ecological footprint is higher than the average based on the correlation between the ecological footprint and the GDP (York et al 2004). The other significant aspect of the assessment of the findings is that the close relationship between the ecological footprint and the GDP questions the appropriateness of the ecological footprint to be able to replace the GDP since we receive the same results, however with another indicator. Not the question is to be blamed but the two measures are not suitable for reaching the goals. Due to the close and stochastic (and both indicators have close correlation with the GDP) connection between the HDI and the ecological footprint, the analyses about the relationship between the HDI and the ecological footprint (e.g. WWF 2012) do not lead to substantive outcome in mapping the countries with developed society as well as with low environmental load. With the help of partial correlation measurement and with filtering the effect of GDP, the relationship between the HDI and the ecological footprint disappears, in practice. It is interesting and professionally surprising that there is no close correlation between the HPI and

the ecological footprint despite the fact that the ecological footprint is part of the HPI.

We can receive more significant result from the analysis including the two indicators in case of comparing the values of HPI and FP. The Figure 1 is placed in the intersection point (2; 50) of axes. Since the value of the ecological footprint can be maintained under 2 gha / person and the value of the HPI is favourable above 50, (according to the usual naming) the countries belonging to the 2nd quarter (e.g. Jamaica, El Salvador and Columbia) are in the most favourable position based on the two indicators. Different strategy can be determined for those countries belonging to the other three horizontal quarters:

- 1st cluster (e.g. Costa Rica, Venezuela, Norway and Switzerland): decreasing the ecological footprint, holding the HPI on level.
- 2nd cluster (all of the Members of the European Union): decreasing of both indicators.
- 3rd cluster (e.g. Angola, Kenya): holding the ecological footprint on level, increasing HPI.

If we exclude the impact of the GDP with partial correlation calculation, the connection between the HDI and the ecological footprint practically disappears. It is interesting –surprising for professionals - that there is no close connection between the values of HPI and the ecological footprint nevertheless the ecological footprint is part of the HPI.

In our contemporary study we conducted the cluster analysis of countries based on the trio of EPI-HPI-HDI. (Figure 1)

IV. THE RESULTS OF OUR SECOND EXAMINATION

Country	Index	Value	Source	Information
Qatar	Ecological footprint (gha/person)	11.68	HPI database	The value of the index is better if it is smaller (The value of the sustainable ecological footprint is under 2 gha/person)
Afghanistan		0.54		
Hungary		3,59		
Botswana	HPI	22.59		The values of indexes can be from 0 to 100. The higher the value of the indicator is, the better the case is.
Costa Rica		64.03		
Hungary		37.4		
Democratic Republic of the Congo	GDP/ person ($ PPP)	347		
Luxemburg		50700		
Hungary		20545		
Democratic Republic of the Congo	HDI	0.286	HDI database	The values of indexes can be from 0 to 1. The higher the value of the indicator is, the better the case is.
Norway		0.943		
Hungary		0.816		
Iraq	EPI	25.32	EPI database	The values of indexes can be from 0 to 100. The higher the value of the indicator is, the better the case is.
Switzerland		76.92		
Hungary		57.06		

Table 2: The most and the least favourable values of the examined alternative indexes and the data of Hungary

The extreme outliers excluded by simple chain method are Costa Rica, Botswana, Iraq and Switzerland. The value of the HPI index of Costa Rica is the highest in the world (64,0359) and the lowest value of the HPI index is Botswana's (22.5912). The highest value of the EPI index is in Switzerland and the lowest is in Iraq (25.32) (Table 2, page 41).

After the exclusion of countries consisting of the four prominent data, we accomplished a cluster analysis and we are presenting the findings by the between-group linkage method in Table 3. In the grouping of the three clusters, it is true for all the three variables of the examination that their spreading is lower than the spreading of the whole mass and we received similar findings with the help of Ward's method, for this reason the grouping is suitable for the original conditions. In Table 3 the values of the non-examined indicators are indicated as well. We examined the deviation from the average of the values of certain indicators (expect from the ecological footprint the higher value is the more favourable). In the cell highlighted with black the values of at least 15% more favourable than the average and in the cells highlighted with grey the values of at least 15% more unfavourable can be found.

	HDI	FP	HPI	GDP	EPI
means	**0.70**	**3.18**	**43.36**	**15800.99**	**53.07**
Cluster 1	0.79	4.45	41.68	25954.03	61.12
Cluster 2	0.71	2.14	55.03	9266.40	55.08
Cluster 3	0.61	2.43	39.64	8856.92	44.26

Table 3: The findings of the cluster analysis

Cluster 1: the indicators of the GDP and EPI of the countries of the first cluster are more favourable than the average, in this sector the highest is the value of the HDI and Ecological Footprint indicators. Among others, the Members of the European Union, Japan and the USA belong to this cluster. These are the richest countries examined in the study. Among the Latin American countries Uruguay can be listed in this cluster.

Cluster 2: the values of the ecological footprint and the HPI indicators of the countries of this cluster are more favourable than the average while the GDP is lower than the average and typically Latin American countries belong to this cluster. The happiest countries belong to this cluster.

Cluster 3: the values of the ecological footprint of these countries are the most favourable while their GDP and EPI are lower than the average. The unhappiest countries belong to this cluster. Among the Latin American countries Haiti is part of this cluster.

V. CONCLUSIONS

As the result of the criticism of the GDP and the increasing changing demand, different scientist teams have established several alternative indicators. Some of these (e.g. HDI or the ecological footprint) strongly correlate with the GDP despite the unlike counting methods. The significant surplus information in the indicators can be useful completion in relation to the judgement of the sustainability of certain countries; however, this fact can question the substitution of GDP. The independence from the GDP provides a possibility for two complex indicators, namely for the EPI and for the HPI to conduct analysis based on other points. In our study besides these two independent indicators the values of the HDI index were placed in our examination. On the basis of the three indicators, the countries can be grouped clearly.

Countries of cluster 2 represent a specific and significantly different development way from the European one. They can live happier by regularly GDP with lower than the average, with smaller environmental problems. (Latin-American

countries, Costa Rica, the extreme outlier excluding from the study, is the happiest state of the world.) It is interesting that the HPI index (50.34) of the happiest European state, Switzerland lags behind the HPI index (50.65) of the least happy Latin American country, namely Dominican Republic. In the 21st century, a paradigm shift happened in the economic policy thinking of the Latin American countries. It is a common belief among the Latin-American politicians and economists that it is not appropriate to take the neoliberal economic policy as without alternative and it is not obvious that the steps initiated by the IMF mean a long-term solutions for the region. It would be worth considering for Hungary as well as for the European countries that besides the economic development represented by GDP, they should prefer improvement based on community building and local cooperation, which are characteristics in the high number of the local trading systems (LES) in Venezuela.[6] On the website of the Complementary Currency Resource Center, we can find some detailed information of 163 Local Exchange Systems of only 27 countries. The number of the members of the LES is altogether more than 792 000. 47 different types of LES system can be distinguished, however, the most common (including 43 organisations) is the Local Exchange Trading System – LETS. The datum of 3 Hungarian organisations can be found in the database: Bakonyi Cserekör, Charity Exchange Shop (Szolnok), Soproni Kékfrank. In those countries where the LES system is more widespread, people are more satisfied with their life. There is no absolute relation of cause and effect between the two factors, so it is likely that the many-coloured local relationships can promote the establishment of LES, which can contribute to the satisfaction of demands on higher levels as well as to the contentment with life, on even lower income level.

6 http://complementarycurrency.org/

VI. THOUGHTS FOR FURTHER THINKING

1. *Not everything important could be measured.* Returning to the original sentence 'What you can measure, you can improve', we must see our research findings from a certain distance. May important things, which can and should be improved, are not measurable. We could well calculate the firmness and the weight of the rail, it is also assessable what temperature it can resist in summer heat. But – apart from extremes and big catastrophes – this is not a priority issue for the society, in worst case we need to cool the rail with irrigation or change some curvy pieces. On the other hand, if the love connections with the closest family members are corrupted, if families are only brought together by economic efficiency, or pairs do not even determine to stay together forever, if communities of friends, villages, around hobby or religion are dissolved or not established at all, it creates a major problem. However, this phenomena is hardly measurable, and much less spectacular or visible, than a curved rail.
2. *Measuring often causes oversimplifications.* For sustainability scientist the most striking story of drawing the wrong conclusions could be the Tragedy of the commons. The example (Lloyd 1833, Hardin 1968) itself could be known only for experts, but the consequences are known for all. There seems to be a consensus that the two major problems of the unsustainability of our Earth are overpopulation and overconsumption. Still, almost all analysts mix the cows (consumption) with the farmers (people on Earth). And everybody seems to promote the third factor of the IPAT equation, the

technology or eco-efficiency. This seems to be the least regret option.

3. *The control panel is more or less working.* Most probably we cannot expect a shift to the sustainable paradigm from simply changing GDP for one or more alternative indicators (or profit for a Corporate Social Responsibility performance index). This has a triple meaning:
    a. Alternative indicators are far from being methodologically perfect, but this also holds for GDP, the power of GDP does not lie in its scientific accuracy;
    b. Most of the alternative indices heavily correlate with GDP statistically, mostly because of the higher life expectancy and more health. This also holds true for happiness indices, at least in terms of trials to measure objective well-being (Amanda W. Vemuri, Robert Costanza, 2006; Ruut Veenhoven, 2011). This makes questionable all the gigantic efforts to change GDP technically (new statistical system), not to speak about the decades it would take.
    c. Happiness, health, expected lifetime (and the hope in salvation) are much more noble and higher values than GDP or any other indicator showing the performance of the economy or society. At no rate we should mix these values, otherwise we will degrade these higher values, not improve GDP, despite our best effort. (A good example is when environmental economics try to measure the value of human life, it gives a value of ten thousand, hundred thousand or million dollars value, however, not instead of zero, but instead if infinite value, putting a price tag on it.)

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