INCREASING RETURNS TO GNI PER CAPITA AND THE HUMAN DEVELOPMENT INDEX (HDI)

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ABSTRACT

Since 1990, UNDP has considered GNI per capita as a microeconomic variable that yields decreasing marginal material welfare in the calculation of HDI. Consequently, international inequality of development is significantly and unrealistically reduced. In this paper we support that GNI per capita is a macroeconomic variable with increasing marginal material welfare at the national level. We then propose an alternative method of transforming GDP per capita into material welfare. We use this formula on HDI data of the year 2016. We obtained a new HDI_2016 for all UN countries; this new HDI_2016 is associated with a new ranking of countries and with a significant and realistic increase in international inequality of development measure.

Key words: GNI per capita; Increasing; marginal utility; Human Development Index

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UTILITÉ MARGINALE CROISSANTE DU PNB PAR TÊTE ET INDICATEUR DU DÉVELOPPEMENT HUMAIN (IDH)

RÉSUMÉ

Depuis 1990, le PNUD considère le PNB par tête, dans le calcul de l'IDH, comme une variable microéconomique dont l'utilité marginale est décroissante. Ceci a pour conséquence de réduire anormalement l'inégalité de niveaux de développement perçu entre nations. Dans cet article, nous soutenons que le PIB par tête est un agrégat macroéconomique dont l'utilité marginale pour les citoyens d'un pays est plutôt croissante. Nous proposons alors une formule alternative de calcul de la composante bien-être matériel de l'IDH. Une application sur les données de l'IDH de l'année 2016 nous donne un nouvel IDH_2016 pour tous les pays considérés par le PNUD. Ce nouveau IDH_2016 modifie significativement le classement des pays et ramène l'inégalité internationale de niveau de développement à un niveau plus réaliste.

MOTS CLÉS : PNB par tête; bien-être matériel croissant; Indice du Développement Humain

زيادة العائدات إلى الدخل القومي الإجمالي للفرد ومؤشر التنمية البشرية

ملخص

يعد برنامج الأمم المتحدة الإنمائي نصيب الفرد من الدخل القومي الإجمالي منذ عام 1990 متغيرًا اقتصاديًا جزئيًا يؤدي إلى انخفاض الرفاهية المادية الهامشية في حساب دليل التنمية البشرية، مما يؤدي وبشكل لافت وغير واقعي إلى تقليص مستويات التنمية بين الدول.

نؤيد في هذه الورقة البحثية أن نصيب الفرد من الدخل القومي الإجمالي هو متغير اقتصادي كلي مع زيادة الرفاهية المادية الهامشية على المستوى الوطني، ومنه نقترح صيغة بديلة لتحويل نصيب الفرد من الدخل القومي الإجمالي إلى رفاهية مادية. إنّ استخدام هذه الصيغة على بيانات مؤشر التنمية البشرية لعام 2016 سيظهر مؤشر تنمية جديد لعام 2016 لكل البلدان التي يمسها برنامج الأمم المتحدة للتنمية (PNUD). يعدل هذا المؤشر الجيد وبشكل ملحوظ ترتيب الدول ويجعل عدم المساواة لمستوى التنمية الدولية أكثر واقعية.

كلمات مفتاحية: الدخل القومي الإجمالي للفرد الواحد، المنفعة المادي، مؤشر التنمية البشرية

INTRODUCTION

Since the end of the 1960s, economists have been looking for an objective[2], synthetic, relevant and operational indicator of the development of Nations. McGranahan (1971) proposed the General Development Index (GDI), but it failed to consider the economic aspects of life. In 1979, Morris D. Morris proposed the Physical Quality of Life Index (PQLI), which considers nine economic and nine social variables. But these numerous variables are sometimes negatively correlated, so the PQLI cannot be considered as relevant. In 1990, the United Nations Development Program (UNDP) proposed the Human Development Index (HDI), and since then, a World *Human Development Report* is published on annual basis.

The HDI is a synthetic development indicator, taking into consideration both economic and social aspects of life. On the economic aspect, material welfare is obtained through a transformation of the countries' GDP per capita. On the social aspect, two variables are considered: education, initially represented by the adult literacy rate; and health represented by life expectancy at birth. The HDI is one of the most popular development indicators, as many political authorities and researchers refer to it. Through this paper we want to contribute to the debate for the amelioration of this indicator. The amelioration we propose aims at reducing the difference of inequality between development indicators, especially between HDI and the revenue per capita, as pointed out by McGillivray and Pillarisetti (2004). These authors emphasized the necessity of reducing the gap in the difference between Purchasing Power Parity (PPP) revenue per capita and the HDI. Their results showed that the importance of this difference depends on the method of transforming PPP revenue per capita into a material welfare measure.

[2] Concurrently, some organisations provide statistics and measures of subjective happiness of countries' citizens: the Gallup World Pool (GWP), the World Values Survey (WVS), the European Social Survey (ESS) and, since 2012, the Centre for Economic Performance of the London School of Economics and Political Science publishes annually a World Happiness Report.

Indeed, since 1990, HDI has faced external and internal critics (Kovacevic, 2011, Ghislandi and al., 2019). Some of these tackle representativeness of included variables (Dasgupta and Weale, 1992, Tinbergen, 1974, Coomb and Manzoor, 1974, Cotlear, 1990, Allen and Kelly, 1991, Hopkins, 1991, Dasgupta, 1993, Dasgupta, 1994, Trabold-Nubler, 1994; Sudhir, 2018). A second category of critics points out the problem of inter-temporal comparison of HDI (Sudhir and Sen, 1992, Anand and Sen, 2000, Saha, 2005, 2009, Zirogianis and al., 2019); a third category tackles the problem of overall coherence of variables (Cornia, 1990, McGillivray, 1991, Noorbakhsh, 1997, 1998, Cahill, 2000, Ravallion, 2012; Sayed and al., 2018). A last category of critics deals with the mathematical treatment of variables (Bhanojirao, 1991, Allen and Kelly, 1991, Sudhir and Sen, 2000, Cahill, 2002, Leon-Castro and al., 2021) in general; in particular, the treatment of Gross Domestic Product (GDP) per capita: the method of transforming it into a material welfare measure has been criticised. Consequently, this method has changed many times and still is to be improved.

In 1990, UNDP considered that the marginal utility of GDP per capita decreases and becomes null after a certain threshold (Y*). The economic welfare measure is then obtained using a logarithmic transformation of GDP per capita.[3] So the material welfare (W) for a country j is given as:

$$W(Y_j) = Log(Y_j) \quad \text{if} \quad Y_j < Y^*$$
$$= Log(Y^*) \text{if} \quad Y_j \geq Y^* \qquad (1)$$

In 1991, after violent critics, UNDP accepts on the one hand that below Y* there is no decreasing marginal utility and, on the other hand, that beyond Y*, additional units of Y* yield decreasing marginal utility. So the following Atkinson (1983) formula is used.

[3] Y* is considered equal to the arithmetic mean of poverty lines in nine rich countries (Federal Republic of Germany, Australia, Canada, USA, Norway, Netherlands, Great Britain, Sweden, and Switzerland), in Purchasing Power Parity (PPP) Dollar.

$$W(Y_j) = Y_j \qquad \text{if} \qquad Y_j \le Y^*$$
$$= Y^* + 2(Y_j - Y^*)^{\frac{1}{2}} \quad \text{if } Y^* < Y_j \le 2Y^* \tag{2}$$
$$= Y^* + 2(Y^*)^{\frac{1}{2}} + 3(Y^*)^{\frac{1}{3}} + ... + n\left[Y_j - (n-1)Y^*\right]^{\frac{1}{n}}$$
$$\text{if } (n-1)Y^* < Y_j < nY^*$$

In 1999, UNDP considers on the one hand that GDP per capita always faces decreasing marginal utility, and, on the other hand abandons the idea of an international poverty line. So the following method is adopted and used since 1999.

$$W(Y_j) = Log(Y_j) \ \forall Y_j \tag{3}$$

As we can see, there has been an important instability in the method of transforming national revenue per capita into a material welfare measure. The reason is the fact that UNDP seems to be confused as the status of GDP per capita is concerned. Is it a microeconomic or a macroeconomic variable? In this article we try to support that GDP per capita is a macroeconomic variable and to propose a more suitable method that can give amore pertinent HDI, with an application on the HDI_2016.

The article is composed of three sections. Section 1 presents the theoretical confusion of the UNDP on the status of GDP per capita and exposes our thesis. Section 2 presents our method of treating GDP per capita, with application on HDI_2016. Section 3 gives a comparison of our results with the UNDP's HDI_2016.

1- THE GDP PER CAPITA: A MICROECONOMIC OR A MACROECONOMIC VARIABLE?

Is GNI/GDP per capita a microeconomic variable that should exhibit decreasing marginal utility or a macroeconomic variable that can exhibit increasing returns? We first present elements that illustrate the UNDP's confusion about this question, and secondly we present arguments supporting that it should be considered as a macroeconomic variable.

1.1-The UNDP position is confused

In the *Human Development Report 1993 (HDR_1993),* on page 105, it is written: *"Life expectancy at birth is an average for an entire group (nation, region, ethnic group), however, not the characteristic property of an individual, as income can be".* This means clearly that according to UNDP experts, GNI per capita is a microeconomic variable[4] with decreasing marginal utility. This decreasing marginal utility of GNI per capita is the main theoretical foundation of all the methods adopted since 1990. On page 107 of this same HDR_1993, UNDP experts explain why before Y*,marginal utility of GNI per capita, considered as a microeconomic variable, is constant, why it is decreasing after, and why an Atkinson formula should be used: "*if we consider the poverty level as the minimal cost of providing for the essential choices, it is difficult to argue that extra income within that range is somehow less effective in increasing well-being…".*

But, surprisingly in the same HDR_1993, page 107, we find arguments supporting the macroeconomic status of GNI per capita: "*Our measure is per capita income, which is a group average rather than personal income* ". A group average means a macroeconomic variable, and, as such, GNI per capita should face increasing marginal utility according to UNDP on the same page: "*..... There is no utility calculable until a minimum level of consumption is achieved with respect to each good in a set of goods. It is only extra consumption - above subsistence- that yields utility"*[5].

So for UNDP experts, it is not so clear whether GNI per capita is a microeconomic variable with decreasing marginal utility or a

[4] An important question arises: As UNDP has combined macroeconomic variables with a microeconomic one into a single development indicator, how have they avoided the consistency problem related to this king of exercise?

[5] Here, UNDP cotes Desai (1990). This citation means that marginal utility of GNI per capita, as a macroeconomic variable, should be rather increasing after Y*. The poverty line (Y*) constitutes a kind of foundation on which consumers build their utility maximization process. Since one cannot build a house without foundation, UNDP experts support that we cannot calculate a consumer utility as long as Y* is not reached.

macroeconomic one with increasing marginal utility. In the paragraph we present our arguments to support that GNI per capita should be considered as a macroeconomic variable with increasing marginal utility at the national level.

1.2- Arguments supporting the macroeconomic status of GNI per capita

We support that GNI per capita is a macroeconomic variable that faces increasing marginal material welfare at the national level. Indeed, in rich countries, government share less important financial resources from taxes on high revenues[6]. These resources are invested in "*public goods or goods provided by public authorities: environment, infrastructure (road network for example), electricity, transport and communication, epidemiological protection, etc* " (Anand and Sen, 1992). Better public goods and better social services are then provided. Better public goods and better social services increase the marginal utility of low personnel incomes.

This is why in rich countries, even poor individuals, as they receive good education and health services, consume good collective infrastructure, live in a clean environment, etc., live better live than poor individuals in poor countries. In these rich and developed countries, high revenues of rich individuals (the very large majority of the population is above the poverty line) help increase the marginal utility of low revenues of poor people. In poor countries on the contrary, rich individuals (a minority of the population) receive relatively poor education and poor health services, they consume relatively poor collective infrastructure, live in relatively poor environment, etc., because governments are relatively poor, and governments are poor because a large proportion of the population are poor. So in poor countries, rich people cannot live as well as their equivalents in rich countries. There is a negative influence of poor people on material welfare of rich people in poor countries, whereas in rich countries there is a positive influence of rich people on the material welfare of poor people. This idea has already been suggested

[6] In many countries today, rich or poor countries, taxation system is progressive, rich individuals pay more taxis, in proportion of their revenue, than poor individual.

by Roser (2013) who indicated that '*today's global inequality of opportunity means that what matters most for your living conditions is the good or bad luck of your place of birth*'[7]. A suitable transformation of GNI per capita into material welfare of the average citizen should then consider it as a macroeconomic variable that yields increasing marginal utility.

2- A MORE APPROPRIATEMETHOD FOR THE TRANSFORMATION OF GNIPER CAPITA INTO A MATERIAL WELFARE MEASURE

2.1- Theoretical presentation of the method

We consider that under a certain threshold Y*, GNI per capita yields constant marginal utility. Beyond Y*, the first supplementary Y* faces increasing marginal utility, the second one faces constant marginal utility, and above 3Y* it faces decreasing marginal utility. Our Y* is not the international poverty line as for UNDP, but an international development line[8]. This international development line (Y*) is the average GNI per capita in upper middle income countries. In 2016, based on the World Bank data, Y*=12,928.203 PPP$. The material welfare (W) for country j whose GNI per capita is Y_j will then be computed as:

$$
\begin{aligned}
&W(Y_j) = Y_j \; if \;\; Y_j \le Y^* \\
&= Y^* + (Y_j - Y^*)^2 \text{ if } Y^* < Y_j \le 2Y^* \qquad (4) \\
&= Y^* + (Y^*)^2 + (Y_j - 2Y^*) \text{ if } 2Y^* < Y_j \le 3Y^* \\
&= Y^* + (Y^*)^2 + Y^* + Log(Y_j - 3Y^*) \;\; \text{if } Y_j > 3Y^* \\
&= 2Y^* + (Y^*)^2 + Log(Y_j - 3Y^*) \quad \text{if} \quad Y_j > 3Y^*
\end{aligned}
$$

[7] Roser M.(2013) emphasized that '*for people's material prosperity, where you live isn't just more important than all your characteristics, it's more important than everything else put together…..you cannot get healthy and wealthy on your own—societies make progress, not individuals…..when everyone is sick, everyone is sick…..*'

[8] By using the international poverty line, UNDP considers the development of Nations simple as simple absence of poverty. We support that development is not simply the absence of poverty, and that development line is superior to the poverty line.

2.2- Calculation of the new materiel welfare index

We have applied this method on UNDP countries for the year 2016. Illustration in given below on the cases of Cameroon (GNI per capita =2,894.278 PPP$) and Canada (GNI per capita=42,581.914 PPP$).

Cameroon: $W(Y) = 2{,}894.278$ as $Y_{cam} < Y^*$

Canada:

$$W(Y) = Y^* + (Y^*)^2 + Y^* + Log(Y_j - 3Y^*) = 167{,}164{,}292.795$$

as $3Y^* < Y_{can} < 4Y^*$

The maximum GNI per capita is that of Qatar,129,915.601 PPP$, so the maximum economic welfare is $W(Y_{max})$=167,164,294.175. The minimum GNI per capita, as adopted by the UNDP, is 100 PPP$, so the minimum economic welfare is $W(Y_{min})$=100. The income index for Cameroon and Canada are then:

For Cameroon: $$II = \frac{2{,}894.278 - 100}{167{,}164{,}294.175 - 100}$$

For Canada: $$II = \frac{167{,}164{,}292.795 - 100}{167{,}164{,}294.175 - 100}$$

Table 1 below presents the results for some countries, comparing this new income index with the UNDP's one in 2016. As we can see, our formula increases the income index for rich countries and reduces it for poor countries, so increases the material welfare inequality across nations. This lager inequality is however closer to the reality than the one associated to the UNDP's income index.

Table 1. Comparison of UNDP's and our income indexes for some selected countries

Country	GNI per capita	UNDP's income index	New income index	Income index variation
Norway	67 614.353	0.984	1.000	0.016
Germany	44 999.647	0.923	1.000	0.077
Denmark	44 518.924	0.921	1.000	0.079
Singapore	78 162.324	1.000	1.000	0.000
United States	53 245.077	0.948	1.000	0.052

Japan	37 267.964	0.894	1.000	0.106
Korea (Republic of)	34 540.649	0.883	1.000	0.117
Italy	33 572.982	0.879	1.000	0.121
Qatar	129 915.601	1.000	1.000	0.000
United Arab Emirates	66 203.300	0.981	1.000	0.019
Kuwait	76 075.207	1.000	1.000	0.000
Panama	19 470.203	0.796	0.256	-0.540
Sri Lanka	10 788.909	0.707	0.000	-0.707
China	13 345.477	0.739	0.001	-0.738
Tonga	5 284.394	0.599	0.000	-0.599
Botswana	14 662.820	0.753	0.018	-0.735
Gabon	19 043.587	0.793	0.224	-0.569
Morocco	7 194.916	0.646	0.000	-0.646
Congo	5 502.559	0.605	0.000	-0.605
Myanmar	4 943.129	0.589	0.000	-0.589
Kenya	2 880.740	0.508	0.000	-0.508
Cameroon	2 894.278	0.508	0.000	-0.508
Senegal	2 250.134	0.470	0.000	-0.470
Malawi	1 073.291	0.359	0.000	-0.358
Mozambique	1 098.436	0.362	0.000	-0.362
Central African Republic	587.474	0.267	0.000	-0.267

Source : Our results

As we can see on the table, countries whose GNI per capita in superior to 2Y* have a new income index approaching 1, while countries with lower GNI per capita register a decrease in their income index which tends to 0. The figure 1 in the appendix, containing all UNDP countries, is more illustrative, showing how income index variations are positive and important for rich countries, negative and important for middle income countries, negative but less important for poor countries.

3- NEW HDI, NEW COUNTRIES' RANKING AND NEWINTERNATIONAL INEQUALITY OF DEVELOPMENT

We have computed a new HDI_2016 for all UNDP countries. Results show a significant difference with the UNDP's HDI_2016 for

many countries, a significant change in the ranking of counties as well as a significant increase in international inequality.

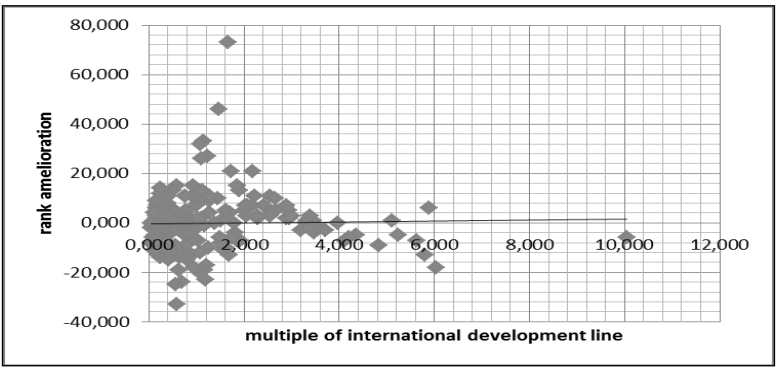
3.1- The new HDI_2016 and new ranking of countries

The new HDI_2016 and the corresponding ranking of countries are presented in table 1 of the appendix and compared with those given in the *HDR_2016*.We can see that for more developed countries there is not a significant difference between the new HDI_2016 and the HDI_2016, but for the less developed countries there is an important difference[9].The variation of the ranking of countries is presented in table 2 of the appendix. This variation is important for some countries and less important for others. The figure 2 of the appendix shows the rank variation for all countries[10]. Our new method is also supposed to favour high revenue countries. For this hypothesis to be accepted, the modification of the ranking should be important for high income countries and less important for low income countries. The figure below suggests that this hypothesis should be rejected.

[9] As illustration: for Norway, New HDI_2016=0.954 and the HDI_2016=0.949; for Australia, new HDI_2016 = 0.989 and HDI_2016 = 0.939; for Canada, new HDI_2016 = 0.948 and HDI_2016 = 0.920, while for Congo D.R, new HDI_2016 = 0.01 and HDI_2016 = 0.435; for Guinea Bissau, new HDI_2016 = 0.011 and HDI_2016 = 0.424, for Burundi, new HDI_2016 = 0.009 and HDI_2016 = 0.404; for Chad, new HDI_2016 = 0.012 and HDI_2016 = 0.396; for Central African Republic, new HDI_2016 = 0.008 and HDI_2016 = 0.352.

[10] On the horizontal axis we put the ranking of countries according to UNDP_2016, from the highest HDI (Norway) to the lowest (Central African Republic); on the vertical axis we put the difference with the new HDI_2016 ranking (HDI_2016 rank – new HDI_2016 rank). When this difference is positive, the new rank for the country has deteriorated; when negative, the new rank for this country is better.

Figure 1. Rank modification in relation with countries' revenue



Source: From our results

On the horizontal axis, we put multiples of our international development line. Qatar has the highest revenue per capita (129,915.601 PPP$), representing more than tin times our international development line. The revenue per capita in Canada is 42,581.914, more than three times the international development line. As we see, the large majority of countries are situated between zero and two times the international development line. On the vertical axis, we have the rank modification, ranging from -40 to 80. The figure shows no clear relation between revenue of countries and variation of their rank. So, our method has not favoured high revenue countries. Furthermore, we have drawn, using Least Square Ordinary (LSO) adjustment technics, a linear relation between the two variables, as it appears on the figure. This linear relation can be considered as not significantly increasing.

3.2. The new international inequality of development

Results also show that the international inequality has increased: the highest new HDI_2016 is 0.989 and the lowest 0.008, the first represents more than 123 times the second, the highest HDI_2016 is 0.949, representing 2.7 times the lowest. The new method then increases international inequality of development levels. The new international inequality is more realistic, close to the one associated

with GDP per capita, as we see on the table below.

Table 2. Comparison of international inequality related to HDI and HDI variables

Indicators	HDI	New HDI	Life Expectancy at Birth	Expected Years of Schooling	Mean Years of Schooling	GNI/capita
Maximum	0.949	0.989	84.163	20.433	13.370	129 915.601
Minimum	0.352	0.008	48.943	4.872	1.442	587.474
Max - Min	0.597	0.982	35.220	15.561	11.928	129 328.127
Mean	0.699	0.316	71.353	12.983	8.372	17 313.866
Standard deviation	0.1551	0.3833	8.2966	2.897	3.0970	19069.312
Relative standard deviation	0.2219	1.212	0.1163	0.22315	0.3699	1.241389

Source: Our results from the UNDP's HDI data

The apparent low relative standard deviation of life expectancy does not take into account the penibility of life. In poor countries, people can live a relative long life, but they certainly live a penible fife. This relative standard deviation would have been higher if it took into account the quality of life. This is true for education. If the quality of education was taken into consideration, the relative standard deviation would have been higher for expected years of schooling and for the mean years of schooling.

The UNDP's HDI 2016 distribution shows a relative standard deviation equal to 0.1551; lower than the one related to the new-HDI 2016 distribution which is 1.212; while the one associated to GNI per capita is 1.241. The inequality of the new_HDI is close to the world reality. UNDP abnormally and irrealistically reduces inequality between rich and poor countries, while in the reality there is a huge difference of quality of life between developed and underdeveloped nations.

CONCLUSION

We have proposed a new methodology of calculating material welfare from the GNI per capita. This method takes into consideration the fact that GNI per capita is a macroeconomic variable and, as such,

faces increasing marginal utility. This is supported by the fact that in rich countries, rich people pay more taxes, so their governments are strong and rich, and can produce adequate social services and collective infrastructure that enable low-income owners to live conveniently; whereas in poor countries, poor governments provide poor social services and poor collective infrastructures that reduce material welfare of high revenue owners.

We have applied this method on HDR_2016 database and computed a new HDI_1996 for all countries. Two important observations can be made. First, the new HDI_2016 ranges from 0.008 (Central African Republic) to 0.989 (Norway); while the HDI_2016 ranges from 0.352 (Central African Republic) to 0.949 (Norway). The inequality of new-HDI_2016 is more important and more realistic than the inequality of HDI_2016. It can then be considered to be closer to the one associated to GNI per capita than the one obtained under diminishing returns of GNI per capita. This is an answer to the problem raised by McGillivray and Pillarisetti (2004). Secondly, there is a modification of countries ranking. This modification is important for some countries, especially for average HDI countries, and not important for other countries, positive for some countries and negative for some others. Some African countries, rich in natural resources, have registered important positive rank modification: Gabon have moved from the 109th to the 63rd position, Equatorial Guinea from the 135th to the 62nd position, Botswana from the 108th to the 75th position. Other countries have registered important negative variation of their rank: Ukraine from the 84th to the 109th position, Armenia from the 84th to the 103rd position, Cuba from the 68th to the 101st position.

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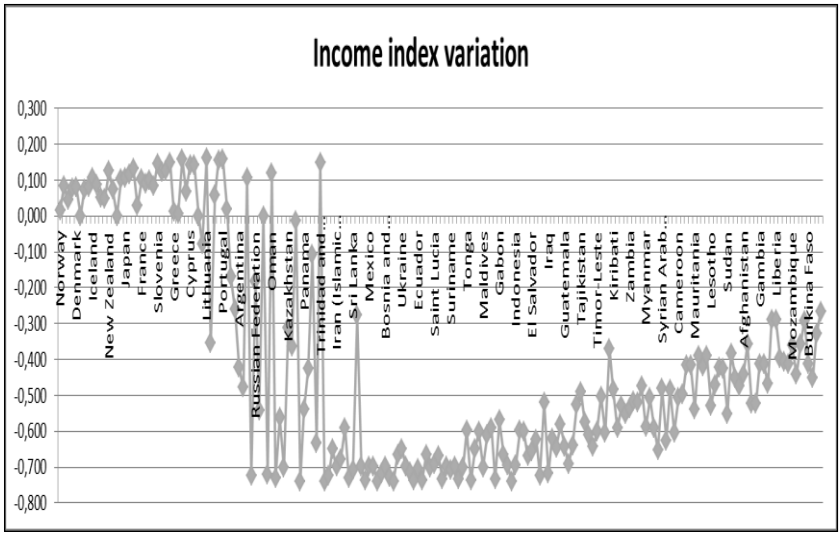
Appendix

Figure 1. Income index variations for countries (New income index – UNDP's income index)



Source: From our results

Table 1. The new HDI_2016 compared to the one published by UNDP

UNDP 2016 HDI and countries' ranking			New 2016 HDI and countries' ranking		
Rank	**Country**	**HDI**	**New Rank**	**Country**	**New HDI**
1	Norway	0.949	1	Australia	0.989
2	Australia	0.939	2	New Zealand	0.968
2	Switzerland	0.939	3	Iceland	0.966
4	Germany	0.926	4	Denmark	0.961
5	Denmark	0.925	5	Ireland	0.955
6	Singapore	0.925	6	Norway	0.954
7	Netherlands	0.924	7	Switzerland	0.953
8	Ireland	0.923	8	Germany	0.951
9	Iceland	0.921	9	Netherlands	0.949
10	Canada	0.920	10	Canada	0.948
11	United States	0.920	11	United Kingdom	0.943
12	Hong Kong, China (SAR)	0.917	12	Israel	0.942
13	New Zealand	0.915	13	Korea (Republic of)	0.939
14	Sweden	0.913	14	Slovenia	0.938
15	Liechtenstein	0.912	15	Japan	0.938
16	United Kingdom	0.909	16	Sweden	0.936
17	Japan	0.903	17	United States	0.936
18	Korea (Republic of)	0.901	18	Hong Kong, China (SAR)	0.933
19	Israel	0.899	19	France	0.930
20	Luxembourg	0.898	20	Finland	0.926
21	France	0.897	21	Czech Republic	0.926
22	Belgium	0.896	22	Italy	0.926
23	Finland	0.895	23	Singapore	0.925

24	Austria	0.893	24	Spain	0.924
25	Slovenia	0.890	25	Belgium	0.924
26	Italy	0.887	26	Austria	0.919
27	Spain	0.884	27	Estonia	0.916
28	Czech Republic	0.878	28	Liechtenstein	0.912
29	Greece	0.866	29	Luxembourg	0.907
30	Brunei Darussalam	0.865	30	Malta	0.900
31	Estonia	0.865	31	Cyprus	0.900
32	Andorra	0.858	32	Lithuania	0.899
33	Cyprus	0.856	33	Slovakia	0.894
34	Malta	0.856	34	Portugal	0.893
35	Qatar	0.856	35	Andorra	0.879
36	Poland	0.855	36	Greece	0.870
37	Lithuania	0.848	37	Brunei Darussalam	0.866
38	Chile	0.847	38	Saudi Arabia	0.863
39	Saudi Arabia	0.847	39	Qatar	0.856
40	Slovakia	0.845	40	Bahrain	0.855
41	Portugal	0.843	41	United Arab Emirates	0.845
42	United Arab Emirates	0.840	42	Oman	0.830
43	Hungary	0.836	43	Poland	0.827
44	Latvia	0.830	44	Trinidad and Tobago	0.823
45	Argentina	0.827	45	Kuwait	0.800
46	Croatia	0.827	46	Malaysia	0.785
47	Bahrain	0.824	47	Hungary	0.775
48	Montenegro	0.807	48	Seychelles	0.746
49	Russian Federation	0.804	49	Russian Federation	0.740
50	Romania	0.802	50	Latvia	0.730

51	Kuwait	0.800	51	Chile	0.699
52	Belarus	0.796	52	Kazakhstan	0.676
53	Oman	0.796	53	Saint Kitts and Nevis	0.667
54	Barbados	0.795	54	Bahamas	0.649
55	Uruguay	0.795	55	Argentina	0.646
56	Bulgaria	0.794	56	Croatia	0.612
57	Kazakhstan	0.794	57	Antigua and Barbuda	0.612
58	Bahamas	0.792	58	Romania	0.547
59	Malaysia	0.789	59	Panama	0.540
60	Palau	0.788	60	Uruguay	0.527
61	Panama	0.788	61	Turkey	0.485
62	Antigua and Barbuda	0.786	62	Equatorial Guinea	0.484
63	Seychelles	0.782	63	Gabon	0.457
64	Mauritius	0.781	64	Mauritius	0.451
65	Trinidad and Tobago	0.780	65	Iran (Islamic Republic of)	0.351
66	Costa Rica	0.776	66	Bulgaria	0.351
67	Serbia	0.776	67	Azerbaijan	0.345
68	Cuba	0.775	68	Mexico	0.345
69	Iran (Islamic Republic)	0.774	69	Belarus	0.307
70	Georgia	0.769	70	Suriname	0.305
71	Turkey	0.767	71	Montenegro	0.294
72	Venezuela (Bolivarian Republic)	0.767	72	Venezuela (Bolivarian Republic)	0.258
73	Sri Lanka	0.766	73	Barbados	0.254
74	Saint Kitts and Nevis	0.765	74	Thailand	0.202
75	Albania	0.764	75	Botswana	0.201
76	Lebanon	0.763	76	Libya	0.177

77	Mexico	0.762	77	Brazil	0.172
78	Azerbaijan	0.759	78	Costa Rica	0.164
79	Brazil	0.754	79	Turkmenistan	0.148
80	Grenada	0.754	80	Palau	0.142
81	Bosnia and Herzegovina	0.750	81	Algeria	0.108
82	The former Yugoslav Republic of Macedonia	0.748	82	China	0.085
83	Algeria	0.745	83	Lebanon	0.083
84	Armenia	0.743	84	Serbia	0.036
85	Ukraine	0.743	85	The former Yugoslav Republic of Macedonia	0.035
86	Jordan	0.741	86	Grenada	0.034
87	Peru	0.740	87	Sri Lanka	0.034
88	Thailand	0.740	88	Colombia	0.034
89	Ecuador	0.739	89	Dominican Republic	0.034
90	China	0.738	90	Albania	0.034
91	Fiji	0.736	91	Peru	0.034
92	Mongolia	0.735	92	Bosnia and Herzegovina	0.033
93	Saint Lucia	0.735	93	Ecuador	0.033
94	Jamaica	0.730	94	Georgia	0.033
95	Colombia	0.727	95	Jordan	0.033
96	Dominica	0.726	96	Mongolia	0.033
97	Suriname	0.725	97	Saint Lucia	0.032
97	Tunisia	0.725	98	Tunisia	0.032
99	Dominican Republic	0.722	99	Saint Vincent and the Grenadines	0.032
100	Saint Vincent and the Grenadines	0.722	100	Dominica	0.032
101	Tonga	0.721	101	Cuba	0.032
102	Libya	0.716	102	Maldives	0.031

103	Belize	0.706	103	Armenia	0.031
104	Samoa	0.704	104	South Africa	0.031
105	Maldives	0.701	105	Fiji	0.031
105	Uzbekistan	0.701	106	Jamaica	0.031
107	Moldova (Republic of)	0.699	107	Egypt	0.030
108	Botswana	0.698	108	Indonesia	0.030
109	Gabon	0.697	109	Ukraine	0.030
110	Paraguay	0.693	110	Iraq	0.030
111	Egypt	0.691	111	Paraguay	0.029
112	Turkmenistan	0.691	112	Belize	0.029
113	Indonesia	0.689	113	Philippines	0.029
114	Palestine, State of	0.684	114	Namibia	0.028
115	Viet Nam	0.683	115	El Salvador	0.028
116	Philippines	0.682	116	Tonga	0.027
117	El Salvador	0.680	117	Uzbekistan	0.027
118	Bolivia (Plurinational State)	0.674	118	Samoa	0.026
119	South Africa	0.666	119	Morocco	0.026
120	Kyrgyzstan	0.664	120	Bolivia (Plurinational State of)	0.026
121	Iraq	0.649	121	Moldova (Republic of)	0.026
122	Cabo Verde	0.648	122	Guatemala	0.026
123	Morocco	0.647	123	Viet Nam	0.026
124	Nicaragua	0.645	124	Palestine, State of	0.025
125	Guatemala	0.640	125	Guyana	0.025
126	Namibia	0.640	126	Cabo Verde	0.025
127	Guyana	0.638	127	Bhutan	0.024
128	Micronesia (Federated States)	0.638	128	India	0.024
129	Tajikistan	0.627	129	Nicaragua	0.023

130	Honduras	0.625	130	Timor-Leste	0.023
131	India	0.624	131	Honduras	0.022
132	Bhutan	0.607	132	Congo	0.022
133	Timor-Leste	0.605	133	Swaziland	0.022
134	Vanuatu	0.597	134	Kyrgyzstan	0.022
135	Congo	0.592	135	Lao People's Democratic Rep.	0.022
136	Equatorial Guinea	0.592	136	Micronesia (Federated States)	0.021
137	Kiribati	0.588	137	Angola	0.021
138	Lao People's Democratic Rep.	0.586	138	Myanmar	0.020
139	Bangladesh	0.579	139	Pakistan	0.020
140	Ghana	0.579	140	Ghana	0.020
141	Zambia	0.579	141	Nigeria	0.020
142	Sao Tome and Principe	0.574	142	Tajikistan	0.020
143	Cambodia	0.563	143	Zambia	0.019
144	Nepal	0.558	144	Bangladesh	0.019
145	Myanmar	0.556	145	Vanuatu	0.019
146	Kenya	0.555	146	Sao Tome and Principe	0.019
147	Pakistan	0.550	147	Cambodia	0.018
148	Swaziland	0.541	148	Kiribati	0.018
149	Syrian Arab Republic	0.536	149	Kenya	0.018
150	Angola	0.533	150	Mauritania	0.017
151	Tanzania	0.531	151	Nepal	0.017
152	Nigeria	0.527	152	Sudan	0.017
153	Cameroon	0.518	153	Cameroon	0.017
154	Papua New Guinea	0.516	154	Lesotho	0.016
155	Zimbabwe	0.516	155	Syrian Arab Republic	0.016
156	Solomon Islands	0.515	156	Tanzania	0.016

157	Mauritania	0.513	157	Papua New Guinea	0.016
158	Madagascar	0.512	158	Djibouti	0.016
159	Rwanda	0.498	159	Côte d'Ivoire	0.016
160	Comoros	0.497	160	Senegal	0.015
161	Lesotho	0.497	161	Yemen	0.015
162	Senegal	0.494	162	Zimbabwe	0.014
163	Haiti	0.493	163	Solomon Islands	0.014
164	Uganda	0.493	164	Benin	0.014
165	Sudan	0.490	165	Rwanda	0.014
166	Togo	0.487	166	Uganda	0.014
167	Benin	0.485	167	Afghanistan	0.014
168	Yemen	0.482	168	Haiti	0.014
169	Afghanistan	0.479	169	Madagascar	0.014
170	Malawi	0.476	170	Mali	0.013
171	Côte d'Ivoire	0.474	171	Comoros	0.013
172	Djibouti	0.473	172	Togo	0.013
173	Gambia	0.452	173	Gambia	0.012
174	Ethiopia	0.448	174	Ethiopia	0.012
175	Mali	0.442	175	South Sudan	0.012
176	Congo D.R.	0.435	176	Malawi	0.012
177	Liberia	0.427	177	Chad	0.012
178	Guinea-Bissau	0.424	178	Sierra Leone	0.012
179	Eritrea	0.420	179	Eritrea	0.011
180	Sierra Leone	0.420	180	Guinea-Bissau	0.011
181	Mozambique	0.418	181	Burkina Faso	0.011
182	South Sudan	0.418	182	Mozambique	0.011
183	Guinea	0.414	183	Guinea	0.010

184	Burundi	0.404	184	Congo D.R.	0.010
185	Burkina Faso	0.402	185	Liberia	0.010
186	Chad	0.396	186	Burundi	0.009
187	Niger	0.353	187	Niger	0.009
188	Central African Republic	0.352	188	Central African Republic	0.008

Source: Our results

Table 2. The countries' ranking modification

Country	**UNDP 2016 countries' ranking**	New 2016 countries' ranking	Rank modification
Norway	1	6	-5
Australia	2	1	1
Switzerland	2	7	-5
Germany	4	8	-4
Denmark	5	4	1
Singapore	5	23	-18
Netherlands	7	9	-2
Ireland	8	5	3
Iceland	9	3	6
Canada	10	10	0
United States	10	17	-7
Hong Kong, China (SAR)	12	18	-6
New Zealand	13	2	11
Sweden	14	16	-2
Liechtenstein	15	28	-13
United Kingdom	16	11	5
Japan	17	15	2

Korea (Republic of)	18	13	5
Israel	19	12	7
Luxembourg	20	29	-9
France	21	19	2
Belgium	22	25	-3
Finland	23	20	3
Austria	24	26	-2
Slovenia	25	14	11
Italy	26	22	4
Spain	27	24	3
Czech Republic	28	21	7
Greece	29	36	-7
Brunei Darussalam	30	37	-7
Estonia	30	27	3
Andorra	32	35	-3
Cyprus	33	31	2
Malta	33	30	3
Qatar	33	39	-6
Poland	36	43	-7
Lithuania	37	32	5
Chile	38	51	-13
Saudi Arabia	38	38	0
Slovakia	40	33	7
Portugal	41	34	7
United Arab Emirates	42	41	1
Hungary	43	47	-4

Latvia	44	50	-6
Argentina	45	55	-10
Croatia	45	56	-11
Bahrain	47	40	7
Montenegro	48	71	-23
Russian Federation	49	49	0
Romania	50	58	-8
Kuwait	51	45	6
Belarus	52	69	-17
Oman	52	42	10
Barbados	54	73	-19
Uruguay	54	60	-6
Bulgaria	56	66	-10
Kazakhstan	56	52	4
Bahamas	58	54	4
Malaysia	59	46	13
Palau	60	80	-20
Panama	60	59	1
Antigua and Barbuda	62	57	5
Seychelles	63	48	15
Mauritius	64	64	0
Trinidad and Tobago	65	44	21
Costa Rica	66	78	-12
Serbia	66	84	-18
Cuba	68	101	-33
Iran (Islamic Republic of)	69	65	4
Georgia	70	94	-24

Turkey	71	61	10
Venezuela (Bolivarian Rep.)	71	72	-1
Sri Lanka	73	87	-14
Saint Kitts and Nevis	74	53	21
Albania	75	90	-15
Lebanon	76	83	-7
Mexico	77	68	9
Azerbaijan	78	67	11
Brazil	79	77	2
Grenada	79	86	-7
Bosnia and Herzegovina	81	92	-11
The former Yugoslav Republic of Macedonia	82	85	-3
Algeria	83	81	2
Armenia	84	103	-19
Ukraine	84	109	-25
Jordan	86	95	-9
Peru	87	91	-4
Thailand	87	74	13
Ecuador	89	93	-4
China	90	82	8
Fiji	91	105	-14
Mongolia	92	96	-4
Saint Lucia	92	97	-5
Jamaica	94	106	-12
Colombia	95	88	7
Dominica	96	100	-4
Suriname	97	70	27

Tunisia	97	98	-1
Dominican Republic	99	89	10
Saint Vincent and the Grenadines	99	99	0
Tonga	101	116	-15
Libya	102	76	26
Belize	103	112	-9
Samoa	104	118	-14
Maldives	105	102	3
Uzbekistan	105	117	-12
Moldova (Republic of)	107	121	-14
Botswana	108	75	33
Gabon	109	63	46
Paraguay	110	111	-1
Egypt	111	107	4
Turkmenistan	111	79	32
Indonesia	113	108	5
Palestine, State of	114	124	-10
Viet Nam	115	123	-8
Philippines	116	113	3
El Salvador	117	115	2
Bolivia (Plurinational State)	118	120	-2
South Africa	119	104	15
Kyrgyzstan	120	134	-14
Iraq	121	110	11
Cabo Verde	122	126	-4
Morocco	123	119	4

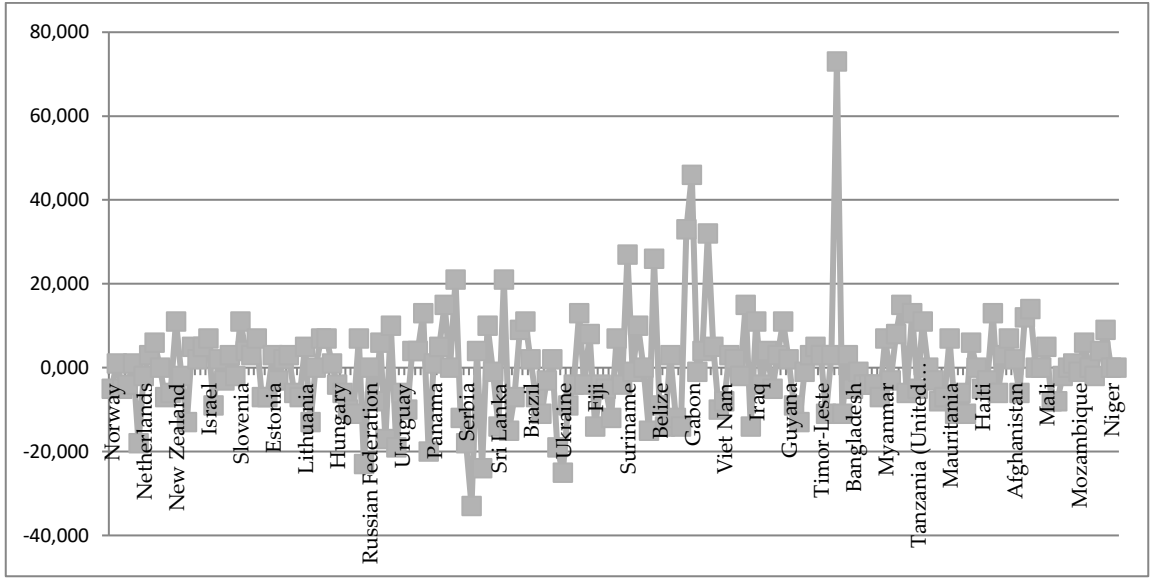
Nicaragua	124	129	-5
Guatemala	125	122	3
Namibia	125	114	11
Guyana	127	125	2
Micronesia (Fed. States of)	127	136	-9
Tajikistan	129	142	-13
Honduras	130	131	-1
India	131	128	3
Bhutan	132	127	5
Timor-Leste	133	130	3
Vanuatu	134	145	-11
Congo	135	132	3
Equatorial Guinea	135	62	73
Kiribati	137	148	-11
Lao People's D. Republic	138	135	3
Bangladesh	139	144	-5
Ghana	139	140	-1
Zambia	139	143	-40
Sao Tome and Principe	142	146	-4
Cambodia	143	147	-4
Nepal	144	151	-7
Myanmar	145	138	7
Kenya	146	149	-3
Pakistan	147	139	8
Swaziland	148	133	15
Syrian Arab Republic	149	155	-6
Angola	150	137	13

Tanzania	151	156	-5
Nigeria	152	141	11
Cameroon	153	153	0
Papua New Guinea	154	157	-3
Zimbabwe	154	162	-8
Solomon Islands	156	163	-7
Mauritania	157	150	7
Madagascar	158	169	-11
Rwanda	159	165	-6
Comoros	160	171	-11
Lesotho	160	154	6
Senegal	162	162	0
Haiti	163	168	-5
Uganda	163	166	-3
Sudan	165	152	13
Togo	166	172	-6
Benin	167	164	3
Yemen	168	161	7
Afghanistan	169	167	2
Malawi	170	176	-6
Côte d'Ivoire	171	159	12
Djibouti	172	158	14
Gambia	173	173	0
Ethiopia	174	174	0
Mali	175	170	5
Congo (Democratic Rep.)	176	184	-8
Liberia	177	185	-8

Guinea-Bissau	178	180	-2
Eritrea	179	179	0
Sierra Leone	179	178	1
Mozambique	181	182	-1
South Sudan	181	175	6
Guinea	183	183	0
Burundi	184	186	-2
Burkina Faso	185	181	4
Chad	186	177	9
Niger	187	187	0
Central African Republic	188	188	0

Source: Our results

Figure 2. Countries' rank variation with the new HDI



Source : Data are our results