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GNI PER CAPITA AND HAPPY PLANET INDEX - A COMPARATIVE ANALYSIS ACROSS DIFFERENT COUNTRY GROUPS

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ABSTRACT In order to assess the well-being of a country and to make comparative analysis across countries, Gross National Income (GNI) per capita is the most commonly and frequently used indicator of well-being. Apart from that, this paper discusses another well-being marker: Happy Planet Index (HPI) which is relatively new in its kind with a view of incorporating higher degree of subjectivity. For the purpose of establishing correspondence (if any) between these well-being indicators, a large number of countries are considered and grouped accordingly.

KEYWORDS : Correspondence Analysis, Gross National Income per capita, Happy Planet Index

INTRODUCTION

Brief accounts of Gross National Income (GNI) per capita and Happy Planet Index (HPI) are needed to make a comparative analysis of these two concepts.

Gross National Income (GNI) per capita GDP or GNP is considered as a measure of well-being of a country. Here we consider Gross National Income (GNI) per capita based on purchasing power parity (PPP, constant 2017 international $) as published by World Bank (Source: International Comparison Programme, World Development Indicators Database, World Bank). PPP GNI is gross national income (GNI) converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GNI as a U.S. dollar has in the United States. GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. Data are in constant 2017 international dollars.

We have listed 121 countries according to their GNI per capita, PPP (constant 2017 international $) and following World Bank's classification, categorized them under four heads, depicted in Table 1.

Table 1: Classification Of Countries According To GNI Per Capita

Classification according to GNI per capita	No. of countries
High income	43
Upper middle income	32
Lower middle income	33
Low income	13
Total	*121*

Source: International Comparison Programme, World Development Indicators Database, World Bank

Happy Planet Index (HPI)

Keeping in view the limitations of Gross National Income (GNI) per capita as an all-round measure of well-being, various alternative and complementary indices have been developed from time to time. Happy Planet Index (HPI) is one among them.

Happy Planet Index is a comprehensive tool that measures the environmental impact on sustainable human well-being. In other words, it estimates the ecological efficiency with which countries provide long and happy life for their population. In July 2006, New Economic Foundation (NEF) introduced this index with the intention 'to provide a simple and transparent headline indicator of how well a nation is doing in terms of two things:
a) people's well-being today

b) impact on the environment (and by implication, possibilities for future well-being)' (The Happy Planet Index: An index of sustainable well-being; Centre for Well-Being, nef (the new economics foundation), UK)

The most recent version (2016) of HPI has undergone some modifications of the same calculated for the previous years. It is a combination of the following components:

1) Life Expectancy, which is the average number of years an infant born in that country is expected to live if prevailing patterns of age-specific mortality rates at the time of birth in the country stay the same throughout the infant's life. It is a common measure of the standard of healthcare in a nation. It is prepared by the Population Division of the Department of Economic and Social Affairs of the United Nations. Instead of using mean life expectancy at birth as was done in previous releases, inequality-adjusted life expectancy is calculated because social welfare is believed to depend on the distribution of an outcome rather than its mean.

Inequality-Adjusted Life Expectancy
= (1– Atkinson Index of Life Expectancy) × Mean Life Expectancy

where Atkinson Index of Life Expectancy
= 1- (Geometric Mean of Life Expectancy / Mean Life Expectancy)

2) Experienced Well-Being, indicates how people's lives are going overall. It is based on the responses to the following ladder of life question collected as part of the Gallup World Poll:
"Please imagine a ladder with steps numbered from zero at the bottom to 10 at the top. Suppose we say that the top of the ladder represents the best possible life for you; and the bottom of the ladder represents the worst possible life for you. On which step of the ladder do you feel you personally stand at the present time, assuming that the higher the step the better you feel about your life, and the lower the step the worse you feel about it? Which step comes closest to the way you feel?"

Here too, experienced well-being is adjusted to get a clear picture of the unequal distribution of the outcome within the population.
Inequality-Adjusted Experienced Well-Being
= (1– Atkinson Index of Experienced Well-Being) × Mean Experienced Well-Being

where Atkinson Index of Experienced Well-Being
= 1- (Geometric Mean of Experienced Well-Being / Mean Experienced Well- Being)

3) Ecological Footprint, an indicator of environmental sustainability and a measure of consumption is quantified by the average amount of land required (per head of population) to provide the renewable resources people use (fruits and vegetables, fish, wood, fibers), the area occupied by infrastructure (space for buildings and roads) and the area required to absorb CO_2 emissions, i.e., for sustenance of a country's consumption patterns. Ecological Footprint is an ecological accounting system and is expressed by 'global hectares (gha)' which is a biologically productive hectare with world average productivity in a given year.

Using these three principal components, HPI is formulated as:
$Happy\ Planet\ Index_{IA} = \Phi \times \{((Experienced\ Wellbeing_{IA} - \alpha \times Life\ Expectancy_{IA}) + \pi\} / Ecological\ Footprint + \beta$

where 'IA' means inequality adjusted,

α (= 0.158) is a constant that is subtracted from the inequality-adjusted Experienced Wellbeing of each country so that each of the variables

(inequality-adjusted Experienced Wellbeing and inequality-adjusted Life Expectancy) contribute the same amount of the variance to the product term, namely 'Inequality-Adjusted Happy Life Years',

β (= 2.067) is a constant which is added to Ecological Footprint so that their coefficient of variance is equivalent to inequality-adjusted Happy Life Years in order to make HPI equally sensitive to the two variables,

Φ (= 3.951) and *π (= 0.452)* are two scaling constants. These are incorporated to imply that 100 and 0 HPI scores respectively mean excellent and poor performance on all three indicators: (i) an inequality adjusted life expectancy of 85 years and 25 years (ii) a maximum score for inequality adjusted wellbeing (10/10) and its minimum score (0/10) (iii) an Ecological Footprint of 1.73 global hectares, the level of demand that is compatible with environmental sustainability and that of 16 global hectares, which is currently higher than any single country in the world.

New Economic Foundation has been publishing data on HPI and its associated factors for different years on global and regional bases. We consider the most current report available that was published in 2016 to track the most recent status of the index and its associates.

With slight modification in NEF classification ranges (in terms of colour-coding HPI map), the same 121 countries are grouped under following headings:

Table 2: Classification Of Countries According To HPI

Classification according to HPI	Range	No. of countries
Very High	> 36.7	12
High	32.7 - 36.6	13
Upper middle	28.7 - 32.6	23
Middle	24.7 - 28.6	23
Lower middle	20.7 - 24.7	22
Low	< 20.7	28
Total		*121*

Source: http://happyplanetindex.org/countries/

We now attempt to perform correspondence analysis for visual and numerical study of the possibility of interrelation among countries which lie at different levels with respect to income, human development and happiness and to find out if there is any relation between GNI per capita and HPI.

Correspondence analysis is a statistical technique, applicable to categorical data and manifests itself in the form of two-dimensional graph. Based on data given in a contingency table, correspondence analysis explores the relative relationships between and within two sets of variables. It is used as a tool when we look for patterns in datasets.

For the purpose of correspondence analysis regarding the relation between GNI per capita and HPI, we consider contingency tables 4, where each number represents the number of countries falling under each pair of categories.

Table 3: Contingency Table Of GNI Per Capita And HPI

GNI per capita HPI Score	High income	Upper middle income	Lower middle income	Low income	Total
Very High	2	7	3	0	12
High	4	5	4	0	13
Upper middle	15	4	4	0	23
Middle	10	6	5	2	23
Lower middle	6	4	9	3	22
Low	6	6	8	8	28
Total	43	32	33	13	121

Correspondence analysis between GNI per capita and HPI

Taking help of the statistical software IBM SPSS Statistics 20, we have found the following results for correspondence analysis. Tables 4 and 5 display the frequency for each category of each variable; they are essentially cross-tabulation frequency tables. Corresponding to Table 4, the following tables offer further analysis.

Table 4: Row Profiles

HPI_SCORE	GNI_PC				
	High income	Upper middle income	Lower middle income	Low income	Active Margin
Very High	.167	.583	.250	.000	1.000
High	.308	.385	.308	.000	1.000
Upper middle	.652	.174	.174	.000	1.000
Middle	.435	.261	.217	.087	1.000
Lower middle	.273	.182	.409	.136	1.000
Low	.214	.214	.286	.286	1.000
Mass	.355	.264	.273	.107	

The Row Profiles table (Table 4) displays the proportions of each column value across each row. It means here, row profiles show relative frequencies of different categories of GNI per capita for each type of HPI score. For instance, there are 2 countries with high GNI per capita out of all 12 countries which have very high HPI score; 2 is 16.7% of 12. It is to be noted that 65.2% of countries with upper middle HPI score corresponds to high per capita income and contrarily, none of the very high, high and upper middle HPI scorers belong to low income group. The Mass values across the bottom refer to the column's proportion of the total sample size. For instance, 43 high income countries represent 35.5% of the total sample of 121 countries.

Table 5: Column Profiles

HPI_SCORE	GNI_PC				
	High income	Upper middle income	Lower middle income	Low income	Mass
Very High	.047	.219	.091	.000	.099
High	.093	.156	.121	.000	.107
Upper middle	.349	.125	.121	.000	.190
Middle	.233	.188	.152	.154	.190
Lower middle	.140	.125	.273	.231	.182
Low	.140	.188	.242	.615	.231
Active Margin	1.000	1.000	1.000	1.000	

The Column Profiles table (Table 5) displays the proportions of each row value down each column, i.e., in column profiles table, a set of columns is considered to compare how different categories of GNI per capita are distributed across various HPI scores. For instance, 2 countries out of 43 high income countries score very high HPI; 2 is 4.7% of 43. Whereas, none of the low income countries belong to very high, high and upper middle HPI groups, 61.5% low income countries have low HPI scores. The Mass values down the right-most column represent each row's proportion of the total sample size. For instance, 28 countries with low HPI represent 23.1% of the total 121 countries.

Table 6: Summary

Dimension	Singular Value	Eigenvalue	Inertia	Chi Square	Sig.	Proportion of Inertia		Confidence Singular Value	
						Accounted for	Cumulative	Standard Deviation	Correlation 2
1	.398	0.158404	.158			.587	.587	.075	.141
2	.303	0.091809	.092			.341	.928	.087	
3	.139	0.019321	.019			.072	1.000		
Total			.270	32.640	.005[a]	1.000	1.000		

a. 15 degrees of freedom

Table 6 displays a variety of useful information. First, we see that 3 dimensions were derived, but only two are interpretable (i.e. only two dimensions account for a supposedly meaningful proportion of the

total inertia value). The Singular Value column displays the canonical correlation between the two variables for each dimension. The Inertia column displays the inertia value for each dimension and the total inertia value. The total inertia value represents the amount of variance accounted for in the original correspondence table by the total model. Each dimension's inertia value thus refers to the amount of that total variance which is accounted for by each dimension. So for instance, we could say that dimension 1 accounts for 15.8% of the 27% of the total variance our model explains in the original correspondence table. Stated another way; our model accounts for 27%of the variance in the original correspondence table and of that (small) percentage, dimension 1 explains 15.8%. The chi-square test is testing the hypothesis that the total inertia value is / is not different than zero. Here, our sig. or p-value is 0.05 (a common cutoff value); which indicates our total inertia value is significantly different than zero. The significant non-zero Chi-square value represents that it is highly likely that real differences exist between the groups of countries according to GNI per capita in terms of their HPI score profiles and vice-versa. We should keep in mind, this chi-square is not a model fit statistic; it does not lend itself to comparing models with different variables as chi-square is often used. It is only testing the inertia value against zero. The Proportion of Inertia columns represent the proportion of total inertia for each dimension; for example, dimension 1 (.158) accounts for 15.8% of total inertia (.27). The Standard Deviation column refers to the standard deviation of the Singular Value(s) and the correlation column refers to the correlation between dimensions.

Table 7: Residuals

GNI per capita HPI	High income	Upper middle income	Lower middle income	Low income
Very High	-0.0186	0.0317	-0.0022	-0.0106
High	-0.0049	0.0131	0.0038	-0.0114
Upper middle	0.0565	-0.0171	-0.0188	-0.0203
Middle	0.0152	-0.0006	-0.0105	-0.0038
Lower middle	-0.0150	-0.0150	0.0247	0.0053
Low	-0.0324	-0.0114	0.0031	0.0414

The central point of the correspondence analysis is to look upon the deviations from the expected frequencies, not in absolute but in relative units. The residuals quantify the difference between the observed data and the data we would expect under the assumption that there is no relationship between the row and column categories of the table. Therefore, big positive residuals mean a strong positive relationship and vice versa.

The biggest residual is 0.0565 for countries with high GNI per capita and upper middle HPI. This means that, the observed proportion of countries with high GNI per capita and upper middle HPI is 12.4%, and this is 5.65% higher than the expected proportion of 6.75%, which is computed under the assumption of no relationship between GNI per capita and HPI scores. Thus, the probable conclusion that we can draw from this is that there is a positive association between high GNI per capita and upper middle HPI scores. That is, countries with high GNI per capita are more likely to have upper middle HPI scores than others.

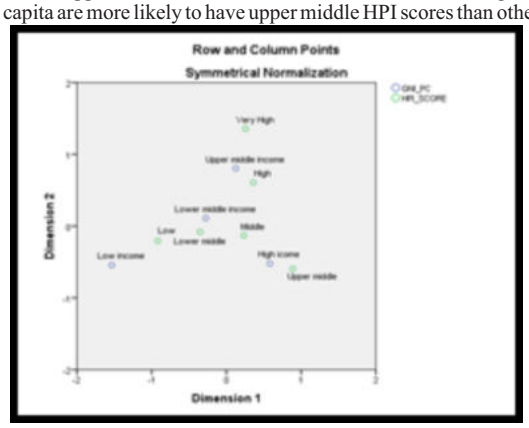

Figure 1: Correspondence Map

The correspondence map shows each category score on both dimensions (at once) for both GNI per capita and HPI score (at once). The scores allow us to compare categories across variables in (this case) two dimensional space. It appears that upper middle income countries have very high and high HPI, high income countries have upper middle HPI and low income countries suffer from low HPI. Again, very high and high HPI scores most probably share negative relation with high income levels. This invites the probability of the fact that happiness does not necessarily depend on income.

CONCLUSION

The above analysis reveals that though there is a positive association between income and happiness across most of the countries, in some cases there are conflicting results. In summary, there is no clear-cut evidence that higher income level can bring happiness and is indicative of the fact that several factors, apart from income can influence happiness.

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