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Proposition of a Macro Health Index in the World

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Abstract: This article provides an aggregated indicator of health in the world from a macroeconomic perspective. Using World Bank Data Based on a sample of 178 countries and regions covering the period 1995-2014, we adopt the principal component analysis (PCA) to estimate the new indicator. The main results are as follows: the new indicator belongs to -5.375 and 4.239, where -5.375 is the score recorded by the worst-ranked country while 4.239 is the highest score recorded. In 2014, 69% of the sample have an index greater than the average of zero because of the normalization of data in ACP. The remaining 31% are mainly found in Africa, mostly in the Sub-Saharan regions.

Key words: Health Index Principal Component Analysis Health Utility Index

JEL Classification: C02; C43; I12

1. Introduction

Questions about the construction of a health indicator already have furnished some work in the past. The best-known of the literature is the Health Utility Index (HUI)[1] which is declined in several levels in its development including HUI: 1, HUI: 2, HUI: 3 (Torrance 1996). In the same way, Danet (2011) dwelt on the construction of a synthetic indicator that differs from the HUI not only in the approach used but also in the dimensions it calls for in its methodology. However, most empirical studies, especially those of a macroeconomic nature, use health status proxies instead (Poirier et al.. 2004 Perronnin et al.. 2006 OECD, 2013). This observation is certainly made because of the limitations left by the use of the Health Utility Index, which is purely micro-economic and therefore does not relay information on the overall health status of populations. Moreover, by inserting it into cardinal utility theory, Torrance et al. (1996) noted that HUI: 2 was effectively applicable in an individual as in a group of people with results that reflect fairly Well the health replicated by the subjects concerned[2]. This gap in the lack of development of a composite health indicator that reflects the overall health score achieved by populations within a country interest in this work. While trying to fill this gap in the literature, it brings a methodological specificity based on principal component analysis.

Indeed, our analytical framework is taken from Cezar (2012) on the construction of a composite indicator of financial development in the world. Among the basic health indicators most used as proxies for health status, life expectancy at birth, as well as the infant mortality rate, are returning on a large scale (Perronnin et al.. 2006 OECD 2013). It should be noted, however, that the chosen indicator must cover several dimensions that can influence health behaviour, both in an epidemiological context and in the various social axes that Dahlgren and Whitehead (1991)[3] have made to define the outlines. This resizing reveals the need to find an indicator that meets this need, no least solving the problem of heterogeneity left by the various proxies of the health Status. It must also specify, the surroundings of the difficulties related to the access of the data in time series completing for this purpose the channels of econometric analysis[4]. It is in that way we formulated the objective of constructing a composite and continuous indicator of the health in the world that concomitantly covers the socio-economic and environmental dimensions. In a sample of 178 countries on the period 1995-2014, we follow the methodological framework used by Cezar (2012) in his article on the construction of the new indicator of financial development in the world. Principal Component Analysis consists in aggregating elementary indicators of health status into one that restores to the maximum the information

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[1]HUI stands for Health Utility Index

[2]The HUI values between 0 and 1: A value close to 0 reflects poor health and a value close to 1 reflects good health

[3]These dimensions cover style relies personnel, social and community networks, conditions of life and work, socio-economic, cultural and environmental.

[4]This refers to the sample size for statistical inferences (see Jarque Bera normality for residue in the regressions).

relayed by each variable. We may be interested to know whether the new indicator proposed in this paper better reflect health status according to the different geographical regions of the world? in other words, will this indicator allow for cross-country comparisons with respect to their level of development around the world? To answer this central question, we assume in the analysis that, this new indicator is correlated with some basic indicators commonly used in the literature such as life expectancy at birth, the infant mortality rate. We also assume that the comparative evolution of the new indicator reflects the level of development of countries in the world.

The rest of this paper is structured on four main sections. Section 1 presents the basic indicators commonly used in the literature; Section 2 briefly visits the literature review on synthetic indicators of health; section 3 reveals the methodological approach to be used and then the results are presented in section 4 before concluding.

2. The Basic Indicators of Health Status

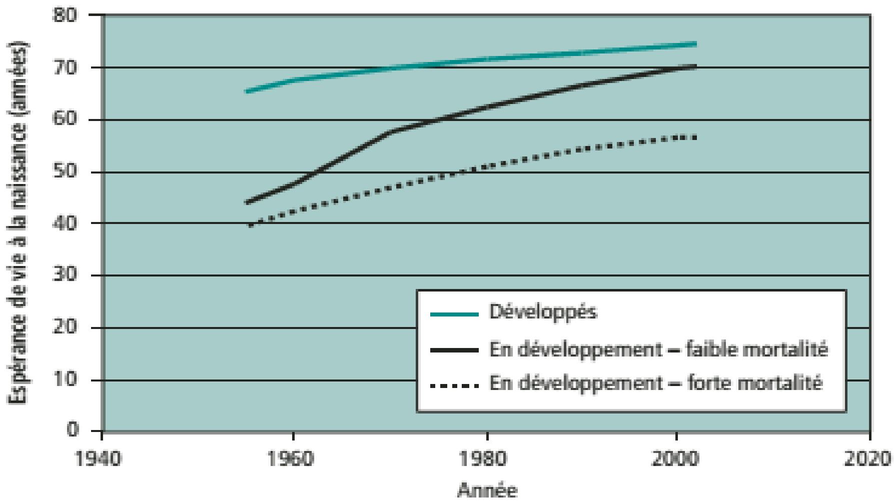
If it has been difficult to decide on an indicator that accurately reflects the health status of populations, it is nevertheless possible to obtain it from some variables. The choice of such variables depends on the degree of correlation between any of them and the health Status. Although the concept of health status is somewhat abstract in its apprehension we can suggest that the health status of an individual depends on several factors that play simultaneously with the contribution of the well-being of the latter. Furlong et al. (2001) define health status at three levels; impairment, disability and the handicap. The weakening refers to the problems at the level of the body, the incapacity defined as problems at individual level, and the handicap referring to the problems that an individual can manifest because of those surrounding him. In this article we use socio-economic and environmental indicators. These are life expectancy at birth, infant mortality rate, CO2 in gas products, per capita GDP, per capita health expenditure, global dependency ratio, and access to electricity. It should be noted that the most commonly cited indicators are life expectancy at birth and infant mortality (Danet 2011; OECD 2013).

2.1 Life Expectancy at Birth and Infant Mortality

As defined by World Health Organisation (2003), life expectancy at birth is the average number of years an individual has to spend on earth. Further on, the OECD (2013) notes that life expectancy at birth is moving in the same direction as per capita health expenditure, especially within the organisation and in emerging countries such as Brazil, South Africa, India, and Russia.

Moreover, the infant mortality rate has an ability to influence health status. High values of this are illustrative of poor health behavior of populations (see Fig.1). That Figure also shows that life expectancy varies with the level of development of the countries.

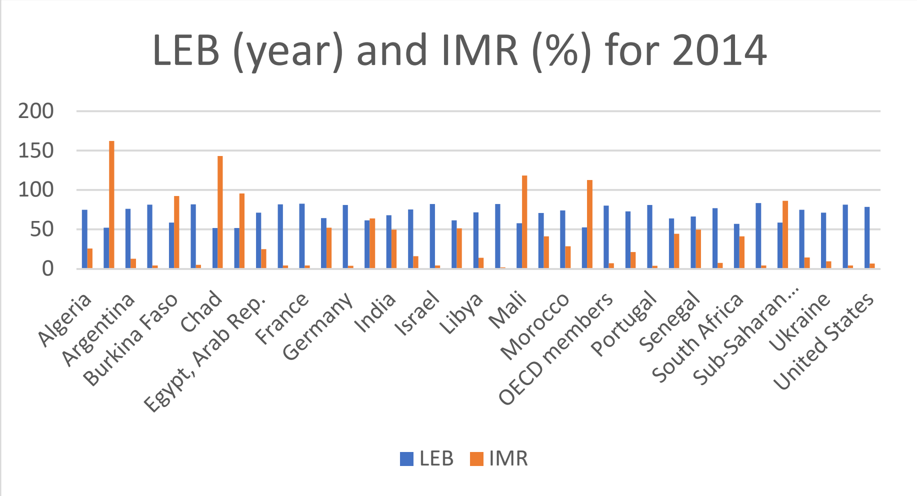
Fig 1: Comparative evolution of life expectancy at birth in the world



Source: World Health Organization report (2003)

By linking this indicator to the mortality rate, countries recording a high life expectancy also record the lowest infant mortality rates and vice versa (see Fig.2). Thus, these variables exert opposite effects on the state of health (positively for life expectancy and negatively for the infant mortality rate). In addition to these indicators, the influence of public health spending and GDP is clearly visible for health.

Fig 2: Life expectancy at birth (LEB) and infant mortality rate (IMR) in some countries of the sample in 2014.

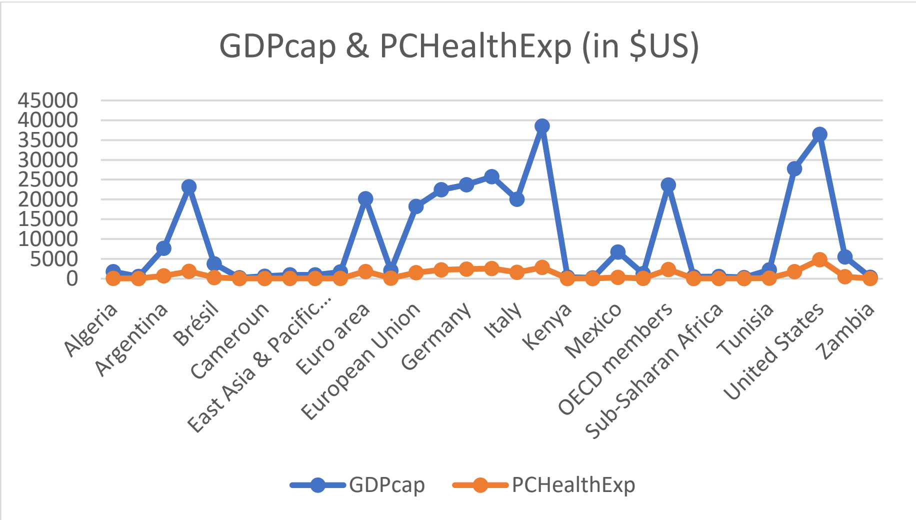


source: Authors from data of WDI using Excel

2.2 Per capita Health expenditure and GDP per capita

The level of GDP per capita of a country can condition the quality of health care that can reach its populations, and immediately influence their health state. In fact, countries with relatively high per capita incomes would devote as much of their income to health monitoring as a remarkable proportion of the latter. Thus, the differences in development between countries in terms of GDP are at the limit the same with health expenditure per capita (see Fig.3).

Fig 3 GDP per capita (GDPcap), Per capita health expenditure (PCHealthExp) in 2000 for some countries of the sample



Source: Authors from WDI data using Excel

Not surprisingly, GDP per capita and per capita health expenditure are higher in some of the most advanced countries or regions of the world in terms of development, with sub-Saharan Africa occupying the bottom seats. These two variables also show the same evolutionary trends in the differences between countries.

3. Literature Review on Health Status Composite Indicators

This paper follows a wide range of empirical works on the health indicators, especially on composite indicators. These composite Indicators are mainly built on the Health Utility Index (Torrance et al. 1996).

From HUI: 1 to HUI: 3

Originally developed by Torrance et al. (1982), The Health Utility Index (HUI) has been famous for its use in clinical studies, with a focus on neonatal problems. Originally coded by HUI: 1 as Health Utility Index mark 1, it contains 4 attributes including a physical function, an attribute related to its role, a socio-emotional function, and health problems, each of them ranking from levels 4 to 8. The HUI: 1 is defined between 0 and 1. The value 0 for the worst health Status and 1 for the best situation. The HUI: 2 developed following the HUI: 1 varies meanwhile between -0.3 and 1; while the HUI: 3 varies between -0.36 and 1.

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Furlong et al. (2001) emphasized on the fact that a negative score is perceived as a status compared to death. The procedure for implementing each HUI is done in four steps: the health status classification system, the definition of a preference-based[5] score function, the definition of the questionnaire for data collection, and the implementation of a construction algorithm of the health utility indicator (HUI). The HUI: 1 applied to its base on a sample of 24 000 individuals is unique in that it is adapted primarily to the problem of cancer in children and precisely emphasizes the problem of infertility. The HUI: 3, on the other hand, was built on a sample of 972 000 people without incorporating the fertility component. This resizing of the HUI: 1 offers the fullness of taking into account the weighted standard of living under the acronym QALY (Quality Adjusted Life Years). The well-being quality system developed by Fanshel and Bush (1970) and taken up by Mo et al. (2004) breaks down into four attributes: mobility, physical activity, social activity, and problems with complex symptoms. This initiative is followed by Cadman et al. (1986), who developed an indicator with 6 attributes, the most important of which is the quality of life expressed in sensory and communication capacity, happiness, clean care, pain, academic ability and learning, and physical activity capacity.

Based on that literature we observed that almost no study has been carrying on the macro aspect of health indicator. This justify the interest of our study.

Methodology

The methodological approach we use in this work is new compared to previous works on the composite indicator of health. This is the Principal Component Analysis (PCA) technique. We are strongly inspired from the work of Cezar (2012) on the construction of a new indicator of financial development. This new indicator will be unique in that it gives a global overview of the health status of the populations of a given country and also covers 178 countries and regions across the world.

3.1 Nature and sources of data

This study is part of a macroeconomic framework in contrast to existing indicators based on microeconomic data. The data used are from the World Development Indicator (2017) database. They are annual and cover the period 1995-2014 collected on a sample of 178 countries and regions across the world.

3.2 Description of the variables

We selected seven variables that serve as a basis for weighting. These are: life expectancy at birth, infant mortality rate, per capita GDP, per capita health expenditure, global dependency ratio, access to electricity, and CO2 content from gaseous products. These variables cover the socio-economic and environmental dimensions. They are chosen according to their degree of influence on the state of health as well as the availability of related data (Dahlgren and Whitehead 1991).

Life expectancy at birth and mortality rates, which are of a social nature, explicitly reflect the health status of a country's population. It is reasonable to believe that a country with a high value of life expectancy concedes at the same time a low infant mortality rate, and hence sees the health status of its populations improved. The overall dependency ratio[6] is in the same register. It can jeopardize the state of health to the extent that the income of the workers does not allow them to comfortably support the needs of the inactive.

The same look at the economic variables GDP per capita and per capita health expenditure suggests that they may contribute implicitly and positively to health status. In general. the higher the GDP per capita, the higher the part of income allocated by citizens of a given country to cover their health expenditure. This may theoretically improve their health status. On the other hand, those in the low per capita GDP may express some unsatisfied needs as far as their health expenditures are concerned for, they may not have enough means to support them. As a result, one can think that countries with high values of economic characteristics have better health than countries with weak equivalents.

Concerning CO2 gas emission variables, and access to electricity, taking them into account will allow us to capture the influence of the environment on health status. CO2 emissions are a real danger to human health and therefore a major economic issue.

Table 1. Abbreviation of variables

Variable	Abbreviation
GDP per capita	GDPcap
Per capita health expenditure (current US $)	PCHealthExp
Life expectancy birth, total (year)	LEB
Child mortality rate, less than 5 years (per 1000)	ChildMR

[5]This utility function is based on the theory of utility type von Neumann and Morgenstern (Torrance et al. 1996; Furlong 2001).
[6]This ratio indicates the number of inactive people supported by assets.

CO2 Emissions Attributable to the consumption of gaseous fuel (% of total)	CO2Fuel
Ratio of inactive population (% of the working-age population)	RinPaP
Access to electricity (% of population)	AccesElec

3.2 Principal component analysis

Apprehended as the most famous of multivariate techniques, principal component analysis (PCA) was introduced by Pearson (1901) and then spread by Hotelling (1933)[7].

3.2.1 Principle of PCA

Suppose that X is a vector of P random variables. As the dimension P becomes too large, it appears important to question on how to reduce it in order to reflect as many as possible the initial information. That is to choose the value of P which gives the maximum variance for initial variables. Hence, Jolliffe (2002) indicates that the first thing to do is to define a first linear function$\alpha_1^{'}X$ with elements into X which relays a maximum variance, where α_1 is a vector of constants of p constants $\alpha_{11}, \alpha_{12}, \dots, \alpha_{1p}$ and $\alpha_1^{'}$ its transposition. So,

$$\alpha_1^{'}X = \alpha_{11}x_1 + \alpha_{12}x_2 + \cdots + \alpha_{1p}x_p = \sum_{j=1}^{p} \alpha_{1j}x_j$$

Next a second linear function $\alpha_2^{'}X$ is defined so that it is uncorrelated to the first one but also has a maximum variance, and so on up to the k-th feature which is uncorrelated to $\alpha_1^{'}X, \alpha_2^{'}X, \dots \alpha_{k-1}^{'}X$ respecting the maximum variance condition. The k-th variable resulting from the function corresponds to the k-th principal component. It should be noted here that our goal of building a composite indicator requires to return just the first principal component in case the opportunity to go further arose. This process of reducing the size of the initial space used to represent the information of the original space into a new space in the case of dimension 2 to maximize inertia[8] explained by each factor axis.

3.2.2 Choice of factor axes

Suppose the vector of random variables X has a known matrix of the variance-covariance noted Σ. following the first component, the variance is given by $Var(\alpha_1^{'}X) = \alpha_1^{'}\Sigma\alpha_1$. Jolliffe (2002) points out that the maximum for this variance will not be achieved as is done right in imposing the normalization constraint $\alpha_1^{'}\alpha_1 = 1$. Therefore, the search for maximum variance is done by solving the optimization program:

maximize $Var(\alpha_1^{'}X) = \alpha_1^{'}\Sigma\alpha_1$ subject to $\alpha_1^{'}\alpha_1 = 1$.

Applying the Lagrange multiplier technique, the programme becomes:

maximize $\alpha_1^{'}\Sigma\alpha_1 - \lambda(\alpha_1^{'}\alpha_1 - 1)$ where λ is the Lagrange multiplier.

The application of the first order conditions led to

$$\Sigma\alpha_1 - \lambda\alpha_1 = 0 \iff (\Sigma - \lambda I_p)\alpha_1 = 0$$

where I_p is the identity matrix of P dimension, λ an eigenvalue of Σ and $\alpha_1$the corresponding eigenvector. In order to know which of the eigenvector of Σ gives the maximum variance, we solve the following program:

Maximize $Var(\alpha_1^{'}X) = \alpha_1^{'}\Sigma\alpha_1 = \alpha_1^{'}\lambda\alpha_1 = \lambda\alpha_1^{'}\alpha_1 = \lambda$.

Hence λ will be the highest possible, and α_1 is the corresponding eigenvector. We generally note by λ_1 the first eigenvalue which corresponds to the first principal component axis.

In general. the k-th main component of X is $Var(\alpha_1^{'}X) = \lambda_k$, with $\lambda_k$the k-th largest eigenvalue of the covariance matrix Σ and α_k the associated eigenvector.

Considering the first two factorial axes, the orthogonality condition between components $\alpha_1^{'}X$ and $\alpha_2^{'}X$ is given by the nullity of the scalar product

$<\alpha_1^{'}X, \alpha_2^{'}X> = \| \alpha_1^{'}X \| . \| \alpha_2^{'}X \| . \cos(\alpha_1^{'}X, \alpha_2^{'}X)$

or in other manner $\text{cov}(\alpha_1^{'}X, \alpha_2^{'}X) = 0$ which is equivalent to $\alpha_1^{'}\Sigma\alpha_2 = 0$ or $\alpha_2^{'}\Sigma\alpha_1 = 0$ or $\alpha_1^{'}\alpha_2 = 0$ or $\alpha_2^{'}\alpha_1 = 0$

In the case where the matrix Σ is normalised, $< \alpha_1^{'}X, \alpha_2^{'}X > = \cos(\alpha_1^{'}X, \alpha_2^{'}X)$

The imposition of the orthogonality condition ensures that the values are different from each other in the diagonalization process of the covariance matrix. The centering and reduction which involves capture all variables in the same scale and reduce gaps in the unit is as follow according to Saporta (2006):

[7]For this author, which includes quite a few independent variables in the analysis, the choice of the main components is done by successive addition of variables in the analysis. As he works with limits correlations and not covariance, especially it does not use matrix notation.

[8] The concept of inertia refers to the variance and reflects the amount of information retained by a factor axis

$Z_i^j = \frac{x_i^j - \bar{x}^j}{s_j}$ where Z_i^j is the new standard score, $\bar{x}^j$ the average of variables x_i^j, the corresponding standard deviation is s_j.

3.2.3 Selection criteria of the number of factor axes

According to Saporta (2006) we generally distinguishe three criteria in the choice of the number of factor axes: the criterion of Kaiser, the criterion type "control card" developed by Karlis, Saporta and Spinakis (2003), then the criterion of the existence of acorn point on the decay diagram of eigenvalues. The first criterion is applied when the variables are centred and reduced and requires that factor axes whose explained inertia is greater than 1 are retained. As to the second criterion, the condition to be met by a factor axis is given by $\lambda > 1 + 2\sqrt{\frac{p-1}{n-1}}$ where p is the number of variables and n the number of individuals. However, Dinno (2009) emphasizes that the method of choosing the number of factors is important because some of these methods underestimate this number while others overestimate it. Therefore, Saporta (2006) states that the choice of any of these criteria must have an implication on the results interpretation. Through data analysis, we use the Stata software to our estimates, drawing on the work of Dinno (2009).

3.3.4 Sample adequacy test

In order to verify the adequacy of our results on sample relatively to correlation between variables we proceed to the Kaiser Test-Maye-Olkin (KMO). In general. the sample is suitable for analysis when the partial correlation coefficients are closed to 1.

4. Results

Remembering that our goal is to build a new indicator of the health for 178 countries over the period 1995 to 2014 in the world, we are considering in this context the veracity of the assumptions we made in the introduction.

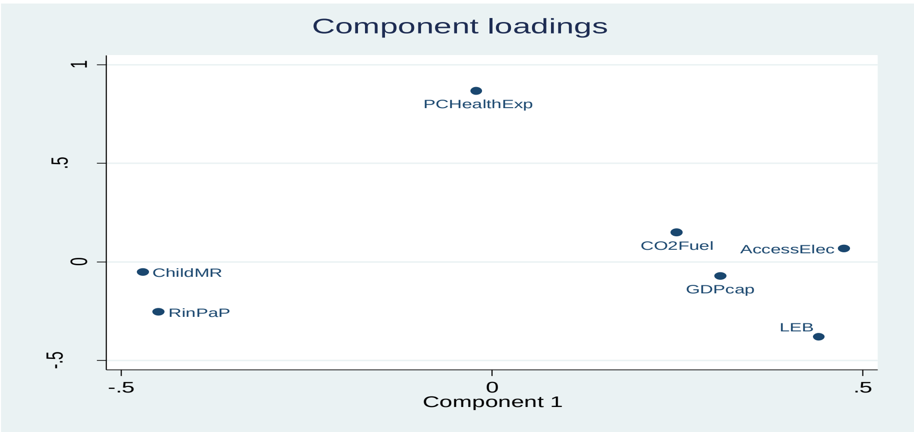
4.1 Results of statistical analysis

We observe that different statistics are very unevenly distributed considering the difference between the minimum and maximum variables (see Table 2 in the appendices). These observations predispose us to such important gaps in our composite indicator.

In terms of the correlation matrix, it is an important tool in ACP (see Table 2 in the appendices). It appears in this regard that the variable access to electricity (AccesElec) is strongly and positively correlated to the variable life expectancy birth (LEB), and at the same time negatively correlated with ratio of inactive population on active population (RinPaP) and Child mortality ratio (ChildMR) with correlation coefficients of 0.7711, -0.8391, -0.8590, respectively.

Table 4 in appendices shows that the inertia explained by the first factorial axis (which is represented by the first eigenvalue) is 3.87 or a percentage of inertia of 55.3% of the total inertia (sum of the eigenvalues is 7). This means that the first axis keeps 55.3% of the information relayed in the 7-dimensional space. As to the second principal component, it restores a maximum variance of 1.24% for a percentage of inertia of 17.55% due to the second-factor axis. If we accept the first two factorial axes, we will manage to explain 72.95% of the total inertia. In most studies on the ACP, the ideal is to hold the first two axes whatever the criterion for choosing factor axis selected. However, our goal is to get an indicator that synthesises as better as possible the initial information into a single component. That is why we retain only the first-factor axis which makes up 55.3% of the total information (see Fig 4). justify the retaining of that decision.

Fig 4. Components of variables on the factorial axes



Source: Authors from stata software

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This Fig shows the components of the different variables on the first two factorial axes. On the first principal component, the values vary between -0.5 and 0.5. We note that with the exception of health expenditure per capita (PCHealthExp), all the other 6 variables are strongly related to the first-factor axis. The representation of these variables quality is also required because none of them is closed to the origin demonstrating all their explanatory power in the formation of this axis. Variable rate of infant mortality (ChildMR) and the global dependency ratio (RinPaP) are negatively correlated to variables life expectancy at birth (LEB), CO2 emissions due to gaseous fuel (CO2Fuel), GDP per capita (GDPcap) and access to electricity (AccesElec).

For the result of standardization of variables (see table 5 in appendices). It ensures that all variables are centred and reduced in order to give the same scale of measurement prior to the estimate of the actual indicator.

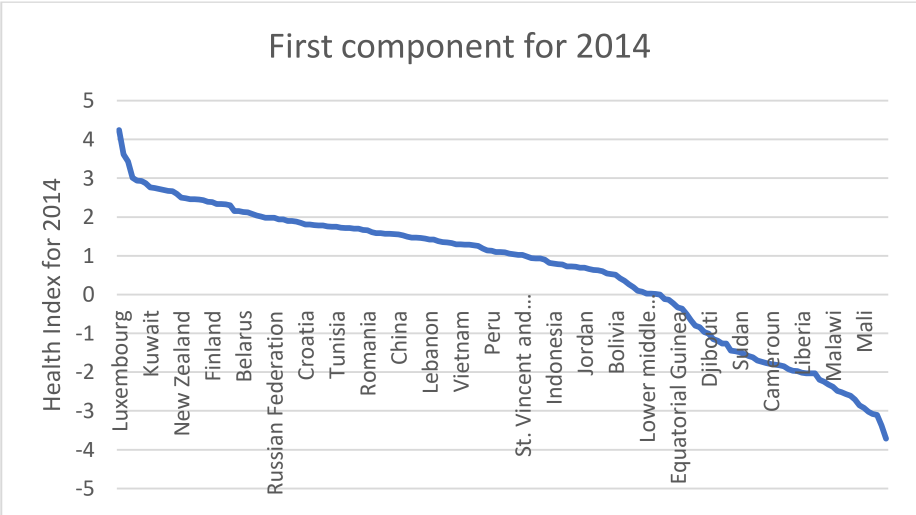
4.2 Results robustness Control

The results of the Kaiser-Meyer-Olkin analysis (KMO) given in allow us to conclude on the adequacy of the sample relative to correlations between variables (see Table 6 in appendices). Indeed, with the exception of the variable health expenditure per capita (PCHealthExp) with a coefficient of 0.1731, all other factors are quite high and besides, the overall coefficient of 0.7139 is very evocative about these. This result supports the findings previous data to the Fig.4 on the variable quality of representation.

4.3 Results of the new indicator and validity

We present in this section the final results of the analysis. In a sample of 178 countries and regions in the world over the period 1995 to 2014, the final indicator has an average value of 1.24e-09 which is closed to 0 (see Table 7 in appendices). This average value of 0 is due to the normalization of data according to the PCA apply technique. Its standard deviation is 1.968. One of the most important results is the range of values. It varies between -5.375 and 4.239. -5.375 represents the most ill-health while 4.239 reflects the best possible condition. However, the maximum index of 4.239 does not exclude the possibility of achieving values close to 5 or 6 in the coming years. That is why we can choose interval value from -6 to 6.

Fig 5. Result of the health composite indicator



Source: Authors from results using Excel

Before commenting on this Fig, note that we have arbitrarily chosen to represent the indicator for 2014. Note also that the same exercise was done for other years (1995 to 2013) without observing a significant change in the general trend of results. To return to the results, note that the decrease movement of the index is due to the classification order made before. Not surprisingly, developed countries have a higher index of health with respect to the poorest countries. Luxembourg for most comparisons has the best score. For year of 2014, it recorded 4.34 and it is followed by Norway, Switzerland, Canada, and the Netherlands which have respectively 3.61, 3.44, 3.01, and 2.94. The United States, the United Kingdom, and France occupy respectively the 13th 14th and 21st positions with a scores of 2.66, 2.60 and 2.39. The Africa countries occupy more often bad positions in the world and this characteristic is also verified in our results. Reasons for that are multiple and do not concern only the health aspect. The last five places are occupied respectively by the Central African Republic, Sierra Leone, Niger, Angola and Chad (178th), which occupies the last position with -3.02, -3.08, -3.10, -3.38, and -3.72 respectively. At least some countries in Africa illustrate fairly well by their position: the case of Tunisia, 50th with 1.75, the Algeria, 64th with 1.56, Mauritius, 75th with 1.34, Libya, 83rd with 1.18, Egypt, 89th with 1.06, and Morocco, 100th with 0.78. Gabon which follows this classification in the African level occupies the 125th position with -0.12. Countries which have an average index are among respectively the India, 119th with 0.07, countries with lower middle-income, 121st with 0.03, Guatemala, 121st with 0.02, Myanmar, 122nd with 0.015, and Nepal with -0003. These statistics show that 123 countries have a health index greater than zero. That constitutes 69% of the sample.

The 31% of the country who are in poor health condition, explain the fact that the general level of health in the world is high (with an index of 1.03, the world is classified at the 92nd position).

These comparative results are likely to validate the assumptions we made upstream of this study include that the indicator is evocative of the level of health of populations worldwide through its correlation with development indicators or wellness.

Conclusion

The health issue that is usually inserted into the human capital theory needs to be treated with the seriousness it deserves. For many centuries, studies made on this subject have tried find social. economic, and even political ways to reverse the mortality curve. The index of the health utility that was originally implemented by Torrance et al. (1982) provides a saving scheme as to its accuracy reflection on the health of patients to whom they are directed. but this last indicator is limited in its application to a microeconomic framework. For many years, research on issues of macroeconomic order have continued to make their ascension. The indicators commonly used in this context such as life expectancy at birth, the infant mortality rate, and many others are not without showing their limitations. Hence, it appears interesting to address the issue of an indicator that can be able at least to take into account the problem of heterogeneity met in many indicators. That is why we proposed ourselves to build a new and continuous composite indicator of health in the world. The implementation of the latter was inspired by the work of Cezar (2012). Seven indicators covering socio-economic and environmental dimensions have been used for the basis weights. There are: Life Expectancy at Birth, Infant Mortality Rate, GDP per capita, Health Expenditures per capita, Total Dependency Ratio, Access to Electricity, and Rates of CO2 from gaseous products. In a sample of 178 countries and regions over the period 1995 to 2014, the values of the new indicator vary from -5.375 to 4.239 according to the results for 2014. The world position is among the third quartile. This is due to the higher percentage of the best 69% of the sample. Its score is 1.03 for the 92nd position. Countries that have the best scores do not surprise. At almost all the periods, developed countries like Luxembourg, Norway, Switzerland, Canada and the Netherlands France, USA occupy the firsts positions. Africa in general and sub-Saharan Africa, in particular, are no exception to the usual closing statement the chef of the rankings. So, the Central African Republic, the Sierra Leone, the Niger, the Angola and the Chad, occupy the last five ranking that are 174th, 175th, 176th, 177th, and 178th respectively. Countries with an average index which is closed to zero are, India, 119th with 0.07, countries with lower middle-income, 121st with 0.03, Guatemala, 121st, with 0.02 Myanmar, 122nd with 0.015, and Nepal with -0.003. These results are highly instructive: first, the new index allows comparisons between countries in terms of health effort as it measures the potential of country efforts in improving the state of health of its population from one year to another. Finally, he concedes the econometric analysis requirements the opportunity to serve for studies on time series.

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Appendix

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
AccessElec	3560	74.29263	32.45365	.0154853	100
RinPaP	3560	64.17359	18.91523	9.853287	114.3035
GDPcap	3560	9249.258	14896.41	65.01142	119172.7
PCHealthExp	3560	1.26e+09	1.86e+10	1.8286	4.30e+11
LEB	3560	67.4405	10.72051	3.185435	83.5878
ChildMR	3560	51.64983	52.18104	2	279.5
CO2Fuel	3556	15.96013	18.7098	-2.882214	89.40435

Table 3. Correlation matrix

	Access~c	RinPaP	GDPcap	PCHeal~p	LEB	ChildMR	CO2Fuel
AccessElec	1.0000						
RinPaP	-0.8391	1.0000					
GDPcap	0.4257	-0.4212	1.0000				
PCHealthExp	0.0170	-0.1914	-0.0054	1.0000			
LEB	0.7711	-0.6239	0.5252	-0.3986	1.0000		
ChildMR	-0.8590	0.8234	-0.4579	-0.0494	-0.8124	1.0000	
CO2Fuel	0.4469	-0.4151	0.1867	-0.0023	0.2647	-0.3026	1.0000

Table 4 inertia proportion explained by each factor axis

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.87108	2.6352	0.5530	0.5530
Comp2	1.23588	.383026	0.1766	0.7296
Comp3	.852851	.175658	0.1218	0.8514
Comp4	.677192	.501544	0.0967	0.9481
Comp5	.175648	.0499219	0.0251	0.9732
Comp6	.125726	.0640943	0.0180	0.9912
Comp7	.0616317	.	0.0088	1.0000

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Table 5. Standardization of variables

	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7
AccessElec	.4747	.06743	.05657	-.2122	.02566	.8311	-.1745
RinPaP	-.4492	-.2547	.006797	.1792	.7788	.2661	-.1543
GDPcap	.3081	-.07198	-.4127	.8406	-.07645	.04954	-.1207
PCHealthExp	-.02108	.8684	-.2205	.04536	.3163	.02283	.3069
LEB	.4405	-.3821	-.1006	-.1041	.3307	-.09917	.721
ChildMR	-.4705	-.05317	.1528	.2607	-.3956	.4596	.5629
CO2Fuel	.2491	.1499	.8628	.3679	.145	-.12	.01774

Table 6.Kaiser-Meyer-Olkin Analysis

Variable	kmo
AccessElec	0.8434
RinPaP	0.8599
GDPcap	0.7315
PCHealthExp	0.1731
LEB	0.6225
ChildMR	0.7527
CO2Fuel	0.7877
Overall	0.7139

Table 7. Descriptive statistics of the final indicator

Variable	Obs	Mean	Std. Dev.	Min	Max
pc1	3556	1.24e-09	1.967505	-5.375282	4.238663