Economics Letters 161 (2017) 38–42

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Testing for the implicit weights of the dimensions of the Human Development Index using stochastic dominance

Mehmet Pinar [a], Thanasis Stengos [b,*], Nikolas Topaloglou [c]

[a] Business School, Edge Hill University, St Helens Road, Ormskirk, Lancashire, United Kingdom
[b] Department of Economics, University of Guelph, Guelph, Ontario, Canada
[c] Department of International & European Economic Studies, 76, Patision Street, GR10434, Athens, Greece

HIGHLIGHTS

- Weight allocation to sub-indices of the Human Development Index is assessed.
- Stochastic Dominance Efficiency method is used to evaluate the implicit weights.
- The implicit weight attached to the education dimension is relatively low.
- The implicit weight attached to the health dimension is relatively high.
- Results suggest health index contribute more to the improvement of the index.

ARTICLE INFO

Article history:
Received 19 May 2017
Received in revised form 19 September 2017
Accepted 20 September 2017
Available online 28 September 2017

JEL classification:
C14
I31
O15

Keywords:
Well-being
Human development
Composite indices
Nonparametric stochastic dominance

ABSTRACT

In 2010, United Nations' Development Programme changed the indicators used to obtain education and income indices in the Human Development Index (HDI). In this paper, we use the Stochastic Dominance Efficiency methodology to evaluate the implicit weights of the dimensions used in the new measurement of the HDI. We find, contrary to the earlier literature, that the implicit weight attached to the education dimension is relatively low suggesting that it is relatively harder to achieve high scores in this dimension compared to other dimensions.

1. Introduction

The most well-known and accepted composite index measuring the composite well-being of countries is the United Nations' Human Development Index (HDI), which is a geometric mean of the education, life expectancy and GNI per capita indices, where these dimensions are assigned equal weights to reflect equal intrinsic value given to each dimension (see e.g. Alkire and Santos, 2014). However, each indicator is normalized through a transformation which leads to weights that are implicitly different than the explicit ones. Normalization of two components might suggest that one component is given implicitly more weight than another one if the difference between the upper and lower bound is relatively low for one component and relatively high for the other one. Then the effect of the former on the composite index becomes somewhat higher than that of the latter (Noorbakhsh, 1998). For instance, one could still keep the explicit weight of a dimension to be the same, but could decrease the upper goalpost for this dimension (e.g., a country can be assigned a full normalized score if it achieves an average of 80 years of life expectancy rather than 85 years of life expectancy in the health dimension). This would be equivalent to increasing the implicit weight of this dimension to arrive at higher levels of human development without any change in the pre-assigned explicit weights. As a result, even though each sub-index is assigned an explicit equal weight, after transforming the raw components into an index, each sub-index gets assigned a

* Corresponding author.
E-mail addresses: mehmet.pinar@edgehill.ac.uk (M. Pinar), tstengos@uoguelph.ca (T. Stengos), nikolas@aueb.gr (N. Topaloglou).

https://doi.org/10.1016/j.econlet.2017.09.023
0165-1765/

different implicit weight. Clearly, the upper and lower bounds used to transform the indicators to obtain the sub-indices of the HDI are somehow arbitrary and will impose different implicit weights to dimensions.

In this paper, we will adopt a data driven alternative weighting scheme to arrive at a composite index based on stochastic dominance efficiency (SDE) analysis that will shed a different light on the implicit weights assigned to dimensions of the HDI. The weights derived from SDE analysis can be thought of as weights that lead to the most optimistic well-being scenario and hence identify whether pre-determined weights impose higher (or lower) implicit weights to some dimensions if one were to measure relative welfare across countries. Since each sub-index in the HDI is bounded between 0 and 1, higher measured human development levels for more countries describe a distribution that is negatively skewed resulting in less variability across countries. As such, SDE analysis applied to scaled data would result in the most optimistic composite index in which more observations correspond to higher measured relative development levels.

In a recent paper, Pinar et al. (2013) used the SDE methodology to obtain the best-case scenario weighting scheme for the sub-indices of the HDI used prior to 2010 edition.[1] They found that weighting the education index relatively more than the pre-determined equal weights would lead to a more optimistic measurement of welfare. Since most countries have already achieved good levels of literacy and enrolment ratios (i.e., indicators considered to measure the education index prior to the 2010 edition of Human Development Report), it has been suggested that these indicators do not serve a purpose any longer for relative welfare comparisons since attaching an equal weight to the education index would allow most countries to achieve one third of so-called human development. The United Nations' Development Programme changed the way the education dimension measured after their 2010 edition to address this issue. Here, we follow the same methodology to test whether the new measurement of the HDI results in implicit weights that are similar to the explicit ones and examine which dimensions receive relatively higher (lower) implicit weights.

From a policy point of view, the reason behind using equal explicit weights is to ensure that each dimension receives the same importance. However, this would not be the case in practice if it is relatively less costly to achieve higher "human development" outcomes by allocating resources in certain dimensions than others. In other words, if the implicit weights are different than the explicit ones, the construction of the HDI could reveal policy incentives for countries to better allocate their resources to improve their "human development" outcomes. The methodology used in this paper will result in obtaining the implicit dimension weights by which countries have increased their measured "human development" over-time. This is not to say that the component that contributes more to the improvement of the index is the most efficient one (since this would depend on the costs of improving each particular dimension of the HDI). However this method would highlight the dimensions that are implicitly favoured (given more importance) by most countries, something that would allow policymakers to obtain a method equating implicit and explicit weights so that the intended message (i.e., assigning equal importance to each dimension) can be implemented in practice.

In the next section we discuss the new measurement of the dimensions used to construct the HDI. Next we present the main framework of our analysis using SDE. Finally, we present the data, findings of the empirical application, and a discussion in light of the empirical results.

2. New measurement of dimensions in the HDI

We use the United Nations' Development Program's HDI and its sub-indices — health, education, and income indices for 1990, 1995, 2005, 2010, 2011, 2012, 2013, 2014, and 2015. HDI scores are obtained as the geometric average of the three sub-indices, where each index is obtained through a normalization procedure by setting minimum and maximum (goalposts) in order to set the index values between 0 and 1.[2]

The health sub-index is measured by life expectancy (LE) at birth component, and normalized sub-index outcomes are obtained by using minimum and maximum goalposts of 20 and 85 years of life expectancy, respectively. Hence, the health index (HI) outcome of a given country is obtained by using the following normalization procedure $HI = \frac{LE-20}{85-20}$ where LE is the life expectancy of a given country.

The education sub-index is measured by mean of years of schooling (MYS) for adults aged 25 years or above and expected years of schooling (EYS) for children of school entering age. Index values for MYS and EYS (MYSI and EYSI, respectively) are obtained by using a minimum values of zero and maximum values of 15 and 18 years respectively, $MYSI = \frac{MYS-0}{15-0}$ and $EYSI = \frac{EYS-0}{18-0}$, respectively. Then, two indices are combined into an education index (EI) using arithmetic mean, $EI = \frac{MYSI+EYSI}{2}$.

Finally, income index (II) is calculated by using the normalization procedure $II = \frac{\ln(\text{GNI per capita})-\ln(100)}{\ln(75000)-\ln(100)}$ where the minimum and maximum goalposts for gross national income (GNI) per capita are \$100 and \$75,000, respectively.

The indicators used to obtain the education and income indices were different before the 2010 HDI edition. The income dimension in the previous measurement used gross domestic product (GDP) per capita and the maximum goalpost for this dimension was \$40,000. On the other hand, the education dimension used literacy rates (percentage of population that is considered as literate) and a gross school enrolment ratio (percentage of students enrolled of the eligible school age population). The upper goalpost for the income dimension is now relatively higher and the indicators used to obtain the education dimension are relatively harder to achieve when compared to its previous indicators used to construct this dimension.

The descriptive statistics for the sub-components of HDI suggest that the health index has the highest mean (median) over-time followed by the income and education indices, respectively (see the Online Appendix Table A.1 for the details). Furthermore, the health index displays noticeably more negative skewness than the other sub-indices suggesting that the majority of the observations are clustered at the upper tail of the distribution.

3. Stochastic dominance efficiency

This section discusses briefly the SDE methodology that we employ. We consider a $3 \times N$ matrix of achievements $\mathbf{Y}$ taking values in R^3, where the observations consist of a realization of achievements in three sub-components of the HDI for N number of countries. We denote by $F(\mathbf{y})$, the continuous cumulative distribution function

[1] The transformation of raw components into an index until 2010 is defined as follows. The value of a country's life expectancy index is obtained by the country's life expectancy in years minus 25 divided by 60, for a number that would lie between 0 and 1. The education index (EI) is defined as $EI = 2/3$ (adult literacy index) + 1/3 (gross enrolment index). This index is constructed so that a 2/3 weight is given to literacy (percentage of the population that is considered literate) and a 1/3 weight is given to gross school enrolment as a percentage of the eligible school age population and it is bounded between 0 and 1. The GDP per capita index is defined as, GDP Index = $\frac{\log(\text{GDP per capita})-\log(100)}{\log(40000)-\log(100)}$.

[2] For details, please refer to Human Development Report 2016 technical notes: http://dev-hdr.pantheonsite.io/sites/default/files/hdr2016_technical_notes_0.pdf.