ON THE POSSIBILITY OF A WEIGHTING SYSTEM FOR FUNCTIONINGS

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ABSTRACT

Measuring well-being of an individual based on his/her levels of functionings raises the following problem: Two vectors representing two individuals' achieved levels of functionings cannot be ranked unless one vector dominates the other. One solution is to combine the elements of a vector into some scalar measure by introducing a set of relative weights. Starting from the premise that each individual in a society has his/her own judgement about relative weights for various functionings, an axiomatic approach has been developed to characterise a rule for aggregation of relative weights attached by all individuals in the society.

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Introduction

The limitations of both income and commodity as the relevant space for assessment of the living standard are well-known. For over a decade now, Amartya Sen has been arguing for an alternative formulation of the concept of the standard of living in terms of what he calls functionings and capabilities[1]. According to this formulation, the life that a person leads should be seen as a combination of various 'doings' and 'beings', which are generically called functionings. Being well nourished, being in good health, having self-respect, taking part in the life of the community are all examples of functionings. The capability of a person refers to the various alternative combinations of functionings, any one of which the person can choose to have. Although Sen's approach is considered to be more persuasive than the existing ones, there arise several analytical issues which need to be fully explored before one attempts to make Sen's approach operational[2]. In this paper, an attempt is made to deal with one such problem, namely, how to evaluate the standard of living of an individual in terms of his/her achieved levels of functionings. Note that by 'evaluation' I mean the entire procedure of arriving at a numerical index for an individual's well-being. Although I have chosen functionings as the relevant dimensions for evaluation of an individual's living standard, the approach which is going to be suggested in the paper is equally applicable to the more general context of any multidimensional concept of the standard of living.

The plan of this paper is as follows. In section 2, I elaborate on the problem of assessing an individual's living standard in terms of Sen's notion of functionings, and explain why we need to go beyond the dominance partial ordering of functioning vectors. In section 3, I provide an axiomatic framework to arrive at a set of weights which would enable us to aggregate over the levels of functionings achieved by an individual. I conclude in section 4

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[1] Sen (1985, 1987, 1993).

[2] See Pattanaik (1993) for some of these issues.

2. The Problem

I focus on an individual's living standard, although, in policy debates, the focus is usually on the standard of living of social groups. By the standard of living of a group we generally mean the aggregate of living standards of all members of the group. Thus, the problem of assessing the standard of living of a group reduces to an exercise involving two steps : First, evaluation of an individual's living standard, and, second, aggregation across individuals[3]. In this paper, I am exclusively concerned with the first.

We follow Sen by claiming that in evaluating well-being the most relevant value objects are functionings and capabilities. Even if we ignore the capability part and confine our attention to the levels of funtionings actually achieved by an individual, the problem of comparison of living standards is far from trivial. An assessment of an individual's living standard involves essentially three aspects: First, identification of the characteristics, $x_1, x_2, \ldots, x_m$, which are considered to be relevant for the individual's living standard; second, obtaining some measure of those relevant characteristics (which gives us the individual's 'profile'); and finally, specification of the manner in which the profile is evaluated. Once we settle on a set of relevant characteristics which are considered to be amenable to measurement, we are left with a vector representation of the individual's profile. We can stop at this point and assert that the individual's standard of living is given by his/her 'profile' (which, in our case is a vector of levels of functionings). Then comes the question as to whether we have to somehow combine the elements of his/her profile into a unitary index of well-being. Clearly, such a procedure is not necessary. We can make interpersonal or intertemporal comparisons by the logic of vector dominance. There might be cases where one vector dominated -- either weakly or strongly -- another. However, in general, we cannot expect to find vector dominance to hold in most of the situations of comparisons. In other words, we end up having a dominance partial order on the vectors of functionings, instead of an ordering[4]. Sen suggests that this dominance ranking often takes us quite a distance. Unfortunately, a quick glance through the Human Development Report, 1993, leaves one unconvinced about Sen's observation.

[3] One could argue that it would be mistaken, from a theoretical point of view, to treat the two aspects of aggregate evaluation separately. This impossibility argument may come from a 'methedological holistic' position. It seems to me that this position, even though it has relevance to analyses of actions or social processes, need not be adhered to in the context of assessment of the living standard.

For each country, the Human Development Report lists a set of indices of achievements which closely correspond to Sen's concept of functionings. I attempt to compare the levels of well-being achieved by different countries belonging to two subgroups of countries. The first group consists of ten developing countries whose Human Development Index ranks range from 1 to 10 whereas the second group consists of ten developing countries whose HDI ranks lie between 162 and 172. Five indices of well-being are selected, namely, life expectancy at birth, adult literacy rate, mean years of schooling, real GDP per capita, and, daily newspaper circulation (per thousand population) (see Appendix I). While it is expected that each country in the first group 'dominates'[5] any country in the second group under pair-wise comparison, it is not at all interesting to compare the achievements in well-being by a country such as Japan with that by, say, Niger. In most instances, we are interested in comparing the levels of well-being achieved by different countries which are close to each other in terms of their achievements. Pair-wise comparisons within each group of countries reveal that we can make such comparisons only in a very few cases, as is evident from the table in appendix I. For the first group we have been able to make such comparison only in 5 out of 45 possible cases, whereas, for the second group, no country is found to have dominated any other country.

[4] An ordering is defined as a binary relation which is reflexive, transitive and complete. If a binary relation is reflexive and transitive but not complete, then it is called a partial ordering.

[5] Country A 'dominates' country B if and only if $f_i^A \geq f_i^B$ for all $i \in \{1,2,3,4,5\}$ and $f_j^A > f_j^B$ for at least one j, where f_i^A and f_i^B denote the levels of achievement by country A and country B, respectively, as measured in terms of the i-th functioning.

The simple piece of evidence presented above suggests that in reality the 'partial order' produced by the vector dominance ranking does not take us very far. Thus it seems that unless we find some way to combine the achieved functionings into a composite index of well-being it is very unlikely that we will succeed in ranking different vectors of functionings. Let me pose the problem in a more formal way.

Let M be the set of functionings which are considered to be valuable. At this point we share Sen's optimism about the possibility of reaching a consensus on the set of functionings identified as valuable. Let there be m such functionings, i.e. $|M| = m$. A functioning vector is assumed to be an element of $\Re^m_+$, where $\Re_+$ is the set of all non-negative real numbers. A typical vector of functionings is denoted by $x = (x_1, x_2, \ldots, x_m)$, where x_i is the level of the i-th functioning. Our objective is to explore the possibility of an ordering over the vectors of functionings. We can induce such an ordering by postulating a well-being function which is the real-valued representation of the ordering, i.e. $W: \Re^m_+ \rightarrow \Re_+$. Our task then is to discover the conditions under which the well-being function, W, takes a specific functional form. Therefore one possible route to evaluation is to specify the nature of the function

(1) $W = W(x_1, x_2, \ldots, x_m)$, where x_i is the level of the i-th functioning achieved by the individual.

Assume now that W is differentiable. Total differential of (1) will then be

$$dW = \frac{\partial W}{\partial x_1} dx_1 + \frac{\partial W}{\partial x_2} dx_2 + \ldots\ldots\ldots + \frac{\partial W}{\partial x_m} dx_m$$

$$\text{where } \frac{\partial W}{\partial x_i} = f_i(x_1, x_2, \ldots\ldots\ldots, x_m), \; i = 1, 2, \ldots\ldots, m$$

If the position of the individual remains in the neighbourhood of ($x_1, x_2, \ldots x_m$) we can assume $\partial W / \partial x_i$ to be some constant a_i. Therefore, if we were interested in comparing [illegible], one of which indicated a small movement from the level of the status quo, we could attempt to find a way to obtain the relative weights a_i s rather than the entire valuation function. This second route will be explored in the next section[6].

3. An Axiomatic Approach

In empirical development literature it has been customary to use a range of socio-economic indicators and rank countries according to some composite index of these indicators. Underlying any such measure is some assumption about how various dimensions of well-being are related to the overall index. There are mainly two ways to establish such a relationship. One is the so-called data-driven method of deriving a set of weights. Starting from observed data on the variables to be included in the measure of well-being, a principal component analysis is carried out, and the first principal component, if it explains a significant proportion of the total variability of the variables, is taken to be a composite index of well-being since the first principal component is a linear combination of the original variables[7]. This method does not define any well-being function explicitly. The problem with this approach is that the relative weights obtained through a pricipal component analysis do not tell us anything about the ethical importance of each variable in the overall index of well-being. An alternative practice is to apply an additive formula with equal weights, by appealing to some justification[8]. The problem with this approach is that, even though it is recognised that one needs to take an ethical position on how one should obtain a composite index, the underlying assumptions are never made explicit. Although in this paper we are not directly concerned with 'countries' standards of living', the formal aspect of our approach helps us appreciate the underlying assumptions needed to develop any composite index for ranking countries.

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[6] Characterisation of a well-being function in terms of functionings have been attempted elsewhere. See Chakraborty (1995).

[7] See Ram (1982), McGranahan et al. (1972), McGranahan et al. (1985), for instance.

[8] Morris (1979), UNDP (1990).

In an attempt to obtain a set of weights, it is possible to list the desirable conditions that a system of weights is supposed to satisfy. This is more or less similar to what is commonly found in the literature on index numbers. Consider, for example, an equal weighting system, i.e. each functioning is attached the same weight. On a superficial observation, it looks less arbitrary than any other set of weights. This may be one of the reasons why it is so popular in the literature on composite indices. An equal weighting system seems to satisfy a kind of neutrality condition. But the choice of this kind of neutrality itself can be questioned on ethical ground.

The explicit value judgement our approach introduces here is that not only do the relative weights to be attached to an individual's achieved bundle of functionings depend on the relative weights attached by the individual herself but also on the weights attached to the same bundle by all other individuals in the society. This is in the spirit of Sen's 'standard evaluation approach'[9]. Sen has suggested two possible approaches to evaluation, namely, self-evaluation and standard evaluation. Self-evaluation refers to valuation by the person whose standard of living is being assessed, whereas the standard-evaluaion approach considers some general valuation function reflecting accepted standards in a society. Sen's standard evaluation approach can be viewed as an attempt to show a third route besides subjectivism of the welfaristic approach and paternalism arising out of an 'experts-know-the-best' approach. Even when Sen mentions self-evaluation as a possibility, he distinguishes between an individual's 'valuation' and his/her 'desire'. Valuation does not follow from desire. A thing may be desired but may not be highly valued. In conventional welfare economics, each person's welfare is evaluated in terms of his/her own preferences. In Sen's system, a person's valuation of vectors of functionings seems to express his/her view, not about what is desirable to him/her, but about what makes a good life for anyone[10]. However, in practice, there is a danger of

[9] Sen (1987).

[10] Sugden (1993).

conflation between the two. The position that I take here avoids the subjectivism implicit in self-evaluation. At the same time it avoids appealing to any externally given standard of evaluation.

Our starting point is the premise that to compare living standards of individuals in a society, a common set of relative weights needs to be developed on the basis of the sets of weights attached to the set of functionings by all the individuals in the society. In what follows, we explore the possibility of an aggregation of the systems of relative weights attached by individuals in a society to a bundle of functionings.

Let $N = \{1, 2, \ldots, n\}$ be a set of individuals who constitute society. Let ω be a set of relative weights attached by the society to m functionings. In order to qualify as a set of relative weights ω must belong to Ω, where Ω is the set of all possible weight profiles, i.e.

$$\Omega = \{(r_1, r_2, \ldots, r_m) \mid r_j \geq 0 \quad \forall j, \; \Sigma r_j = 1\}.$$

Notice that $\omega \equiv (\omega^1, \omega^2, \ldots, \omega^m)$ where ω^j is the weight attached to the j-th functioning by the society. I propose that, for all j, ω^j depends, in general, on ω_1, $\omega_2, \ldots, \omega_n$, where ω_i denotes the set of weights attached to m functionings by individual i. Notice that, for all i (i= 1, 2,..., n), ω_i is an m-dimensional vector, i.e. $\omega_i = (\omega_i^1, \omega_i^2, \ldots, \omega_i^m)$, ω_i^j being the i-th individual's weight on the j-th functioning. Thus, we can write

$$(2) \qquad \omega = (\omega^1, \omega^2, \ldots, \omega^m) = h(\omega_1, \omega_2, \ldots, \omega_n)$$

Alternatively, we can write (2) as

$$\omega^1 = h^1(\omega_1, \omega_2, \ldots, \omega_n)$$

$$\omega^2 = h^2(\omega_1, \omega_2, \ldots, \omega_n)$$

....

$$\omega^m = h^m(\omega_1, \omega_2, \ldots, \omega_n)$$

Let us call the function h an *aggregator* which is defined as a mapping $h: \Omega^n \rightarrow \Omega$.

My aim is to establish that h(.) takes a specific form under a set of reasonable conditions. I propose the following axioms :

Axiom 1 (Independence): For all ω, ω' in Ω^n, if for all $i \in N$, $\omega_i^j = \omega_i'^j$, then $\omega^j = \omega'^j$.

The implication of axiom 1 is that the society's weight on the j-th functioning depends on the weights attached by all individuals to the j-th functioning only.

Axiom 2 (Anonymity): For every permutation ρ of N, and for all $\omega, \omega' \in \Omega^n$, if $\omega_i^j = \omega'^j_{\rho(i)}$ for all i, then $\omega^j = \omega'^j$.

Axiom 3 (Irrelevance of Individuals Having Invariant Weight): Let I be an arbitrary subset of N. Assuming that axiom 1 holds, for every w, x, y, z in Ω^n, if every individual $i \in I$ is such that $w_i^j = y_i^j$ and $x_i^j = z_i^j$ whereas every individual k in (N - I) is such that $w_k^j = x_k^j$ and $y_k^j = z_k^j$, then $w^j \geq x^j$ if and only if $y^j \geq z^j$.

Notice that axiom 3 is contingent on the condition that axiom 1 holds. What axiom 3 says is that, the ranking of various possible social weights on any particular functioning should be independent of the weights of those individuals who have the same weight across possible configurations of individual weights. Let me explain it in terms of the following example. Consider a society consisting of three individuals. Further, consider four alternative triples of individual weights attached to the j-th functioning : (.5, .7, .4), (.3, .6, .4), (.5, .7, .8), and (.3, .6, .8). Thus, (.5, .7, .4) refers to the case where the first individual attaches the weight .5 to the j-th functioning, the second individual attaches .7 to the j-th functioning, and so on. Consider $w^j = h^j(.5, .7, .4)$, $x^j = h^j(.3, .6, .4)$, $y^j = h^j(.5, .7, .8)$, and $z^j = h^j(.3, .6, .8)$. It is reasonable to assume that $w^j > x^j$. If it is so, then axiom 3 states that $y^j > z^j$. The fact that the third individual has different weights in x^j and y^j does not matter because in matters of comparison between w^j and x^j on the one hand, or between y^j and z^j, on the other, it is irrelevant what number he/she has in these configurations as long as he/she has the same weight in w^j and x^j, and in y^j and z^j.

Axiom 4 (Unanimity) : If $w_i^j = \alpha$ for all i, then $w^j = \alpha$.

If everyone in a society attaches a weight of, say, .3, to the j-th functioning, then there is no reason why the society should attach a different weight.

Theorem 1: Axioms 1 through 4 are necessary and sufficient for a continuous aggregator to take the following form :

$$\omega^j = \frac{1}{n}\sum_{i=1}^{n} \omega_i^j \qquad (3)$$

We need the following lemma in order to prove theorem 1.

Let us start from the following definition :

Definition 1: Let F be a function from $\mathbb{R}_+^n \rightarrow \mathbb{R}$ such that, for all $(x_1, x_2, \ldots, x_n) \in \mathbb{R}_+^n$,

$$F(x_1, x_2, \ldots, x_n) = F^1(x_1) + F^2(x_2) + \ldots + F^n(x_n).$$

where, for all i (i = 1,2,..., n), F^i is a function from $\mathbb{R}_+$ to $\mathbb{R}$. We say that F is *symmetric* iff for all $(x_1, x_2, \ldots, x_n) \in \mathbb{R}_+^n$ and for every one-to-one and onto function σ from $\{x_1, x_2, \ldots, x_n\}$ to $\{x_1, x_2, \ldots, x_n\}$,

$$F(x_1, x_2, \ldots, x_n) = F(\sigma(x_1), \sigma(x_2), \ldots, \sigma(x_n)).$$

Lemma 1: If F is symmetric, then there exists a function $f : \mathbb{R}_+ \rightarrow \mathbb{R}$ such that, for all

$$(x_1, x_2, \ldots, x_n) \in \mathbb{R}_+^n,\ F(x_1, x_2, \ldots, x_n) = f(x_1) + f(x_2) + \ldots + f(x_n).$$

Proof of Lemma 1 : Suppose F is symmetric. Then for every $(x_1, x_2, \ldots, x_n) \in \mathbb{R}_+^n$ and every one-to-one and onto function σ from $\{x_1, x_2, \ldots, x_n\}$ to $\{x_1, x_2, \ldots, x_n\}$,

$$F^1(x_1) + F^2(x_2) + \ldots + F^n(x_n) = F^1(\sigma(x_1)) + F^2(\sigma(x_2)) + \ldots + F^n(\sigma(x_n)) \qquad (4)$$

Consider $(x_1, x_2, \ldots, x_n), (x_1', x_2', \ldots, x_n') \in \mathbb{R}_+^n$ such that for some [illegible] i, j $\in$ {1,2,...,n}, $x_i = a = x_j'$ and $x_j = b = x_i'$ where a and b are any two non-negative real numbers, and for all $k \in \{\{1,2,\ldots,n\} - \{i,j\}\}$, $x_k = x_k$. Then by (4),

$$F^i(a) + F^j(b) = F^j(b) + F^i(a),$$

and hence $$F^i(a) - F^j(a) = F^i(b) - F^j(b).$$

Since this is true for all $a, b \in \mathbb{R}_+$, it is clear that, there exists a real number t_{ij} such that, for all $d \in \mathbb{R}_+$, $F^i(d) = t_{ij} + F^j(d)$. Note that this holds for all distinct $i, j \in \{1,2,\ldots,n\}$, and, in particular, for $i = 1$ and $j \in \{2,\ldots,n\}$. Hence

$$F(x_1, x_2,\ldots, x_n) = F^1(x_1) + F^2(x_2) + \ldots + F^n(x_n)$$

$$= F^1(x_1) + [t_{12} + F^1(x_2)] + \ldots + [t_{1n} + F^1(x_n)]$$

(5) $$= (t_{12} + \ldots + t_{1n}) + F^1(x_1) + \ldots + F^1(x_n)$$

Define a function $f : \mathbb{R}_+ \rightarrow \mathbb{R}$ such that, for all $d \in \mathbb{R}_+$,

(6) $$f(d) = (t_{12} + \ldots + t_{1n})/n + F^1(d)$$

Then, from (5) and (6),

$$F(x_1, x_2,\ldots, x_n) = f(x_1) + f(x_2) + \ldots + f(x_n).$$

Proof of Theorem 1 :

(Necessity) : It is easy to verify that (3) satisfies axioms 1 through 4.

(Sufficiency) : By axiom 1,

$$\omega^j = f^j(\omega_1^j, \omega_2^j, \ldots \omega_n^j).$$

Notice that axiom 3 is equivalent to the strong separability condition (Debreu (1960)[11]). Therefore, given axiom 3, by theorem 3 of Debreu(1960), there exist functions $h^1, h^2, \ldots, h^n$ such that

$$\omega^j = h^1(\omega_1^j) + h^2(\omega_2^j) + \ldots + h^n(\omega_n^j)$$

Then, by axiom 2 and lemma 1, there exists h such that

[11] See also Maskin (1978) for a use of this axiom to characterise utilitarianism. For other references to this axiom, all in the context of utilitarianism, see d'Aspremont (1985).

$$\omega^j = h(\omega_1^j) + h(\omega_2^j) + \ldots + h(\omega_n^j).$$

By axiom 4, $$\alpha = h(\alpha) + h(\alpha) + \ldots + h(\alpha)$$

The only possible form which satisfies above is given by (3).

4. Conclusion

In this paper, a framework for combining the elements of a functioning bundle into a scalar measure of an individual's standard of living has been suggested. Sen's suggestion in this context, however, is to go by vector dominance. Clearly, Sen's position does not suffice for interpersonal comparisons of well-being. To get around this problem I have proposed a way to derive a set of relative weights which would reflect society's judgement about the rates of trade-off between functionings. The explicit value judgement I have introduced in this context is as follows. Not only does evaluation of an individual's achieved bundle of functionings depend on how the individual in question values his/her bundle but also on the valuation of the same bundle by all other individuals in society. I have proposed a set of reasonable axioms which completely characterise a rule for aggregation of individual relative weights so as to arrive at a common set of weights for all individuals in the society.

The approach is particularly attractive for its moral philosophic implications. There has always been a tension between the libertarian position that the government should not seek to impose any way of life on individuals, and the view that it is the responsibility of the government to promote overall good of society. The latter view admittedly has always been in danger of being paternalistic. The idea that someone other than the persons concerned knows what is best for them has a dubious history whose lessons should not be forgotten. To minimise the dangers of paternalism, I have proposed evaluation of a person's well-being generally by the members of the society he or she belongs to, rather than by an 'expert'. This can be viewed as an attempt towards a solution to avoid the dangers of paternalism on the one hand, and, the limitations of libertarianism arising out of its reliance on subjective preferences of individuals (for example, the 'problem' of the happy poor who has reconciled with her misfortune).

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APPENDIX 1

The following table presents data on 5 indicators for 20 countries grouped into two groups : 'high HDI' and 'low HDI'. To make pair-wise comparisons within each group one needs to look at 45 pairs in each group. In the first group, there are 5 cases of vector dominance. If we denote vector dominance by > and indicate countries by their respective HDI ranks, then we can state our results of pair-wise comparisons as follows : 1>9, 2>8, 3>10, 4>9, and 5>9. Notice that, for the second group of countries, there is not a single case of vector dominance.

HDI rank	Countries	Life expectancy at birth (years)	Adult literacy rate (%)	Mean years of schooling	Real GDP per capita (PPP$)	Daily newspaper circulation (per 1000 people)
1	Japan	78.6	99	10.7	17616	587
2	Canada	77	99	12.1	19232	228
3	Norway	77.1	99	11.6	16028	614
4	Switzerland	77.4	99	11.1	20874	463
5	Sweden	77.4	99	1.1	17014	533
6	USA	75.9	99	12.3	21449	250
7	Australia	76.5	99	11.5	16051	249
8	France	76.4	99	11.6	17405	210
9	Netherlands	77.2	99	10.6	15695	311
10	United Kingdom	75.7	99	11.5	15804	195
162	Benin	47	23.4	0.7	1043	3
164	Guinea-Bissau	42.5	36.5	0.3	841	6
165	Chad	46.5	29.8	0.2	559	(.)
166	Somalia	46.1	24.1	0.2	836	1
167	Gambia	44	27.2	0.6	913	2
168	Mali	45	32	0.3	572	1
169	Niger	45.5	28.4	0.1	645	1
170	Burkina Faso	48.2	18.2	0.1	618	(.)
171	Afghanistan	42.5	29.4	0.8	714	11
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2

(.) indicates less than .5'.