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Abstract

In this working paper we present a method to compute opportunity gains in health, in Sen's *capabilities* framework. This method allows us to perform *cost-opportunity* analysis to evaluate alternative health programs.

Resumen

En este documento de trabajo presentamos un procedimiento para calcular ganancias de oportunidades en salud, en el marco de las *capacidades* de Sen. Mediante este método se pueden realizar análisis *coste-oportunidad* para la evaluación de programas de salud alternativos.

Key words

Cost-opportunity analysis, capability sets, comparability.

Palabras clave

Análisis coste-oportunidad, conjuntos de capacidades, comparabilidad.

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C O N T E N T S

1. Introduction

IN his book *Commodities and Capabilities* (1985), Amartya Sen develops a theory of freedom and well-being. The focus of this approach is mostly the distinction between *achievement* and *freedom to achieve*. He argues that the distinction between both concepts is central to social evaluation. There are different ways of judging achievement, as, for instance, by utility (such as pleasures achieved or desires fulfilled), or by opulence (such as incomes earned or consumption enjoyed), or by the quality of life (such as some measures of living standards). But the important point is the distinction between the actual achievement of an individual and his freedom to achieve. For example, in the commodity consumption situation, the 'budget set' represents the extent of the person's freedom to achieve the consumption of various alternative commodity bundles, while the chosen commodity bundle is the actual achieved consumption. Sen offers a way of formalizing 'freedom to achieve' well-being, by using what he calls the *capability approach*. The well-being of a person can be understood in terms of the quality of the person's being. Living may be seen as consisting of a set of interrelated 'functionings', made out of beings and doings. A person's achievement in this respect can be seen as the vector of his functionings. Examples of functionings are: being adequately nourished, being adequately sheltered, being in good health, or more complex achievements, such as being happy, having self-respect, etc. Closely related to the concept of functioning is the *capability* to function. Function, which represents the various combinations of functionings that the person can achieve. Capability is, thus, a set of vectors of functionings, reflecting the person's freedom to lead one type of life or another. Just as the budget set represents a person's freedom to buy commodity bundles, the *capability set* in the functioning space reflects the person's freedom to choose from possible livings.

We concentrate here on the health aspect of the person's living. The various dimensions that reflect achievements in health (as in the EuroQol system, or in the Health Utility Indices) can be viewed as a representation of different functionings related to health, with different degrees of achievement. Under this perspective, the capability set of a person in the health aspect is made out of the different profiles of health that person can achieve.

If we consider the health profile actually enjoyed by a person, it is nothing but the *realization* of one of the various life-plans (in terms of health) available to that person. How successful this person was in his achievement depends not only on his actual profile but also on how good this profile is in relation to the full set of (possible) profiles that a priori were available to him, that is, on the relative valuation of his actual life with respect to the set of available life-plans (i.e., his capability set).

Opportunities are thus interpreted in terms of capability sets. Two different persons enjoy *equality of opportunity* whenever their capability sets coincide, even though their specific realizations do not. Nonetheless, not all persons have identical capability sets in terms of health. For instance, all else being equal, the capability set of a handicapped individual is smaller than that of a person without any sort of handicap. The mobility functionings of a crippled person are diminished in relation to those of a person without any handicap.

In this paper we make a proposal to evaluate the differences in opportunity for health for different people. This proposal may be useful when trying to evaluate some health programs in terms of *opportunity gains*. This sort of analysis could be seen as complementary to the traditional one, in which *utility gains* are evaluated. Besides performing a cost-utility analysis, a sort of cost-opportunity analysis can also be performed. This could be particularly useful in dealing with prevention programs or screening programs in which, by early detection, the development of a certain illness could be prevented, or else its symptoms could be controlled in such a way that most (or some) of the functionings in terms of health of the individuals are unaffected, or undesirable effects are alleviated.

In this working paper we rationalize the capabilities approach suggested by Sen to the analysis of opportunities in health. We differentiate between opportunities and achievement. According to Sen, the egalitarian planner should be worried about equalization of opportunities, and not about equalization of actual achievements. Individuals are characterized by their circumstances, which, in the health context, could be identified with chronic impairments or diseases. The capability set of an individual, understood as the set of health profiles achievable by him, can be approximated by the health profiles actually enjoyed by all individuals in the population sharing his circumstances.

The working paper is structured as follows. In section 2 the concept of capabilities in the health context is introduced. In section 3 a method to approximate opportunities and to measure opportunity gains is proposed.

In section 4 an example is provided. In section 5 the case in which the individuals affected by a program have different capability sets is considered, and the comparability problem is stated. In section 6 some final comments and remarks are offered to close the working paper.

2. Capabilities in Health

LET us consider a set of functionings in health. As an example, but not claiming that all functionings in health are perfectly captured by it, we may consider the five attributes in the EuroQol system: 1) mobility, 2) ability of self-care, 3) ability to perform usual activities, 4) absence of pain and discomfort, and 5) absence of anxiety or depression. Each of these attributes can be achieved at a different level. The combinations of the different levels of the different attributes produces the set of health states Σ. In our example, Σ consists of the 243 EuroQol health states (Brooks, 1996). As another example, we may consider the Health Utility Index Mark 2 (HUI2), with the attributes: 1) sensation, 2) mobility, 3) emotion, 4) cognitive, 5) self care, 6) pain, and 7) fertitily, all of them with different levels, or the Health Utility Index Mark 3 (HUI3), with 1) vision, 2) hearing, 3) speech, 4) ambulation, 5) dexterity, 6) emotion, 7) cognition, and 8) pain (Torrance, Furlong and Feeny, 2002; Horsman et al., 2003).

Let us now consider a particular individual. This individual enjoyed along his life a certain health profile, *x*. This health profile is the outcome of a variety of inputs: whether he was born with or without any impairment, whether the family he was born into was affluent or poor, whether he behaves in a healthy way or not, whether he suffers from a chronic illnes or handicap, etc. All possible combinations of individual behavior combined with the remaining characteristics give rise to a set of attainable health profiles (or life-plans) for this individual, or, in Sen's words, his *capability set.* The particular health profile, *x,* is one of the elements in that capability set: the result of the combination of the characteristics, including behavior. That is, the actual *functioning in terms of health* of such an individual depends on his circumstances, on his behavior, and (also) on some sort of random variable (luck).

How to evaluate capability sets? In cost-utility analysis a single valuation function of the cardinal type is used for evaluating individuals' states of health, and consequently, health profiles. This function is typically computed through an algorithm based on a representative sample of the population (Dolan, 1997; Furlong et al., 1998). Again the EuroQol valuation system, or the Health Utility Index valuation systema are examples of such valuation functions.

In principle, capability sets may differ across individuals. Nonetheless, we may identify groups of individuals (those sharing the set of relevant circumstances) such that they should have identical capability sets. Differences in realizations depend, thus, on individual behavior and luck. Consider, ideally, a situation in which all individuals enjoy identical capability sets. We may think of the case in which the full population belongs to a single group. In this case, we may interpret the health profiles realizations for the population as a representation of the 'common' individual's capability set. If that is the case, for a certain population N, we may consider the set of health profiles enjoyed by all individuals in the population as a representation of their capability sets. If we call $C(i)$ the capability set of individual i, then, $C(i) = C(j)$ for all $i, j \in N$, $C(i) = \{h_k : k \in N\}$, where h_k stands for the health profile of individual k.

Consider now two different groups in the population: the first group made up of handicapped individuals, and the second group containing non-handicapped individuals. Let us consider a handicapped person. For him, there are some states of health out of reach, and therefore, some health profiles that he cannot achieve, namely, out of his capability set. Consider now the group of all handicapped people in the population. The set of health profiles realizations for this group could be interpreted as the capability set of a handicapped person. This set is smaller than that of the full population, since some of the health states available to the full population (in particular to be in full health) are not available to the handicapped group. In this case, and if we denote the group of handicapped people by H, we can define the capability set of a handicapped individual $l \in H$ as the set of health profiles actually experienced by all people within the handicapped group, that is, $C(l) = \{h_k : k \in H\}$.

Notice that when considering capability sets, we approximate them by means of the health profiles (enjoyed along their full life span) of all individuals in the population with similar characteristics. What we understand by characteristics is open to the problem we would like to study. Demographic variables, as age, gender, country or region of residence, etc. could be taken into account in order to consider the relevant characteristics.

Summarizing, the capability set of a certain individual is a set of health profiles, i.e., those achievable by this individual. The capability set of an individual is not his health outcome, but rather, the set of all his plausible health outcomes. For a *given population, we may define a set of reference groups, differentiated by relevant characteristics, such that all individuals belonging to the same group share identical capability sets. The capability set of a group can be approximated by the set of health profiles actually experienced by the group members.*

3. Opportunity Gains

CONSIDER an individual suffering from a certain (chronic) handicap. How could we measure the opportunity loss due to the suffering of the handicap for such an individual? In other words, our problem is to provide a measure of the lack of opportunities due to the handicap. If this problem is solved, we will be able to measure opportunity losses due to the suffering of a certain impairment, or else, we could measure opportunity gains due to the implementation of a certain program that avoids the suffering of an impairment.

The problem is, therefore, to evaluate capability sets and, thus, to compare the capability sets associated to people suffering from the handicap with the capability sets of people free from the handicap. To do so, and for a well defined population, we consider, once again, two differentiated groups: handicapped people, and people without any handicap. As mentioned in the previous section, the actual health profiles of individuals within each group is a good representation of their respective capability sets. Assuming that the size of the handicapped group is small with respect to the healthy one, our proposal is to approximate those capability sets by means of the health profiles enjoyed, respectively, by the group of all handicapped people, and by the population at large.

Consider the example of poliomielitis vaccination. We want to evaluate opportunity gains derived from implementing such a program. If the program is not implemented, a certain number of children will suffer from the condition, and because of this, their capability set will shrink, that is, it will be that of the handicapped group. Nonetheless, if the program is implemented, this group of people will recover the capability set of the population at large.

How could we evaluate the opportunity gains derived from such a program? Our next proposal aims at fulfilling two goals: first, to approximate such opportunity gains, and, second, to provide a way of measuring those opportunity gains.

Consider then the population of children for whom the vaccination program is implemented. Without the vaccination, a certain number of children will suffer the illness, and, because of that, they will face a reduction of opportunities for health. Assume that the number of children potentially affected is q. We may assume that other sorts of characteristics and the likelihood of suffering the condition are uncorrelated. As such, the distribution of health of these q individuals will mimic that of the handicapped population. Let i be any of those children. His capability set, C_h (i), is made up of all health profiles enjoyed by the handicapped group. By considering the probability distribution associated with the distribution of health profiles for the handicapped group, we could compute the *expected health profile*, e_h of any individual within the handicapped group and, under the veil of ignorance, this profile could be thought of as a good approximation of the expected health profile of a child potentially affected by the condition. If this individual receives the vaccine, he will not suffer from the condition, and thus, his new capability set C (i) will be that of the full population, and consequently, his expected health profile may well be approximated by using the health profiles distribution of the population at large. Let e be the expected health profile of an individual within the full population. Thus, the difference between e and e_h could be interpreted as an approximation of the opportunity gains of an individual affected by the program.

Let v be a valuation function of health states and, likewise, a valuation function of health profiles The difference in the valuations $v(e) - v(e_h)$ is a measure of the opportunity loss faced by this individual because of the lack of the program, or alternatively, a measure of the opportunity gains enjoyed by this individual due to the vaccination program. A measure of the aggregate opportunity gains can then be obtained by adding up all individual opportunity gains over all potentially affected individuals, in this case, $q\,[v(e) - v(e_h)]$.

Summarizing: Given a partition of the population into groups, the capability set of an individual can be approximated by the family of health profiles enjoyed by the group he belongs to. If we consider two groups in the population: healthy and impaired individuals, the capability set of impaired individuals is smaller than that of healthy ones. The opportunity loss due to a certain impairment can be approximated by the difference between the valuation of the expected health profile of the full population and that of an impaired individual. The expected health profile of an individual can be approximated by using the distribution of health profiles within his group.

Observe that if we consider the Qaly measure as our valuation function of health states and profiles, the valuation of the expected health profile of a certain individual is nothing but the QALEs of this individual. For other evaluation functions, it would be the difference between the utility scores of e and e_h.

4. An Example

CONSIDER a population with six different health profiles, h_1, h_2, h_3, h_4, h_5, h_6. Table 4.1 presents the valuation in Qalys terms of these health profiles as well as their frequency in the population at large.

TABLE 4.1: Population at large

	h_1	h_2	h_3	h_4	h_5	h_6
Qalys	30	40	50	60	70	80
Frequencies (percentages)	1	9	10	30	30	20

Then, the capability set of an individual i in this population is $C(i) = \{h_1, h_2, h_3, h_4, h_5, h_6\}$ and the expected health profile of someone within this population is a lottery e, with possible outcomes h_1 to h_6, and probabilities 0.01, 0.09, 0.1, 0.3, 0.3, and 0.2, respectively. Furthermore, if we evaluate this expected profile by means of the QALE, we have that $v(e) = 30 \times 0.01 + 40 \times 0.09 + 50 \times 0.1 + 60 \times 0.3 + 70 \times 0.3 + 80 \times 0.2 = 63.9$.

Suppose now that the profiles accesible to the handicapped group within this population is made up of h_1, h_2, h_3, h_4, where the valuations in terms of Qalys and frequencies are given in the table below:

TABLE 4.2: Handicapped group

	h_1	h_2	h_3	h_4
Qalys	30	40	50	60
Frequencies (percentages)	10	10	50	30

Then, the capability set of an individual j in this group is $C(j) = \{h_1, h_2, h_3, h_4\}$ and the expected health profile of someone within this group is the lottery e_h with possible outcomes h_1 to h_4, and probabilities 0.2, 0.2, 0.4, and 0.2, respectively. Furthermore, if we evaluate this expected profile by means of the QALE, we have that $v\ (e_h) = 30 \times 0.1 + 40 \times 0.1 + 50 \times 0.5 + 60 \times 0.3 = 50$.

Assuming that the handicapped group is small with respect to the full population, we can approximate the opportunity loss of an individual with a handicap as being of 13.9 Qalys, since:

$$v\ (e) - v\ (e_h) = 63.9 - 50.0 = 13.9.$$

Now, suppose that a vaccination program can prevent 50 people from being affected by the condition. Then, the aggregate opportunity gains due to the implementation of the program can be approximated by $50 \times 13.9 = 695$ Qalys.

In this example, and since the valuation function is taken to be the Qaly, we measure opportunities in terms of expected Qalys, where the expected Qaly for a handicapped individual is obtained from the actual health profiles and frequencies within the handicapped people in the reference population. Any other valuation function can also be used, nonetheless, to measure opportunities, and consequently, to measure opportunity sets.

5. Non-Comparable Opportunity Gains

THE technique we explained before could be useful when all individuals affected by a certain program have identical opportunity sets before the implementation of the program, and they also enjoy identical opportunity sets after the implementation of the program. In such a case, we could evaluate opportunity gains as suggested in section 4. Nonetheless, if this is not the case, we may face some inconsistencies by using a common valuation function in order to evaluate opportunity gains. As has been pointed out elsewhere (see Fryback and Lawrence, 1997; Sunstein, 1997; Nord et al., 1999) the valuation of health may be a relative concept related to the expectations and abilities of people. That is, the set of attainable health profiles (or capability set) differs across people. People consider their health relative to the set of attainable health profiles and, consequently, their valuation of health varies with this set. The use of a single utility for a specific health state ignores such differences in the set of attainable health states and can lead to a distorted measure of the total benefit that a health care program brings about, in terms of opportunity gains. However, if we want to retain full comparability and apply cost-opportunity analysis in the face of relative health states valuations then a method must be found to make health states valuations comparable across individuals. Such a method was presented in Bleichrodt, Herrero and Pinto (2002).

To illustrate why using a single measure we could distort the computation of opportunity gains, consider the case of a condition that can affect individuals, uncorrelated with them being handicapped. We face again the population of the example in section 4. Now, both healthy and impaired individuals may suffer this new condition. On average, the deterioration of health due to the condition in the general population produces a loss of 8.9 Qalys. Consequently, the opportunity loss due to the condition in the population at large is of 8.9 Qalys, and for those affected by the new condition, the evaluation of their opportunity set shrinks from 63.9 to 55.

Consider now the case of handicapped individuals affected by the condition. The deterioration of health in those individuals is different from that of the healthy ones, and they lose on average 7 Qalys. Accordingly, their capability set shrinks from 50 to 43.

Apparently, handicapped individuals face a smaller opportunity loss due to the condition. Nonetheless, it happens that $\frac{43}{50} = \frac{55}{63.9}$. That is, both healthy and handicapped individuals face identical relative opportunity loss because of the condition.

This example illustrates that by evaluating absolute losses of opportunity, it may happen that a sort of double jeopardy appears when deciding who is going to receive treatment. We could discriminate against handicapped individuals or against individuals with some chronic impairment because of their inability to reach full health.

The previous qualitative bias cannot appear when absolute losses of handicapped agents are larger than that of healthy ones, since in such a case, relative losses of handicapped agents are also larger than those of healthy ones.

As a consequence, we argue here in favour of performing the evaluation exercise in two steps. First, we make states and profiles of health comparable by means of the use of *equivalent health states,* as suggested in Bleichrodt, Herrero and Pinto (2002). Then, once capability sets prior to the implementation of the program and after implementation of the program are comparable, we apply the technique explained in section 4.

Let us perform this exercise in our example. Given the distribution of health of the population at large, and that of impaired individuals, we get the following scales:

TABLE 5.1: Distribution of health of the general and impaired population

GP	*Qalys*	40	50	55	60	63.9	65	70	80
	Cumfreq	10	20	35	50	65.6	70	80	100
IP	*Qalys*	30	40	43	46	49.1	50	53.3	60

Given the cumulative frequence of the population, we have the Qalys corresponding both in the General population (upper line) and in the impaired population (bottom line). That is, 10% of the population at large have an amount of Qalys up to 40, while for the impaired population their Qalys are only 30. Half of the population at large, have an amount of Qalys up to 60, but for the impaired population, half of them have 46 Qalys or less. In Bleichrodt, Herrero and Pinto (2002), it is suggested to make *comparable* health states by using previous statistical information on the distribution of health. By the same token, we may think that the situation of an impaired individual at a certain centile of his distribution is comparable to that of some other healthy individual at the same centile. By so doing, it happens that an expected opportunity of 55 Qalys for the general population is comparable to 43 in the impaired population. Similarly, 50 for an impaired individual is comparable to 65 in the population at large. Consequently, the 7 Qalys loss due to the new condition for impaired individuals (from 50 to 43) is comparable to a loss of 10 Qalys (from 65 to 55) in the population at large, and thus larger than the loss of individuals in the general population (8.9 Qalys, from 63.9 to 55).

6. Final Remarks

IN this working paper we rationalize the capabilities approach suggested by Sen to the analysis of opportunities in health. We differentiate between *opportunities* and *achievement*. According to Sen, the egalitarian planner should be worried about equalization of opportunities, and not about equalization of actual achievements. Individuals are characterized by their circumstances which, in the health context, could be identified with chronic impairments or diseases. The capability set of an individual, understood as the set of health profiles achievable by him, can be approximated by the health profiles actually enjoyed by all individuals in the population sharing his circumstances.

A non trivial problem is that of properly evaluate and compare capability sets (see Herrero, 1996). Here, we propose a way of so doing in our context that, besides fulfilling the properties of a solid evaluation function, is implementable provided we have information on the average profile of health of different population subgroups. This method is particularly suitable to easily compute opportunity gains and/or losses due to a certain handicap or condition. Our proposal is to approximate opportunities by the profiles distributions of the healthy and impaired population. Opportunity gains can be measured by computing the difference between the valuations of the expected health profile in the two populations.

Whenever the analysis of opportunity losses is done for non homogeneous populations, a comparability problem may arise. This comparability problem could lead to discrimination due to differences in capacity to benefit from the treatment, as happens in cost-utility analysis (Harris, 1988; Hadorn, 1992, Nord et al., 1999; Johannesson, 2001). In order to solve such a comparability problem, we suggest applying the method presented in Bleichrodt, Herrero and Pinto (2002), in order to make the situation of all individuals affected by the program comparable, prior to performing the cost-opportunity analysis.

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