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Abstract
We offer a new framework for defining and measuring disparities in the distribution of health opportunities. These are conceived as inversely related to the cost of a specified bundle of health services of given quality, computed by monetizing all the concrete impediments that must be overcome to get access. In the ex-ante perspective we adopt, what is salient is the distribution of costs across cells, where each cell is defined by a set of characteristics determining access barriers. Differently from the existing health literature, our approach allows to disentangle the opportunities individuals enjoy from the mere utilization of health services, working equally well with monetary as well as real costs of access (formal and effective equality of opportunity), where real costs accounts for socioeconomic conditions. Accordingly, an index for the measurement of equality of health opportunities is proposed and resource-conditional policy suggestions are deducted. Given available resources, the design of egalitarian policies is found to depend on how chances of access and socioeconomic conditions are distributed, as well as on the cost borne by the individual occupying the best-off cell.

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JEL codes: I14, I18
1 Introduction

Over the last decades, low economic growth and a dramatic increase in the cost of provision of health services - mainly due to rapid technological progress and population ageing - have downplayed the expectation of a fair distribution of health opportunities in Western countries.

Motivated by the search for financial sustainability, many governments have then contemplated radical reforms of the national health services that exacerbate the public health effect of economic crises (Karanikolos et al., 2013). Indeed, a recent study using data on self-reported perception of access to health care across and within 29 European countries, identifies many individual characteristics (e.g. poor health, lack of citizenship in the country where one resides, unemployment) that are systematically associated with perceived access barriers (Cylus, 2015).

A legitimate aspiration to increasing justice in the distribution of health opportunities is still present in Western societies. The problem, however, is how to conjugate legitimate aspirations to increasing justice with the objective difficulties governments meet in financing health systems. This problem requires a big effort, both to re-define the general principles informing the national health policies and to reform the national health systems accordingly.

The present paper contributes to this effort by offering a normative framework for defining and measuring equality in the distribution of both formal and effective health opportunities. Within this framework, an index for measuring disparities is proposed, and clear-cut, resource-conditional policy suggestions are deducted.

Our approach is novel. The existing health literature adopts an ex-post approach that is not able to disentangle the opportunities individuals enjoy from the effective use of health services. This is a relevant shortcoming. As use also depends on individuals’ preferences and attitudes, conceptualizing (hence measuring) opportunities as use is misleading.

The ex-ante perspective we propose is not affected by this shortcoming, for, what is salient, is how the monetization of access barriers (either nominal or real costs of access) to a fixed-quality bundle of health services is distributed across cells, where each cell is defined by a set of characteristics which are relevant in determining barriers (age, geographic location, presence of a disability, etc.). Access is then guaranteed only when the monetization of the barriers characterizing a given cell is lower than the financial resources the individual occupying that cell may have access to (e.g., income, wealth, loans, private and public transfers). As a consequence, since it is not known ex-ante what the matching between individuals and cells will be, access is granted only to cells whose associated cost is below the lower support of the distribution of individuals’ available resources. Universal access is realized when every cell related cost is below minimum financial resources.
As access is what gives concrete meaning to the more abstract notion of opportunity, equality of opportunity first requires that universal access be granted. Therefore, in our perspective, equality can only increase either when an additional cell gains access (the related cost gets below the lower support of the distribution of individuals’ resources), or when the costs of access are somewhat equalized across cells once universal access is granted. In other words, between two equally-sized cost distributions, a preference is to be granted to the one allowing access to a greater number of cells; only once universal access is established, the focus can be shifted to similarity in costs, hence the standard toolbox for the measurement of income inequality, e.g. Lorenz dominance, can be used.

As far as our perspective is concerned, it is worth noticing that any notion of equality of opportunity only makes sense if it is referred to the whole population. Whenever universal access is not granted, the very operation of measuring equality of opportunity as disparities in costs is indeed meaningless, for it should be implemented taking into consideration only the subset of cells having access and not the whole set of cells.

It should also be evident that the exercise of measuring equality of opportunity may have different meanings in different contexts, for it is very sensitive to the treatments included in the bundle whose cost is relevant. Access can be assessed at different standards. Treatments that individuals can easily get in Western countries may be very hard to get in some other regions of the world. In Sub-saharian Africa, for example, very basic treatments are those which are probably suitable to consider key to assess opportunities (over geographic location or time). Movements in the direction of fostering equality of opportunity cannot but be movements towards guaranteeing access to presumably basic treatments to a greater number of cells. As a consequence, depending on what the bundle of fixed-quality health treatments contains, our methodology can require to apply the standard methods of income inequality (Lorenz Dominance) or not. Our methodology is sufficiently elastic to adapt to different circumstances.

As suggested by previous literature on the topic (e.g. Le Grand, 1987), we recognize that equalizing the barriers that stand in the way of obtaining a pre-determined basket of health-related goods and services of agreed quality does not automatically imply equity in the distribution of chances of access - i.e. equality in the effective (or real) chances - for this also depends on the distribution of resources among individuals. A clear distinction is therefore made in this paper between equality of formal and equality of effective health opportunities (what we also term equality and equity respectively). Specifically, we argue that effective health opportunities are co-determined by purchasing power (e.g., income, local and national taxes/transfers, benefits from non-health related public services). As the individuals’ required effort to overcome access barriers in an equity perspective matters, comparisons have to assume real costs of access - i.e. the ratio between the
monetary cost of access related to one cell and the socio-economic conditions of the (representative) individual occupying that cell - as the basis for the analysis.

With these distinctions in mind, we develop a general index for the measurement of both equality and equity in the distribution of health opportunities and a set of resource-contingent policy suggestions; we also deduct some results in terms of required resources, depending on whether the normative standard is one related to formal or effective equality.

The Index we propose can be easily managed for empirical comparisons across countries and over time. It has the following properties: it is only sensitive to the number of cells having access until universal access is granted; it decreases with inequality in (either monetary or real) costs (as measured by the Gini Index) once universal access is achieved. As compared to the existing literature, it is then of a lexicographic fashion and allows to go beyond the mere focus on similarity in monetary or effective costs of access.

In a policy perspective, as our analysis emphasizes, whenever resources are not sufficient to grant access to any cell, they must be employed so as to maximize the number of cells having access. This implies that resources are to be allocated first to grant access to cells with the smallest cost gap from minimum income. A counter-intuitive consequence of this is that to enhance the distribution of health opportunities, resources are not employed to ameliorate first the condition of whom may be considered more at a disadvantage: equality of health opportunities may be promoted by increasing statistical inequality. Diversely, when resources are sufficient to grant access to any cell, all the costs must be reduced below the minimum income, starting from the highest ones: equality of health opportunities can be only promoted by reducing statistical inequality.

Resource constraints can be more or less severe, depending on the distribution of costs as well socioeconomic conditions. As we will show, if the normative standard is given by effective equality of opportunity, the distribution of monetary costs with respect to socioeconomic conditions may sensibly affect the amount of resources required for the achievement of the desired distributive goals.

In particular, if the monetary cost is distributed in such a way as to penalize cells with worse socioeconomic conditions (as it commonly is), then, as compared to the normative standard provided by perfect equality in the monetary costs of access, a greater financial effort is required.

The paper is organized as follows. Section 2 discusses the philosophical underpinnings of our notion of equality of opportunity in health, introduces our perspective and stresses some differences between ours and competing approaches. We make clear what our notion borrows from Amartya Sen’s (2002) approach as well as from Rawls’ (1971) conception of justice as equal command over resources. Section 3 sketches the normative framework. The index for the measurement of equality of health opportunities is also derived.
Section 4 is concerned with the problem of the optimal policy design with resource constraints. Section 5 concludes.

2 Equality of Opportunity and Equality of Opportunity for Health

The literature on health inequality provides a wide choice set from which a normative criterion, the equalizandum, can be drawn. At a very general level, such a set can be partitioned along the line marking a key distinction between an approach inspired by the so-called egalitarianism of outcomes and an approach supporting the view that egalitarianism should instead be concerned with opportunities. By the former, the normative standard is concerned with health outcomes, as measured, for instance, in terms of Quality-Adjusted Life Years (QALY). By the latter, instead, it is concerned with the opportunity of receiving health care, the opportunity of being in good health.

Egalitarianism of outcomes has been widely criticized, for, as emphasized by Amartya Sen, “health depends on many factors varying from genetic propensities, individual incomes, food habits and lifestyles, on the one hand, to the epidemiological environment and work condition, on the other” (Sen 2002). Equality of opportunity has then proved to be a more defensible perspective. Indeed, starting from Rawls (1971), the best interpretation of the ideal of distributive equality has been commonly understood as ultimately grounded in the idea of equal opportunity. It is not surprising, then, that rationales to promote universal access to health care have been commonly deducted from general principles claiming that individuals’ opportunities should be somewhat equalized.

The most common way to understand egalitarianism of opportunities in health is based on a notion of horizontal equity, for, it is said, the end goal consists of equal health care for those in equal need of health care (Wagstaff and van Doorslaer 2000). Within the latter perspective, utilization of health treatments is taken as the basic information for assessing disparities in health opportunities. However, as utilization depends on both access conditions to health care and individual preferences (e.g., risk aversion, acceptance of health treatments), it follows that, even if access conditions were equalized across the entire population, equal health care for those in equal need would probably not.

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1For the debate on egalitarianism of outcomes vs. egalitarianism of opportunity see, among others, Fleurbaey (1995) and Fleurbaey (2001).

2According to Allin et al. (2007) equal health care for those in equal need requires more proactive (and possibly very costly) efforts by policy makers, and would require that potentially acceptable reasons for unequal use of health care services (by those in equal need) be overridden, such as differences in lifestyle preferences and/or levels of risk aversion.
As an alternative, egalitarianism of opportunities has also been conjugated in terms of *equal access to health care for those in equal need of health care* (Allin et al. 2007). However, to the extent that health needs manifest themselves ex-post, when *utilization* takes place, this approach is affected by the same drawback affecting the *equal health care for those in equal need of health care* notion.

In what follows we offer a new, ex-ante perspective to opportunity egalitarianism in health, where the *equalizandum*, identified in terms of access to health care, is *independent* of health needs.

### 2.1 Equality of Opportunity and Access to Health Care

As Daniels (2013) clarifies, “a family of egalitarian theories that talk about equality of opportunity in different ways might thus all support equity in access to health care because of its impact on opportunity, but they justify different kinds of access because they view the obligation to promote opportunity in somewhat different ways”.

The aforementioned idea that health care is necessary to protect individuals’ fair shares of opportunity, is key to prominent egalitarian perspectives; it can be seen as innervating Rawls’ (1999, 1971) appeal to a principle of *fair equality of opportunity* (Daniels 1981, 1985, 2008), as well as Sen’s (1980, 1992) work on *capabilities*.

Rawls appeals to the principle of *fair equality of opportunity*, by which, it is said, those who are at the same level of talent and ability, and have the same willingness to use them, should have the same prospects of success regardless of their initial place in the social system. In this sense, as emphasized by Sugden (1993), “individuals have equal opportunities . . . if they have equal command over resources”.

It is known that Rawls’ theory of justice is silent on issues related to health. According to Sugden (1993), this is consistent with Rawls’ understanding of any human society as a *system of fair cooperation*. In any such system, what has to be distributed justly - or fairly - are the benefits and burdens of *social cooperation*; this requires fairness in the distribution of the so-called *social primary goods*, and not in the distribution of *natural primary goods*, some of which are related to the health status at a very fundamental level (e.g. congenital handicaps). According to a diverse - philologically less accurate but perhaps more pragmatic - reading of Rawls’ theory of justice, his appeal to a principle of *fair equality of opportunity* indeed presupposes, inevitably, that people function normally (Daniels 2013), so that “... any social obligations we have to protect opportunity imply obligations to protect and promote health (normal functioning) for all people”. This would clearly imply a social obligation to grant access to health care to everyone.

As being healthy is a precondition for fair equality of opportunity to
get established, any social commitment to protect opportunity implies a social commitment to protect and promote health for all people, a view that is shared by Sen’s capability approach. However, while in Rawls’ moral system health *plays an ancillary role* with respect to the relevant outcome as defined in terms of socioeconomic inequalities, in Sen’s health is something that has *special moral importance* in itself.

In Sen’s perspective, the distinction between health achievements and the capability to achieve good health (which may or may not be exercised) is crucial. Indeed, his major concern is that of defining a space of functionings individuals can choose to exercise as a means to protecting opportunities that it is reasonable for people to exercise. As outlined by Pereira (1993, p.40), who also provides an elegant formalization of Sen’s capability approach as applied to health, “*in terms of equity our interest is less in whether a person is functioning in a certain way and more on whether that individual has the capability to do so. Hence the guiding equity principle being equality of basic capabilities...*”. In this sense, justice in health requires that all individuals share *ex ante* the same health prospects, whose realization, ex post, depends inevitably on individual choices as well as on the amount of resources available to the individual.3

In this paper we borrow from Sen the idea that equal opportunities for health is valuable *per se*. We also share Sen’s ex-ante approach but, in our view, the relevant outcome variable is not given by the health prospect any individual is able to enjoy (whose equalization would be a very demanding objective), but by the concrete impediments (measured by monetary costs) individuals face in obtaining access to health care. In this sense, our notion is closer to Rawls’ ideal of *equal command over resources*.4

Finally, as equalizing opportunities in our approach can only come about through a reduction of the individual costs of access (and not through a redistribution of cost from one individual to another), in line with Sen (2002), equalizing opportunities crucially depends *on the overall allocation of resources to health*.4

### 2.2 Access barriers to health care

As it should be clear from the previous Section, any attempt to adapt the notion of equality of opportunity in such a way as to make it suitable to cope

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3A similar rationale based on the equalization of health prospects (independently of circumstances) is proposed in Li Donni et al. (2014) by implementing the notion of ex-ante inequality of opportunity as derived from Roemer’s idea of *levelling the playing field* (Fleurbae and Peragine 2012).

4Even if health is intended as an outcome of moral importance in itself, Sen (2002) also emphasizes that health equity cannot be concerned only with health, seen in isolation, because *... some of the most important policy issues in the promotion of health care are deeply dependent on the overall allocation of resources to health, rather than only on distributive arrangements within health care.*
with health related issues is reasonably based on the notion of access. Access stands for chance of access which is the opportunity we are referring to, whereas equal access means equal chances to take advantage of something, that is, equal opportunities.

The question of what should be meant by access, and, consequently, by equal access, is not a trivial one. Most of the literature (e.g. Mooney 1983) sees access as depending on supply as well as demand factors. Supply factors affecting access to health relate to the spatial distribution of providers, the production technology as well as other factors influencing the cost and the appropriateness of health services. Demand factors are generally related to the individual capacity of obtaining and processing the necessary information; health needs; the individual skills and attitudes; the diffusion of self-care practices (Aday and Andersen 1974; Andersen 1995).

The strand of literature focusing on the role played by demand factors - hence stressing the role played by elements such as beliefs, health needs, preferences and information constraints - does not allow to properly disentangle potential from effective use of health services. This is particularly relevant, for, in assessing opportunities, what really matters is potential use.

To clarify this point, let us suppose that, due to cultural beliefs, some individuals are not willing to get a health treatment that would be appropriate for a given disease. For these individuals the opportunity to take advantage of health services may well be the same as for any other, i.e. cultural beliefs as well as psychological factors do not affect the objective possibilities of access. More generally, this is the case for all “cultural and social factors determining the possibility for people to accept the aspects of the service (e.g. the sex or social group of providers, the beliefs associated to systems of medicine) and the judged appropriateness for the persons to seek care” (Levesque et al. 2013). In a similar fashion, different health needs may determine different effective use of health services ex-post, but this is not at all concerned with potential access to health services.

On the contrary, let us suppose that, due to the lack of acceptable supply standards in their residence area, individuals belonging to a given group are either forced to consume bad quality health services or prevented from receiving what is considered an appropriate treatment. In these cases chances are unequally distributed and this fact is independent of demand factors.

As emphasized by Levesque et al. (2013), objective possibilities of access are immediately affected by availability and accommodation. These “refer to the fact that health services ... can be reached both physically and in a timely manner”. Availability constitutes the physical existence of health resources with sufficient capacity to produce services (existence of productive facilities). It results from characteristics of facilities (e.g. density, concentration, distribution, building accessibility) and of urban contexts (e.g. decentrali-
sation, urban spread, and transportation system).

2.3 What do we mean for equal access?

The literature on health inequality provides some interesting definitions of equal (potential) access to health care (Le Grand, 1982; Le Grand, 1987; Olsen and Rogers, 1991). Although for our purposes we do not consider any of such definitions as fully satisfactory - that is why we propose a definition of our own - each of them shares with the others the great merit of contributing to set the stage for meaningful discussion and proposals.

In this paper we propose a definition of equal access as equality in the cost to be faced in order to obtain a specified bundle of health related services of given quality, where, by cost of access, we mean the monetization of all the concrete impediments that have to be overcome.

According to an ex-ante perspective, we refer to the distribution of the cost of access across cells, and not - as it is commonly understood - across individuals, where each cell is defined by a set of characteristics determining the objective impediments (e.g., distance from the nearest place where a treatment of given quality is delivered, fees/cost-sharing for access to the health treatment, ...).

Remarkably, we focus on health treatments of given (fixed) quality. Specifying the quality of the health treatments under consideration is necessary, given the presumably strong heterogeneity characterizing health treatments across geographic locations or over time. As for the treatments that might be included in the bundle, we only require: (i) medical consensus on treatment appropriateness, and (ii) social consensus about the relevance of the health needs to be treated.

In our analysis, health needs enter the definition of equal access through

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5 Notice that, to the extent that information on health needs and treatments is to be processed by each individual, poor education might be considered as a demand-related impediment preventing individuals to physically reach service providers. This would however be misleading. In general, information on health needs and treatments is not processed by the individual, but by the General Practitioner. In this sense, access would be limited by poor access to GP which is a supply-related impediment.

6 To report some valuable examples, Le Grand (1982) sees equal access as corresponding to a situation in which all the individuals face the same price (in terms of both money and time) for health care, a view that, however, does not take individuals’ resources into account, so that “two individuals facing the same price of health care would enjoy the same access even if they had no income, which seems absurd” (Culyer and Wagstaff 1993). In an attempt to ameliorate his previous definition, Le Grand (1987) has also suggested that two individuals may be considered as having equal access if (and only if) they face the same feasible choice set (something requiring an identical budget space); a too-broad suggestion, according to Olsen and Rogers (1991), that does not recognize the special concern to be reserved to access to health care. In this vein, they suggest that access to health can be considered as fully equalized if and only if everyone is able to consume the same maximum attainable amount of health services.
the choice of the treatments to be included in the relevant bundle. It follows that both handicaps and old-age matter to the extent that equally adequate/appropriate health services are not uniformly distributed across geographical areas so that individual costs may sensibly differ due to heterogeneous support needs (in the existing literature handicaps and old-age are commonly considered in order to capture the heterogeneity of health needs across individuals within an ex-post approach).

Our definition of equal access innervates our notion of equality of opportunities for health. Such a notion may be either formal or effective (equity). It is formal, when it only pretends that there are no discriminatory (perhaps legal) impediments to consumption and that the monetary cost faced by any individual for a given bundle of health services is the same. It is effective - equity in access to health care - when requiring that the real cost of access associated to a specified cell be equal to the real cost of access associated to any other cell, given the purchasing power of the (representative) individual associated to each cell. As such, in our framework socioeconomic variables can be introduced to change the perspective from formal to effective health opportunities; in the existing literature, socioeconomic variables are only instrumental to highlight that health inequalities are even worse when coupled with unequal socioeconomic conditions (Le Grand 1987, Whitehead and Dahlgren 2006).

It should be now more clear that, as in our view the chance of access is crucial for any notion of equality (formal or effective) of health opportunities to have meaning, the procedure of just summarizing distances in the cost of access within the set of all cells is meaningless as far as universal access is not granted; indeed, stretching in any direction the cost associated to a given cell does not stretch opportunities until access is not granted to the cell.

Hence, equality of access can be only achieved by first granting universal access, and then by equalizing the (monetary or real) costs individuals face. As such, if access is granted to an additional cell, then both equality and equity are improved. On the contrary, any cost equalization is ineffective if

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7To the extent that the quantity and quality of the health treatment is defined by the policy-maker, and not by individual preferences, the health system is intended as a merit good.

8It is worth noticing that even the distribution of resources between central and local governments may have an impact on the distribution of health opportunities. On this, see Di Novi et al. 2015

9To be more precise, socioeconomic conditions have been also considered in the existing literature on horizontal health equity (Wagstaff and van Doorslaer 2000). Here, as in the literature on socioeconomic health inequalities, socioeconomic conditions are used to emphasize that horizontal iniquity, due to differences in the distribution of health needs and health care, is even worse when disadvantaging the poorest part of the population (for an attempt to reconcile the two approaches within Roemer’s (1998) ideal of leveling the playing field, see Fleurbaey and Schokkaert (2009)).
universal access is not granted yet.

These principles are embedded in the normative framework outlined in the following Section.

3 Formal Analysis

3.1 Basic definitions

In this Section we introduce formal notation and definitions.

Let $\Theta = \times_{k=1}^{m} \Theta_k$ be the space of characteristics affecting the direct\textsuperscript{10} cost of access to health care (e.g., distance, transport facilities, accommodation needs, fee for service...), that is, the cost borne by an individual to get access to a bundle of health treatments of given quality, which may be intended as either a composite good\textsuperscript{11}, or a single health treatment. A vector $\theta_i \in \Theta$ is a point in the $\Theta$-space fully characterizing the $i^{th}$ cell. Let $\theta = \{\theta_i\}_{i=1}^{n}$ be the set of such cells.

We write $C(\theta) := \{c(\theta_1), ..., c(\theta_n)\}$ to denote the initial cost distribution, i.e. the cost that an individual occupying cell $i$ has to bear in order to obtain the health treatment of pre-determined quality.

We indicate by $Y$ the distribution of financial resources available to any individual (e.g., income, wealth, loans, private and public transfers) to get access to a treatment of given quality; $[y, \overline{y}]$ are the supports of such distribution. Hereafter, $y$ will be referred to as ‘minor pocket’.

As it is not known, from an ex-ante perspective, what the matching between individuals and cells will be, access is granted only to those individuals whose income is greater than the cost associated to any possible cell. Universal access is therefore realized when all the costs are not greater than minor pocket, i.e. $c(\theta_i) \leq y \ \forall \ i$.

We denote by $I_{C(\theta)} \equiv \{\theta_i : c(\theta_i) \leq y\}$ the set of cells having access to the health treatment, when the cost distribution is given by $C(\theta)$.

Let $r : \mathbb{R}^n \rightarrow \mathbb{R}^n$ be a leveling function, i.e. a function associating to any initial vector of costs a vector of non-negative transfers $r(\theta) = [r(\theta_1), ..., r(\theta_n)]$ such that $\sum_{i=1}^{n} r(\theta_i) \leq B$, where $B$ is the total amount of resources allocated to the Health sector. In what follows, $C(\theta, r(\theta))$ will denote the cost distribution where $c(\theta_i, r(\theta)) = c(\theta_i) - r(\theta)$ is the policy induced cost associated to cell $i$.

\textsuperscript{10}It is not worthy that we do not consider some relevant indirect costs, such as for-gone income opportunities. Indeed, in an equality of opportunity perspective what really matters is that anyone is faced with the same barriers to access.

\textsuperscript{11}To the extent that a composite good is considered, it is implicitly assumed that Hicksian condition on prices of single health treatments holds (Hicks 1939). Evidently, given the multidimensional nature of this problem (i.e., aggregating costs of different health treatments across different cells/individuals), several alternative solutions may be proposed whose convenience is not independent of the type of variables one has access to for empirical purposes.
In very general terms, the leveling function might be conceived as capturing the consequences of any cost-reducing health policy.

3.2 Equality in health: a normative framework

In evaluating equality of opportunities for health it is fundamental to disentangle formal from effective equality.

As observed above, as far as the distribution of opportunities for health is concerned, equal command over resources can be interpreted as equal cost of access to a given (bundle of) health treatment(s) of predetermined quality.

In formal terms, let $\Gamma$ be the criterion used to measure individuals’ dis-opportunities; that is, $\Gamma$ maps the cost associated to a given cell (i.e., cell-specific monetary cost) into a point on the dis-opportunity curve $\Omega_i = \Gamma(c(\theta_i, r(\theta)))$ with $r(\theta) \geq 0$. As $\Gamma$ is independent of the characteristics of each cell, it must be the case that the sole distribution of costs matters, meaning that, opportunities are equalized whenever the cost of the health treatment is the same, irrespective of both the cell an individual occupies and her identity.

More specifically, we write $\Gamma(c(\theta_i, r(\theta))) = c(\theta_i, r(\theta))$ to quantify dis-opportunities for each cell having access to the health treatment; we write $\Gamma(c(\theta_i, r(\theta))) = \sigma$ when $c(\theta_i, r(\theta)) > y$, with $\sigma$ arbitrarily large and such that $\sigma > \max[c(\theta_i, r(\theta))]$. In other words, if a treatment is not affordable, dis-opportunities are at their maximum, whatever the gap to the minor pocket.

Remarkably, as $r(\theta)$ is assumed to be a non-negative transfer, we strictly refer to a purely benefit system whose costs are covered by general taxation. As such, it is implicitly assumed that cost transfers among cells are not conceivable, so that perfect equality of opportunity can be obtained exclusively through the elimination of complaints as perceived by each cell with respect to the “best-off” (Temkin 1986), i.e. the cell with the lowest cost of access.

In what follows, we write $C(\theta, r(\theta)) \succ C(\theta)$ to mean that, according to the opportunities granted by each distribution of costs, $C(\theta, r(\theta))$ is ‘at least as good in terms of equality of opportunity’ as $C(\theta)$ (by construction). More in general, for any pair of cost distributions, we write $C(\theta, r(\theta)) \succeq C'(\theta, r'(\theta))$ to indicate that $C(\theta, r(\theta))$ is at least as good than $C'(\theta, r'(\theta))$ in terms of equality of opportunity, with $\succ$ and $\sim$ indicating the asymmetric and symmetric component of the opportunity equality ordering respectively.

Our proposal to rank arbitrary distribution of costs in terms of equality of health care opportunities is based on two principles. First, given that access is the conditio sine qua non for any notion of equality of opportunities for health to have meaning, if the cost associated to a given cell is reduced in such a way as to get smaller than the minor pocket - so that the individual occupying that cell obtains access to health care whatever her resources - the distribution of opportunities is to be considered less unequal (complaints
for no access got reduced). Second, provided that the distribution of costs is such as to allow access to any cell (universal access), (dis-)opportunities are more equal whenever cost disparities are reduced.

Here we formalize the basic normative background for the construction of opportunity equality orderings.

**Axiom 1. (Anonymity).** Let $C(\theta, r(\theta))$ be the cost vector and let $C'(\theta, r'(\theta)) = P \times C(\theta, r(\theta))$ be any cost vector obtained through a permutation of $C(\theta, r(\theta))$. Then $C'(\theta, r'(\theta)) \sim C(\theta, r(\theta))$.

Evidently, the anonymity requirement properly characterizes the (formal) equality perspective where $\Gamma(.)$ is assumed to be the same for all $i$.

**Axiom 2. (Transfer).** Let $C'(\theta, r'(\theta))$ be a cost vector obtained by $C(\theta, r(\theta))$ by reducing the cost of the $j$th cell. Provided that $I_{C(\theta,r(\theta))} = \theta$, $C'(\theta, r'(\theta)) > C(\theta, r(\theta))$ if and only if $c(\theta_j, r'(\theta)) < y < c(\theta_j, r(\theta))$.

By Axiom 2 a cost reduction is worth whenever access is allowed for some cell having no access otherwise. Conversely, recalling that $\Gamma(c(\theta_i, r(\theta))) = \sigma$ whenever $c(\theta_i, r(\theta)) > y$, if the cost reduction does not allow access, then this is ineffective in terms of opportunities whatever the gap to the minor pocket. Remarkably, if universal access is not granted, then equality of opportunity can be exclusively promoted by increasing the frequency of access. As such, any improvement in statistical equality in the cost distribution might be ineffective, for statistical equality is not capturing equality of opportunity unless universal access is granted.

Recalling the complaint-based approach to inequality (Temkin 1983, Cowell and Ebert 2004), a distinction is made between complainants and non-complainants when the cause of complaint is the chance of access. In this view, equality of opportunity is improved if and only if resources in the Health sector are used to reduce the number of complainants.

**Axiom 3. (Lorenz Dominance).** Let $C(\theta, r(\theta))$ and $C'(\theta, r'(\theta))$ be two cost vectors, and let $L\{F[c(\theta_i, r(\theta))]\}$ and $L\{F[c(\theta_i, r'(\theta))]\}$ be the corresponding Lorenz curves with $F[.]$ indicating the distribution function. Provided that $I_{C(\theta, r(\theta))} = I_{C'(\theta, r'(\theta))} = \theta$, if $L\{F[c(\theta_i, r(\theta))]\} \geq L\{F[c(\theta_i, r'(\theta))]\}$ $\forall i$, then $C(\theta, r(\theta)) \succeq C'(\theta, r'(\theta))$.

Axiom 3 introduces an additional norm where opportunity equality orderings are defined in terms of Lorenz dominance. Remarkably, meanwhile Axiom 2 states that equality of health opportunities is improved when the chance of access is extended to more cells, Axiom 3 implies that any statistical inequality reduction in the cost distribution enhances equality of health opportunities when universal access has been granted first.

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Equality, as formulated in terms of Lorenz dominance (Axiom 3) is formally equivalent to imposing the Pigou-Dalton principle of transfer in the presence of scale invariance (Muirhead 1903, Hardy et al. 1929).
Before considering the equity problem, two observations are required. First, Axioms 1-3 characterize a partial, not complete, opportunity equality ordering. More precisely, Axiom 1 and 2 are compatible with a complete ordering, but the opportunity equality ordering, $\succeq$, becomes inevitably partial when universal access is granted, i.e. when Lorenz dominance conditions apply. As such, Axioms 1-3 may not be able to rank alternative cost distributions. Second, if the social planner is purely egalitarian - meaning that the promotion of equality of opportunities is elevated to unique goal of health policies - the opportunity equality ordering corresponds then to the social preference relation.

3.3 Equity in health: a normative framework

Within an equality perspective, (dis-)opportunities have been measured by the cost of access to a predetermined health treatment of given quality. To the extent that opportunities are defined by considering the sole monetization of the barriers to access (cell-specific monetary cost), equality of opportunity is formal, in that it does not capture the extent of the effective opportunities people can enjoy.

Here, we claim that effective equality (equity) in health demands something that does not necessarily agree with the final goal of equalizing the monetary cost of access across cells. In our view, equity in health is rather captured by equality in the distribution of the real cost of access where, for our purposes, the latter is defined by the ratio between the monetary cost and an index of the purchasing power of the representative individual associated to each cell. In this sense, equity, as compared to equality, is inevitably more information demanding, as, within an ex-ante perspective, one is additionally required to account for the distribution of purchasing power conditional to each cell.

In this paper we do not tackle many of the controversial issues related to monetizing the purchasing power. This calculus is indeed far than innocent and such as to be affected by some debatable choices, reflecting, among other things, the value judgements embedded in the rules of calculus, which determine, for example: (i) the selection of variables determining the purchasing power of each cell (e.g. income, family composition, local and national taxes/transfers, benefits from non-health related public services like education and elderly care, etc...)\(^{13}\); (ii) the selection of a synthetic (ex-ante)

\(^{13}\)It is clear that the way socioeconomic conditions are monetized is somewhat of political nature, given that a comprehensive identification of all the variables affecting the purchasing power is out of reach, or equivalently, not achievable at a reasonable cost. For instance: if the monetization of benefits from schooling services is neglected, the distribution of purchasing power of potential users, typically non-elderly, is undervalued, and their real cost of access results higher; if the quality of schooling services, typically not uniformly distributed across geographical location, is ignored, the undesirable consequence of fixing at an higher level the real cost of access of potential users belonging to areas
measure (e.g., mean, median, equally distributed equivalent value, etc ...) for the purchasing power distribution associated to each cell (one that is able to catch the purchasing power of the representative individual associated to the cell)\textsuperscript{14}.

Formally, given the set of cells, $\theta = \{\theta_i\}_{i=1}^n$, $s(\theta_i)$ indicates the (ex-ante) socioeconomic conditions associated to the $i$th cell, $S(\theta) := \{s(\theta_i)\}_{i=1}^n$, and $\Gamma$ the criterion used to measure individuals’ (dis)-opportunities. As for equality, access to the health treatment is granted if and only if the monetary cost of access is less than the minor pocket, i.e. if $c(\theta_i, r(\theta)) \leq y$ (independently of $s(\theta_i)$).

We assume $S(\theta)$ as given, hence we assume that distributional objectives in terms of health opportunities are pursued by forging the cost of access to the health treatments only, and not by redistributing non-health related endowments.

A key definition on the measurement of effective health (dis)-opportunities, follows from the discussion above.

\begin{definition}
Effective health (dis)-opportunities are measured by the ratio between the monetary cost of access and the socioeconomic conditions (purchasing power) computed in accordance with the criteria established by the policy-maker, i.e. $\Psi_i = \Gamma\left(\frac{c(\theta_i, r(\theta))}{s(\theta_i)}\right)$, where $\Gamma$ is such that:
\begin{enumerate}
\item $\Gamma(.) = \gamma$ for all $c(\theta_i, r(\theta)) > y$, with $\gamma$ arbitrarily large;
\item $\Gamma(.) = \frac{c(\theta_i, r(\theta))}{s(\theta_i)}$ for all $c(\theta_i, r(\theta)) \leq y$.
\end{enumerate}

By the previous definition, a reduction in the real cost of access faced by an individual increases her opportunity, provided that access is ex-ante granted to her.

Before proceeding any further, notice that, as a matter of notation, in what follows, given $C_r(\theta) \equiv C_r [C(\theta, r(\theta)), S(\theta)] := \left\{\frac{c(\theta_i, r(\theta))}{s(\theta_i)}\right\}_{i=1}^n$, we write $C_r \succeq_r C'_r(\theta)$, where $C'_r(\theta) \equiv C'_r [C'(\theta, r'(\theta)), S(\theta)]$, to mean that, according to the health opportunities effectively granted, $C_r(\theta)$ is at least as good in terms of equality of opportunity than $C'_r(\theta)$. We write $\succ_r$ and $\sim_r$ to indicate the asymmetric and symmetric component of the opportunity equality ordering respectively.

As it will become clear shortly, the formulation of the Axioms gets slightly changed in such a way as to take the distribution of socioeconomic conditions into account. More precisely:

\footnote{\textsuperscript{14}By opting for mean instead of equally distributed equivalent value, for example, the policy-maker is implicitly manifesting indifference with respect to variance within each cell; this may benefit some cells while damaging others.}
1. Axiom 1 (Anonymity) is intended in terms of permutations of real costs, therefore $C'_r(\theta) = P \times C_r(\theta)$ implies $C'_r(\theta) \sim_r C_r(\theta)$; this is straightforward as the design of inequity reducing health policies is now expected to account for socioeconomic conditions. As a result, recalling the monetary cost distribution $C(\theta, r(\theta))$, $C'(\theta, r'(\theta)) = P \times C(\theta, r(\theta))$ does not imply $C'_r(\theta) \sim_r C_r(\theta)$ unless $S(\theta)$ is equally distributed across cells.\(^{15}\)

2. Axiom 2 (Transfer) holds unchanged, because access depends on the monetary cost of the health treatment under consideration. Hence, when universal access is not granted, $C'_r(\theta) \succ_r C_r(\theta)$ if and only if the leveling function is modified from $r(\theta)$ to $r'(\theta)$ in such a way as to give access to an additional cell.

3. Axiom 3 (Lorenz Dominance) still holds; however, in order to account for differences in socio-economic conditions, it is reformulated in terms of real costs of access. So, given two policy-induced cost vectors ensuring universal access and the corresponding socioeconomic conditions,

$$L \left\{ F \left( \frac{c(\theta_i, r(\theta))}{S(\theta)} \right) \right\} \geq L \left\{ F \left( \frac{c(\theta_i, r'(\theta))}{S(\theta)} \right) \right\}, \forall i$$

implies $C'_r(\theta) \succeq_r C_r(\theta)$.

On these grounds the policy-maker is expected to equalize real costs of access to health, according to its own definition of socioeconomic conditions. This is not without any implication for the amount of resources required for either improving equity in the distribution of the health prospects, or attaining perfect equity, which is a point we will have to come back to.

### 3.4 A Measurement Proposal

Given the normative framework discussed above, we propose an Index for the measurement of both equality and equity in health, which can be empirically implemented for comparisons across countries and/or over time. This Index is able to determine a complete opportunity equality ordering which is normatively consistent with the axiomatic framework set above.

We propose the following Index of equality of (formal or effective) health opportunities.

$$HG = \left( \frac{q}{n} \right) \max \left\{ 1; [1 + (1 - G)]^{1+q-n} \right\} \quad (1)$$

\(^{15}\)In this sense, anonymity can be formulated in partial terms only (Cowell 1980), by which, any permutation of the monetary cost of cells $i$ and $j$ with $s(\theta_i) = s(\theta_j)$ implies $C'_r(\theta) \sim_r C_r(\theta)$.
where \( q = \sharp I_{C(\theta,r(\theta))} \) is the number of cells having access. Specifically, the general formulation in eq. (1) accounts for each of the two conditions below (i-ii). Indeed,

(i) if \( q < n \), as the term in square brackets cannot be lower than one and the corresponding exponent \((1 + q - n)\) is no greater than zero, then \( \max\{.\} = 1 \) and, as a result, \( HG = HG_1 = \frac{q}{n} \);

(ii) if \( q = n \), \( HG = HG_2 = 2 - G \).

Moreover, to the extent that \( HG \) is a sort of composite Index accounting for both the Headcount ratio and Gini index, it must be the case that two additional properties hold.

First, \( HG \) is scale invariant as it can be shown that, given two populations such that \( y' = \lambda y \) and \( C'(\theta, r'(\theta)) = \lambda C(\theta, r(\theta)) \) (or, \( C'_r(\theta) = \lambda C_r(\theta) \)) with \( \lambda > 0 \), it must be the case that \( HG' = HG \). This implies, for example, that \( HG \) is independent of the currency one is considering for the analysis.

Second, \( HG \) is replication invariant as it can be shown that if \( C'(\theta, r'(\theta)) \) is obtained from \( C(\theta, r(\theta)) \) (or, \( C'_r(\theta) \) from \( C_r(\theta) \)) through a \( k \)-fold replication of the population with \( k \in \mathbb{N} \), then it must be the case that \( HG' = HG \). As such, \( HG \) is said to be independent of the size of the population.

As a result, if \( q < n \), then \( HG \in [0,1] \), meanwhile \( HG \in [1,2] \) for all (monetary or real) cost distributions implying universal access with non-zero inequality. In particular, given universal access, \( HG > 1 \) if \( G < 1 \); meanwhile \( HG = 1 \) if inequality is maximum, i.e. \( G = 1 \).

It is worth observing that, once perfect equality/equity has been achieved \((HG = 2)\), any additional resource employed to the benefit of all cells in such a way as to preserve perfect equality or equity, by scale invariance, is not affecting equality of opportunity. Differently, given \( HG = 2 \), any additional resource employed to the benefit of some but not all cells is inevitably reducing equality (equity) of health opportunities.

**Proposition 3.1.** Index \( HG \) satisfies Axioms 1-3.

**Proof.** Appendix.

As compared to the existing literature, Index \( HG \) is of a lexicographic fashion - yet not purely lexicographic - for it is not limited to capture disparities in the distribution of (monetary or real) costs of access. Specifically, the number of accesses is considered first, reduction in disparities next. However, in contrast with a pure lexicographic criterion, any reduction in statistical inequality \((G)\) does not enhance, ceteris paribus, the social judgement relative to a given distribution \((HG)\) until universal access has not been granted.
4 Egalitarian Health Policies

To the extent that perfect equality (formal or effective) is attained by leveling all cells to the best-off, not by carrying out redistribution of costs (e.g. by leveling all cells to the average cost), financial resources are necessarily required to implement egalitarian health policies, whose design itself, as will be clarified shortly, is conditioned by resource availability. As will be also clarified in this Section, resource constraints can be more or less severe, depending on the distribution of costs as well as (possibly) socioeconomic conditions.

4.1 Resource constrained egalitarian health policies

4.1.1 Equality Perspective

Let $B$ indicate the amount of resources allocated to the Health Sector and let $F = \sum_{i=1}^{n} \max \{0, [c(\theta_i) - y]\}$ be the amount of resources necessary to reduce the cost associated to any cell up to the minor pocket $y$; given $\bar{c} = \min\{C(\theta)\}$, $M = \sum_{i=1}^{n} [c(\theta_i) - \min\{\bar{c}, y\}]$ is the amount of resources necessary to reduce the cost of any cell up to the minimum between $\bar{c}$ and $y$.

As we show in the following Proposition, if the opportunity equality ordering $\succeq$ is defined by Axioms 1-3, then the design of the leveling function strictly depends on the amount of resources allocated to the Health sector.

**Proposition 4.1.** Let $C(\theta, r(\theta))$ be the policy-induced cost distribution originating from $C(\theta)$ by means of $r(\theta)$. Depending on the availability of resources, $B$, a necessary and sufficient condition for minimizing inequality of opportunity, is that

i) if $B \leq F$, $B$ must be allocated to equalize costs to the minor pocket, giving priority to cells whose cost is closer to it;

ii) if $F < B < M$, $B$ must be allocated in such a way as to grant universal access first, and then to reduce the highest costs, avoiding re-ranking;

iii) if $B = M$, $B$ must be allocated in such a way as to obtain $c(\theta_i, r(\theta)) = \min\{c(\theta_i)\}$ $\forall i$.

**Proof.** Appendix.

Proposition 4.1 maintains that, whenever the amount of resources is not sufficient to grant access to all cells, the leveling function must be designed in such a way as to maximize the number of accesses. This implies that available resources must be first allocated to grant access to the cells with the smallest gap from the minor pocket , i.e. to cells with the lowest costs among those having no access (i.e. complainants). Apparently this may increase statistical inequality among those cells. Actually such an increase in inequality is irrelevant because the size of the gap to the minor pocket is
not something that impinges on opportunities when access is not granted. In other words, a policy that made all the costs closer to the minor pocket without pushing any cost below it, would be uneffective.

When resources are sufficient to grant access to any cell, the leveling function is instead to be designed in such a way as to minimize statistical inequality. This implies that B is allocated to reduce all the costs (first below the minor pocket) starting from the highest one. Indeed, in a way that resembles the well known Rawlsian maximin principle, inequality improvements - as defined in terms of Lorenz dominance (Axiom 3) - can be obtained in this case through a non-reranking and non-negative resource transfer if and only if the recipient is the worst-off cell.

Evidently, if \(c(\theta_i, r(\theta)) = c < y\), then equality of health opportunity cannot be ulteriorly increased, so that any additional available resource that is equally shared among cells, i.e. preserving perfect equality, would be ineffective in terms of equality of opportunity.

4.1.2 An equity perspective

As we said above, within an equity perspective it is the distribution of effective health opportunities that really matters. So, the focus is on the real cost of access where the latter is defined by the ratio between the monetary cost and the purchasing power (socioeconomic conditions) associated to each cell.

Once again, let \(B\) and \(F = \sum_{i=1}^{n} \max\{0, c(\theta_i) - y\}\) indicate, respectively, the amount of resources allocated to the Health Sector and the amount of resources necessary to reduce the cost associated to any cell up to the minor pocket.

To define the minimum amount of resources required to achieve perfect equity, let \(\hat{c}\) and \(\hat{s}\) indicate the monetary cost and the socioeconomic conditions associated to the minimum real cost among cells having access to the health treatment respectively, i.e.

\[
\frac{\hat{c}}{\hat{s}} = \min \left\{ \frac{c(\theta_i)}{s(\theta_i)}, \forall i : c(\theta_i) \leq y \right\}.
\]

Also, let \(\bar{s}\) be the maximum value of socioeconomic conditions among cells with no access, i.e.

\[
\bar{s} = \max\{s(\theta_i), \forall i : c(\theta_i) > y\}\]

According to Axioms 1-3, perfect equity is achieved whenever

\[
\frac{c(\theta_i, r(\theta))}{s(\theta_i)} = \min \left\{ \frac{\hat{c}}{\hat{s}}, \frac{\bar{s}}{\bar{s}}, \forall i, \right\}
\]
where \( \bar{y} \) is the minimum real cost among cells with no access once universal access is granted.\(^{16}\) As such, it can be shown that the minimum amount of resources necessary to achieve an egalitarian distribution of real costs becomes

\[
M_r = \sum_{i=1}^{n} \left[ c(\theta_i) - s(\theta_i) \min \left\{ \hat{c}, \bar{y} \right\} \right] \quad (\text{see appendix A.1}).
\]

Recalling Proposition (4.1), as Axiom 2 (Transfer) is unaffected when the distribution of socioeconomic conditions is accounted for, \( F \) is unaffected when moving from a formal to an effective equality of opportunity perspective; hence, result (i) from Proposition (4.1) still holds: if available resources are not sufficient to grant universal access, they should primarily be allocated to grant access to the cells whose monetary cost of access is closer to the minor pocket.

Result (ii) from Proposition (4.1) still holds, although in a slightly modified form: once universal access is granted, resources must be allocated in such a way as to benefit cells bearing the highest real costs first. Remarkably, as cells with the highest real costs may not coincide with cells with the highest monetary costs, it may be the case that equity improvements in health are obtained by increasing inequality in the monetary cost of access.

As it should be clear, also the design of equity-oriented policy fundamentally depends on the amount of available resources in a way that replicates what has been observed within a formal equality perspective. However, it is worth observing that the minimum amount of resources required to equalize effective health opportunities - which we have referred to as \( M \) - is highly sensitive to the distribution of socioeconomic conditions. From this it follows that the amount of resources necessary to achieve a given distributional objective (e.g. Sen 2002) cannot be determined \textit{a priori}, without first observing the distribution of socioeconomic conditions in the population at hand.

### 4.2 Formal versus effective equality: resource requirements

To the extent that the minimum amount of resources necessary to achieve perfect equality (\( M \)) may differ from the one necessary to achieve perfect equity (\( M_r \)), opting for equality or equity-oriented policies is not equally demanding in terms of financial resources. The following Proposition shows that perfect equality may be less or more expensive than perfect equity depending on: (i) whether universal access is granted under the initial monetary cost distribution (\( C(\theta) \)); (ii) the relation between the initial monetary cost distribution (\( C(\theta) \)) and the distribution of socioeconomic conditions (\( S(\theta) \)).

\(^{16}\) As \( \bar{s} \) may greater, equal or lower than \( \hat{s} \), \( \frac{\bar{y}}{\bar{s}} \) may be even lower than the minimum real cost among cells having access (i.e., \( \frac{\hat{c}}{\hat{s}} \)). More precisely, as \( \bar{y} \geq \hat{c} \) by construction, a necessary (but not sufficient) condition for \( \frac{\bar{y}}{\bar{s}} < \frac{\hat{c}}{\hat{s}} \) is \( \bar{s} > \hat{s} \).
Proposition 4.2. Perfect equity requires more resources than perfect equality for any distribution of monetary costs and socioeconomic conditions if and only if access is not ex-ante granted to any cell. When universal access is instead granted, perfect equity requires less resources than perfect equality whenever the monetary costs of access increases in socioeconomic conditions more than proportionally or proportionally, the latter case implying perfect equity by definition.

Proof. Appendix. \(\square\)

Intuitively, if access is not allowed to any cell, then the primary objective of the policy-maker is one of reducing the monetary costs of all cells in such a way as to obtain \(c(\theta_i, r(\theta)) = y_i, \forall i\). In this sense, resources are first allocated to grant equality, which does not imply that equity is attained, unless socioeconomic conditions are equally distributed. As such, additional resources are required to equalize real costs. This is not irrelevant for the policy-maker as it implies that for health treatments so expensive that access is denied to any cell, equity is more resource-demanding than equality.

Differently, if access is granted to some cells, then perfect equity may be less expensive than equality. As a special case, if access is granted to all cells and effective health opportunities are strictly decreasing with socioeconomic conditions, then equity is necessarily less expensive than equality. Basically, under these conditions the (unequal) distribution of socioeconomic conditions partially offsets the unequal distribution of monetary costs in such a way as to render the equalization of real costs less resource-demanding, and, ultimately, zero resource-demanding in the case of perfect proportionality between the two distributions.

This is immediately relevant for policy purposes as it emphasizes that within an equity perspective, as compared to equality, the distribution of monetary costs with respect to socioeconomic conditions may sensibly affect the amount of resources required for the achievement of the desired distributive goal. In particular, if the monetary cost is distributed in such a way as to penalize cells with the worse socioeconomic conditions, then, as compared to perfect equality, a greater financial effort is required to achieve perfect equity. This result is particularly striking whenever one focuses on the fact that better socioeconomic conditions are usually coupled with lower monetary costs of access. For instance, it is usually the case that rural areas, as compared to metropolitan ones, are characterized by both worse socioeconomic conditions and more expensive access to health (Whitehead and Dahlgren 2006).

Proposition 4.2 shows that the normative standard (formal or effective health opportunities) is immediately relevant for the amount of resources that is required to achieve the distributional target \((M, M_r)\). In particular, the financial effort required to achieve the normative standard is found to
depend on the number of accesses and the relation between the initial monetary cost distribution and the distribution of socioeconomic conditions. As shown in the following Proposition, it is not however the initial degree of inequality of the monetary cost distribution that really matters to determine resources, but the initial (formal or effective) health opportunities associated to the best-off cell.

**Proposition 4.3.** Given the set of cost distributions, differing from each other in terms of inequality only, the minimum amount of resources required to achieve perfect equality or equity only depends on the best-off cell.

**Proof.** Appendix.

To the extent that a cost distribution $C'(θ)$ can be obtained from $C(θ)$ through a high-to-low pairwise cost transfer, it must be the case that monetary costs of any two cells are made more equal, but the overall amount of resources required to grant to them the same opportunities of the best-off cell (i.e., lowest monetary cost) does not change, unless the lowest monetary cost has changed. On the contrary, when the pairwise cost transfer alters the cost of the best-off cell, then the target of the leveling function (that is the cost of the best-off) may result closer or farther for all the other cells, which immediately affects the amount of resources required to attain distributional objectives. Remarkably, this result holds for both perfect equality and perfect equity.

Clearly, the latter result originates from the complaint-based approach to inequality (Temkin 1993, Cowell and Ebert 2004) we have opted for in the paper; given that perfect equality (or equity) is achieved when each cell is not complaining with respect to the best-off cell, it must be the case that the amount of resources required to achieve perfect equality (or equity) is larger, the lowest is the monetary (or real) cost of the best-off cell. For policy purposes this means that, for the definition of resources to be allocated to the Health sector to promote egalitarian goals, the status of the most advantaged cell (cost of access for the best-off) should matter more than the initial inequality conditions in the cost distribution (i.e. in the absence of public health policies).

### 5 Concluding Remarks

Low economic growth, a dramatic increase in the cost of provision of health services and the need to cut public deficits are currently downplaying the expectation of adequate health opportunities for all citizens in Western countries. This is happening with perhaps greater strength in Europe, where an aspiration to an adequate level of justice in health is still present. We believe that such an aspiration can exhibit a more substantial meaning if it comes
to be grounded in a suitable frame allowing to address the issue in a more consistent manner. This is the task we have undertaken in this paper.

We have argued that the evaluation of equality of health opportunities have to take simultaneously into account the distribution of the chances of access (i.e. frequency) as well as the disparities in the cost of access (i.e. intensity). Specifically, we made a clear distinction between equality of formal and effective health opportunities, where the latter are assumed to account for socioeconomic conditions also. With these principles in mind we have shown that equality-enhancing policies should be designed in such a way as to first grant (ex-ante) access to as many individuals as possible, independently of the inequality in the distribution of the cost of access. Only once universal access is granted, equality of health opportunities can be promoted by reducing inequalities in the cost distribution, which means that resources can be allocated to ameliorate the conditions of whom may be considered at a greater (cost) disadvantage.

The Index for the measurement of equality of health opportunities that we have proposed, indeed requires that both the chances of access and the disparities in the cost distribution be taken (lexicographically) into account when comparing cost distributions across countries and over time.

As we have shown, access universality (along with the relation between the initial monetary cost distribution and the distribution of socioeconomic conditions) also affects whether a given normative standard (e.g. perfect equality of formal opportunity) is more or less expensive than the other (perfect equality of effective opportunity); even though the amount of financial resources required for the attainment of any normative standard has as the major determinant the health opportunities of the best-off cell.

It is evident that the exercise of measuring equality of health opportunities has different meanings in different contexts, for it is very sensitive to the treatments included in the bundle whose cost is relevant. In other words, access can be assessed at different standards. Such standards cannot be determined a priori. We believe that the set of treatments to be included in the bundle whose cost is relevant to assess health opportunities is something that needs to be chosen wisely.

As in the choice of the functionings constituting the capabilities a society aims to protect, the best procedure is still the one of an open public discussion.
Appendix

**Proof. (Proposition 3.1).** Axiom 1 holds as \( q, n, G, \) and \( \mu \) are all invariant with respect to any permutation of the (monetary or real) cost vector. To prove that Axiom 2 holds we proceed as follows. For all \( q < (n - 1), \) \( HG_1 \) is lower than one and increasing in \( q. \) When \( q = (n - 1), \) if access is given to the \( n^{th} \) cell also, then \( HG_2 \) becomes relevant with \( H_2 \geq 1. \) To prove that \( HG \) satisfies Axiom 3, notice that when \( q = n \) and \( G > 0, \) any Lorenz majorization which reduces \( G \) up to \( G = \varepsilon > 0 \) increases index \( HG_2 \) with \( HG_2 < 2. \) □

**Proof. (Proposition 4.1).** To prove i), given two different leveling functions \( r(\theta) \) and \( r'(\theta), \) by Axioms 1 and 2, necessary condition for \( C(\theta, r(\theta)) \geq C'(\theta, r'(\theta)) \) is \( I_{C(\theta, r(\theta))} \geq I_{C'(\theta, r'(\theta))}, \) which requires \( r(\theta) = (c(\theta) - y) > 0 \) and \( r'(\theta) = 0 \) whenever \( y < c(\theta) < c(\theta). \) By contradiction, suppose that \( r(\theta) = 0 \) and \( r'(\theta) = (c(\theta) - y) > 0. \) Then, to obtain \( I_{C(\theta, r(\theta))} = I_{C'(\theta, r'(\theta))}, \) additional resources \( [c(\theta) - c(\theta)] \) are necessary. In addition, suppose that \( r(\theta) > 0 \) and \( r'(\theta) = 0 \) such that \( c(\theta) < c(\theta) \) \( < y, \) then to obtain \( I_{C(\theta, r(\theta))} = I_{C'(\theta, r'(\theta))}, \) additional resources \( [y - c(\theta), c(\theta)] \) are necessary. Sufficient condition for \( C(\theta, r(\theta)) \geq C'(\theta, r'(\theta)) \) is the two previous conditions must hold \( \forall i, j : y < c(\theta) < c(\theta). \) To prove ii), given the initial cost distribution \( C(\theta), \) let \( \hat{C}(\theta, r(\theta)) \) be the increasingly ordered (policy-induced) cost distribution with \( c(\theta), r(\theta)) \leq y \forall i, \) and \( L\{F[c(\theta), r(\theta)]\} \) the corresponding Lorenz curve. If \( C(\theta, r(\theta)) \) is obtained from \( C(\theta, r(\theta)) \) so that \( r(\theta) = r(\theta) \forall i \neq j \) and \( r'(\theta) = r(\theta) + \Delta \) with \( \Delta > 0 \) and non-reranking, then, by construction of the Lorenz curve, it must be the case that, for all \( j \neq 1 \) and \( j = n, L\{F[c(\theta), r(\theta)]\} \) and \( r(\theta) \) cross to each other. For \( j = 1, L\{F[c(\theta), r(\theta)]\} > L\{F[c(\theta), r(\theta)]\} \forall i, \) whereas for \( j = n, L\{F[c(\theta), r(\theta)]\} < L\{F[c(\theta), r(\theta)]\} \forall i. \) Thus, a non-reranking transfer \( (\Delta) \) generates a Lorenz majorization (i.e., inequality improvement) if and only if the recipient is the worst-off. The proof of iii) follows immediately from proof ii). □

**Proof. A.1.** Given \( \hat{\xi} = \min\{c(\theta) \leq y \} \) and \( \bar{\xi} = \max\{s(\theta) \forall i : c(\theta) \leq y \}, \) it must be the case that \( \hat{\xi} \) is the minimum real cost among cells with no access, once universal access is granted to them by reducing their monetary cost to \( y. \) Within this framework, perfect equity is achieved when the leveling function is designed such that \( \frac{c(\theta) \leq r(\theta)}{s(\theta)} = \min\left\{ \frac{\hat{\xi} \leq y}{\bar{\xi}} \right\} \forall i. \) Recalling that \( c(\theta, r(\theta)) = c(\theta) - r(\theta), \) the latter condition can be rewritten as \( r(\theta) = c(\theta) - s(\theta)i \min\left\{ \frac{\hat{\xi} \leq y}{\bar{\xi}} \right\} \forall i. \) As such, considering the population as a whole, the minimum amount of resources to achieve an egalitarian distribution of real costs must be \( M_r = \sum_{i=1}^{n} \left[ c(\theta) - s(\theta)i \min\left\{ \frac{\hat{\xi} \leq y}{\bar{\xi}} \right\} \right] \) □
\textbf{Proof. (Proposition 4.2).} Recall $M = \sum_{i=1}^{n} [c(\theta_i) - \min \{c, y\}]$. Then, $(M_r - M) = n \min \{c, y\} - \bar{s}(\theta_i) \min \{\frac{\hat{c}}{\tilde{s}}, \frac{y}{\tilde{s}}\}$, with $\bar{s}(\theta_i) = \frac{1}{n} \sum_{i=1}^{n} s(\theta_i)$. To prove the first part, if $c(\theta_i) > y$ for some cell, then resources must be first allocated to that cell. Thus, for any equality-oriented social-planner, the effect on $M$ is straightforward that, for any equality-oriented social-planner, the effect on $M$ is straightforward. For the same result in the case of an equity-oriented social planner, recall $\frac{\hat{c}}{\tilde{s}} = \min_{i} \{c(\theta_i) \leq \hat{c} \leq y\}$ and $\bar{s} = \max \{s(\theta_i) \leq \hat{c} \}$ is null. For the same result in the case of an equity-oriented social planner, recall $\frac{\hat{c}}{\tilde{s}} = \min_{i} \{c(\theta_i) \leq \hat{c} \leq y\}$ and $\bar{s} = \max \{s(\theta_i) \leq \hat{c} \}$. Given $M_r = \sum_{i=1}^{n} [c(\theta_i) - s(\theta_i) \min \{\frac{\hat{c}}{\tilde{s}}, \frac{y}{\tilde{s}}\}]$, the effect of a pairwise monetary cost transfer on $M_r$ is $\frac{\partial M_r}{\partial c(\theta_i)} - \frac{\partial M_r}{\partial c(\theta_j)}$. The effect on $M_r$ of this pairwise cost transfer occurs between $\hat{c}$ when $\frac{\hat{c}}{\tilde{s}} < \frac{y}{\tilde{s}}$ (or $\frac{\hat{c}}{\tilde{s}} > \frac{y}{\tilde{s}}$), and some other $c(\theta_i) \neq \hat{c}$. The effect on $M_r$ of this pairwise cost transfer occurs between $\hat{c}$ when $\frac{\hat{c}}{\tilde{s}} < \frac{y}{\tilde{s}}$ (or $\frac{\hat{c}}{\tilde{s}} > \frac{y}{\tilde{s}}$), and some other $c(\theta_i) \neq \hat{c}$. The effect on $M_r$ of this permutation is given by $\pm \frac{\partial M_r}{\partial c(\theta_i)} - \frac{\partial M_r}{\partial c(\theta_j)}$, which, given $\frac{\partial M_r}{\partial c(\theta_i)} < 0 \forall \tilde{s}$ and $\frac{\partial M_r}{\partial c(\theta_i)} > 0 \forall \tilde{s}$, cannot be null. \hfill $\square$
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