Economic Modelling 132 (2024) 106659

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.journals.elsevier.com/economic-modelling

Measuring health care access and its inequality: A decomposition approach ☆

Antonio Abatemarco [a], Massimo Aria [b], Sergio Beraldo [c], Michela Collaro [b,*]

[a] Department of Economics and Statistics, University of Salerno and CELPE, Via Giovanni Paolo II 132, Fisciano (SA), 84084, Italy
[b] Department of Economics and Statistics, University of Napoli 'Federico II', Via Vicinale Cupa Cintia 21, Naples, 80126, Italy
[c] Department of Economics and Statistics, University of Napoli 'Federico II' and CSEF, Via Vicinale Cupa Cintia 21, Naples, 80126, Italy

ARTICLE INFO

Dataset link: Replication of the paper "Measuring Access and Inequality of Access to Health Care: A Decomposition Approach" (Original data)

Keywords:
Health care
Equality of opportunity
Factor decomposition
Health policy

ABSTRACT

We introduce a new method for assessing health care access disparities, focusing on the 'Access Gap'. This gap represents the difference between the (out-of-pocket) cost of access to adequate health care and available financial resources. Our method quantifies this gap for groups with similar characteristics, using indicators like the Gini coefficient and Entropy for overall inequality analysis. Applied to breast cancer treatment in Italy, we consider geographic location as the primary distinguishing characteristic for individual groups. The analysis covers costs of transportation, accommodation, doctor consultations, diagnostic tests, and non-oncology drugs. Financial resource distribution data comes from the Bank of Italy. Our findings show a pronounced Access Gap in Italy's southern regions, particularly in Campania. We decompose this gap to understand the influence of supply-side (provider distribution) and demand-side (health spending capacity) factors. The results indicate that disparities in access are mainly driven by demand-side elements, specifically regional spending capacity variations.

1. Introduction

Universal access to adequate health treatments is known to be somewhat precluded in developing economies, as well as in countries where only *partial* health coverage is provided by the national health system. In addition, due to budget cuts and increasing out-of-pocket expenses (Purcel et al., 2023), access limitations to care are also observed (and perceived) in Europe, where a mandate for universal health coverage is usually established (Karanikolos et al., 2013; Cylus and Papanicolas, 2015). Indeed, even disregarding the case of unsatisfactory health treatments, more than 2% of Europeans report unmet needs for medical care, with some countries displaying proportions above 5% (OECD and EU, 2022).[1]

In this paper, we propose a novel measurement strategy to assess inequality of opportunity in health care that also accounts for the quality of health treatments. This strategy, based on the ideal of *equal potential access* (e.g., Aday et al., 1980; Mooney, 1983; Khan, 1992), allows to recognize how supply-side factors, such as the delivery of health care services, and demand-side factors, such as health spending capacity of individuals, contribute to observed inequality of access to adequate health treatments (Levesque et al., 2013). In this sense, both the magnitude and the determinants of inequality of access to care are specifically considered.

Despite some similarities, our proposal presents several differences from popular conceptions of equity in health/health care discussed in Section 2. Following the Rawlsian tradition of *fair equality of opportunity* (Rawls, 1971; Daniels, 1985), we assess equity in health care by focusing on the distribution of access opportunities, defined in terms of "potential access" to a health treatment. As a major departure from the main literature, potential access is considered *ex-ante* – that is, before a health need has arisen – and assessed independently from health care *utilization*, which is inevitably affected by individual responsible choices and health needs.

Any methodological proposal for the measurement of "inequality of access" to health care cannot but be initially concerned with the definition of "access".

In our ex-ante perspective, (potential) access is specified in terms of its immediate counterpart, that is, the risk that an individual will have access to adequate care denied in case of need. For each individual,

☆ The authors are grateful to Vincenzo Carrieri, Andrew Jones, Catia Nicodemo, Vincenzo Prete, Martin Siegel, Gilberto Turati, Claudio Zoli, two anonymous reviewers and the editor for helpful comments and suggestions. We also thank seminar participants at the EuHEA Conference 2022, at the AEHE Workshop 2022, and at the EHEW 2022.

* Corresponding author.
E-mail address: michela.collaro@unina.it (M. Collaro).

[1] In China, despite 96.8% of the population having received universal health coverage since 2018, it has been shown that current public health insurance schemes cannot meet the needs of the most vulnerable groups and households with lower socioeconomic standings (Chen et al., 2023).

https://doi.org/10.1016/j.econmod.2024.106659
Received 21 December 2022; Received in revised form 15 January 2024; Accepted 23 January 2024
Available online 30 January 2024

the access risk is said to be conditional on the characteristics affecting the out-of-pocket cost of access (e.g., place of living, assistance needs) which, in turn, is immediately influenced by the distribution of health care providers on the territory. Hence, we claim that individuals, independent of their characteristics, should bear the same risk to have a health need radically or substantially unmet (Abatemarco et al., 2020a,b).

For the risk of access to be assessed ex-ante – that is, when health needs and responsible choices are unknown – two key pieces of information are assumed to be available: (i) individual characteristics affecting the out-of-pocket cost of access (e.g., place of living, assistance needs), and (ii) the distribution of individual health spending capacity in each group of individuals with homogeneous characteristics. Hence, provided that people with homogeneous characteristics share both (i) the same out-of-pocket cost of access and (ii) the same distribution of health spending capacity, we can identify the access risk associated with each group. More specifically, by drawing from the existing literature on poverty (Foster et al., 1984; Blackwood and Lynch, 1994), we propose to use the Access Gap index for the measurement of potential access in each group. This index is zero if universal access is granted within that group, whereas it is positive if universal access is not attained; intuitively, the Access Gap consists of the money transfer required to grant universal access in a group of individuals with the same characteristics. Remarkably, this index, which can be expressed as the product of the frequency (headcount ratio) and the intensity (money gap) of access, is factor decomposable in terms of supply-side (cost-specific) and demand-side (spending capacity) determinants. Hence, for each group of individuals with homogeneous characteristics, the origins of denied access to adequate health care can be identified through a non-parametric estimation strategy.

Once potential access for each group of individuals with homogeneous characteristics is measured in money terms by the Access Gap index, inequality of access to adequate health care is measured by applying standard inequality metrics (Gini, Entropy, …) to the Access Gap distribution.[2] In addition, given the observed inequality of access in the entire population, non-parametric techniques for the factor decomposition of inequality can be implemented (Shorrocks, 1982; Lerman and Yitzhaki, 1985; Shorrocks, 2013). In this way, the contribution of several determinants to the overall inequality of access to care is identified. Specifically, we focus on the contribution of (i) production inefficiencies in the supply of health treatments, (ii) under-supply of health care providers, (iii) within-group, and (iv) between-group inequality of (individual) health spending capacity.

From a policy perspective, the possibility of factor decomposing overall inequality is particularly relevant because different sources (determinants) of health care inequality may require different policy responses.[3] For instance, inequality of opportunity in health care originating from supply-side (cost-specific) factors may require a better administration of public funds allocated to the health sector. Differently, demand-side determinants of inequality (spending capacity) may require more general redistributive policies based, for example, on means-tested tax expenditures or, reimbursements of out-of-pocket costs of access to care.

To show how the measurement strategy we propose can be implemented in practice, we report an exercise for the case of breast cancer surgery in Italy. Given, for each of the twenty regions, (i) the set of treatment-specific out-of-pocket costs of access and (ii) the health spending capacity distribution, we show that inequality of opportunity to adequate care can be measured ex-ante; most importantly, the contribution of both supply-side and demand-side factors can be estimated. Specifically, we find that, on average, demand (resp. supply) factors cause the 90% (resp. 10%) of access limitations in the north and 87% (resp. 13%) in the south of Italy. As for access inequalities between northern and southern regions, we find that most of them originate from unequal inter- and intra-regional (individual) endowments of health spending capacity (81%), even if a remarkable contribution to overall inequality of access is also coming from productive inefficiencies in the south (19%).

To sum up, two major contributions characterize our methodological proposal. First, we propose a measurement strategy for inequality of opportunity in health care that ameliorates existing techniques by taking into account both (i) the disparity among individuals having access and those having not (i.e. Access Gap index), and (ii) the disparity of access opportunities among individuals facing different access conditions (inequality of Access Gaps). Second, our proposal is the first attempt to obtain a factor decomposition of inequality of opportunity in health care within an ex-ante perspective, where it is the distribution of opportunity before a health need has really emerged that matters, independent of the utilization of health treatments.

The paper is organized as follows. In Section 2, the literature on the definition and measurement of equity in health care is discussed. Also, previous contributions in the field of inequality decomposition are considered. The methodological proposal is outlined in Section 3. The focus is on the measurement of potential access in terms of Access Gap and, then, on the measurement and decomposition of overall inequality of potential access. In Section 4, we run a simple empirical exercise to illustrate how our methodology can be applied. Section 5 concludes.

2. Related literature

Equity in *health care* represents a desirable goal that is known to differ from its twin counterpart, equity in *health* (status). According to the World Health Organization, "equity in health is achieved when everyone can attain their full potential for health and well-being". Equity in health care is instead concerned with individual chances of having health needs met by the health care system, that is, with the absence of disparities in the opportunity of receiving adequate health treatments. The main difference between equity in health and equity in health care comes from the nature of disparities observed in the distribution of interest (i.e., health status or health care). In addition to the health care received, inequality in health mainly depends on factors falling beyond the working of the health system, such as lifestyles, treatment preferences, and genetic endowments. Inequality in health care, in contrast, is mostly driven by disparities in health needs and is strongly affected by factors within the health systems' domain, such as the availability and affordability of health treatments (Oliver and Mossialos, 2004; Levesque et al., 2013).

Three main approaches have emerged in the health economics literature attempting to formalize a unique definition of equity in health care and to suggest proper methodologies for its evaluation.[4]

The first is the horizontal equity principle, claiming "equal health care for those in equal health need" (Wagstaff and Van Doorslaer, 2000). Here, inequalities in health care are tolerated – that is, treated as *fair* – if and only if motivated by differences in health needs. On the contrary, disparities in the utilization of health treatments among individuals with same health needs are said to be *unfair* and to be eradicated. In addition, *unfair* disparities among equally needy individuals are said to be even more deleterious if they penalize people with worse socioeconomic conditions.

Within this *equal use-per-need* tradition, most empirical studies exploit measures of concentration (e.g., Concentration index, Gini) to

[2] For the application of inequality metrics to local poverty indicators, see, among all, Andreoli et al. (2021).

[3] Not surprisingly, decomposition procedures have also been proposed for utilization-based approaches to equity in health/health care (Wagstaff et al., 2003; Carrieri and Jones, 2018).

[4] For a review on the theoretical and empirical literature on health care equity, see Allin et al. (2007) and Abatemarco et al. (2023).

quantify the distance between observed disparities in health care and those that would have been observed if equal health care had been granted to patients with same health needs (Wagstaff et al., 1991). In this framework, it has been shown that concentration metrics used to assess inequality in health care can be decomposed in such a way as to identify the determinants of the observed inequality. For instance, Wagstaff et al. (2003) propose a decomposition strategy to identify the causes of health inequalities (child malnutrition) in Vietnam. Assuming a linear relationship between the variable of interest (health) and its determinants (individual and family characteristics), the authors prove – within a semi-parametric approach – that overall inequality measured by the Concentration index might be expressed as a weighted sum of the Concentration indexes of the regressors (age, gender, parental education, . . .).[5]

Two major traits characterize the application of the horizontal equity principle to health care equity. First, the ideal of equal use-per-need strongly relies on the definition of health needs that is a multi-faceted concept.[6] Second, the equal use-per-need principle is mostly focused on the *utilization* of health treatments, independent from *access* conditions (Allin et al., 2007). As far as utilization (and not access) is concerned, (i) the fundamental disparity between individuals with access to health care and those without access is ignored, and (ii) individual preferences affecting utilization choices (e.g., anti-vaxxers) are implicitly embedded in the equity assessment of the health care delivery.

A second equity approach inspired by the income distribution literature (Roemer, 1993, 1998) has tried to introduce the *responsibility* principle as a relevant factor in assessing health needs and health/health care disparities. Here, a distinction is made between *fair* and *unfair* inequalities based on their origins. Specifically, a separating line is drawn between the set of origins beyond individual control (*circumstance* variables) and those under individual control (*effort* variables). Hence, provided that individual choices might produce or exacerbate health needs (e.g., smoking) or, they might affect the utilization of health services (e.g., anti-vaxxers), the health inequalities originating solely from circumstances are considered unfair.

Empirical studies in this field are mostly based on the implementation of the *counterfactual* approach (Trannoy et al., 2010; Li Donni et al., 2014), that is, on the construction of the *virtual* health/health care distribution that would have been observed under the hypothesis of equal responsible choices (direct fairness) or equal circumstances (direct unfairness).[7] Within this framework, Carrieri and Jones (2018) propose a semi-parametric decomposition strategy to separate the contribution of circumstances from individual effort in determining inequalities in health biomarkers.[8] Given the initial partition of the population into *types* – that is, groups of people sharing the same circumstances – and assuming a linear relationship between effort and health outcomes (biomarkers), they suggest a decomposition of overall health inequality that allows disentangling: (i) the direct effect of circumstances, (ii) the indirect effect that circumstances exert through their influence on effort, and (iii) the contribution of effort variables.

Although there is a general agreement about the identification of *circumstances* (demographic, ethnic and socioeconomic characteristics, . . .), the same cannot be said for the effort dimension, especially in the field of health care equity. Indeed, while it is widely agreed that health care inequalities due to treatment preferences (anti-vaxxers) are fair, it is still an open debate if differences in lifestyle preferences (e.g., smoking) can legitimate unequal utilization of health treatments (Fleurbaey and Schokkaert, 2011).[9] As emphasized by Cappelen and Norheim (2005), the consequences of unhealthy lifestyle preferences like smoking might vary according to other factors lying beyond the individual sphere of control, such as luck and genetic dispositions (e.g., developing lung cancer). The equity principle would therefore neglect, and treat as fair, disparities for which the individual should not be considered fully responsible.

Differently from the two equity principles described so far, a third definition of equity in health care focuses on access opportunities rather than on the utilization of health treatments. In this vein, it is inequality across opportunity sets that matters (Kranich, 1996), so that equity in health care is said to be achieved if access opportunities to care are granted to all citizens (Le Grand, 1982, 1987; Mooney, 1983; Abatemarco et al., 2020b).

Empirical studies in this field are first concerned with the definition of access to health care (Khan, 1992; Culyer and Wagstaff, 1993). As compared to utilization-based approaches, here the focus is on potential access, which concerns the chance for an individual to have a health need satisfied, should a health need emerge. Once access is defined, equity in health care is measured *sic et simpliciter* in terms of inequality of access to care, which is usually referred to as inequality of opportunity in health care.

Such perspective – Rawlsian in spirit – allows identifying the primary disparity between individuals having access to care and those having not, which is often disregarded in utilization-based approaches. Moreover, the focus on the opportunity set singles out unfair disparities because it purifies the *equalizandum* from both lifestyles and treatment preferences.

In this paper, we embrace this latter perspective, proposing a (fully) non-parametric estimation strategy to assess access opportunities and related inequalities in the population. Most importantly, we propose a decomposition procedure by which the determinants of inequality of access are identified. To our knowledge, this is the first attempt to obtain policy-relevant information within the access-based approach by means of the decomposition of overall inequality.

3. Methodology

3.1. Notations

Let $\Theta = \times\Theta_{k=1}^{m}$ be the space of individual characteristics that, given the features of the health care delivery (e.g., spatial distribution of health care providers) and other more general aspects of the economy (e.g., transportation system), affect the out-of-pocket cost an individual would bear to actually have a need for care fulfilled (hereafter cost of access) . Characteristics may include both factors within and beyond individual control (e.g., place of living, age, assistance needs) that are treatment-specific.[10] We refer to both direct and indirect costs of access (e.g., health care fees and transportation expenses, respectively), while excluding opportunity costs (e.g., illness-related earnings loss).

A vector $\theta_i \in \Theta$ is a point in the Θ-space fully characterizing the ith group of individuals sharing the same characteristics. Let $\theta = \{\theta_i\}_{i=1}^{n}$

[5] For the sake of completeness, the authors also compare different decomposition strategies to identify the main determinants of changes in health inequality over time.

[6] The health economics literature suggests defining health needs as either (i) current health status; (ii) capacity to benefit from health care, (iii) health care necessary to achieve equality of health; or (iv) health care required to exhaust capacity to benefit (Culyer and Wagstaff, 1993).

[7] For a review of these estimation strategies, see Ramos and Van de Gaer (2016).

[8] The authors consider as circumstances beyond individual control (i) age class, (ii) gender, (iii) educational level, and (iv) place of living, whereas effort includes (i) smoking, (ii) alcohol frequency and intensity, and (iii) dietary habits.

[9] E.g., whether priorities in the delivery of health treatments can be motivated by individual responsibility.

[10] Characteristics should not be confused with “types” that refer to only those factors beyond individual control (e.g., Li Donni et al., 2014); the place of living, for instance, is affected by both responsible choices and circumstances (Agyeman et al., 2016).

be the set of such groups defining a disjoint and exhaustive partition of the entire population. Individuals belonging to a given group, θ_i, or populating a partition, are pooled together because their situation is identified by the same point in the space of characteristics (for example: they live in the same place, they have the same assistance needs, and so on). Remarkably, a given cost of access to health care is associated to each group in case a health need emerges.

Let $\hat{H}$ be the set of all health care providers of the NHS supplying a given health treatment. We indicate by $H \subset \hat{H}$ the sub-set of health care providers granting adequate quality of the treatment under investigation. As for adequacy assessments, one may consider official statistics that report, for each of the health treatments, (i) the list of relevant quality indicators to be considered, (ii) the cut-off point for each quality indicator fixed by the health authority, and (iii) the performance of each health care provider relative to the cut-off.[11] Remarkably, quality indicators are expected to be affected, among all, by waiting lists both directly (e.g., days from referral to treatment) and indirectly (e.g., readmissions/mortality rates).

We write $C(\Theta|H) = \{c(\theta_1|H), c(\theta_2|H)\dots, c(\theta_n|H)\}$ to denote the distribution of the minimum cost of access to a health treatment of adequate quality, that is, the minimum cost that individuals in the ith group must bear to obtain the health treatment under consideration. Differently, $C(\Theta|\hat{H}) = \{c(\theta_1|\hat{H}), c(\theta_2|\hat{H})\dots c(\theta_n|\hat{H})\}$ is the corresponding distribution of the minimum cost of access to a generic health care provider – usually the nearest – independently from the quality level of supplied care (also referred to as the *cheapest* health care provider). To simplify notations, in what follows we write $c_i = c(\theta_i|H)$ and $\hat{c}_i = c(\theta_i|\hat{H})$ to indicate the cost associated to group i in $C(\Theta|H)$ and $C(\Theta|\hat{H})$, respectively. Clearly, $c_i \geq \hat{c}_i$ with $c_i = \hat{c}_i$ if, and only if, the cheapest provider for group i supplies health treatments of adequate quality. Finally, we define the average cost of access to a health treatment (independently from quality standards) as $\hat{c} = (1/n)\sum_{i=1}^{n}\hat{c}_i$.

For each individual j populating group i, we define the health spending capacity, y_{ij}, as the overall value of the assets the patient can readily employ to bear out-of-pocket expenses in case of need (hereafter spending capacity). Patient's spending capacity for out-of-pocket expenditures in health care is somehow indicated as "ability to pay" or "capacity to pay" (Levesque et al., 2013; OECD, 2019).[12] Hence, $y_i = (y_{i1}, y_{i2}, \dots, y_{in_i})$ indicates the spending capacity distribution associated to n_i individuals belonging to the ith group. Group-specific and overall average spending capacity are defined as, respectively, $\mu_i = (1/n_i)\sum_{j=1}^{n_i} y_{ij}$ and $\mu = (1/N)\sum_{i=1}^{n}\sum_{j=1}^{n_i} y_{ij}$, with $N = \sum_{i=1}^{n} n_i$.

3.2. Measuring potential access

Before health needs emerge, an individual j in the ith group is said to have potential access to a health treatment of adequate quality if they can afford it, that is, if the out-of-pocket cost of access is not greater than their spending capacity, that is, $c_i \leq y_{ij}$.

If one considers all the individuals populating the ith group, the proportion of individuals (*frequency*) for whom access to a health treatment of adequate quality is denied corresponds to the headcount ratio (q_i/n_i), where q_i is the number of individuals with no access in the ith group. In addition, the *intensity* of the lack of access can be measured by the magnitude of the average *per capita* transfer required to grant universal access in the ith group; that is, $\left((1/q_i)\sum_{j=1}^{q_i}(c_i - y_{ij})\right)$.

Hence, by drawing from the wide literature on poverty measurement (Blackwood and Lynch, 1994), given the ith partition populated by individuals $j = 1,\dots n_i$, we define the Access Gap index, A_i, as follows

$$A_i = \frac{1}{n_i}\sum_{j=1}^{n_i}\max\left(c_i - y_{ij}, 0\right) = \left(\frac{q_i}{n_i}\right)\left(\frac{1}{q_i}\sum_{j=1}^{q_i}(c_i - y_{ij})\right) \tag{1}$$

This index accounts for both the frequency and the intensity of the *potential* lack of access in the ith group, which is our money measure of access (dis)opportunities, or access risk, for an individual belonging to the ith group.

Intuitively, the Access Gap, A_i, measures the *absolute* amount of financial resources that should be allocated, on average, to the ith group in order to grant universal access in that group. In this sense, the access risk for an individual in the ith group is measured by the distance from the policy target, that is universal access. Notice that, by normalizing the Access Gap index by c_i, *relative* versions of the same index can be obtained (Foster et al., 1984). Here, the money metric, that is, the absolute version, has been preferred because it facilitates the intelligibility for policy purposes, providing immediate information on the money transfer required to achieve universal access at the group level.[13]

The Access Gap index in (1) satisfies the following normative and statistical properties: (i) focus (i.e., invariance to income variations above the cost of access), (ii) income monotonicity, (iii) cost monotonicity, (iv) anonymity, (v) translation invariance, (vi) population invariance, and (vii) additive subgroup decomposability. Formal statements of these properties are reported in Appendix. Remarkably, from (i) and (ii), it follows that within-group (non re-ranking) rich-to-poor transfers of spending capacity, from an individual with access to one without, must reduce the Access Gap.

In addition, the Access Gap index in (1) is additively decomposable by factors (sources), in that it can be rewritten as the sum of Access Gaps calculated when single factors contributing to the overall Access Gap are considered separately.

(viii) *Additive Factor Decomposability*: given $g_{ij} = (c_i - y_{ij})$, let g_{ij}^k be the contribution of factor $k = (1,\dots,K)$ to g_{ij} $\forall\, j$ such that $g_{ij} = \sum_{k=1}^{K} g_{ij}^k > 0$, then $A_i = \sum_{k=1}^{K} A_i^k$ with $A_i^k = (1/n)\sum_{j=1}^{q_i} g_{ij}^k$.

This property is naturally satisfied in our framework, for we opted for measuring the risk of access to adequate care in terms of *affordability* once formal and informal barriers to access are opportunely monetized. Among all of the properties, *factor decomposability* is particularly relevant for our purposes because, as discussed in the next section, it allows quantifying the contribution of different possible determinants to the observed inequality of access.

Last but not least, the Access Gap index, A_i, is *transfer independent*, that is, it is unaffected by rich-to-poor transfers among individuals for whom access to the health treatment is denied.

(ix) *Transfer Independence*: let (y_i, y_k) be two spending capacity distributions such that $y_{ij} = y_{kj}$ $\forall\, j \neq v, z$, provided that $y_{iv} < y_{iz} \leq c_i$ and $y_{kv} < y_{kz} \leq c_k$, if $y_{iv} = y_{kv} + \delta$, $y_{iz} = y_{kz} - \delta$ with $\delta > 0$, then $A_i = A_k$.

This property implies that a transfer of spending capacity from an individual with no access to the treatment (of adequate quality) to another individual with a lower spending capacity is useless as far as access is still denied to both. Even if this property is not necessarily required in the field of poverty analysis, it suits, instead, the measurement of access to health care. Intuitively, in the field of poverty, rich-to-poor

[11] Official statistics on the quality of health treatments are increasingly available for health systems, at least in advanced economies (e.g., the Programma Nazionale Esiti (PNE) in Italy, the National Healthcare Quality and Disparities Report (NHQDR) in the United States, Quality and Safety Indicators (QSI) in France, …).

[12] The health spending capacity of individuals is widely used in the field of catastrophic health expenditure (Xu et al., 2003; Kumar et al., 2012).

[13] For a review on the debate between relative and absolute poverty metrics, see Blackorby and Donaldson (1980), Foster and Shorrocks (1991) and Zheng (1994).

income transfers among poor recipients may reasonably alleviate the overall intensity of poverty conditions, in that the cost of the transfer for the "less poor" (donor) is expected to be more than compensated by the benefit for the "poorer" individual (recipient). In our framework, instead, provided that access to care is still denied after the transfer, rich-to-poor transfers (of spending capacity) among individuals without access to adequate health care do not ameliorate access conditions at all because access is still denied for both the donor and the recipient. In this sense, as far as rich-to-poor transfers among individuals having no access (i) do not alter the amount of overall spending capacity required to achieve universal access, and (ii) do not induce better access conditions in the society, *transfer independence* seems to be a natural starting gate for the measurement of access to care.

Compared to poverty measurement, it is also worth observing that the cost of access in (1), c_i, is not exogenously given in a policy perspective. Hence, access opportunities may be ameliorated by both/either reducing the cost of access and/or increasing individuals' spending capacity. This implies that universal access may be alternatively, or even jointly, pursued through both health care supply and income/wealth distribution policies.

3.2.1. Decomposing the access gap

In what follows, we propose a factor decomposition of the Access Gap (1) into four different determinants. Two concern the supply of health care services and are related to the cost of access; the other two pertain to demand factors and are related to the health spending capacity. Specifically, we consider the following decomposition,

$$A_i = A_i^1 + A_i^2 + A_i^3 + A_i^4 = \\ = \left(\frac{q_i}{n_i}(c_i - \hat{c}_i)\right) + \left(\frac{q_i}{n_i}(\hat{c}_i - \hat{\bar{c}})\right) + \\ + \left(\frac{q_i}{n_i}\sum_{j=1}^{q_i}\frac{\hat{\bar{c}} - \tilde{y}_{ij}}{q_i}\right) + \left(\frac{q_i}{n_i}\sum_{j=1}^{q_i}\frac{\tilde{y}_{ij} - y_{ij}}{q_i}\right) \tag{2}$$

where $\tilde{y}_i = (\tilde{y}_{i1}, \tilde{y}_{i2}, \dots \tilde{y}_{in_i})$ with $\tilde{y}_{ij} = (\mu/\mu_i)y_{ij}$ is the *counterfactual* spending capacity distribution in the ith group, which is obtained by rescaling the corresponding actual distribution, y_i, under the hypothesis of equally distributed average spending capacity across groups. Basically, the counterfactual spending capacity associated to the jth individual in the ith group, $\tilde{y}_{ij}$, indicates the spending capacity they would have be endowed with if, holding inequality fixed, the average spending capacity in their group were the same as the one of the population as a whole. It turns out that group-specific counterfactual distributions of spending capacity can differ from each other exclusively in terms of inequality, not on average.

As for the factor decomposition in (2), we first observe that each of the four components is *weighted* by the headcount ratio, (q_i/n_i), which accounts for the share of individuals in the ith group having no access to the health treatment of adequate quality.

The first two components, A_i^1 and A_i^2, estimate the impact of two different cost-related determinants, or supply factors, on the access risk borne by an individual belonging to the ith group.

A_i^1 is the contribution to the Access Gap, A_i, of local productive inefficiencies, intended as the extra cost of access, $(c_i - \hat{c}_i)$, that an individual in the ith group must bear to receive a health treatment of adequate quality at the cost of access c_i when the cost of access to the cheapest (usually, the nearest) provider is $\hat{c}_i$. Hence, this component measures the increase in the cost of access originating from the existence of health care providers that, even if supplying the treatment of interest, do not grant an adequate quality. Remarkably, $A_i^1 = 0$ if either universal access in the ith group is granted ($q_i = 0$) or the cheapest health care provider supplies a health treatment of adequate quality ($c_i = \hat{c}_i$).

A_i^2 is the contribution to the Access Gap, A_i, of the difference between the minimum cost of access for individuals in the ith group ($\hat{c}_i$) and the average minimum cost of access calculated for the entire population ($\hat{\bar{c}}$). This value is positive (resp. negative) when, independently from the quality of the treatment of interest, individuals in the ith group are penalized (resp. advantaged) with respect to the rest of the population; for example, due to the lack of health care providers supplying that treatment in a territory, the minimum cost of access may be greater for its inhabitants. Hence, this second component mostly concerns the geographic distribution of health care providers, and it is an extra cost in the case of relatively lower supply of the treatment of interest for individuals in the ith group; conversely, it is an extra benefit, or equivalently a negative extra cost, in the case of relatively higher supply with respect to the rest of the population. As compared to the previous cost-related component, A_i^1, here it is the lack, rather than the productive inefficiency, of existing health care providers that matters. Remarkably, $A_i^2 = 0$ if either universal access in the ith group is granted ($q_i = 0$), or the cost of access to the health care treatment supplied by the cheapest health care provider is the same as the average cost (i.e., $\hat{c}_i = \hat{\bar{c}}$).[14]

The other two components account for the lack of access to treatments of adequate quality originating from limited spending capacity across groups in the population, that is, from demand factors.

A_i^3 measures the contribution to the Access Gap, A_i, of inequality in the ith distribution of spending capacity (i.e., within-group inequality). Formally, given the average cost of access to health treatments provided by the cheapest providers ($\hat{\bar{c}}$), the greater is inequality in the actual spending capacity distribution of the ith group (y_i)—that is, by construction, the same as inequality in the corresponding counterfactual spending capacity distribution ($\tilde{y}_i$)—the lower is the spending capacity one is expected to observe among those having no access to care.[15] Intuitively, the lack of access to care is expected to be observed more frequently and more intensively in societies characterized by greater inequality of spending capacity. Remarkably, the contribution of the A_i^3 component to the overall Access Gap, A_i, is zero if either the counterfactual spending capacity distribution of the ith group, $\tilde{y}_i$, is egalitarian for those having no access with $\hat{\bar{c}} = \tilde{y}_{ij}$,[16] or access is universally granted in the ith group, so that $q_i = 0$.

A_i^4 is the gap between the counterfactual and the actual spending capacity of each individual with no access to the treatment in the ith group. It can be easily reformulated so as to highlight the gap between the counterfactual and the actual average spending capacity held by individuals with no access to the treatment of adequate quality in the ith group. Hence, this component captures the impact of the rescaling transformation used to obtain the counterfactual spending capacity distribution from the actual one, that is, the contribution to the access gap of poor average spending capacity for individuals in the ith group as compared to the rest of the population. In a sense, while the A_i^3 component quantifies the contribution to the Access Gap of within-group inequality of spending capacity, the A_i^4 component measures the impact of between-group inequalities in the population. Such contribution is negative (positive) when $\mu_i > \mu$ ($\mu_i < \mu$), and it is zero if either the average health spending capacity in the ith group is the same as the national one ($\mu_i = \mu$) or access is universally granted in the ith group ($q_i = 0$).[17]

Summing up, the factor decomposition is implemented in our framework to assess how much productive inefficiencies (A_i^1), undersupply

[14] In the latter case, the supply of health care providers would be neither penalizing nor advantaging individuals in the ith group with respect to the rest of the population.

[15] It can be shown that $A_i^3 = \frac{q_i}{n_i}\hat{\bar{c}} - \mu L(\frac{q_i}{n_i})$ where $L(\cdot)$ is the Lorenz curve of the original (or, equivalently, counterfactual) spending capacity distribution. Hence, given a fixed headcount ratio, (q_i/n_i), the A_i^3 component is lower the larger is the share of spending capacity held by individuals without access to health treatments of adequate quality.

[16] This would not imply that access is universally granted according to the actual spending capacity distribution of the ith group, and vice versa.

[17] This is straightforward from $A_i^4 = (\frac{\mu - \mu_i}{n_i \mu_i})\sum_{j=1}^{q_i} y_{ij}$.

of health care providers (A_i^2), and within-group and between-group inequalities of spending capacity (A_i^3 and A_i^4, respectively) contribute to the lack of access observed in the ith group.

From the factor decomposition in (2), the proportional contribution to the Access Gap of each factor can be measured both at the group and at the national level. At the group level, given $k = (1, \ldots, 4)$, $a_i^k = (A_i^k / A_i)$ identifies the proportional contribution of the kth factor to the Access Gap in the ith group ($\sum_{k=1}^4 a_i^k = 1$). As for the national level, instead, let $\mathbf{A} = \sum_{i=1}^n \sum_{k=1}^4 A_i^k$ be the Access gap index for the entire population, which is the amount of financial resources that should be allocated, on average, to the entire population to grant universal access at the national level. Hence, $\mathbf{a}^k = \frac{\sum_{i=1}^n A_i^k}{\mathbf{A}}$, with $\sum_{k=1}^4 \mathbf{a}^k = 1$, is the proportional contribution of the kth factor to the national Access Gap, $\mathbf{A}$.

3.3. The measurement of inequality of access

The identification of the contribution of each factor to the Access Gap observed in the ith group is not only relevant *per se* but, provided that the same indicator is computed for all groups in the population, it is additionally important for a better understanding of the origins of unequal opportunities of access to adequate health care across groups. Indeed, because the Access Gap index measures the potential (lack of) access in terms of a *monetary* distance between real and universal access conditions in the ith group, the factor decomposition in (2) resembles the standard income (i.e., monetary) decomposition by sources implemented in the field of inequality measurement (Shorrocks, 1982; Lerman and Yitzhaki, 1985; Shorrocks, 2013).

Formally, given the definition of the Access Gap index in (1) for a single group of the population, let $A = (A_1, \ldots, A_n)$ be the vector of increasingly ordered Access Gaps associated to the disjoint and exhaustive partition of the entire population into n groups. Inequality of access to health care across groups can be measured by taking any inequality metric. As far as the factor decomposition of the inequality metric is crucial for our analysis, we opt for Generalized Entropy measures and the Gini index, which are known to be additively decomposable by sources. Next, these two metrics are used to implement the Shapley decomposition for the same purposes.

Generalized entropy measures

Let $\mu(A)$ indicate the mean Access Gap obtained from the vector of Access Gaps, $A = (A_1, \ldots, A_n)$. The generalized class of entropy measures calculated across Access Gaps, $(A_1, \ldots, A_n)$, is defined as follows

$$GE(\alpha) = \begin{cases} \dfrac{1}{n\alpha(\alpha-1)} \displaystyle\sum_{i=1}^n \left(\left(\frac{A_i}{\mu(A)} \right)^\alpha - 1 \right) & \alpha \neq 0, 1 \\ \dfrac{1}{n} \displaystyle\sum_{i=1}^n \frac{A_i}{\mu(A)} \ln \frac{A_i}{\mu(A)} & \alpha = 1 \\ -\dfrac{1}{n} \displaystyle\sum_{i=1}^n \ln \frac{A_i}{\mu(A)} & \alpha = 0 \end{cases} \quad (3)$$

Provided that each Access Gap index, i.e. for each group, is constructed in such a way as to quantify (dis)opportunities of access to care (of adequate quality) for individuals in that group and that $GE(\alpha)$ measures the disparities between Access Gaps of different groups, it must be the case that $GE(\alpha)$ is a measure of inequality of opportunity in health care across groups of the population.

Notably, the parameter α regulates the weight given to pairwise inequalities at different parts of the increasingly ordered vector of Access Gaps, $A = (A_1, \ldots, A_n)$; the greater is α, the more the index is sensitive to variations of high Access Gaps, that is, inequality increases more when a high Access Gap increases (e.g., A_n). Vice versa, the lower is α, the more the index is sensitive to low Access Gaps, that is, inequality increases more when a low Access Gap decreases (e.g., A_1).

Several well-known inequality metrics can be obtained from generalized entropy measures by using different values of α (e.g., the mean log deviation index for $\alpha = 0$, the Theil index for $\alpha = 1, \ldots$). In this paper, we restrict our attention to $GE(2)$, which is known to be half the square Coefficient of Variation (CV), that is,

$$GE(2) = \frac{1}{2} \frac{\sigma^2(A)}{(\mu(A))^2} = \frac{1}{2} CV^2 \quad (4)$$

This decision is driven by reasons of expediency since some of the factor-components, A_i^k, might go reasonably negative,[18] so that both log transformations and odd exponents would not be applicable for our purposes. This clearly excludes all parameters such that $\alpha < 0$, as well as $\alpha = 0$ and $\alpha = 1$, with the CV being the only renowned entropy index matching our framework.

Define the vector $A^k = (A_1^k, \ldots, A_n^k)$ with A_i^k indicating the contribution of the kth component to the Access Gap in the ith group. By definition of variance

$$\sigma^2(A) = \sum_{k=1}^4 \sigma^2(A^k) + \sum_{j \neq k} \sum_{k=1}^4 \rho_{jk} \sigma(A^j) \sigma(A^k) \quad (5)$$

where ρ_{jk} is the correlation coefficient between the vectors A^k and A^j. Notice that, as far as ρ_{jk} can be also negative, $\sum_{k=1}^4 \sigma^2(A^k)$ might be greater than $\sigma^2(A)$, implying that some factor(s) is (are) reducing the overall variance.

Hence, if $\rho_{jk} = 0 \ \forall \ j, k$, then the decomposition of overall inequality would be simply obtained by considering the variances originating from each of the four component distributions $\sigma^2(A^k)$. Instead, if $\exists \ j, k \ : \rho_{jk} \neq 0$, as shown in Shorrocks (1982), the "natural" decomposition of the variance assigns to factor k half the value of all the interaction terms involving this factor. The contribution of factor k then becomes

$$\sigma^2(A^k) + \sum_{j \neq k} \rho_{jk} \sigma(A^j) \sigma(A^k) = Cov(A, A^k) \quad (6)$$

Hence, it follows that the CV is factor decomposable as follows:

$$CV = \sum_{k=1}^4 \frac{Cov(A, A^k)}{(\mu(A))^2} \quad (7)$$

so that the proportional k-factor contribution to overall inequality of access (to be not confused with the k-factor contribution to the Access Gap, a_i^k, defined above) is

$$CV_k(\%) = \frac{Cov(A, A^k)}{\sigma^2(A)} \quad (8)$$

that sum up to unity for all factors.

Gini index

Let $A = (A_1, \ldots, A_n)$ be the increasingly ordered distribution of Access Gaps associated to n cells. Following Stuart (1954) and Kakwani (1980), the Gini index can be defined with respect to the covariance between Access Gaps and group ranks (in terms of Access Gap) so that

$$G = \frac{2Cov(F(A), A)}{\mu(A)} \quad (9)$$

where $\mu(A)$ and $F(A)$ indicate, respectively, the mean and the cumulative distribution (rank). Remarkably, as shown by Lerman and Yitzhaki (1985), the Gini coefficient can be factor-decomposed as follows:

$$G = \frac{\sum_{k=1}^4 2Cov(F(A), A^k)}{\mu(A)} \quad (10)$$

[18] For instance, as far as the component A_i^2 in (2) consists of a mean deviation, at least one negative value of A_i^2 must exist, except for the case of a perfectly egalitarian distribution of $\hat{c}$. For similar motivations, negative values are expected for the A_i^4 component as well.

where $Cov(F(A), A^k)$ is the covariance between the cumulative distribution, $F(A)$, and the k-factor contributions, $A^k = (A_1^k, \dots, A_n^k)$.

Through easy algebraic calculations, the k-factor contribution can be further decomposed in terms of the product of three components:

$$G = \sum_{k=1}^{4} \left(\frac{Cov(F(A), A^k)}{Cov(F(A^k), A^k)} \right) \left(\frac{2Cov(F(A^k), A^k)}{\mu(A^k)} \right) \left(\frac{\mu(A^k)}{\mu(A)} \right) = \sum_{k=1}^{4} (R_k G_k S_k) \tag{11}$$

where R_k is the correlation between the k-factor contribution, A^k, and the Access Gap, A; G_k is the Gini calculated with respect to the k-factor contribution, A^k[19]; S_k is the k-factor share.

From the Gini decomposition in (10), the proportional k-factor contribution to overall inequality of access is then defined as

$$G_k(\%) = \frac{Cov(F(A), A^k)}{Cov(F(A), A)} \tag{12}$$

that sum up to unity for all factors.

Two major differences can be highlighted with respect to the CV. First, the Gini index is rank-dependent (Atkinson, 1970); hence, rich-to-poor redistribution is more inequality-reducing according to the Gini when occurring between the top- and low-ranked groups, whereas only the monetary values of the Access Gaps matter for the CV. Second, the CV is known to be much more sensitive than the Gini to variations of top values (Cowell and Falchaire, 2007); hence, the contribution of a factor is over-estimated by the CV (with respect to the Gini) when this is highly positive in groups with higher Access Gaps.

Shapley decomposition

Despite the vast use of inequality metrics decomposable by sources, a new methodology based on some concepts of the cooperative game theory has spread in the economic literature related to decomposition analysis. This technique, known as the *Shapley decomposition*, estimates the relative importance of different factors affecting the aggregate statistical indicator of interest, applying a procedure formally equivalent to the *Shapley value* (Shorrocks, 2013).

Basically, this procedure consists of calculating the marginal impact of dropping each factor in sequence and then averaging the marginal effects obtained, considering all of the possible dropping sequences. For the desirable properties in terms of intuitive interpretation, as well as for the exact additivity of the contributory terms, the Shapley decomposition has attracted a large interest for its applicability to both factor- and subgroup-decomposition procedures.[20]

Recall the increasingly ordered distribution of Access Gaps associated to n groups, $A = (A_1, \dots, A_n)$, and the k-factor contributions, $A^k = (A_1^k, \dots, A_n^k)$ with $k = (1, \dots, 4)$. Given a generic inequality index $I : \Re_+^n \rightarrow \Re$, let $\sigma = (\sigma_1, \dots, \sigma_m)$ be the order in which factors are removed and $S(\sigma_r, \sigma) = \{\sigma_i | i > r\}$ be the set of factors that remain after factor σ_r has been excluded. Considering altogether the $m!$ possible elimination paths $[\Sigma]$, and then averaging the marginal effects of adding factor k to the set S, denoted by $\Delta_k I(A|S)$, the Shapley decomposition allows disentangling the expected marginal contribution of the k factor to the overall level of inequality of access, that is,

$$C_k = \frac{1}{m!} \sum_{\sigma \in \Sigma} C_k^{\sigma} = \frac{1}{m!} \sum_{\sigma \in \Sigma} \Delta_k I\left(A | S\left(k, \sigma\right)\right) \tag{13}$$

Hence, the proportional k-factor contribution to overall inequality of access is

$$C_k(\%) = \frac{C_k}{I(A)} \tag{14}$$

that sum up to unity for all factors.

4. An application to breast cancer surgery in Italy

In the remainder of the paper, we illustrate with a simple example how our methodology can be applied. To this end, we consider a single health treatment, breast cancer surgery, and focus on Italian data. The case of breast cancer surgery is of particular interest, for breast cancer is the most common cancer among women; it represents about 30% of all female cancer diagnoses in Italy (AIOM and AIRTUM, 2020) . Moreover, as reported by AGENAS, the Italian National Agency that supervises the performance of the National Health Service (NHS), about 13.50% of total hospital admissions in 2017 occurred in regions different from the one in which the patient resided, which clearly affects the cost of access to treatment.[21] As the exercise performed here is intended to be merely illustrative of the proposed methodology, we rely only on one characteristic affecting access opportunities, that is, the region of residence. Indeed, our methodology can cope with more (and not necessarily geographic) variables for the construction of the initial partition of the population.[22]

4.1. Data

The Italian NHS allows patients to be treated anywhere in Italy, irrespective of their place of residence. However, because the Italian health system is decentralized at the regional level, the quality of care might vary sensibly among the pool of health care providers located in different areas of the country and across different types of treatments. As for the adequacy of breast cancer care, the Italian Ministry of Health lists the relevant quality indicators and related cut-off points, providing official statistics for all the health facilities delivering the surgical treatment of interest, which is breast cancer surgery (Programma Nazionale Esiti, AGENAS). Such indicators include, among others, the volume of activities, readmissions and proportion of simultaneous breast reconstructions during mastectomy, which is the surgical intervention that removes the entire breast (see Appendix A.2.1 for a detailed description of the indicators and related cut-off points). According to the data, in 2017, only eight of the 490 hospitals delivering breast cancer surgery respected all of the quality standards selected for our illustrative exercise.[23] Fig. 1a illustrates the number of health care providers by province, whereas Fig. 1b shows where the hospitals providing adequate treatment are located. As is evident from the maps,

[19] Notice that the vector of k-factor contributions, A^k, may include negative values as well. Hence, the Gini index, G_k, loses the normalization property because it is known to be no longer bounded between 0 and 1 (Chen et al. 1982; Berrebi and Silber, 1985).

[20] As for the decomposition in terms of within-group and between-group inequality, it has been shown that the Shapley decomposition satisfies path independence, in that the within-group inequality component does not depend on between-group inequality, a property only satisfied by the mean log deviation index among all other generalized entropy measures (Foster and Shneyerov, 2000; Shorrocks, 2013).

[21] More in general, a large flow of patients going from southern to northern regions in search of better quality health treatments has been observed (Levaggi and Zanola, 2004; Fabbri and Robone, 2010; Beraldo et al., 2023).

[22] Especially for health treatments excluded by the essential levels of health assistance (Livelli Essenziali di Assistenza, or LEA), the chance of access to adequate treatments might be extremely sensitive to characteristics other than the place of living like urbanization, personal attitudes and psychological traits, transparency and education, … (Levesque et al., 2013; Perucca et al., 2019).

[23] In the attempt to provide insights into how our methodology applies, we opted for a particularly severe perspective by which only the health treatments satisfying all of the quality indicators are considered adequate.

although health care providers are evenly distributed across Italian provinces, those delivering treatment of adequate quality are not.

After considering the quality of health care providers delivering breast cancer surgery in Italy, we need two other pieces of information to assess the risk of denied access. On the one hand, we need the minimum cost of access that individuals should bear to receive the treatment, which is immediately affected by the supply-side of the health care market. On the other hand, we need the health spending capacity distribution in the population of interest, which reflects the potential purchasing power of individuals characterizing the demand of health care services. Indeed, access to a treatment of adequate quality may not be (potentially) affordable for some individuals because (i) the out-of-pocket cost of access is too high, especially when boosted by mobility costs; (ii) the health spending capacity of all – or some of – the individuals populating a group is low, which is more likely to occur when income and wealth are unequally distributed at the regional and national level.

Out-of-pocket cost of access

As for the costs of access, even though the Italian NHS provides breast cancer treatment and surgery to anyone in need, a considerable amount of out-of-pocket expenses is generally sustained by oncology patients. These charges significantly affect patient consumption patterns (Mennini and Marcellusi, 2019). Out-of-pocket costs are mainly related to (a) transportation and accommodation, (b) physician consultations, (c) diagnostic tests, and (d) non-oncology drugs.

We assume that the only relevant characteristic distinguishing each group of individuals from any other in terms of out-of-pocket cost of access is the geographic location (i.e., the region of residence of the individual). Hence, we consider twenty groups corresponding to the twenty Italian regions. For each group, we compute the costs of mobility (a), given by the sum of transportation and accommodation costs. We calculate transportation costs by car from any region of residence to the health care providers satisfying quality standards, and then add the accommodation costs for the days of average hospital stay. As for the other expenses described above – from (b) to (d) –, we take information from a survey aimed at assessing breast cancer costs borne by Italian households (LILT, 2008). Additional details of cost computation are reported in Appendix A.2.2.

The map in Fig. 1c displays the distribution of the cost of access to breast cancer surgery of adequate quality associated to each group. Such cost is significantly different across Italian regions. In particular, it is higher for people living either in southern regions or in the extreme north.

Health spending capacity

To compute disparities in access opportunities, it is also necessary to consider the distribution of spending capacity available to potential patients, which may be remarkably different from the simple distribution of income. Indeed, someone with a health care need may either use their wealth (past savings) or receive additional resources from other members of the social networks they belong to (family, friends, and so on). With these considerations in mind, to estimate the spending capacity of an individual we use data provided by the Survey of the Bank of Italy on Household Income and Wealth (Bank of Italy, 2015). Starting from these data, we estimate – for each individual populating our groups – the amount of financial resources beyond the subsistence level that can be possibly used in case of need, given the household's income. We then add to this amount of resources the whole family savings and other immediately available financial assets (for more detail, please see Appendix A.2.3).

Given our computation of the (individual) spending capacity distribution in each region, the map in Fig. 2 displays the average values. The Figure highlights spatial disparities that confirm the well-known north–south gradient in income and wealth distributions.

4.2. Results

Given ith distribution of health spending capacity, $y_i = (y_{i1}, \dots, y_{in_i})$, as well as ith cost of access associated to each region ($i = 1, \dots, 20$), c_i, we compute the Access Gap index (1). Results are reported in Table A.1 in the Appendix. This index measures the risk for an individual to have no access to an adequate treatment in case of need, conditional on where they live (region). Noteworthily, it implicitly accounts for the quality of treatments as the cost of access is immediately affected by the quality-based ranking of the hospitals delivering breast cancer surgery discussed above. A graphical illustration of the Access Gap index in each region is shown in Fig. 3. Provided that the Access Gap index in (1) is equivalent to the product between the headcount ratio (q_i/n_i), and the average *per capita* transfer required to grant universal access $\left((1/q_i)\sum_{j=1}^{q_i}(c_i - y_{ij})\right)$, in Fig. 3b and 3c we also plot these two components for each region. As discussed in Section 3.2, this decomposition allows to quantify the two ingredients of the Access Gap which concern the number of individuals for whom access is denied (frequency) and the money investment required to grant access (intensity).

Our computations highlight that the Access Gap is sensibly higher in southern regions (Fig. 3a), especially in Campania. This result is driven by the probability that a randomly chosen person does not have access to a breast cancer surgery of adequate quality (Fig. 3b). This probability is about 25% in southern regions and about 15% in northern ones (see column 2, Table A.1 in the Appendix). Moreover, the intensity of the lack of access (Fig. 3b), given by the amount of financial resources people who do not have access need to fill the gap, on average, is slightly higher in southern regions than in northern ones (respectively 1,750 versus 1,726 euro according to column 3, Table A.1 in the Appendix).

As emphasized in Section 2, a finer decomposition of the Access Gap in each group allows determining the contribution to the Access Gap of four factors; two of whom are related to supply-side conditions (i.e., the cost of access), whereas the other two concern the demand-side (i.e., the health spending capacity). Table A.2 in the Appendix reports the results of the decomposition exercise that are graphically represented in Fig. 4. Specifically, Table A.2 presents the absolute values of each Access Gap factor, as they are computed by applying the decomposition in (2), whereas Fig. 4 displays the relative contribution, in percentage points, of each factor to the *local* Access Gap, a_i^k.

On the supply-side, it is evident that productive inefficiencies of local health care providers – whose proportional contribution is measured by $a_i^1 = A_i^1/A_i$ (see Section 3.2.1) – cause extra costs for patients in several regions, especially in the south (e.g., 27% in Sicily). According to the results of the present exercise, the under-supply of health care providers, that is, $a_i^2 = A_i^2/A_i$, has a negligible impact on the Access Gap in almost all regions. Recall that a_i^2 measures the penalization (resp. advantage) for individuals in the ith region due to the lower (resp. greater) supply of health care providers on their territory independently from the quality of the treatment, i.e., as if all health care providers ensured an adequate quality of the treatment of interest. Hence, by considering the two supply-side factors together (a_i^1 and a_i^2), we observe that, on average, access limitations are not originating from the lack of health care providers supplying the treatment of interest, but from the inadequate quality of these providers in some territories.

On the demand-side, a huge effect on access conditions is caused by inequality of health spending capacity within each region, which is measured by $a_i^3 = A_i^3/A_i$; remarkably, this effect is found to be extremely relevant in northern regions (e.g., 106% in Emilia Romagna and Lombardy). Conversely, as one may expect for the north–south divide in Italy, the lack of spending capacity ($a_i^4 = A_i^4/A_i$) is found to penalize access to adequate treatments especially in southern regions (e.g., 44% in Sicily, 42% in Sardinia). This is in line with available evidence suggesting that poor households are less likely to seek health care relative to non-poor households, which highlights the vulnerability of the poor in terms of health care availability (Brown et al., 2014).

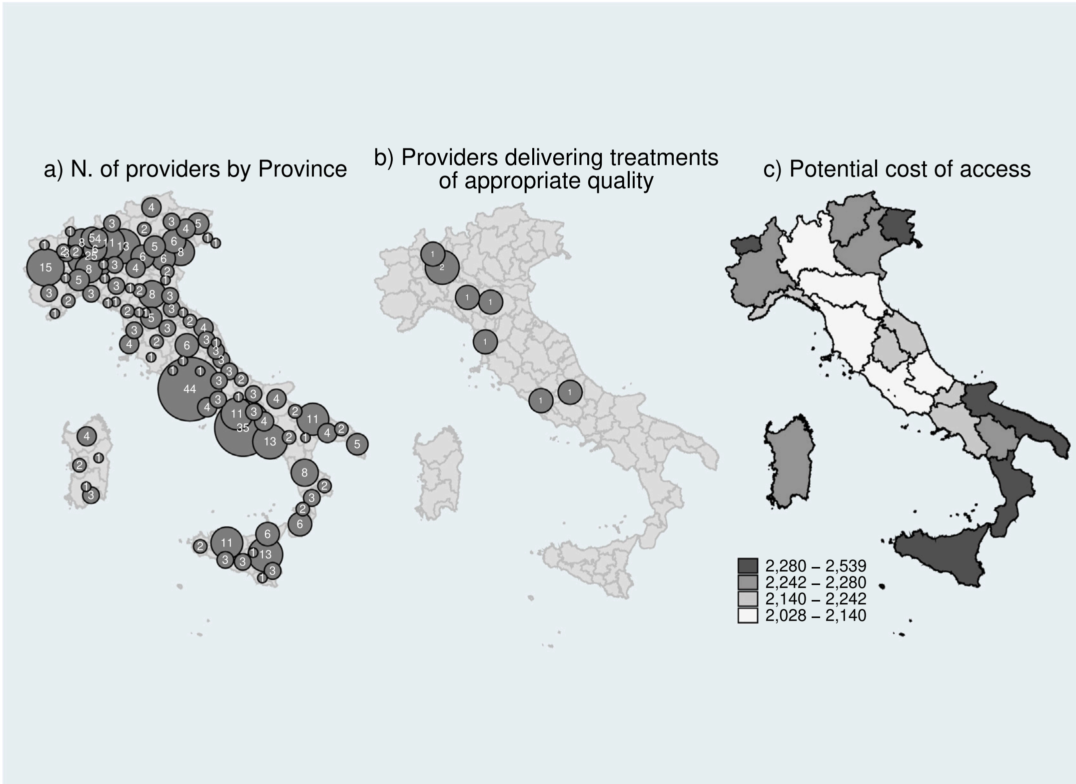

Fig. 1. Geographical distribution of health care providers and related cost of access (€).
Notes: (b) List of providers delivering adequate treatment: i. Mater Domini (VA); ii. IEO (MI); iii. Humanitas (MI); iv. AOU-MO (MO); v. AOU-PR (PR); vi. AOU-PI (PI); vii. S. Eugenio (RM); viii. S. Salvatore (AQ).

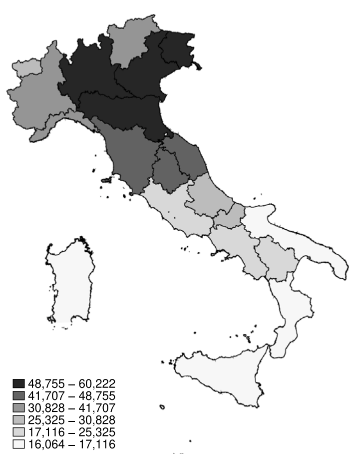

Fig. 2. Average spending capacity by region (€).

Overall, the Access Gap decomposition for each region highlights that the determinants of access barriers differ considerably across regions, meaning that, for egalitarian health policies to be more effective, diversification is highly recommended. Also, it is worth observing that, as for the health treatment under investigation, the problem is not related with the lack of health care providers on the territory, rather with the fact than most providers do not deliver treatments of adequate quality.

Given the computation of Access Gaps for each region (group), we can now focus on the inequality of Access Gaps across Italian regions. As discussed in Section 3, we compute standard inequality measures on the distribution of Access Gap indexes, that is, the CV and the Gini index, which are known to be factor decomposable. We also implement the Shapley decomposition procedure, which is a more recent technique used for the same purposes. Basically, all of the decomposition procedures implemented in this section allow quantifying the contribution of each single factor to the inequality of Access Gaps observed across regions; the contribution of each factor is positive if that factor increases overall inequality across groups, and it is negative in the opposite case.

In Columns 1 and 3 of Table 1, we report the relative contribution of each factor according to the decomposition of the CV, CV_k(%), and the Gini index, G_k(%), respectively. Columns 2 and 4 display results of Shapley decomposition. Results are found to be very similar in each of the four columns, so that we only comment on those reported in Column 1.

Our evidence shows that the main contribution to disparities in access conditions come from demand-side factors, that is, from the shape of regional spending capacity distributions. More specifically, given overall inequality of Access Gaps, $CV = 0.108$, 28.7% of such inequality originates from within-region disparities in the distribution of (out-of-pocket) spending capacity and, more importantly, 52.8% derives from disparities in terms of average spending capacity across regions, that is, from the well-known north–south gradient in income and wealth.

Looking at the supply side, productive inefficiencies at the regional level are responsible for 19.1% of the overall inequality of access opportunities, whereas local under-supply of health care providers displays a negligible negative contribution (−0.6%). The negative contribution implies that, if the quality of health treatments were ignored, then southern regions would not appear to be penalized with respect to northern ones.

Summing up, this simple application to breast cancer in Italy suggests that the contribution of distinct sources (factors) of inequality of access to adequate health care may sensibly differ across regions, implying that, for equality of access opportunities to be effectively promoted,

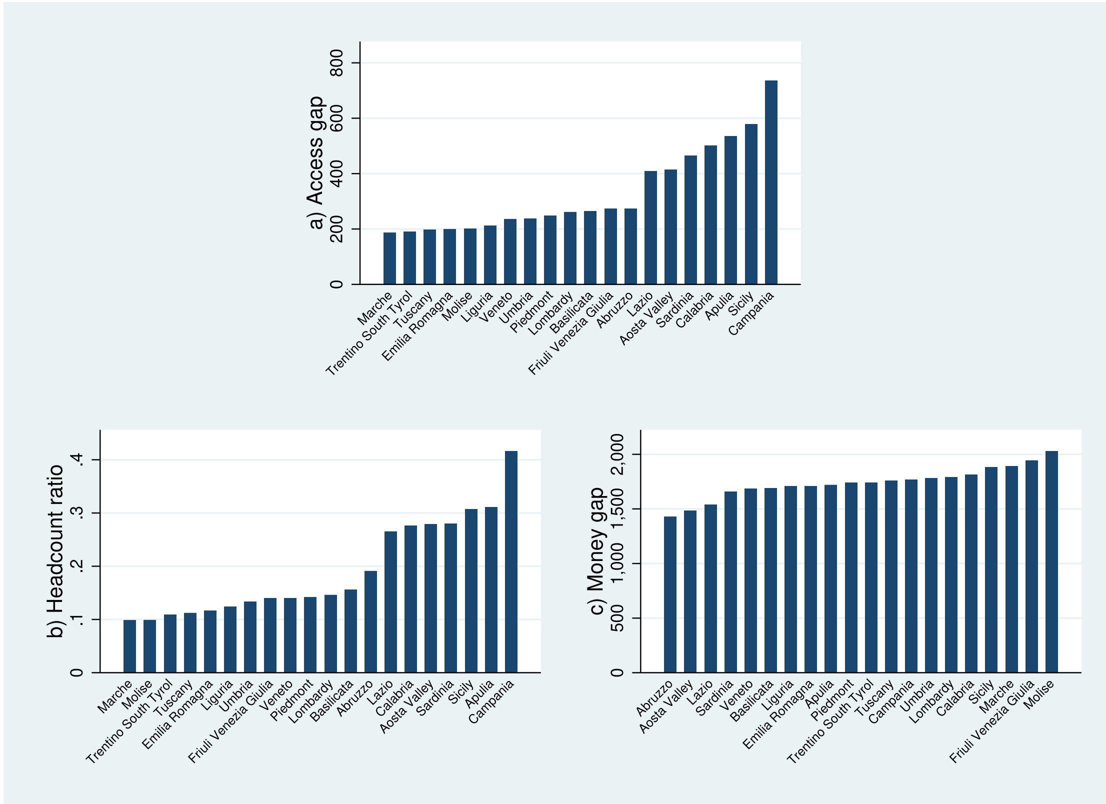

Fig. 3. Access for breast cancer surgery in Italy.

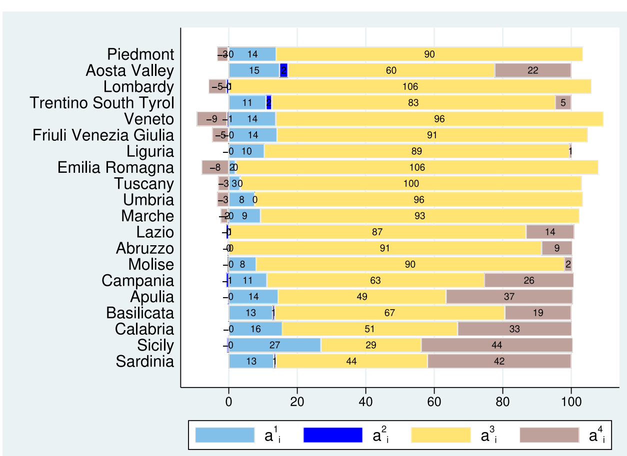

Fig. 4. Access gap decomposition.
Notes: (i) a_i^1 is the (%) contribution of production inefficiencies, (ii) a_i^2 is the (%) contribution of the under-supply of health care providers, (iii) a_i^3 is the (%) contribution of within-group inequality of health spending capacity, (iv) a_i^4 is the (%) contribution of between-group inequality of health spending capacity.

health policies should be partially differentiated at the local level. On the one hand, provided that most of the contribution to inequality of access originates from within- and between-region inequality of health spending capacity (A^3 and A^4), means-tested tax expenditures for out-of-pocket payments would sensibly reduce inequality of access. On the other hand, the negative contribution of the supply of health care providers (A^2), jointly with the positive contribution of productive inefficiencies (A^1), suggests that inequality of access may be improved by concentrating, in southern regions, health investments in fewer but adequate health care providers, at least for the health treatment of interest. This is an objective that may be pursued, for instance, through inter-regional agreements and networks for a better harmonization of the health care supply.

Table 1
Inequality decomposition by sources.

	CV (=0.108)		Gini (=0.243)	
	(1) CV_k(%)	(2) C_k^{CV}(%)	(3) G_k(%)	(4) C_k^G(%)
A^1	0.191	0.191	0.190	0.186
A^2	−0.006	−0.006	−0.004	0.002
A^3	0.287	0.287	0.284	0.304
A^4	0.528	0.528	0.529	0.507
Total	1.00	1.00	1.00	1.00

Notes: (i) A^1 is the contribution of production inefficiencies in the supply of health treatments, (ii) A^2 is the contribution of the under-supply of health care providers, (iii) A^3 is the contribution of within-group inequality of health spending capacity, (iv) A^4 is the contribution of between-group inequality of health spending capacity.

5. Concluding remarks

In this paper, we have proposed a non-parametric estimation strategy to assess disparities in access to health care. Such a strategy is based on the ideal of *equal potential access* and is suitable to disentangle the contribution of supply-side factors from that of demand-side factors to overall inequality.

Our approach accounts for different inequities characterizing access to care, that is, (i) the disparity among individuals having access and those having not, and (ii) the disparity of access opportunities across the population. We also account for the quality of health treatments because access opportunities may be different when citizens are required to travel to get access to adequate care.

In a way that resembles previous contributions (Wagstaff et al., 2003; Carrieri and Jones, 2018), our measurement strategy allows gathering direct policy suggestions through the application of standard factor-decomposition techniques. By virtue of such decomposition, it is indeed possible to isolate the impact of various supply and demand factors on access opportunities, which is particularly relevant for policy-makers, especially in decentralized health systems.

For illustrative purposes, we have performed a simple exercise on data from breast cancer surgery in Italy. Results suggest that isolating the impact on access opportunities of various supply and demand factors might be relevant for policy-makers. For example, we find that in northern regions, access problems are mainly related to inequalities in the local distribution of spending capacity (within-group inequality), whereas in southern regions, denied access mainly originates from the low level of health spending capacity (between-group inequality), as well as inadequacy of health care providers.

Future research effort will be devoted to the application of the methodology proposed in this paper when (i) more characteristics (not only geographic) and more dis-aggregated spacial units (e.g., health districts) are considered for the initial partition of the population in terms of Access Gaps, and (ii) a bundle of health treatments, such as essential health assistance services, is considered instead of a single treatment.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data shared at the following link: 10.17632/ncpwm55snp.1

Replication of the paper "Measuring Access and Inequality of Access to Health Care: A Decomposition Approach" (Original data) (Mendeley Data)

Appendix

A.1. Properties of the access gap

In what follows, we report formal statements for properties of the Access Gap index (1) in Section 3.2.

(i) *Focus*: let (y_i, y_k) be two equally-sized spending capacity distributions such that $y_{ij} = y_{kj}\ \forall\ j \neq z$ and $y_{iz} > y_{kz}$ with $y_{iz} > c_i$ and $y_{kz} > c_k$, then $A_i = A_k$.
(ii) *Income Monotonicity*: if $c_i = c_k$, let (y_i, y_k) be two equally-sized spending capacity distributions such that $y_{ij} = y_{kj}\ \forall\ j \neq z$ and $y_{iz} > y_{kz}$ with $y_{iz} \leq c_i$ and $y_{kz} \leq c_k$, then $A_i < A_k$.
(iii) *Cost Monotonicity*: given two spending capacity distributions such that $y_i = y_k$, if $c_i < c_k$, then $A_i < A_k$.
(iv) *Anonymity*: if $c_i = c_k$, let (y_i, y_k) be two spending capacity distributions such that $y_k = y_i \times M$ with M indicating any $n_i \times n_i$ permutation matrix, then $A_i = A_k$.
(v) *Translation Invariance*: let (y_i, y_k) be two spending capacity distributions such that $y_k = y_i + \lambda\mathbf{1}$ and $c_k = c_i + \lambda$ with $\lambda \in \mathfrak{R}$, then $A_i = A_k$.[24]
(vi) *Population Invariance*: let (y_i, y_k) be two spending capacity distributions such that y_k is a t-fold replication of Y_i with t indicating any positive integer and $c_k = c_i$, then $A_i = A_k$.
(vii) *Additive Subgroup Decomposability*: let $(A_i^1, A_i^2, \ldots, A_i^s)$ be the Access Gap indexes associated to a disjoint and exhaustive s-partition of the population in the ith group, it must be the case that $A_i = \frac{n_i^1}{n_i} A_i^1 + \frac{n_i^2}{n_i} A_i^2 + \cdots \frac{n_i^s}{n_i} A_i^s$, with n_i^v indicating the number of individuals populating the νth subgroup.

A.2. Empirical exercise: Variable definitions

A.2.1. Identifying quality standards

When determining the adequacy of breast cancer surgery, the Italian Ministry of Health lists, among others, the following criteria:

1. number of per-year surgical treatments, greater than 150;
2. share of annual hospital breast cancer surgical treatments, implemented in hospital wards performing more than 135 of such treatments per year, no smaller than 80%;
3. share of patients readmitted within 120 days of discharge, no greater than 8%;
4. share of patients receiving either immediate implant breast reconstruction or a tissue expander during total mastectomy, no smaller than 70%.

To be considered as a health facility providing adequate treatments, in what follows we posit that all of the above criteria must be satisfied. We concede that this is a particularly severe perspective that might be softened in different applications, where adequacy might be assessed with less stringent criteria. This choice is justified in our empirical exercise, for our aim is simply to providing insight into how the methodology can be applied. As we consider a restricted number of groups (specifically, the twenty Italian regions), more stringent criteria allow us to identify differences at the macro level that we might otherwise overlook.

A.2.2. Computing access costs

Because we assume that the only relevant characteristic that distinguishes one group from any other is geographic location (region of residence), we treat all of the usual out-of-pocket expenses for breast cancer as fixed, focusing on the cost of mobility (transportation and accommodation costs). Hence, let $v = 1, \ldots, 8$ indicate the location of the health care providers satisfying the quality standards discussed above, the minimum cost of access to adequate care for an individual living in group i is obtained by summing up, respectively,

$$c_{iv} = \overline{CI} + TC_{iv} + AC_v \quad \forall\ i = 1, \ldots, 20; \forall\ v = 1, \ldots, 8 \tag{15}$$

where

- $\overline{CI}$ is the group-invariant cost the patient must bear independently from where they reside. Group-invariant costs are defined up to the sum of the main out-of-pocket expenses related to care needs and informal payments. Data come from a survey aimed at assessing breast cancer costs borne by Italian households (LILT, 2008). Such expenses basically consist of: (1) cancer specialist consultations, (2) medical examinations, (3) rehabilitation services, (4) drugs never covered by the NHS, (5) reconstructive supports (prostheses, hairpieces)[25];
- TC_{iv} is the travel cost from region i to province v, borne by the patient and by whoever provides personal assistance to the patient. Transportation costs are computed using the Michelin Guide, considering the cheapest route between any province including the regional capital and each health care provider supplying treatment defined as adequate[26];

[24] This property is replaced by *scale invariance* when the relative version of the Access Gap index is obtained by normalizing A_i for c_i.

[25] Some additional costs might be considered in more comprehensive applications, such as those related to the necessary professional assistance to people with disabilities.

[26] We assume that all of the out-of-pocket expenses associated to any regional capital are representative of those borne by people residing in any other area of the region to which the regional capital belongs.

- AC_v is the accommodation cost, borne by the caregiver during the period of hospitalization. Accommodation costs incurred by the caregiver during the four days (on average) the patient is hospitalized are calculated using information on the accommodation prices required by the B&Bs and/or the hotels advertised on the websites of the eight Italian hospitals providing adequate treatments in the area dedicated to informing patients about facilities.

As for the cost of access to the cheapest provider in the ith cell, $\hat{c}_i$, because there is at least one health facility delivering breast cancer surgery in any region, we consider the sum of the group-invariant costs related to care needs, $\overline{CI}$, and the public transportation cost to commute to the health facility, PTC_i, as follows:

$$\hat{c}_i = \overline{CI} + PTC_i \qquad \forall\ i = 1, \dots, 20 \tag{16}$$

where PTC_i is computed by considering the regional hourly cost of public transportation weighted by the ratio of the regional kilometer coverage of health facilities over the national one.[27]

A.2.3. Computing the health spending capacity

The distribution of individual spending capacity may be remarkably different from the simple distribution of income. Patients in need may indeed either use their own wealth (past savings) or receive additional resources from other members of their social networks (family, friends, and so on) to demand health treatments.

To estimate the individual spending capacity for out-of-pocket expenses, we use data provided by the Survey of the Bank of Italy on Household Income and Wealth (Bank of Italy, 2015). This survey gathers data on income and wealth of the Italian households. The sample comprises about 8,000 households (20,000 individuals) distributed across the twenty provinces including the regional capitals of Italy.

We have drawn information about the net disposable income and consumption for every household in the survey. Then, using the equivalence scales provided by the Italian Statistical Office (ISTAT), we have computed the equivalent consumption on an individual basis. Comparing this with the poverty threshold (ISTAT, 2018) to determine the equivalent absolute poverty in consumption, we have estimated, for each individual j,[28] the amount of financial resources, beyond the subsistence level, that can be possibly used to tackle unforeseen risky events related to the health status.

Accepting the hypothesis that in the case one's health is adversely affected, all the family savings can be used to help the member in need, we have added to the difference between one's equivalent consumption and the poverty threshold, the whole family savings and other financial assets.[29]

Therefore, the amount of equivalent accessible resources (y_{ij}) for individual j in group i is equal to

$$y_{ij} = (C^E_{ij} - P^E_{ij}) + S_j + FA_j \tag{17}$$

where the difference between the equivalent per-capita consumption within the household, C^E_{ij}, and the equivalent poverty line, P^E_{ij}, gives the spending capacity that an individual can rely upon in case of need; S_j and FA_j indicate, respectively, the overall savings of the family and other immediately available financial assets.

[27] Notice that PTC_i is sustained twice by the patient, whereas the caregiver commutes during the four days (on average) the patient is hospitalized.

[28] We assume that a generic individual j is representative of the household's potential health need. Even though the probability of having the need might vary according to family composition, we maintain this simplifying assumption due to the illustrative nature of the exercise.

[29] Because we are not considering rehabilitation costs, we have excluded non-financial illiquid assets, such as the house where one lives, for the obvious reason that they cannot be converted into promptly usable resources. Moreover, although we have implicitly made the assumption of intra-household transfers, we have neglected – for lack of reliable data – other transfers that individuals might enjoy because of their membership in other social networks.

Table A.1
Regional Access Gaps with frequency and intensity components

Region	(1) A_i	(2) Headcount ratio	(3) Money gap
Piedmont	247.34	0.14	1740.98
Aosta Valley	414.52	0.28	1485.35
Lombardy	261.64	0.15	1789.78
Trentino South Tyrol	190.35	0.11	1742.41
Veneto	236.35	0.14	1684.84
Friuli Venezia Giulia	272.69	0.14	1945.20
Liguria	211.65	0.12	1707.94
Emilia Romagna	199.47	0.12	1709.37
Tuscany	197.63	0.11	1758.33
Umbria	238.16	0.13	1783.00
Marche	186.55	0.10	1892.97
Lazio	408.39	0.26	1538.28
Abruzzo	273.32	0.19	1429.69
Molise	201.10	0.10	2029.25
Campania	736.48	0.42	1769.52
Apulia	535.58	0.31	1720.70
Basilicata	264.19	0.16	1690.82
Calabria	501.87	0.28	1815.09
Sicily	579.16	0.31	1883.79
Sardinia	464.34	0.28	1659.06

Table A.2
Factor decomposition of regional Access Gaps.

Region	(1) A_1	(2) A_2	(3) A_3	(4) A_4
Piedmont	34.28	−0.58	221.52	−7.88
Aosta Valley	61.41	10.14	250.32	92.64
Lombardy	0.00	−1.82	277.20	−13.74
Trentino South Tyrol	20.68	3.20	157.52	8.95
Veneto	32.42	−1.25	226.01	−20.84
Friuli Venezia Giulia	38.47	−0.18	247.38	−12.97
Liguria	21.96	−0.53	188.41	1.80
Emilia Romagna	3.81	0.26	211.25	−15.85
Tuscany	6.42	0.38	196.90	−6.07
Umbria	18.05	0.42	227.74	−8.04
Marche	17.30	−0.52	173.67	−3.90
Lazio	0.00	−3.48	354.37	57.50
Abruzzo	0.00	−0.97	249.65	24.64
Molise	16.12	−0.60	180.87	4.71
Campania	81.87	−5.82	467.44	192.99
Apulia	77.35	−2.25	262.22	198.26
Basilicata	33.84	1.59	177.49	51.27
Calabria	78.61	−0.95	256.56	167.65
Sicily	155.87	−2.73	169.35	256.67
Sardinia	61.03	2.68	205.54	195.09

A.3. Detailed results

See Tables A.1 and A.2.

References

Abatemarco, A., Aria, M., Beraldo, S., Stroffolini, F., 2020a. Measuring disparities in access to health care: A proposal based on an ex-ante perspective. Soc. Indic. Res. 150, 549–568.

Abatemarco, A., Beraldo, S., Collaro, M., 2023. Equality of opportunity in health care. In: Sardoč, M. (Ed.), Handbook of Equality of Opportunity. Springer, Cham.

Abatemarco, A., Beraldo, S., Stroffolini, F., 2020b. Equality of opportunity in health care: Access and equal access revisited. Int. Rev. Econ. 67, 13–29.

Aday, L.A., Andersen, R., Fleming, G.V., 1980. Health Care in the US: Equitable for Whom? Sage, Beverly Hills, CA.

Agyeman, J., Schlosberg, D., Craven, L., Matthews, C., 2016. Trends and directions in environmental justice: From inequity to everyday life, community, and just sustainabilities. Annu. Rev. Environ. Resour. 41 (1), 321–340.

AIOM, AIRTUM, 2020. I numeri del cancro in italia. Intermedia Editore SIAPEC-IAP.

Allin, S., Masseria, C., Sorenson, C., Papanicola, I., Mossialos, E., 2007. Measuring inequalities in access to health care: A review of the indices. Lond. Sch. Econ. Polit. Sci. 1–24.

Andreoli, F., Mussini, M., Prete, V., Zoli, C., 2021. Urban poverty: Measurement theory and evidence from American cities. J. Econ. Inequal. 19 (4), 599–642.
Beraldo, S., Collaro, M., Marino, I., 2023. Patient migration as a response to the regulation of subnational healthcare budgets. Reg. Stud. 1–13.
Blackorby, C., Donaldson, D., 1980. Ethical indices for the measurement of poverty. Econometrica 1053–1060.
Blackwood, D., Lynch, R.G., 1994. The measurement of inequality and poverty: A policy maker's guide to the literature. World Dev. 22 (4), 567–578.
Brown, S., Hole, A.R., Kilic, D., 2014. Out-of-pocket health care expenditure in Turkey: Analysis of the 2003–2008 Household Budget Surveys. Econ. Model. 41, 211–218.
Cappelen, A.W., Norheim, O.F., 2005. Responsibility in health care: A liberal egalitarian approach. J. Med. Ethics 31 (8), 476–480.
Carrieri, V., Jones, A.M., 2018. Inequality of opportunity in health: A decomposition-based approach. Health Econ. 27 (12), 1981–1995.
Chen, M., Xu, L., Si, L., Wang, Z., Jan, S., 2023. Examining the level and distribution of catastrophic health expenditure from 2013 to 2018: A province-level study in China. Econ. Model. 121, 106233.
Culyer, A.J., Wagstaff, A., 1993. Equity and equality in health and health care. J. Health Econ. 12 (4), 431–457.
Cylus, J., Papanicolas, I., 2015. An analysis of perceived access to health care in Europe: How universal is universal coverage? Health Policy 119 (9), 1133–1144.
Daniels, N., 1985. Just Health Care. Cambridge University Press.
Fabbri, D., Robone, S., 2010. The geography of hospital admission in a national health service with patient choice. Health Econ. 19 (9), 1029–1047.
Fleurbaey, M., Schokkaert, E., 2011. Equity in health and health care. In: Handbook of Health Economics, vol. 2, Elsevier, pp. 1003–1092.
Foster, J., Greer, J., Thorbecke, E., 1984. A class of decomposable poverty measures. Econometrica 761–766.
Foster, J.E., Shorrocks, A.F., 1991. Subgroup consistent poverty indices. Econometrica 687–709.
Karanikolos, M., Mladovsky, P., Cylus, J., Thomson, S., Basu, S., Stuckler, D., Mackenbach, J.P., McKee, M., 2013. Financial crisis, austerity, and health in Europe. Lancet 381 (9874), 1323–1331.
Khan, A.A., 1992. An integrated approach to measuring potential spatial access to health care services. Soc.-Econ. Plan. Sci. 26 (4), 275–287.
Kranich, L., 1996. Equitable opportunities: An axiomatic approach. J. Econom. Theory 71 (1), 131–147.
Kumar, G.A., Dilip, T.R., Dandona, L., Dandona, R., 2012. Burden of out-of-pocket expenditure for road traffic injuries in urban India. BMC Health Serv. Res. 12 (285).
Le Grand, J., 1982. The Strategy of Equality: Redistribution and the Social Services. Allen & Unwin.
Le Grand, J., 1987. Equity, health, and health care. Soc. Justice Res. 1, 257–274.
Lerman, R.I., Yitzhaki, S., 1985. Income inequality effects by income source: A new approach and applications to the United States. Rev. Econ. Stat. 151–156.
Levaggi, R., Zanola, R., 2004. Patients' migration across regions: The case of Italy. Appl. Econ. 36 (16), 1751–1757.
Levesque, J.F., Harris, M.F., Russell, G., 2013. Patient-centred access to health care: Conceptualising access at the interface of health systems and populations. Int. J. Equity Health 12, 1–9.
Li Donni, P., Peragine, V., Pignataro, G., 2014. Ex-ante and ex-post measurement of equality of opportunity in health: A normative decomposition. Health Econ. 23 (2), 182–198.
LILT, 2008. Indagine Retrospettiva Sul Costo Del Tumore Al Seno Per Le Famiglie. URL https://www.lilt.it/notizie/primo-piano/2008/indagine-retrospettiva-sul-costo-del-tumore-al-seno-per-le-famiglie (26/05/2020).
Mennini, F.S., Marcellusi, A., 2019. 6. Costi socio-assistenziali del carcinoma mammario in italia. FAVO, 11 Rapporto sulla Condizione Assistenziale dei Malati Oncologici 53–58.
Mooney, G.H., 1983. Equity in health care: Confronting the confusion. Eff. Health Care 1 (4), 179–185.
OECD, 2019. Health for Everyone?: Social Inequalities in Health and Health Systems. OECD Health Policy Studies, OECD Publishing, Paris, p. 192. http://dx.doi.org/10.1787/3c8385d0-en, URL https://www.oecd-ilibrary.org/content/publication/3c8385d0-en.
OECD, EU, 2022. Health At a Glance: Europe 2022. OECD Publishing, Paris, p. 219. http://dx.doi.org/10.1787/507433b0-en, URL https://www.oecd-ilibrary.org/content/publication/507433b0-en.
Oliver, A., Mossialos, E., 2004. Equity of access to health care: Outlining the foundations for action. J. Epidemiol. Community Health 58 (8), 655–658.
Perucca, G., Piacenza, M., Turati, G., 2019. Spatial inequality in access to healthcare: Evidence from an Italian Alpine region. Reg. Stud. 53 (4), 478–489. http://dx.doi.org/10.1080/00343404.2018.1462481.
Purcel, A.A., Dragos, C.M., Mare, C., Dragos, S.L., 2023. Voluntary health insurance and out-of-pocket payments in European OECD countries. Econ. Model. 120, 106190.
Ramos, X., Van de Gaer, D., 2016. Approaches to inequality of opportunity: Principles, measures and evidence. J. Econ. Surv. 30 (5), 855–883.
Rawls, J., 1971. A Theory of Justice. Cambridge, Harvard University Press.
Roemer, J.E., 1993. A pragmatic theory of responsibility for the egalitarian planner. Philos. Public Aff. 146–166.
Roemer, J.E., 1998. Theories of Distributive Justice. Harvard University Press.
Shorrocks, A.F., 1982. Inequality decomposition by factor components. Econometrica 193–211.
Shorrocks, A.F., 2013. Decomposition procedures for distributional analysis: A unified framework based on the Shapley value. J. Econ. Inequal. 11 (1), 99.
Trannoy, A., Tubeuf, S., Jusot, F., Devaux, M., 2010. Inequality of opportunities in health in France: A first pass. Health Econ. 19 (8), 921–938.
Wagstaff, A., Van Doorslaer, E., 2000. Equity in health care finance and delivery. In: Handbook of Health Economics, vol. 1, Elsevier, pp. 1803–1862.
Wagstaff, A., Van Doorslaer, E., Paci, P., 1991. On the measurement of horizontal inequity in the delivery of health care. J. Health Econ. 10 (2), 169–205.
Wagstaff, A., Van Doorslaer, E., Watanabe, N., 2003. On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in Vietnam. J. Econometrics 112 (1), 207–223.
Xu, K., Evans, D.B., Kawabata, K., Zeramdini, R., Klavus, J., Murray, C.J., 2003. Household catastrophic health expenditure: A multicountry analysis. Lancet 362 (9378), 111–117. http://dx.doi.org/10.1016/S0140-6736(03)13861-5.
Zheng, B., 1994. Can a poverty index be both relative and absolute? Econometrica 1453–1458.