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Understanding the vertical equity judgements underpinning health inequality measures

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Abstract

The choice of income-related health inequality measures in comparative studies is often determined by custom and analytical concerns, without much explicit consideration of the vertical equity judgements underlying alternative measures. This note employs an inequality map to illustrate how it these judgements that affect the ranking of populations by health inequality. In particular, it is shown that relative indices of inequality in health attainments and shortfalls embody distinct vertical equity judgments, where each may represent ethically defensible positions in specific contexts. Further research is needed to explore people's preferences over distributions of income and health.

Keywords: health inequality; vertical equity judgements; inequality equivalence criteria; inequality maps

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1. Introduction

The choice of health inequality measures in comparative studies is often determined by custom and analytical concerns, without much explicit consideration for the more fundamental properties of these measures. This choice matters as it can affect the ranking of populations by income-related health inequality (IRHI). In particular, Clarke et al. (2002) showed empirically that relative and absolute indices can produce different rankings and, moreover, that whether health is measured with respect to attainments or shortfalls also matters for relative indices. We illustrate graphically why this is the case by building on the observation that different IRHI measures embody different mean-invariance or equivalence criteria, reflecting alternative vertical equity judgments.[1] We proceed to consider the implications for the choice of IRHI measure.

2. Graphical Analysis

An IRHI equivalence criterion specifies how, given the joint distribution of health and income, a given change in population health should be distributed so as to leave IRHI unchanged.[2] For example, relative and absolute indices are invariant to equiproportionate and uniform changes in health respectively. But, in contrast to absolute indices, relative indices imply different IRHI equivalence criteria depending on whether health is measured with respect to attainments or shortfalls, since an equiproportionate change in attainments will not generally constitute an equiproportionate change in shortfalls, and *vice versa*. By implication, any IRHI measure defines a set of health distributions that are IRHI-equivalent, with these sets constituting iso-inequality contours and thereby forming an inequality map (cf. Amiel and Cowell, 1999).

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[1] See Culyer and Wagstaff (1993) for a discussion of equity issues in health and healthcare.

[2] See Zoli (2003) for a discussion of inequality equivalence criteria with reference to income.

To gain a better understanding about the iso-inequality contours associated with particular IRHI measures we consider a two-person inequality map. Figure 1 plots the health of two arbitrarily chosen individuals, where the inequality map may be interpreted as a projection of the general *n*-person case into a two-dimensional view. Alternatively, the figure may be taken to show the health outcomes of a representative rich and poor person. The figure is drawn on the assumption that the health variable is bounded in the unit interval, and may therefore be interpreted as a 'standardised' health variable in the sense of Erreygers and van Ourti (2011). If health is unbounded from above then it will be infeasible to consider health shortfalls. Also IRHI measures that are normalised by mean health, such as the concentration index, will only be 'useful when there is a natural origin of measurement or comparisons are being made between distributions with similar origins' (Kendall et al., 1986, Volume 1, p.60).

Health attainments and shortfalls are measured from the origins at the bottom left and top right corners of the diagram respectively. The set of health distributions corresponding to perfect equality is a ray at 45° through the origin(s). Points below the line of perfect equality correspond to distributions in which the health of the richer person is better than that of the poorer individual, which is likely to be the case on average. We consider an arbitrary distribution of health, point A, to illustrate the nature of the vertical equity judgements embodied in alternative IRHI measures.

We note first that a mean-preserving spread of health outcomes from A will result in a perpendicular movement away from the line of perfect equality (along the mean-preserving line), representing an increase in inequality according to all IRHI measures that satisfy the principle of

health transfers.[3] Thus the choice of IRHI measure only becomes a significant issue when comparing health distributions with different levels of mean health since it will only then be necessary to specify the type of equivalence property that the measure should satisfy.

We specifically consider the iso-inequality contours associated with the various equivalence criteria defined in Table 1. Each criterion defines a class of IRHI measures, including both commonly used and less familiar indices, which share a common vertical equity judgement and hence give rise to the same iso-inequality contours.

To facilitate the subsequent discussion, we label the vertical equity judgments implied by the IRHI equivalence criteria of relative and absolute measures of inequality in health attainments as 'rightist' and 'leftist' and respectively. The 'rightist' class of IRHI measures, including the concentration index in health attainments, are invariant to equal relative changes in health attainments and thus generate iso-inequality contour I in Figure 1, which is a ray from the attainments origin that passes through A.[4] In contrast, the 'leftist' class of IRHI measures, including the Generalised Concentration and Erreygers indices, are invariant to equal absolute health changes and the corresponding iso-inequality contour II is thus parallel to the line of perfect equality. Health distributions lying between these two contours will be ranked more unequal than the distribution A according to one criterion and less unequal according to the other.

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[3] This requires that inequality decreases if we redistribute health from a healthy individual to a less healthy one, leaving their respective ranking unchanged (see, Bleichrodt and van Doorslaer, 2006, for discussion).

[4] Note that the health attainments origin does not constitute part of the 'rightist' iso-inequality contour since the resultant class of inequality measures are undefined if mean health attainment is equal to zero. More generally, the iso-inequality contours associated with inequality measures that are normalised by mean health attainment and/or shortfalls will not include the corresponding origin(s).

The 'rightist' and 'leftist' labels were introduced for income inequality by Kolm (1976) on the basis that a equiproportionate rise in incomes is less egalitarian than an uniform increase, though the identification of these positions with the political spectrum is problematic in that an equiproportionate fall (e.g. due to a tax) is more egalitarian than a uniform decrease (Atkinson, 1983). Our usage of the labels reflects the fact that health attainment is a 'good' like income, and it is similarly apparent from Figure 1 that whether 'rightist' views would be considered less egalitarian than 'leftist' views will depend on whether one is comparing A to a distribution with lower or higher mean health – contour I lies closer to the line of perfect equality than II for lower mean health levels and further away for higher levels.

We follow Zheng (2007) in further identifying 'intermediate', 'extreme rightist' and 'extreme leftist' views. Various 'intermediate' inequality equivalence criteria have been proposed in the literature (see Del Rio and Alonso-Villar, 2010) with all yielding the 'rightist' and 'leftist' views as polar cases. In particular, the widely referenced Bossert and Pfingsten (1990) criterion is defined as a simple weighted average of the 'rightist' and 'leftist' criteria, giving rise to a class of IRHI measures that includes the 'intermediate' concentration index of health attainments $IC(h)$. The concentration and generalised concentration indices are obtained from $IC(h)$ by setting $\alpha = 1$ and $\alpha = 0$ respectively, whereas intermediate values of α lead to IRHI measures that increase as a result of equiproportionate health improvements but fall in response to uniform improvements and therefore generate iso-inequality contours that lie between I and II (not shown). We further note that 'extreme rightist' measures could be obtained by setting $\alpha > 1$ in $IC(h)$, where these measures fall as a result of equiproportionate health improvements and therefore have iso-inequality contours flatter than I (not shown). Conversely, if $\alpha < 0$ then $IC(h)$ would give rise to 'extreme leftist' measures that increase in response to

uniform health improvements and thus have iso-inequality contours such as III (to be discussed further below) that are steeper than II.[5]

While health attainments and shortfalls are but "two sides of the same coin" (Clarke et al, 2002), this need not be the case for the corresponding IRHI indices. In particular, Figure 1 demonstrates graphically the distinct nature of the vertical equity judgements embodied in relative indices of inequality in health attainments and shortfalls, with the latter giving rise to iso-inequality contour III that radiates from the health shortfall origin, not the health attainments origin. Thus relative IRHI measures in shortfalls embody an 'extreme leftist' not 'rightist' view: an equiproportionate reduction in health shortfalls from A (e.g. due to some improvement in health care) will result in no change in relative IRHI in shortfalls but reductions in both relative and absolute IRHI in health attainments.

In contrast, absolute indices embody the same 'leftist' invariance criterion irrespective of whether IRHI is measured with respect to attainments or shortfalls, giving rise to contour II in both cases. By implication, contour II is symmetric about the 'mirror line', which is defined by the set of health distributions where mean health is equal to the mid-point of the health range. In general, any IRHI index that satisfies the 'mirror condition' (Erreygers, 2009a) - that health inequalities measured with respect to attainments and shortfalls are of equal size but opposite sign – will generate iso-inequality contours that are symmetric about the 'mirror line'.

All the equivalence criteria discussed so far give rise to linear iso-inequality contours. In contrast the criterion underpinning the Wagstaff (2005) measure is non-linear, generating iso-inequality contour IV that radiates from both origins. Thus the Wagstaff index embodies a

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[5] Note that if $\alpha > 1$ then the applicability of the resultant measures may have to be restricted to avoid generating a logical contradiction, given that any iso-inequality contour through A cannot touch the line of perfect equality (see Amiel and Cowell, 1999).

variable rather than fixed vertical equity judgement (see Wagstaff, 2009), with these judgements bounded by the 'rightist' and 'extreme leftist' views embodied in relative indices in health attainments and shortfalls respectively, tending to the former as mean attainments tend to zero and to the latter as mean shortfalls tend to zero (see Erreygers and van Ourti, 2011; Kjellsson and Gerdtham, 2011; and Allanson and Petrie, 2012; for further discussion). The index satisfies the 'mirror condition' (Erreygers, 2009a) and the iso-inequality contour is therefore symmetric about the 'mirror line', reflecting a 'leftist' view if mean health is equal to the mid-point of the health range.

Finally, the iso-inequality contours implied by particular equivalence criteria will be the same irrespective of the relative importance or weights attached to the health of the rich and poor. Thus the preceding discussion applies equally to 'extended' versions of the IRHI measures defined in Table 1 in which a 'distributional judgment' parameter is introduced to calibrate the poverty focus of the evaluation by controlling the rate at which the weights decrease from poorest to richest (see e.g. Wagstaff, 2002). Indeed, Figure 1 may be taken to represent the vertical equity judgements implicit not only in IRHI measures but also in pure health inequality measures such as the health Gini coefficient (Le Grand, 1987; Erreygers, 2009b).

Discussion

The choice of health inequality measures in comparative studies is often determined by custom and analytical concerns, without much explicit consideration for the vertical equity judgements underlying alternative measures. This note has illustrated the nature of these judgements by plotting the iso-inequality contours associated with different measures. The resultant inequality map serves to highlight how the choice of health inequality measure may affect the ranking of distributions. In particular, relative measures of inequality in health attainments and shortfalls are

shown to embody fundamentally different vertical equity judgments that may affect whether one distribution exhibits more IRHI than another. In contrast, conclusions from inequality indices that satisfy the 'mirror' condition, such as the generalised concentration, Wagstaff (2005) and Erreygers (2009a) indices, will be invariant to whether IRHI is measured with respect to health attainments or shortfalls (see also Lambert and Zheng, 2011) as they embody the same inequality equivalence criteria.

The norm in the income literature has been to adopt either a "rightist" or a "leftist" perspective, but these two benchmarks of distributional neutrality do not bound the range of ethically defensible positions in the health inequality context. In particular, Allanson and Petrie (2012) note that the "extreme leftist" judgement embodied in relative measures of inequality in health shortfalls is consistent with the principle of 'proportionate universalism' advocated in the Marmot Review (Marmot, 2010; p.15): "To reduce the steepness of the social gradient in health, actions must be universal, but with a scale and intensity that is proportionate to the level of disadvantage". If the priority is to 'heal the sick' then this may be taken to imply that healthcare improvements should equalise the distribution of health attainments not just in relative but also in absolute terms.

More empirical work is called for to investigate people's preferences regarding distributions of health and income such that the most appropriate measure can be chosen for use in comparative evaluations, where we note that this choice may be population and context specific.[6] In the meantime, studies should present and interpret findings for a range of measures in order to provide policymakers with a number of alternative viewpoints from which to compare

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[6] See Bleichrodt et al. (2012) for some recent empirical work of this nature.

health distributions, justifying any choice of preferred measure in terms of its underlying vertical

equity judgement.

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Table I: Definition of income-related health inequality equivalence criteria (IEC) and associated IRHI measures.

'Rightist' IEC: $I(h) = I(\lambda h)$; all admissable λ

Concentration index of health attainments $CI(h) = \dfrac{2}{\overline{h}} \operatorname{cov}(h, R)$

Relative inequality index of health attainments $RII(h) = \dfrac{\operatorname{cov}(h, R)}{\overline{h} \operatorname{var}(R)} = \dfrac{CI(h)}{2 \operatorname{var}(R)}$

'Leftist' IEC: $I(h) = I(h + \lambda e)$; all admissable λ

Generalised concentration indices of health attainments and shortfalls $GCI(h) = 2 \operatorname{cov}(h, R) = -2 \operatorname{cov}(b - h, R) = -GCI(s)$

Slope inequality indices of health attainments and shortfalls $SII(h) = \dfrac{\operatorname{cov}(h, R)}{\operatorname{var}(R)} = \dfrac{GCI(h)}{2 \operatorname{var}(R)} = -SII(s)$

Erreygers (2009a) indices of health attainments and shortfalls $EI(h) = \dfrac{8 \operatorname{cov}(h, R)}{(b - a)} = \dfrac{4 GCI(h)}{(b - a)} = -EI(s)$

Bossert and Pfingsten (1990) 'intermediate' IEC: $I(h) = I\big(h + \lambda\big(\alpha h + (1 - \alpha)e\big)\big)$; $0 \leq \alpha \leq 1$; all admissable λ

'Intermediate' concentration index of health attainments $ICI(h) = \dfrac{2}{\alpha \overline{h} + (1 - \alpha)} \operatorname{cov}(h, R) = \dfrac{GCI(h)}{\alpha \overline{h} + (1 - \alpha)}$

An 'Extreme leftist' IEC: $I\big((b - h)\big) = I\big(\lambda(b - h)\big)$; all admissable λ

Concentration index of health shortfalls $CI(s) = \dfrac{2}{\big(b - \overline{h}\big)} \operatorname{cov}(b - h, R) = \dfrac{-\overline{h}\, CI(h)}{\big(b - \overline{h}\big)}$

Relative inequality index of health shortfalls $RII(s) = \dfrac{\operatorname{cov}(b - h, R)}{\big(b - \overline{h}\big) \operatorname{var}(R)} = \dfrac{CI(s)}{2 \operatorname{var}(R)}$

Wagstaff IEC: $I(h) = I\left(\lambda \overline{h} + \big(h - \overline{h}\big) \dfrac{\big(b - \lambda \overline{h}\big)\big(\lambda \overline{h} - a\big)}{\big(b - \overline{h}\big)\big(\overline{h} - a\big)} \right)$; all admissable λ

Wagstaff (2005) indices of health attainments and shortfalls $WI(h) = \dfrac{2(b - a)}{(b - \overline{h})(\overline{h} - a)} \operatorname{cov}(h, R) = \dfrac{(b - a) GCI(h)}{(b - \overline{h})(\overline{h} - a)} = -WI(s)$

Notation: h is a measure of health attainment with bounds $0 \leq a \leq h \leq b$ and mean $\overline{h}$; $s = b - h$ is the corresponding measure of shortfalls; R is the fractional income rank with variance $\operatorname{var}(R)$ and covariance with health $\operatorname{cov}(h, R)$; e is the unit vector; and $I(h)$ and $I(s)$ are inequality indices of health attainments and shortfalls respectively.

Figure 1. Two-person inequality map.