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Reply

Correcting the Concentration Index: A reply to Wagstaff

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ABSTRACT

In this note, I reply to Adam Wagstaff's criticism of my corrected version of the Concentration Index for bounded health variables. I focus on three issues: (1) Wagstaff's suggestions with regard to the scale invariance property; (2) his distinction of relative and absolute inequality; and (3) a comparison of Wagstaff's index W with my index E. I show that his criticism is unfounded, and that his index is not superior to mine.
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1. Introduction

Adam Wagstaff's work has been an important source of inspiration for my research into health inequality measurement. I therefore very much appreciate his comment (Wagstaff, in press) on my proposal (Erreygers, 2009) to correct the Concentration Index (CI) when the health variable is bounded. My contribution was written partly in order to improve the modified CI which he suggested for the case when the health variable is binary (Wagstaff, 2005). I carefully noted what I perceive to be the strengths and the weaknesses of his index. I developed an axiomatic approach in order to make explicit and to clarify which properties a socioeconomic health inequality index should have. (Such an approach was lacking in Wagstaff's paper.) In short, I adopted a constructive attitude and tried to make a positive contribution to the literature.

I welcome this opportunity to discuss Wagstaff's and my views on health inequality measurement. I am afraid that his comment fails to convince me that I have followed the wrong approach or that his index is superior to mine—quite the contrary. I will focus on three issues: (1) Wagstaff's suggestions with regard to the scale invariance property; (2) his distinction of relative and absolute inequality; and (3) a comparison of Wagstaff's index with mine. I will end with a few more general observations on inequality measurement for bounded variables.[1]

2. Scale invariance

Health variables come in different varieties, with the most important categories being ordinal, cardinal (or interval-scale), and ratio-scale variables. For each type of variable we can define a specific scale invariance property, which expresses that we want our inequality indicator to be independent of nominal changes in the unit of measurement of health, such as switching from centimetres to inches or from degrees Celsius to degrees Fahrenheit. The idea is that if nobody's real health situation is changing, then the measured degree of inequality must remain the same. In particular, if the health variable is cardinal, then the indicator should be insensitive to any simultaneous positive linear transformation of all health levels *and* of the lower and upper bounds of the variable; if the health variable is of the ratio-scale type, the insensitivity should be limited to a proportional transformation of the levels and the bounds. In the case of a bounded health variable, it is obvious that the same must hold with regard to changes in the unit of measurement of the ill health variable.

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[1] For the sake of brevity I do not include formal proofs of all the claims made in this note. Full proofs will be available in a paper on the properties of rank-dependent indicators of socioeconomic inequality which I am currently writing jointly with Tom Van Ourti. The notation which I use in this reply coincides with that of my paper, not with that of Wagstaff's comment.

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The standard CI has the property of ratio-scale invariance, but not that of cardinal invariance. This means that its use must be limited to ratio-scale variables. Now it may be that many health variables are of the ratio-scale type, but it would certainly be an exaggeration if we claimed that they always are. The Health Utility Index is a prominent example of a cardinal health variable (Horsman et al., 2003). It is therefore useful to have an index which can handle cardinal variables too. It should also be kept in mind that an index which has the property of cardinal invariance automatically has the property of ratio-scale invariance, which means that one does not have to sacrifice ratio-scale invariance on the altar of cardinal invariance.

This was my motivation for imposing the property of cardinal invariance. When Wagstaff writes: “I must confess that I do not see the sense in this quest.” (Wagstaff, in press: xxx), I remain simply perplexed. And my bafflement is increased by the fact that Wagstaff's own index *W* has precisely the property of cardinal invariance, just as my index *E*. It seems arbitrary to me, to say the least, to criticize someone for doing something openly and explicitly, but to remain silent if you yourself do something which in the end leads to exactly the same result.

But there is more. The fact is that in conjunction with the other properties which I imposed in my paper, it does not make any difference whether one requires cardinal invariance or only ratio-scale invariance. Put differently, replacing cardinal invariance by ratio-scale invariance produces exactly the same outcome: only index *E* possesses all the required properties. It is an illusion to think that the index which I derived is the result of “forcing [the] index to accommodate interval-scale variables” (Wagstaff, in press: xxx). Wagstaff's conclusion that the “quest to modify the CI so it can be used with interval-scale variables as well as ratio-scale variables is, in my view, misguided” (Wagstaff, in press: xxx) is therefore unfounded.

3. Absolute and relative inequality

Wagstaff claims that my index is a measure of absolute inequality and as a result is unsuitable for the measurement of relative inequality. In my paper I tried to avoid as much as possible to refer to concepts such as absolute and relative inequality, because I think their meaning is not entirely clear as soon as we are dealing with bounded variables. By contrast, in his comment Wagstaff juggles the terms as if their meaning is self-evident and does not bother to define them precisely. Toward the end of his comment he even introduces the notions of absolute inequality value judgment and relative inequality value judgment.

To illustrate why I am somewhat reluctant to sharply distinguish absolute and relative inequality, let us consider a health variable which varies between 0 and 1, with h_i measuring the health level of person i and $s_i = 1 - h_i$ the ill-health level of the same person. Suppose the health levels of all persons diminish by the same proportion, say from h_i to αh_i, where $0 < \alpha < 1$. Clearly all relative health differences remain the same, since for any i and j we have: $h_i/h_j = \alpha h_i/\alpha h_j$. One could say that in this case relative health inequality is unchanged. But if one looks at the corresponding ill-health levels, the relative differences do not remain the same, since for any i and j such that $h_i \neq h_j$ we have: $(1-h_i)/(1-h_j) \neq (1-\alpha h_i)/(1-\alpha h_j)$. In other words, relative ill-health inequality does change. So, depending on whether you look at one side (health) or the other (ill-health), the same change may be seen as relative inequality preserving or as relative inequality changing. Unless you have a compelling reason to privilege one point of view over the other, you must admit that in the present context the notion of relative inequality is literally ambivalent.

The point may seem entirely semantic, but it is not. If you are using an index which is sensitive only to changes in relative positions, in the case above you would measure no change in health inequality, and some change in ill-health inequality. This would, however, violate the mirror condition, which states that the health and ill-health indices must always move in opposite directions. Hence it is impossible to construct an index which is sensitive to relative inequality changes only *and* satisfies the mirror condition. Since both my index *E* and Wagstaff's index *W* satisfy the mirror property, it is clear that neither of them is a pure relative inequality measure.

But what about the claim that my index is an absolute inequality measure? If one defines such a measure as one that remains constant if everyone's health increases by the same amount (in other words, if it has the level independence property), then index *E* clearly belongs to that category. But what I contest is that this property turns it into an indicator which is sensitive *only* to absolute inequality and *therefore* not an appropriate measure of relative inequality. This is indeed the message which pervades Wagstaff's comment: that an inequality measure must be either an absolute inequality measure or a relative inequality measure. It is true that in the case of an unbounded ratio-scale variable such as income, an inequality measure cannot be simultaneously insensitive to proportional changes of all incomes (usually called ‘scale invariance’) and to equal additions to all incomes (usually called ‘translation-invariance’); and if one identifies the class of relative inequality measures as those that are scale-invariant and the class of absolute inequality measures as those that are translation-invariant, then an indicator cannot possibly be both. In the case of a bounded variable, however, the notion of a proportional change becomes ambiguous, since what is seen as a proportional change in attainment levels is mirrored by a non-proportional change in shortfall levels. Hence the very notion of a relative inequality measure becomes problematic, and one must certainly think twice before one proclaims that what is true for one type of variable automatically holds for another.

What motivated me when writing my paper was the drive to find an index, or a class of indices, which satisfies a set of basic properties. Wagstaff attributes to me a commitment to measure absolute inequality, thereby implying that I am not interested in the measurement of relative inequality. I repeat that I find the use of these labels in the present context not very illuminating. The important thing is that my index *E* is sensitive to changes in both relative and absolute positions. And for that matter, so is Wagstaff's index *W*, as he “somewhat confusingly” (Wagstaff, in press: xxx) admits.

4. Comparing *W* and *E*

Wagstaff's index *W* and my index *E* have quite a lot in common. Both of them satisfy the properties of cardinal invariance, transfer and mirror. Index *E*, but not index *W*, has the property of level independence as well as the associated property of monotonicity, which according to Wagstaff is something about which I should be worried. Perhaps I should, but nothing in what he writes gives me reason to do so.

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