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Health, Income, and Measures of Inequality – Why Inequality May Decline When All Inequality Measures Indicate the Opposite

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Health, Income, and Measures of Inequality – Why Inequality May Decline When All Inequality Measures Indicate the Opposite

Abstract

We study how measures of socioeconomic health inequality inform about welfare inequality. We argue that transfers of either income or health from a better off to a worse off individual should reduce welfare inequality. Lacking an objective measure of individual welfare, we suggest that such a transfer should reduce at least one measure of inequality: inequality in income, health or socioeconomic health. This puts restrictions on measures of socioeconomic health inequality, where a correlation between income and health meets the requirement, while the concentration index only meets the requirement in a statistical sense. Finally, we show empirically that changes in the concentration index over time can be dominated by changes in income. Using data from HUNT, income changes account for 90% of the changes in the concentration index, while health and income are equally important with data from EU-SILC, with large variation across countries and years.

JEL-Codes: D310, I120.

Keywords: socioeconomic inequality, health inequality, health transfers, income transfers, concentration index.

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1. Introduction

The identification of a clear social gradient in health reveals that wherever you are in the socioeconomic hierarchy, those above you are expected to have better health than you, whereas those below you will most likely have worse health. [4] But, like Fleurbaey and Schokkaert (2009), we will argue that these socioeconomic health inequalities should be integrated in a broader perspective on distributive justice, in particular we will argue for considering the joint distribution of both income and health.

Brekke and Kverndokk (2012) (see also Schokkaert et al., 2013) argued that policies that equalize income but leave health unchanged, can increase the social gradient. Here we extend this argument by analyzing more generally the properties of transfers – both of income and health – from a better off to a worse off individual. We look at the impact, not only on measures of socioeconomic health inequality, but also on health inequality as such and on income inequality.

Our paper adds to the literature on socioeconomic health inequality in several ways. First, the literature has focused on the impact of transfers of health (Bleichrodt and van Doorslaer, 2006; Erreygers, 2009). However, we will argue that empirically, changes in measures of socioeconomic health inequality over time are just as much – probably more - influenced by changes in income than by changes in health. Hence, it is important to extend the focus to also include transfers of income.

Secondly, we focus on transfers from a better off to a worse off individual, not only from rich to poor individuals. As both health and income are important for well-being, a transfer from a rich to a poor individual may also be a transfer from a worse off to a better off individual. Extending the focus to transfers from better off to worse off individuals, suggests generalizing the Dalton (1920) principle of transfers,[5] that such a transfer – either in health or income – should reduce overall inequality.

A third contribution to the literature is to focus jointly on measures of both income inequality, health inequality and socioeconomic health inequality. Without sticking to a specification of a

[4] See, e.g. Marmot et al. (1991), Wilkinsson (1996), Smith (1999), Wagstaff and van Doorslaer (2000), Deaton (2003), Subramanian and Kawachi (2004), Marmot (2004), Marmot and Wilkinson (2006), Currie and Schwandt (2016), Barrat et al. (2017), Mackenbach et al. (2018), Schneider et al. (2022) and Gutacker et al. (2023).
[5] This principle of transfers states that transferring income from a rich to a poor person should decrease the value of the inequality measure.

general welfare function, as a function of income and health, we cannot measure overall inequality. To extend Dalton´s principle we thus, suggest that a transfer – either income or health – from a better off to a worse off individual should reduce inequality according to at least one measure of inequality: inequality of income, health or socioeconomic health.

If the better off person also has higher income, and the transfer is in terms of income, then the Gini index of income inequality will drop. Similarly, if health is transferred and the better off is healthier, then a health Gini will drop. However, if the better off individual is better off in health, but not in income, and we transfer income from this person to the other person without changing their utility ranking, we have what we call an example of *mixed transfers*. Here the Gini will increase, while a measure of pure health inequality is constant. To satisfy the principle we would thus require that the measure of socioeconomic health inequality should decrease. We will show that if we measure socioeconomic health inequality using correlation between health and income, this measure satisfies the criterion. We will demonstrate that the concentration index satisfies the criterion only in a statistical sense, but not in a strict sense; it will always be possible to pick such mixed transfers in a way to increase the CI, but in expectation – properly defined – it will decrease.

A final contribution to the literature is an empirical illustration based on two different datasets. One dataset from a Norwegian region, where data on health and other data are collected in intervals of 11 years (HUNT), and one EU dataset that provide yearly data for European countries (EU-SILC). In the HUNT database, we can follow the same individuals at different points in time, while EU-SILC uses a rotating panel. The differences in time between the comparisons may matter. By decomposing the contributions of income and health to the inequality measures, we find that in the HUNT data, changes in the concentration index from one period to the next, are almost exclusively due to income changes (90%) whereas only a small part is due to changes in health from one period to the next (10%). For the EU-SILC data, this is much more mixed, where income in some cases being more important and while health changes are more important in other cases. Using the EU-SILC data, we also measure changes in income-, health- and socioeconomic health inequality as well as overall inequality using a simple utility function. Typically, they move in different directions, making the change hard to interpret, and when the three move in the same direction, instances where overall inequality – for a given utility function – move in the other direction, are very rare. Anyway, the empirical results show that income transfers are

important to the measurement of inequality, and the characteristics of the socioeconomic health inequality should, therefore, be taken into account.

The paper is organized as follows: In Section 2 we illustrate the problem of just considering a measure of socioeconomic health inequality when studying an improvement in either income or health. In Section 3, we outline new principles of transfers when we care about the overall well-being, and also a criterion for transfers when persons rank differently in health and income (mixed rank transfers). Then, in Section 4, we follow up on mixed rank transfers and show how different measures of socioeconomic health inequality meet the criterion from Section 3. While Section 4 studies effects of transfers between two individuals, Section 5 focuses on expected effects of mixed transfers in a typical large population, i.e., in a statistical sense. Empirical results based on Norwegian and European panel data to illustrate the analytical results, are presented in Section 6. The final section concludes.

2. Socioeconomic health inequality in a broader context

As measures of socioeconomic health inequality must be bivariate; they require data on both health and a measure of socioeconomic status such as income. The distribution of both variables matters. A change in the distribution of one variable while keeping the distribution of the other variable constant should therefore affect the measure of the socioeconomic health inequality. When it comes to a transfer in income, the consensus has been that narrowing the income distribution will reduce the relative socioeconomic inequalities in health (see Contoyannis and Forster, 1999; Wagstaff et al., 2003; Blakely and Wilson, 2006). In contrast to this, both van Ourti et al. (2009) and Baeten et al. (2013) found that a reduction in income inequality does not necessarily lead to a lower income-related health inequality as measured by the concentration index (CI). Brekke and Kverndokk (2012) argued that transfers of income from a rich to a poor can cause an increase in common measures of socioeconomic health inequality. When other factors causing inequalities in socioeconomic status are reduced, poor health may remain as the primary reason why individuals end up at the bottom of the socioeconomic status ladder in egalitarian countries. This means that an increase in a measure of socioeconomic health inequality may be the result of an egalitarian income policy.

This argument can easily be illustrated with a simple example, see Figure 1.[6] Consider two societies; one egalitarian where your social class does not affect your income, and one where

[6] This figure is not taken from Brekke and Kverndokk (2012).

social class matters for income. There are two groups of people in each society, one with good health and one with bad health. In the egalitarian society, there is a positive correlation between health and income. This is also true in the class society, but only within the same class. Those belonging to the upper class are able to earn a high income even if the health is bad, while those in the lower class have limited possibilities to receive a high income. As seen from the figure, the correlation between health and income is higher in the egalitarian society than in the class society. Even if the egalitarian society implements a policy that improves health and income for those worse off (moving from the dotted to the black square in the left of the diagram), the correlation will still be stronger than in the class society. As the concentration index is a measure of socioeconomic health inequality, and the concentration index also tend to increase in the correlation between health and income rank (see, e.g., Koolman and van Doorslaer, 2004, and Schokkaert et al., 2013), this example may illustrate problems with income transfers for socioeconomic health inequality.

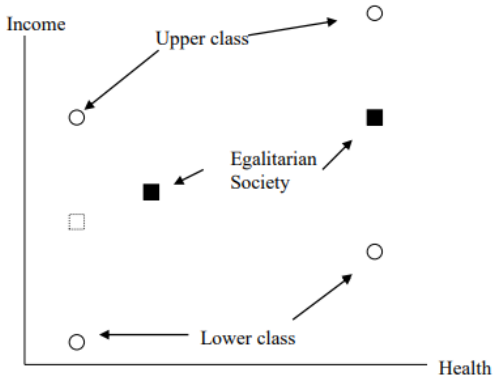

Figure 1: An example illustrating correlation between health and income in an egalitarian and a class society.

This figure illustrates the importance of thinking about inequality in terms of overall inequality. Only a measure of socioeconomic health inequality would indicate that the egalitarian society has most inequality, while in terms of overall inequality the opposite is true. In this case a standard Gini index will complete the picture.

We now reverse the picture and swap axes so that income is on the horizontal axis. Assume that the change is a major improvement in health for the least healthy, irrespective of income. We could imagine that it had no effect on income distribution (like the egalitarian society has the same health distribution as the class society if we use the open left square rather than the solid one). In this case, we would have a major improvement in overall equality, that only

show up in the health distribution, the standard Gini index plus a measure of socioeconomic health inequality would give a misleading picture. We thus argue that we should see socioeconomic health inequality in the context of both health and income distribution.

3. Principles of transfers from better off to worse off individuals - generalized Dalton transfers

A key principle in the literature on socioeconomic health inequality was introduced by Bleichrodt and van Doorslaer (2006, p. 952) as the "principle of income-related health transfers." According to this principle, "transferring health from someone who is better off in terms of socioeconomic status to someone who is worse off in terms of socioeconomic status does not lead to a reduction in social welfare provided the transfer does not change the ranking of the individuals in terms of socioeconomic status". This principle is also central to the axiomatic justification of the concentration index in Erreygers (2009).

We will add to this literature by extending the focus to transfers of both income and health, not just from richer to poorer individuals, but from a better off to a worse off individual. Such a transfer from a better off to a worse off individual can be named a generalized Dalton transfer, and should reduce inequality and improve social welfare, for most social welfare functions.[7] The transfer can either be in income or in health. We state this as a principle:

Principle 1: *Transferring either health or income from someone who is overall better off to someone who is overall worse off, does not lead to a reduction in social welfare provided that the transfer does not change the ranking of the individuals in terms of total utility*.

To determine who is better off, we need a utility function defining well-being as a function of both income and health:

$$u_i = u(h_i, x_i) \tag{1}$$

where h_i is health, x_i is income, u_i is individual welfare, and *i* refers to the individual. We assume that the function is the same for all individuals, and that it is increasing in both its elements.

[7] This follows for instance if there are falling marginal individual utility in income and health, or if there are preferences about distribution.

We could use such a utility function to study the inequality of utility or even add the individual utility functions to get a social welfare function.[8] This would however require strong assumption about the utility function in equation (1). Rather we will apply the principle to infer properties for measures of inequality. A transfer from a better off individual to a worse off – without altering their ranking – increases social welfare because inequality is reduced. A weaker principle is to require that there should at least be some hint in the inequality measures that inequality is reduced. Such inequality measures may be indexes of health inequality, income inequality as well as the interaction of the two: socioeconomic health inequality.

Principle 2: *Transferring either health or income from someone who is overall better off to someone who is overall worse off should reduce inequality in at least one of the three indexes.*

Measures of inequality in a single dimension, such as income inequality, is extensively studied in the literature,[9] and we do not add to this literature. Thus, we want to establish that if measures of pure income inequality or pure health inequality satisfies a one-dimensional Dalton principle, Principle 2 primarily puts a restriction on the measure of socioeconomic health inequality.

To analyze the implication of this principle, consider two persons, b and w. Suppose that b is **b**etter off than w who is **w**orse off in welfare as defined by equation (1) above. According to the principle, a transfer from b to w should reduce inequality in at least one index. Consider first the case that the better off is better off in both dimensions: $h_b > h_w$ and $x_b > x_w$. In this case, a small transfer of either health or income, from b to w will reduce inequality in pure income – if income is transferred, or pure health – if health is transferred. Thus at least one index will show reduced inequality as required by Principle 2.

The challenging case is when b is worse off in one dimension and we make the transfer to w in this dimension, e.g., if $h_b > h_w$ but $x_b < x_w$, and we transfer income from b to w, i.e., from the poorer to the richer. Reasonable measures of income inequality would indicate more income inequality. Still, as the transfer is from the better off to the worse off, we would like to have an indication of reduced overall inequality. A measure of pure health inequality will not

[8] This is the standard utilitarian social welfare function (Harsanyi, 1955).
[9] See, e.g., Goesling and Firebaugh (2004) for health inequality indexes, and De Maio (2007) for income inequality measures.

change as there is no transfer of health. To satisfy Principle 2, we thus require that the last index, the measure of socioeconomic health inequality, should decline to indicate that overall inequality has decreased. We state this as a criterion, but first we need a definition.

Definition: *A **mixed rank transfer** is a transfer between two persons who rank differently in the health and income dimension, and the recipient, who is overall worse off, rank highest in the good that is transferred.*

Criterion: *Mixed rank transfers should reduce the measure of socioeconomic health inequality. Stated formally, this means:*

(i) *If* $h_b > h_w$ *but* $x_b < x_w$ *and* $u(h_b, x_b) > u(h_w, x_w)$*, the measure of socioeconomic health inequality should decrease when income is transferred from b to w, given that the utility ranking of the individuals does not change.*

(ii) *If* $h_b < h_w$ *but* $x_b > x_w$ *and* $u(h_b, x_b) > u(h_w, x_w)$*, the measure of socioeconomic health inequality should decrease when health is transferred from b to w, given that the utility ranking of the individuals does not change.*

Note that if $h_b > h_w$ and $x_b < x_w$, b may or may not be better off than w (and vice versa). Thus, without knowing the utility function, we cannot know if the criterion should apply in a specific case. However we assume that the utility function is such that the criterion bites:

Assumption 1: *We assume the utility function is such that, if* $h_b > h_w$ *and* $x_b < x_w$ *but* $u(h_b, x_b) \geq u(h_w, x_w)$*. Then it is possible to raise health of individual w to* h'_w *or reduce income of individual b to* x'_b*, and thus keep the ranking* $h_b > h'_w$ *and* $x_b < x'_w$*, such that* $u(h_b, x'_b) < u(h'_w, x_w)$*, and similarly with the reversed mixed ranking.*

With this assumption, there are cases of mixed ranking of both types specified in the criterion. Thus, if there are violation of the criterion for **all** mixed rankings, we can conclude that for any given utility function, the criterion is violated.

4. Measures of socioeconomic health inequality and mixed rank transfers

Next, we consider if different measures of socioeconomic health inequality from the literature satisfy our criterion. Measures in the literature include odds-rations, the gradient (correlation between income and health) and the concentration index.

The odds-ratio does not satisfy the criterion for the simple reason that it responds only to transfers that change the composition of the top and bottom of the income distribution. Transfers in the middle will show no improvement in inequality.

We will now turn to how two central measures of socioeconomic health inequality, the concentration index and the correlation, respond to mixed rank transfers. We first consider the concentration index.

As mentioned above, the concentration index is a bivariate measure of socioeconomic inequality of health that considers the distributions of health and one socioeconomic variable, mainly income, which is also what we consider here. Several versions of the concentration index exist such as the standard, the generalized and the modified (see, e.g., O'Donnel et al., 2016), but they all depend on level of health and the rank of income.[10]

Consider a population of *n* individuals, and let (x_i, h_i) denote income and health for person *i*. Let λ_i denote the income rank, with *1* as the poorest and *n* as the richest, that is: $\lambda_i = i$, where *i = 1,…,n*. In case of income ties, all individuals at the same income level get the average rank for the group. Also, let μ be the average health, i.e. $\mu = \frac{1}{n}(\sum_{i=1}^{n} h_i)$. The concentration index (CI) is now defined as:

$$CI = \frac{\sum_{i=1}^{n}(2\lambda_i - 1)h_i}{n^2\mu} - 1 = \frac{2}{n^2\mu}\sum_{i=1}^{n}\lambda_i h_i - \frac{1}{n} - 1. \quad (2)$$

The term $\sum_{i=1}^{n}\lambda_i h_i$ shows that CI is related to the covariance between the income rank and the health level. The value of the index is between 1 and -1, in which a positive number means that health is distributed in favor of the rich. Moreover, an increase in the value of the index means that health is distributed more in favor of the rich.

We start with the following Lemma, which we will use below:

Lemma: *A marginal transfer of income from person i to person j will change the concentration index as follows:*

[10] One alternative way is to use the level of both variables, see Erreygers and Kessels (2017). They show that rank-dependent and level-dependent indicators do not necessary give the same outcome.

- *If only the rank of j moves one place the change is* $\Delta_j = \frac{2}{n^2\mu}(h_j - h_{j+1})$
- *If only the rank of i moves one place, the change is* $\Delta_i = \frac{2}{n^2\mu}(h_{i-1} - h_i)$

Now, we can state a Theorem about mixed transfers and CI:

Theorem 1: *The concentration index does not satisfy our Criterion (i) but it does satisfy Criterion (ii).*

Proof: The CI is known to satisfy the principle of income related health transfers, thus the index decreases if health is transferred from a richer to a poorer, irrespective of how their health ranks. As a direct consequence, criterion (ii) is satisfied.

Consider a marginal income transfer. The impact of the transfer will depend on the health of the neighbor in the income ranking as described by the Lemma. The premise of criterion (i) is $h_b > h_w$, $x_b < x_w$ *and* $u(h_b, x_b) > u(h_w, x_w)$, As seen from the Lemma, the transfer from the rich w, to the poor b, will increase CI e.g. if, only the poor moves and $h_b > h_{b+1}$. By assumption 1 we can, for any utility function construct cases such that $h_b > h_w$, $x_b < x_w$ *and* $u(h_b, x_b) > u(h_w, x_w)$. Moreover, by choosing appropriate income and health for neighbouring individuals we can construct the case such that a modest transfer only moves the poor's income rank, and where $h_b > h_{b+1}$. Hence the violation applies to any utility function satisfying our assumption. **QED**

Note that violations of the criterion exist in the sense that we can imagine a population where it would be violated. If income and health are perfectly correlated, then it will always be the case that $h_b < h_{b+1}$. However, the proof only shows that there are examples of populations and transfers violating the criterion. We do not claim that this is always the case for mixed rank transfer, or even that it can be expected in a typical such transfer. We return to this in Section 5.

We now turn to the correlation between income and health. The correlation between *h* and *x* is defined as

$$corr(h,x) = \frac{\sum_i \left(h_i - \bar{h}\right)\left(x_i - \bar{x}\right)}{\sqrt{\sum_i \left(h_i - \bar{h}\right)^2 \sum_i \left(x_i - \bar{x}\right)^2}}, \tag{3}$$

where $\bar{h}$ and $\bar{x}$ are mean values.

Theorem 2: *The correlation between income and health satisfies the criterion.*

Proof: Correlations are symmetric, so we only need to prove case (i) where $h_b > h_w$ but $x_b < x_w$, i.e., that an income transfer of Δ from the better off to the worse off decreases the correlation. If this is the case, then (ii) follow by symmetry.

The numerator in (3) covers the terms in the definition of the covariance. Note that a pure transfer does not change the mean, thus the only terms in the definition of a covariance that is affected are those involving individuals *w* and *b.* These terms in the covariance are

$$C = (h_w - \bar{h})(x_w - \bar{x}) + (h_b - \bar{h})(x_b - \bar{x})$$

Now, an income transfer Δ from *b* to *w* will change x_b to $x_b - \Delta$ and x_w to $x_w + \Delta$.

$$C' = (h_w - \bar{h})(x_w + \Delta - \bar{x}) + (h_b - \bar{h})(x_b - \Delta - \bar{x})$$

$$= (h_w - \bar{h})(x_w - \bar{x}) + \Delta(h_w - \bar{h}) + (h_b - \bar{h})(x_b - \bar{x}) - \Delta(h_b - \bar{h}) = C + \Delta(h_w - h_b)$$

The change in C is $\Delta(h_w - h_b) < 0$, and the covariance decreases. However, to get to the correlation we also need to consider the variance of income and health, which are the terms in the denominator in the definition of the correlation.

The variance of health does not change, but the transfer affects the variance of income. The relevant terms of the variance are

$$V = (x_w - \bar{x})^2 + (x_b - \bar{x})^2,$$

which changes to $V' = (x_w + \Delta - \bar{x})^2 + (x_b - \Delta - \bar{x})^2$ which further gives $V' = (x_w - \bar{x} + \Delta)^2 + (x_b - \bar{x} - \Delta)^2$ and finally

$$V' = (x_w - \bar{x})^2 + 2\Delta(x_w - \bar{x}) + \Delta^2 + (x_b - \bar{x})^2 - 2\Delta(x_b - \bar{x}) + \Delta^2$$

$$= V + 2\Delta(x_w - x_b) + 2\Delta^2$$

Hence, $V' - V = 2\Delta(x_w - x_b) + 2\Delta^2 > 0$.

We conclude that covariance decreases and the standard deviation increases, thus correlation decreases. **QED**

Note that CI satisfies our criterion for health transfers but not for income transfers, while correlation satisfy both. Correlation is a symmetrical index where health and income are treated equally, while CI treat health and income differently – income only enters through income rank. Axiomatic derivations of the CI, such as Erreygers (2009), derive the index from axioms only related to individual health transfers. Still, while the index fails to satisfy the criterion for each individual income transfer, it may perform better in aggregate. We will study this below, but we first further explore how the CI responds to income transfers.

5. Asymmetries and expected effects of mixed rank transfers

Much of the literature on inequality measures are based on axiomatic foundations stating how measures should respond to individual transfers. While this approach has been very successful in many cases, it is still the case that the typical use of these indexes is to compare countries or changes within one country over a period such as a year. In this period the changes amount to the total impact of thousands of transfers. The fact that we can figure up single transfers where the index has unfortunate properties, may thus be a weak foundation for evaluating an index. While we do not attempt to characterize the effect of many transfers, we will in this section, study the expected impact of mixed rank transfers in a typical large population.

We noted above that the violations of our criterion when we use the CI, only appear for income transfers not for health transfers. Also, the correlation between income and health is symmetric in the effect of income and health transfers and does not violate our criterion. We thus want to further explore this asymmetry of the CI.

To study the expected effect of an income transfer, we need assumptions about the distribution of income and health. We start with the following assumption:

Assumption 2: *Income and health are drawn from a joint distribution, such that the expected health for a given level of income,* $E(h \mid x)$ *, is strictly increasing in income, x.*

The theorem below illustrates the asymmetric properties of the CI:[11]

[11] We focus on the simplest case where the rank of each moves by one. This is not essential, a poor person is likely to be of better health than the average given his income, if its health equals that of a richer person. Similarly the rich is of poorer health than expected given its income. Thus, if only one of them moves or if one moves more than one rank, the results is expected to be the same.

Theorem 3: *Transfers of health and income have asymmetric impacts on the concentration index*

- *A transfer of health between two persons of equal income has no impact on the concentration index.*
- *A transfer of income from a rich to a poor person of equal health, moving the rank of each of them only one position, will – in expectation - increase the concentration index*

Proof: The first point is trivial and merely an inverse restatement of the principle of income-related health transfers, see, e.g. Bleichrodt and van Doorslaer (2006) and Khaled et al. (2018), which is one of the axioms in Erreygers (2009). It is also easily seen from the definition of CI as individuals of equal income have equal income rank and thus only their average health matters, and their average health does not change with an income transfer.

The second point follows from the Lemma above, noting that in expectation the health of those closest in rank is Eh_{j+1} and Eh_{i-1}, where *i* is the rich and *j* is the poor Thus, the total change is, using the Lemma:

$$\Delta = \Delta_i + \Delta_j = \frac{2}{n^2\mu}\left[\left(h_j - h_i\right) + \left(Eh_{i-1} - Eh_{j+1}\right)\right] = \frac{2}{n^2\mu}\left[\left(Eh_{i-1} - Eh_{j+1}\right)\right],$$

as $h_i = h_j$. Since *i-1* is richer than *j+1*, and since assumption the gradient is positive, $\Delta > 0$. **QED**

As found in the proof above, $\Delta = \frac{2}{n^2\mu}\left[\left(h_j - h_i\right) + \left(Eh_{i-1} - Eh_{j+1}\right)\right]$, with a transfer of income from i to j. Now if the transfer is a mixed rank transfer of income, i must be the better off, but poorer. This means that the health of *i* is better than the health of *j*. Thus, with a transfer of income from *i* to *j*, we see that $h_j - h_i < 0$. Moreover, as i now is the poorer, $Eh_{i-1} - Eh_{j+1} < 0$. Hence, $\Delta < 0$. This gives the following Corollary:

Corollary: *A mixed rank transfer of income, moving each exactly one rank, will reduce the CI in expectation.*

This result indicate that the violation of Principle 2 is not typical, and perhaps axioms on properties for individual transfers is not the best approach in this case. Note also that as the poor is the better off, the poor will typically have better health than others at similar income.

As this poor swap place in rank with others of equal health, CI will decline. A similar argument applies to the rich who is the worse off, and hence typically with a lower health than others at similar income. We thus, think the observation in the Corollary applies well beyond the case where each move one place, but we need to specify additional assumptions to state it as a theorem, which may muddle the general insight. Since the problem is clearly related to income transfers, we will also study empirically the relative importance of income changes and health changes for changes in CI over time.

6. Empirical Results

To study the empirically the effects on CI of income and health transfers, we first make a decomposition of the CI, where we decompose a change in the index in income transfers and health transfers. We then use the decomposition methodology to analyze the impacts of income and health transfers separately on the CI.

For the empirical investigation, we choose two different panels. The first is the HUNT-study, where health surveys are repeatedly held for a region in mid-Norway about every eleventh year. Every citizen above a certain age in the region has the possibility to participate, and we can therefore follow individuals at different points in time. The health data are combined with Norwegian register data on income. The second panel is the EU-SILC study, which is an annual study performed in EU and EFTA countries. Compared to the HUNT-study, the EU-SILC uses a rotating panel. Thus, the two panels differ when it comes to frequency, i.e., the time interval between two consecutive studies, but also as only one of the studies follows the same group of individuals over a long time period. Due to the differences between the studies, we think including both of them may give a more comprehensive picture of the empirical characteristics of the CI.

6.1 Decomposing changes in the Concentration Index

Noting that the CI is asymmetric in the treatment of income and health, and that the failure to satisfy our criterion is related to transfers of income, we may wonder how important are changes in income for the changes in CI. For this purpose, we decompose the CI

Consider a comparison of the CI for a given population at different points in time. Let $x^t = (x_1^t, ..., x_n^t)$ denote the vector of income[12] for each individual at time *t*. Similarly, h^t is the vector of health at time *t.* The concentration index at time *t* can then be written as $C(x^t, h^t)$. From time *t = 1* to *t = 2* the concentration index changes from $C(x^1, h^1)$ to $C(x^2, h^2)$. This change can be decomposed as:[13,14]

$$(4) \qquad C(x^2,h^2) - C(x^1,h^1) = \left[C(x^1,h^2) - C(x^1,h^1)\right] + \left[C(x^2,h^2) - C(x^1,h^2)\right].$$

The first term, $C(x^1,h^2) - C(x^1,h^1)$, reflects the effects of the redistribution of health for a given level of income. That is the change in the index if no individual changed their income from on period to the next, only their health changed. The second term, $C(x^2,h^2) - C(x^1,h^2)$, represents the effect of changes in income if all individuals' health were unchanged, and equal to the health in period 2.

Note that we cannot use this decomposition when comparing CI across countries. This decomposition requires that the index is defined over the same set of individuals at both time *t=1* and *t=2.* Since the concentration index is essentially a correlation as mentioned above, cross-period indexes $C(x^1,h^2)$ would not be invariant to pivotation of one of the vectors x^1 or h^2 and not the other. Pivotation is not uniquely defined unless we have the same individuals in both periods, hence the decomposition would be arbitrary.

Below, we use the decomposition in (4) to study the effects of redistribution of income and health separately in two different datasets, to compare the effects of the two types of redistribution.

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[12] As mentioned above, the concentration index uses income rank rather than the income level, but this does not matter in this general specification.

[13] The decomposition is not unique as we also could keep income from the second period and health from the first period constant: $C(x^2,h^2) - C(x^1,h^1) = \left[C(x^2,h^1) - C(x^1,h^1)\right] + \left[C(x^2,h^2) - C(x^2,h^1)\right]$.

[14] There exists several decompositions of the concentration index, see, e.g., Wagstaff et al. (2003), van Ourti et al. (2009), Allanson et al. (2010), Baeten et al. (2013), Heckley et al. (2016), Kessels and Erreygers (2019) and Coveney et al. (2020), but as far as we know, Coveney et al. (2020) is the only study that uses a similar decomposition as in our study, citing an earlier version of this paper.

6.2 HUNT data

Health data are taken from the Trøndelag Health Study (HUNT),[15] a longitudinal population health study from a county in mid-Norway. HUNT is a unique database of questionnaire data, clinical measurements and samples from a county's inhabitants since 1984. There has been four instances of this study, HUNT1 (1984-1986), HUNT2 (1995-1997), HUNT3 (2006-2008), and HUNT4 (2017-2019). The first three HUNT studies do not include a large city, while the fourth study also includes the city of Trondheim, Norway's third largest city.

We use data on subjective health from the three first studies (HUNT1-3). Thus, we can study individuals participating in two consecutive studies. 77,203 persons participated in HUNT1 (89.4% response rate), 65,229 participated in HUNT2 (69.5% response rate) and 50,802 participated in HUNT3 (54.1% response rate).

Subjective health is a measure with scores ranging from 1 to 4, with 4 as the best. Based on the data, there is little health inequality in the sample, and for the three riches quintiles in HUNT 1, the health is more or less equal, see Figure 2.

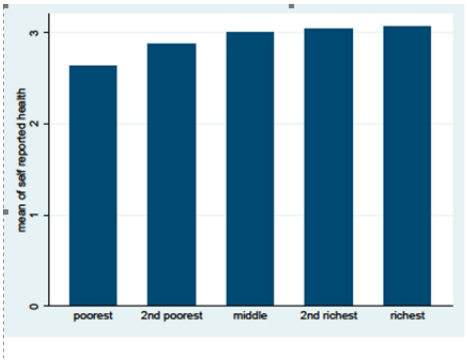

Figure 2: Average health in HUNT1, where the population is dived into five groups.

Income data are taken from the Norwegian administrative registry data made available from Statistics Norway. We use income data for the middle year of the HUNT studies, i.e. 1985, 1996 and 2007. The only income that is registered for the whole period from 1984 to 2008 is *pensionable income*, i.e., gross wage and business income. Thus, we use this income concept in the first analysis below.[16]

[15] See https://www.ntnu.edu/hunt and Holmen et al. (2003).

[16] There is one problem using pensionable income as the income-concept in the study of socioeconomic health inequality. Subjects on disability pension or who are retired, will have a reported income of zero even when they get a monthly pay check. Not only is this a poor measure of real income, it is also particularly problematic in our context. As there are 11 years between each survey, the older part of the panel is likely to be registered with zero

Figure 3 shows the concentration curve for HUNT1 using this income concept.

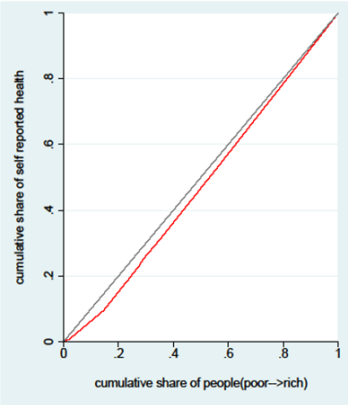

Figure 3: Concentration curve for HUNT1

As seen from the figure, there is also little socioeconomic health inequality among the subjects in HUNT1. One reason is the little health inequality, but also that income increases with age, while health decreases.

In the following, we compare HUNT1 and HUNT2, and HUNT2 and HUNT3 respectively. 46,710 persons are registered with pensionable income in both HUNT1 and HUNT2. Excluding those with zero income, reduces the sample to 29,497. The corresponding numbers for HUNT2 and HUNT3 are 35,588 and 24,954.

6.2.1 Changes over time in CI, Gini index and Health Gini

Below, we calculate three indexes based on HUNT-data for health and income data; CI, a Gini index and a Health Gini. A summary of the results comparing HUNT1 and HUNT2 is given in Table 1, where we use the decomposition in 6.1 to calculate the changes in CI from income and health.

income in the last survey. Older people also tend to have poorer health than younger ones. Thus, it is the unhealthy ones that – in our data – apparently loses their income. Taking the income away from those with poor health naturally increases the concentration index. Therefore, we only include those who have a positive income in both periods in the sample.

CI		Change in CI due to		Gini index		Health Gini		
HUNT1	HUNT2	income changes	health changes	1985	1996	HUNT1	HUNT2	N
0.0026	0.0232	90.7%	9.3%	0.3062	0.2981	0.0897	0.1056	29,497

Table 1: Calculations of CI, Gini index and Health Gini for HUNT1 and HUNT2, and the change in CI due to changes in health and income.

From the table, we have several interesting results. First, while there is an increase in both CI and the Health Gini from HUNT1 to HUNT2, the Gini index falls. Second, CI is very small for both HUNT studies, as also indicated by Figure 3. One additional reason is that removing the individuals with zero income probably also removes the individuals with worst health as these individuals receive several forms of pension. Further, health inequality is lower than income inequality. The low health inequality is consistent with Figure 2 above.

Also, there is a relatively large increase in CI from HUNT1 to HUNT2. However, more than 90% of this change is due to changes in income, even if we see that the Gini coefficient has declined, and the health inequality has increased.

Table 2 below gives a similar comparison of HUNT2 and HUNT3.

CI		Change in CI due to		Gini index		Health Gini		
HUNT2	HUNT3	income changes	health changes	1996	2007	HUNT2	HUNT3	N
0.0080	0.0285	90.9%	9.1%	0.2718	0.3121	0.0976	0.1073	24,954

Table 2: Calculations of CI, Gini index and Health Gini for HUNT2 and HUNT3, and the change in CI due to changes in health and income.

Note that the numbers for the different indexes for HUNT2 differ from Table 1, as the panel is different. Now, we compare those who have positive pensionable income both in HUNT2 and HUNT3. While some of the subjects are included in both panels, the latter panel also includes new subjects.[17]

[17] As mentioned above, the panel that is included in HUNT1 and HUNT2 with positive pensionable income consists of 29,497 individuals, whit the corresponding number for HUNT2 and HUNT3 is 24,954.

We see from the table that both income inequality and health inequality increase from HUNT2 to HUNT3. CI increases also, but the relative increase in CI is much higher than the relative increase in the Gini index and the Health Gini; while CI increases by a factor of 3.5, the increase in the Gini index is 15%, while the increase in Health Gini is 10%. Thus, in contrast to the comparison between HUNT1 and HUNT2, all inequality measures increase from HUNT2 to HUNT3. As for the comparison between HUNT1 and HUNT2, we see that more than 90% of the change in the CI comes from income changes. Thus, the CI is very sensitive to changes in income.

6.2.2 The effect of taxation

As income transfers have a large impact on the CI, we take a further look at this, by studying a pure income transfer – taxation. Each individual will, of course, have the same health before and after tax.

The Norwegian tax system is in general terms progressive, but with a marginal tax well below 100%. If person *i* has higher income than person *j* before taxation, the marginal tax rate below 100% should ensure that *j* is the poorest also after tax. Thus, if our income concept were the only basis for taxation, we would expect no changes in the income rank and thus no impact on CI, while the Gini index will be reduced due to the system being progressive. But the system is more complex than this, and some will lose rank and other gain.

To study this, we use data from HUNT2 and HUNT3, where we use the income concepts *total income* and *income after tax*. Total income is defined as pensionable income plus capital income and transfers, while income after tax is total income minus income taxes. Again, we remove individuals registered with no income.

	Concentration index		Gini index		
	Before tax	After tax	Before tax	After tax	N
HUNT2	0.0280	0.0260	0.3154	0.2746	64.430
HUNT3	0.0294	0.0275	0.2881	0.2472	49,124

Table 3: Calculations of CI and Gini index in HUNT2 and HUNT3, using income before and after tax.

Not surprisingly, the Gini index is lower in both panels when we use the income after tax. For both panels the CI also falls. If low income people also have worse health than high income

people, Principle 2 is met as high income people is taxed more than low income people, otherwise the Gini indexes would not have been reduced.

Note further that while the tax system, as a first order approximation, should have little impact on CI due to the marginal tax below 100%, the actual effects on the CI in the two panels is 7-8%, almost the same as the effect of health changes over an 11 years period, see Table 2. This further illustrates that we need to consider the impact on income transfers on the CI, not only the health impact.

6.3 EU SILC-data

The EU-SILC (European Union Statistics on Income and Living Conditions) dataset initiated by the Eurostat. It is a comprehensive and standardized collection of data designed to assess income, poverty, social exclusion, and living conditions across EU member states. The dataset includes, amongst others, variables on income and health. Using a consistent methodology across countries, EU-SILC allows for cross-national comparisons as well as longitudinal studies. EU-SILC uses a rotating panel.

We have data from EU-SILC for the years 2007-2018, with four year rolling panel. As we need observation from the same individual for all years to do the decomposition, we have only used four-year panels. The main results are given in the Appendix for 2015-2018 for all countries where the relevant variables where available.

Health, PH010 is coded as 1for best health and 5 for worst, however, we recoded this to let a higher value be better health: Health=6-PH010. The income variable is the sum of gross cash or near-cash employee income (PY010G) plus pensions received from individual private plans (PY080G), unemployment benefits (PY090G), old-age benefits (PY100G), but excluding sickness benefits (PY120G) and disability benefits (PY130G).

We have excluded individuals with an age above 60 years or below 30 years, in 2018. This reduces the impact of changes in income due to education or retirement. The remaining sample size varies between countries from 287 in Luxemburg to 3,343 in France.

6.4 EU SILC results

Results for all countries where the variables where defined, is given in the tables A1 and A2 in the Appendix. The share of changes in CI due to income, based on the decomposition above, ranges from a factor of +42 to a factor of -2.7. A factor of -2.7 means that the change

due to income is in the opposite direction of the total change in CI, and 2.7 times as large. The changes in CI due to health must then be 3.7 times the total change in CI. Such large shares thus, reflect the cases where income and health causes changes that are similar in size but in opposite directions. In general, there is no tendency that income has less impact on CI than health changes.

Next we consider some alternative measures of distribution in income and health. We compute the Gini, the Health Gini, the CI and the correlation. We also compute an index for total welfare[18]

$$w_i = u(h_i, x_i) = \ln(x_i) + ah_i, \tag{5}$$

where a is chosen such that one standard deviation change in either ln (x_i) or h_i counts equally. Calibrating the model to the case of the UK, we have chosen $a = 1.1575$. We then compute a Gini-coefficient for this welfare indicator, called the welfare Gini.

In table A1 in the Appendix, we find that typically changes in the welfare Gini is explained by changes in either the health or the income Gini. In the few cases where both the health and the income Gini move in the opposite direction of the welfare Gini, the change in the welfare Gini is explained by the change in the CI and by the change in the correlation. For the years 2015-2018, we found no single instance where the welfare Gini move in one direction and the indexes: income and Health Gini and either CI or correlation, move in the other direction.[19]

For the UK in the years 2009-2010, however, the welfare Gini falls from 0.0458 to 0.0450 while the income Gini increased from 0.396 to 0.407, the Health Gini increased from 0.0797 to 0.0801 and the correlation increased from 0.1823 to 0.1824. In this case the CI fell from 0.0186 to 0.017, being the only index that moves in the same direction as the welfare Gini. For individual transfers we showed above that a case where all indexes move in the opposite direction to the welfare Gini is only possible if socioeconomic health inequality is measured using the CI and not when using correlation. This result thus, questions the usefulness of

[18] This welfare function is admittedly rather arbitrary but can still serve as an interesting reference point.
[19] Note that the correlation with the welfare Gini is quite high for all the indexes with 0.61 for the Gini, 0.66 for the Health Gini, 0.63 for the CI and 0.55 for the correlation.

evaluating the indexes based on properties for individual transfers rather than statistical properties.

7. Conclusions

It is well documented that there is a correlation between socioeconomic status and health, which is interesting to study for several reasons. One important reason is "unfair" inequalities. Many consider social background as an ethically illegitimate reason for health inequality, see, e.g. Fleurbaey and Schokkart (2009) and Garcia-Gómez et al. (2015).[20] Thus, if socioeconomic economic status is a factor that affects your health,[21] it may be interesting to study how this inequality can be reduced and how it develops over time.

There are many measures of socioeconomic health inequality, such as the correlation, the concentration index and odds ratios. In this paper we have assessed the properties of both the correlation and the concentration index.

While the concentration index is derived from premises about how it responds to single transfers of health from richer to poorer individuals, we find that empirically changes in the concentration index over time is just as much due to changes in income. In one of our datasets, HUNT, income changes is the dominating source of changes in the concentration index. We thus argued that it is more relevant to evaluate the impact of both health and income changes on the concentration index, rather than just study health transfers. However, we show that single transfers of health and income have asymmetric impacts on the concentration index.

We extend the perspective by analyzing more generally the properties of transfers – both of income and health – from a better off to a worse off individual, arguing that this should reduce overall welfare. In this case, beings better off depends on both income and health. We further argue that without an objective individual welfare function, a reasonable principle is that when overall inequality declines, at least one measure of inequality should decline.

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[20] This is the focus in Europe. In e.g. the US the focus is on racial disparities in health (see, e.g. Sternthal et al 2011; Fleurbaey and Schokkaert, 2012), and in South Africa both social inequality and racial disparities in health is studied (Nwosu and Oyenubi, 2021).

[21] One strand of literature argues that health condition affects socioeconomic status (Grossman, 2000; Deaton, 2003; Behrman and Rosenzweig, 2004; Case et al., 2005; Black et al., 2007), whereas another and more pronounced strand argues that socioeconomic status affects your health (see Smith, 1999, for a review). A third points out that shared underlying factors (genetics, self-control, preferences, etc.) can help explain the social gradient in health (see e.g. Barsky et al., 1997). Lastly, some argue that all these causal relationships coexist.

Relevant measures of inequality would in this case be a measure of income inequality, a measure of health inequality, and a measure of socioeconomic health inequality.

We find that such a principle mainly puts restriction on measures of socioeconomic health inequality, in particular it puts restrictions on how the measures responds to *mixed transfers*: If the better off individual is worse off in one dimension – income or health – and the transfer is in this dimension, we have what we call an example of mixed transfers.

We show that for any individual welfare function, there are mixed transfers of income where overall welfare inequality drops while the concentration index will increase, at the same the regular Gini (in income) will increase, and a Health Gini is constant. Thus, all three inequality measures will be non-decreasing while inequality in welfare decreases. The concentration index will, therefore, not satisfy our principle. However, a correlation between health and income as a measure of socioeconomic health inequality, would fall due to the income transfer, and thus satisfy the principle.

Note, however, that while it is possible to find instances of such transfers, they are not typical. We find that in a statistical sense, measured as expected effects of mixed transfers, the concentration index will decrease if welfare inequality drops and the two other indexes increases. Thus, principles based on single transactions may not be so useful when studying large datasets.

The analytical results are supplemented with empirical results. In addition to the HUNT data, we also used the EU-SILC data to compute all indexes as well as a measure of inequality in welfare for all EU-countries. For this purpose, we used a simple function of individual welfare: the sum of log income and health where a standard deviation in either variable had equal weight. For the period 2015-2018 we found no case where all three indexes changed in the opposite direction of the change in welfare inequality. For UK in 2009-2010 we found however, that welfare inequality fell while regular Gini, the Health Gini and the correlation increased. In this case the concentration index fell, and, therefore, pointed in the same direction as the welfare inequality.

Based on this result we may question the usefulness of basing measures of the socioeconomic health inequality on a principle on single transfers, rather than looking at their statistical properties and how easy they are to interpret.

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Appendix

Table A1*: Gini, Health Gini, Concentration index (CI), Correlation income-health, and welfare Gini for European countries in the period 2015-2018. "% income" report the share of CI changes from the previous year that is due to income changes, and "% inc. total" is the share of CI changes from 2015-2018 that are due to income changes.*

Austria								
N	Year	Gini	H Gini	CI	Corr	W.Gini	% income	% inc. total
798	2015	0.376514	0.105804	0.019132	0.090867	0.051138		
798	2016	0.348554	0.109098	0.016658	0.155374	0.049897	-49 %	
798	2017	0.355749	0.109985	0.021614	0.157669	0.052395	59 %	
798	2018	0.349734	0.104724	0.019283	0.147975	0.049518	93 %	1334 %
Belgium								
721	2015	0.273521	0.092665	0.023293	0.173366	0.040719		
721	2016	0.271311	0.088918	0.020473	0.162759	0.038466	17 %	
721	2017	0.303271	0.095521	0.024076	0.0532	0.041165	-32 %	
721	2018	0.271404	0.090923	0.023611	0.149653	0.03937	-174 %	-15 %
Bulgaria								
1863	2015	0.339085	0.075326	0.010242	0.054964	0.046479		
1863	2016	0.391671	0.075207	0.00737	0.083914	0.048511	91 %	
1863	2017	0.370633	0.079771	0.010316	0.111986	0.048831	-38 %	
1863	2018	0.412697	0.084821	0.012117	0.107094	0.053317	-45 %	-322 %
Cyprus								
634	2015	0.422298	0.071572	0.003687	0.023085	0.040775		
634	2016	0.423248	0.079257	0.003706	0.040878	0.041792	4294 %	
634	2017	0.418714	0.082128	0.005722	-0.02325	0.042541	-27 %	
634	2018	0.38054	0.083018	0.010799	0.058363	0.042431	90 %	49 %
Czech Republic								
663	2015	0.331543	0.094297	0.03327	0.257648	0.049859		
663	2016	0.323422	0.096604	0.038178	0.314489	0.049863	-65 %	
663	2017	0.312078	0.095678	0.03768	0.294902	0.049017	431 %	
663	2018	0.300675	0.091081	0.029373	0.237882	0.0452	40 %	73 %
Estonia								
476	2015	0.371368	0.090092	0.021527	0.210669	0.048191		
476	2016	0.363054	0.100722	0.029125	0.204881	0.051736	17 %	
476	2017	0.360648	0.102467	0.026561	0.212331	0.052817	156 %	
476	2018	0.332269	0.095043	0.029962	0.2337	0.048078	112 %	43 %
Greece								

N	Year	Gini	H Gini	CI	Corr	W.Gini	% income	% inc. total
2139	2015	0.278131	0.080484	0.000638	0.014511	0.037904		
2139	2016	0.27798	0.081459	-0.00068	-0.01153	0.037812	-104 %	
2139	2017	0.269972	0.084923	-0.00269	-0.03296	0.037749	68 %	
2139	2018	0.265879	0.08202	-0.00478	-0.04726	0.036594	-7 %	-30 %
Spain								
1788	2015	0.373466	0.072337	0.007346	0.072967	0.044612		
1788	2016	0.3751	0.07152	0.011421	0.073673	0.044184	31 %	
1788	2017	0.364748	0.078767	0.014467	0.135155	0.045442	28 %	
1788	2018	0.358024	0.078134	0.011261	0.103204	0.044549	6 %	36 %
Finland								
787	2015	0.315573	0.08893	0.018502	0.150177	0.044919		
787	2016	0.331201	0.089437	0.017973	0.163481	0.044927	-83 %	
787	2017	0.317747	0.087837	0.027001	0.229785	0.045903	41 %	*
787	2018	0.324236	0.092954	0.027688	0.226896	0.047554	189 %	43 %
France								
3343	2015	0.307904	0.107203	0.019308	0.108253	0.046164		
3343	2016	0.310012	0.108451	0.021106	0.139474	0.04628	7 %	
3343	2017	0.313205	0.109702	0.01778	0.09134	0.045961	-22 %	*
3343	2018	0.312419	0.110579	0.019882	0.118957	0.046382	-7 %	-176 %
Italy								
1370	2015	0.307934	0.074143	0.008513	0.068693	0.036895		
1370	2016	0.309942	0.063797	0.002454	0.018627	0.03435	11 %	
1370	2017	0.319316	0.052682	0.006746	0.072186	0.032652	-12 %	
1370	2018	0.334917	0.061822	0.007005	0.07387	0.034872	-243 %	141 %
Lithuania								
321	2015	0.374136	0.104285	0.03158	0.253087	0.059296		
321	2016	0.353863	0.099573	0.028013	0.195415	0.053556	-27 %	
321	2017	0.337353	0.095165	0.02684	0.229381	0.050261	-269 %	
321	2018	0.334728	0.089956	0.029462	0.292978	0.049734	33 %	-277 %
Luxembourg								
287	2015	0.330347	0.112128	0.011627	0.119186	0.044926		
287	2016	0.351884	0.109096	0.01488	0.117683	0.044723	128 %	
287	2017	0.361064	0.120762	0.013515	0.129078	0.04784	148 %	
287	2018	0.417227	0.116351	0.015713	0.045298	0.048038	215 %	-55 %

Latvia								
N	Year	Gini	H Gini	CI	Corr	W.Gini	% income	% inc. total
761	2015	0.379571	0.091471	0.020449	0.178243	0.050811		
761	2016	0.385593	0.089003	0.028676	0.233013	0.050693	-3 %	
761	2017	0.382252	0.097891	0.025914	0.208991	0.05224	106 %	
761	2018	0.382823	0.093409	0.02656	0.233188	0.05216	462 %	-13 %
Netherlands								
735	2015	0.304281	0.082093	0.011115	0.10811	0.040693		
735	2016	0.31107	0.078191	0.009332	0.104905	0.039254	-128 %	
735	2017	0.349482	0.085139	0.015602	0.086379	0.042026	23 %	
735	2018	0.322006	0.083134	0.018063	0.167526	0.041403	75 %	53 %
Norway								
405	2015	0.256732	0.081305	0.018382	0.190054	0.038094		
405	2016	0.241622	0.083663	0.025726	0.275404	0.040879	22 %	
405	2017	0.239822	0.088973	0.020122	0.18847	0.038844	-9 %	
405	2018	0.243812	0.088703	0.022582	0.202397	0.039033	45 %	60 %
Poland								
1149	2015	0.31865	0.096931	0.013322	0.093661	0.045979		
1149	2016	0.315535	0.09352	0.017245	0.136283	0.045092	-21 %	
1149	2017	0.303224	0.093463	0.016949	0.116891	0.043921	416 %	
1149	2018	0.313238	0.088936	0.018557	0.138325	0.04396	-38 %	6 %
Romania								
1058	2015	0.2507	0.074124	0.008536	0.060747	0.037366		
1058	2016	0.24224	0.06988	0.011242	0.107171	0.036084	49 %	
1058	2017	0.235795	0.071575	0.010673	0.08451	0.036078	277 %	
1058	2018	0.23389	0.070013	0.010438	0.082166	0.034484	925 %	3 %
Sweden								
408	2015	0.265245	0.087583	0.014107	0.106191	0.040486		
408	2016	0.260535	0.086937	0.011922	0.129518	0.038316	42 %	
408	2017	0.254161	0.086631	0.018784	0.18547	0.039747	-13 %	
408	2018	0.24796	0.091198	0.016189	0.154854	0.040433	-96 %	-102 %
Slovenia								
530	2015	0.308502	0.111495	0.022332	0.173252	0.050003		
530	2016	0.306144	0.102399	0.029987	0.235101	0.047752	53 %	
530	2017	0.307727	0.105037	0.030093	0.227733	0.048523	1680 %	
530	2018	0.308055	0.106204	0.039005	0.292316	0.050451	7 %	33 %

***Table A2**: Gini, Health Gini, welfare Gini, average welfare, health and income, Correlation income-health Concentration index, and welfare Gini for European countries in the period 2007-2010. "% due to income" report the share of CI changes from the previous year that is due to income changes.*

UK	**Gini**	**Health gini**	**Welfare Gini**	**Average Welfare**	**Average Health**	**Average Income**	**Correl. Inc - Hth**	**Concen. Index**	**% due to Income**
2007	0.388	0.0872	0.0454	15.26	4.29	39276	0.1133	0.0149	
2008	0.400	0.0792	0.0436	15.33	4.41	37198	0.1146	0.0124	61 %
2009	0.396	0.0797	0.0458	15.19	4.41	32226	0.1823	0.0186	-21 %
2010	0.407	0.0801	0.0450	15.19	4.34	34927	0.1824	0.0170	202 %
BE									
2007	0.270	0.0936	0.0406	15.01	4.12	31948	0.1194	0.0177	
2008	0.267	0.0909	0.0392	15.02	4.08	33408	0.1221	0.0164	-75 %
2009	0.260	0.0934	0.0397	15.12	4.13	34841	0.1671	0.0195	-17 %
2010	0.279	0.0924	0.0404	15.07	4.07	36765	0.1486	0.0207	168 %
ES									
2007	0.309	0.0784	0.0389	14.33	3.95	20872	0.0541	0.0053	
2008	0.313	0.0698	0.0372	14.44	3.97	22630	0.0712	0.0074	-37 %
2009	0.314	0.0760	0.0385	14.47	3.95	23891	0.1028	0.0099	-27 %
2010	0.312	0.0762	0.0386	14.50	3.96	24119	0.0843	0.0112	14 %
FR									
2007	0.307	0.1007	0.0465	14.69	4.06	26562	0.1261	0.0187	
2008	0.308	0.1007	0.0449	14.67	3.98	28305	0.1195	0.0179	76 %
2009	0.310	0.1060	0.0462	14.68	3.95	29674	0.1109	0.0173	-14 %
2010	0.314	0.1054	0.0462	14.64	3.90	30667	0.1169	0.0185	-9 %
IT	**Gini**	**Health gini**	**Welfare Gini**	**Average Welfare**	**Average Health**	**Average Income**	**Correl. Inc - Hth**	**Concen. Lindex**	**% due to Income**
2007	0.300	0.0861	0.0399	14.49	3.88	26579	0.0265	0.0042	
2008	0.288	0.0830	0.0368	14.57	3.88	27716	0.0183	0.0027	3 %
2009	0.303	0.0869	0.0389	14.54	3.84	28751	0.0355	0.0054	61 %
2010	0.309	0.0844	0.0385	14.63	3.88	30158	0.0260	0.0051	585 %
PL									
2007	0.350	0.1066	0.0496	12.95	3.70	7234	0.0699	0.0096	
2008	0.334	0.1040	0.0471	13.15	3.72	8323	0.0992	0.0111	-63 %
2009	0.314	0.1007	0.0460	13.32	3.72	9696	0.1372	0.0157	55 %
2010	0.323	0.1013	0.0478	13.12	3.70	8335	0.1165	0.0153	-95 %

PT									
2007	0.392	0.1055	0.0493	13.37	3.53	13948	0.0865	0.0162	
2008	0.387	0.1028	0.0481	13.51	3.61	14597	0.1075	0.0181	90 %
2009	0.385	0.1136	0.0520	13.49	3.57	14855	0.1543	0.0265	22 %
2010	0.394	0.1112	0.0501	13.53	3.51	16670	0.0977	0.0216	39 %
SE	**Gini**	**Health gini**	**Welfare Gini**	**Average Welfare**	**Average Health**	**Average Income**	**Correl. Inc - Hth**	**Concen. Lindex**	**% due to Income**
2007	0.263	0.0940	0.0456	15.08	4.27	30124	0.2114	0.0258	
2008	0.261	0.0975	0.0449	15.09	4.23	31412	0.2176	0.0227	-41 %
2009	0.254	0.0896	0.0413	15.12	4.23	31897	0.1796	0.0185	-55 %
2010	0.250	0.0976	0.0441	15.00	4.18	30145	0.2046	0.0229	69 %