# Health contingent income transfers. Are they relevant?

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# Health contingent income transfers. Are they relevant?[1]

by

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**Abstract**

This paper is an extension of Brekke and Kverndokk (2014), which showed that a limited income transfers from a rich to a poor, both with equal health, will increase the concentration index. In this paper we will demonstrate that such health contingent income transfers are implicit in linear models commonly used in the health economic literature, except if the direction of causality is only in the direction of income to health. However, health contingent transfers may also appear with causality from income to health. We show this in a simplified version of a model in Brekke et al. (2011). The prevalence of health contingent transfers in simple models, indicate that such transfers may be as relevant as the non-contingent ones. Together with our previous results this indicates that we may expect the measured health inequality to be higher the more egalitarian a country is.

**Keywords:** socioeconomic inequality, health inequality, welfare states, health transfers, income transfers, concentration index

**JEL-classification:** D31, I12

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## 1. Introduction

The correlation between socioeconomic status and health is well documented through a large number of empirical studies within the fields of epidemiology, social medicine, sociology and economics.[2] 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. It is important to document this inequality, but to evaluate policies targeted at reducing socioeconomic health inequality we would need to compare health inequality over time or across countries. In Brekke and Kverndokk (2014) we show that a transfer of income from a rich to a poor person will – if both have the same health – increase the concentration index. We call such transfers "health contingent income transfers". We also argued that this is an unwanted property for a measure of social health inequality. In this note we will argue that such health contingent transfers are an important class of transfers.

In our earlier working paper (Brekke et al., 2011) we proved two theorems for impacts of transfers on the concentration index. The first theorem is merely a restatement of what is often referred to as the principle of income-related health transfers. The theorem states that a transfer of health from a rich to a poor person will reduce the concentration index, while if the transfer of health is contingent on the two having equal income, the health transfer has no impact on the concentration index (Theorem 1). We further consider the effect of income transfers. If we pick two individuals at random the richer will tend to have better health and we show a transfer of income from the rich to the poor in this case will reduce the concentration index. On the other hand, if we impose the condition that the two should have equal health, then a transfer of income from the rich to the poor will increase the concentration index. We further argued that for small income transfers the random drawing case is the border line between positive and negative impact on the concentration index. If the two have more similar health than their income level would suggest, then the effect of a small income transfer is that the concentration index increases (Theorem 2).

Now to assess the importance of this result we need to consider the relevance of health contingent income transfers. Is there any reason to think that transfers of income between

[2] See, e.g. Marmot et al. (1991), Wilkinson (1996), Smith (1999), Wagstaff and van Doorslaer (2000), Deaton (2003), Subramanian and Kawachi (2004), Marmot (2004) and Marmot and Wilkinson (2006).


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individuals of equal health are relevant? The porpose of this paper is to illustrate that such transfers are implicit in two very different types of theoretical model. We first consider the class of linear model for the relationship between income and health and show that health contingent transfers are implicit in these models, except when the direction of causality is purely from income to health. In a very different fashion we also present a simplified version of a model from Brekke et al. (2011) based on cognitive stress theories where health is caused by status (relative income). We show that also in this case income transfers are best viewed as health contingent.

## 2. Health contingent transfers in linear models

Theorem 2 referred above indicates that a transfer of income has different effects on the concentration index depending on whether it is contingent on health or not. Health contingent transfers may seem like a rather special kind of transfer; between individuals of equal health. However, health contingent transfers may be relevant. Below, we introduce several models where the causality between income and health goes indifferent directions[3] to further show that this type of transfer is as relevant as the non-contingent one, and may provide a plausible explanation of the health equality paradox.

We first consider simple linear models with different causal directions. Let us start with a model where the *causality goes from health to income*, as studied in Brekke and Kverndokk (2012). With some normalization, their income function can be written as

$$x_l = x_0 + \phi b_l + \psi h_l . \tag{1}$$

There we found that an egalitarian policy that reduces the parameter $\phi$ (removing privileges, introducing a free and public education system, etc.) will then constitute a health-contingent income transfer from those with favorable background to those with unfavorable background. This can be seen as seen as a series of transfers between individuals of equal health. Theorem 2 then predicts that a reduction in $\phi$ will increase the concentration index as the transfers can

[3] 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.


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be written as a sum of pair wise transfers where all are health contingent. As reducing $\phi$ can be interpreted as giving everybody more equal opportunities, this is consistent with the empirical findings in Ásgeirsdóttir and Ragnarsdóttir (2013) that there is a positive association between health-income inequality based on the concentration index and public expenditure on education.

Next, if we add an error term

(2) $$x_l = x_0 + \phi b_l + \psi h_l + u_l$$

where $u_l$ *is* a discrete error term with *Eu*=0. We can then redo the analysis above for each level of $u_l$: Consider the group of all individuals with a given level of health $\hat{h}$ and with a given level of the error term $\hat{u}$. Now average income in this group is $x_0 + \psi\hat{h} + \hat{u}$ and will not be affected by a decrease in $\phi$. Such a decrease is, thus, a pure transfer of income, but contingent on health. A reduction in $\phi$ will therefore increase the concentration index at each level of $u_i$, and the effect when averaging over all levels will also be an increase. Thus adding an error term does not change the conclusion.

On the other hand, if we consider a reduction in $\psi$, we can similarly condition on *b* and *u*. If we normalize the health variable to have a mean equal to zero, then the reduction will be a pure transfer of income from rich to poor, unconditional on health. The change means that health does not matter so much for income anymore, e.g., that everybody gets an opportunity to work even if they have bad health, or as an increase in disability pension. This is not a transfer if we condition on health, as then all individuals get the same change in income. Conditional on *b* and *u*, a reduction in $\psi$ will decrease the concentration index, and when we average over all *b* and *u*, the effect is still a decrease in the concentration index. We see that for a reduction in $\psi$, this is like picking two individuals at random and transfer of income from the rich to the poor in this case will reduce the concentration index. This is in contrast to the conclusions in the case of a reduction in $\phi$, and shows that the type of egalitarian policy matters for the concentration index, even if the outcome is similar; income is more evenly distributed and the health distribution is unchanged.


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Consider next the case where both health and income are explained by *a common underlying variable z*, which also can take both positive and negative values and with zero mean. This can be interpreted as genes, intelligence etc.

(3) $$x_l = x_0 + \phi b_l + \eta z_l + v_l \quad \text{and} \quad h_l = h_0 + \theta z_l + u_l$$

Now the contingency $h_i = h_j$ implies a restriction on $z_i$ and $z_j$. But by fixing the level of the error terms to $\hat{v}$ and $\hat{u}$,[4] a reduction in $\phi$ will be a pure transfer between individuals of equal health, which increases the concentration index according to the second part of Theorem 2. By averaging over all levels of the error term, we still have an increase in the concentration index. On the other hand, the same argument applied to a reduction in $\eta$ shows that this will be a non-contingent transfer that will reduce the concentration index by the first part of Theorem 2.

Finally, consider the case where the causality is in the alternative direction *from income to health*;

(4) $$h_l = h_0 + \eta x_l + u_l \quad \text{and} \quad x_l = x_0 + \varphi b_l + v_l$$

In this case the health contingent redistribution of income does not make sense, as the distribution of health will change when the distribution of income changes. Now, a shift in $\phi$, will be a pure income transfer (for fixed error terms), decreasing the concentration index by the first part of Theorem 2. In addition, as the poor get richer her health will improve and vice versa, thus there is also a redistribution of health from the rich to the poor, which further decreases the concentration index.

To summarize so far, the discussion of linear models above indicates that both parts of Theorem 2 are relevant. Which part of the Theorem that applies depends on the mechanism through which income is equalized, but also on the direction of causality. Assuming causality from income to health is common in the literature on the concentration index (see e.g. van

[4] For convenience, we have used the same symbols for the error terms.


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Ourti et al., 2009). On the other hand, in an econometric test of the direction of causality, Adams et al (2003) find that they are unable to reject the hypothesis that there is no causal effect of income on health. Still, we will next show that even with this direction of causality health contingent transfers are relevant.

## 3. Health contingent transfers in a signaling model

We now present a model where income is causing health, but where we still find that health contingent transfers are relevant. The model is in accordance with cognitive stress theories (e.g. Eriksen and Ursin, 2002, 2004) that argue that stress may explain the gradient in health. The simple intuition is that it is harder to fail when everybody has equal opportunities, as there is no-one else to blame. A low income may give a low status, which creates stress that may negatively affect health (Marmot, 2004). For instance, animal studies show that low status males (with poor perspectives of mating) have high levels of stress hormones (Sapolski, 1993), which may be detrimental to their health.

Consider the simple model which is a simplified version of the one presented in Brekke et al (2011):

(5) $x_l = a_l + b_l$,

where *x* is income, *a* is ability and *b* is background. If both income and background is observable, then we can directly infer $a_l$, but if only income is observable, we can only infer the conditional probability distribution of ability for a given level of income. The cognitive stress theory is based on an assumption that being seen as a failure by others induces cognitive stress and thus, poor health. As an extremely simplified representation of this idea we assume that $h(I) = E(a_l \mid I)$, where the expectation is conditional on available information *I*. It follows that if background is *unobservable,* then the available information is $I = x_l$*:*

(6) $h(x_l) = E(a_l \mid x_l)$.

From equation (6), we see that higher observed income causes higher health. Thus, the causality goes from income to health.


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On the other hand, if background is *observable* as well, then health is

(7) $h(x_l, b_l) = E(a_l \mid x_l, b_l) = a_l$ .

Note that for a given level of $x_l$, we have:

(8) $E(h(x_l, b_l) \mid x_l) = E\left(E(a_l \mid x_l, b_l) \mid x_l\right) = E\left(a_l \mid x_l\right) = h(x_l)$ .

Thus, average health for a given level of income is the same for both observable and unobservable background. If background is observable, health will also depend on background and hence the spread in health distribution is larger in this case, i.e., there is more inequality in health. The intuition is the following. Consider two individuals of equal income, but different background. When background is not observable, they will have equal health. Even though they have different abilities, their ability is partly concealed. On the other hand, if background is observable, ability is observable and they will have different health. If we could make background unobservable, that would thus induce an income contingent transfer of health from the healthy to the unhealthy. But as we know from Theorem 1, this transfer has no impact on the concentration index.

Let us next consider an *egalitarian society*, where we again use very stylistic assumptions, and assume that policies like free education remove the impact of individual background, so that everybody has equal opportunities. Thus, we define an egalitarian society as a society with equal opportunities. This gives

(9) $x'_l = a_l + \bar{b}$ ,

where $\bar{b}$ is the average of $b_l$. Note that since all individuals have the same background, it is observable for everybody. Thus, health in this case is $a_l$, just as when both income and background are observable above.

Now, consider the move from the original distribution $(x, h)$ where background matters, but


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is not observable, to the egalitarian $(x', h')$ where everybody has equal background. In the first case we have $x_i = a_i + b_i$ and $h_i = h(x_i) = E(a_i \mid x_i)$, while in the egalitarian society income and health are $x'_i = a_i + \bar{b}$ and $h'_i = a_i$ respectively.

Note that $h'_i = E(a_i \mid b_i, x_i)$, that is the health level the same individual would have had in the non-egalitarian society if background was observable. Now for a give level of ability $a_i$ we see that $x_i = a_i + b_i$ and $x'_i = a_i + \bar{b}$ have the same average, but $x_i$ has a larger spread, i.e., there is more income inequality in the non-egalitarian society. Note also that ability equals health in the egalitarian society, and in this case the move from $(x, h')$ to the egalitarian $(x', h')$ would be a health contingent income transfer.

Let $C(x, h)$ denote the concentration index for the distribution $(x, h)$. We want to evaluate the effect of moving from a non-egalitarian to an egalitarian society. Consider the change in the concentration index between the non-egalitarian and the egalitarian society:

(10) $$C(x,h) - C(x',h') = C(x,h) - C(x,h') + C(x,h') - C(x',h')$$

That is, we decompose the change into two steps: (a) from the non-egalitarian $(x, h)$ to $(x, h')$ and then, and (b) from $(x, h')$ to the egalitarian $(x', h')$.

The first move (a) is an income contingent health transfer. As $h$ has lower variance than $h'$, health is more unequal in $h'$, but we know from Theorem 1 that since the transfer is income contingent, it has no impact on *C*.

Next, the move (b) from $(x, h')$ to the egalitarian $(x', h')$ is a health contingent income transfer. We noted above that the move from $x_i$ to $x'_i$ is a pure transfer if we condition on ability, but as $h'_i = a_i$ that is the same as conditioning on health when we compare $(x, h')$ to $(x', h')$. We know from Theorem 2 that such a transfer will increase the *C*.

Thus, we find that the move from $(x, h)$ to the egalitarian $(x', h')$ does imply that health is more unequal in the egalitarian society and income is more equal. We also find that *C* is


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higher in the egalitarian society. The striking observation is that *C* is not higher because health is more unequal. The index is unaffected by the move from $(x,h)$ to $(x,h')$ which induces a higher spread in health. The reason why the *C* is higher in the egalitarian society is purely that income is more equal.

Note finally that even though health is caused by income in this model, the conclusion on health contingent income transfers applies. Thus even when income causes health, equalizing income may increase the concentration index.

## 4. Conclusions

Measures of socioeconomic inequalities in health, such as the concentration index, use two variables, both health and some variable of socioeconomic standing, such as income. Hence, the distributions of both variables affect the measures. And as we have demonstrated before, transfers of income from a rich to a poor person of equal health are expected to increase the concentration index. In this paper we have demonstrated that such health contingent transfers are indeed important to understand the effect of egalitarian policy using either simple linear models or a simple signaling model.

We showed that with simple linear models, policy changes that equalize income by reducing the importance of background would also increase the concentration index, as they imply health contingent income transfers. This is consistent with the finding in Ásgeirsdóttir and Ragnarsdóttir (2013) that health-income inequality is positively correlated with public expenditures on education. With linear models, the only case where there are no health contingent income transfers is when the causality is from income to health, but we argued that we cannot conclude that the contingent transfers are irrelevant with this direction of causality, and showed this in a highly stylized model inspired by cognitive stress theory.

Our results indicate that an increased concentration index (indicating more inequality) is a plausible consequence of egalitarian policy. Increases in other bivariate measures are equally plausible, although we have not formally discussed them.

The above discussion illustrates that the concentration index may not be very helpful in comparing socioeconomic health inequality in different societies or in the same society over


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time. Socioeconomic health inequality measured by the concentration index may increase for several reasons such that education is accessible for everyone (everybody gets equal opportunities), compressed income structure, or that high income groups are given priority in health treatment. Only some of these reasons are unfair. If one takes socioeconomic inequality in health seriously, one should model the unfair mechanisms and then estimate them. This would also take the causality seriously, which is important for effective policy measures.

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