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Decomposition of the Gini Coefficient by Income Components: Various Types of Applications and Interpretations

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$$\hat{b} = \bar{y} - \hat{a}\bar{x}$$

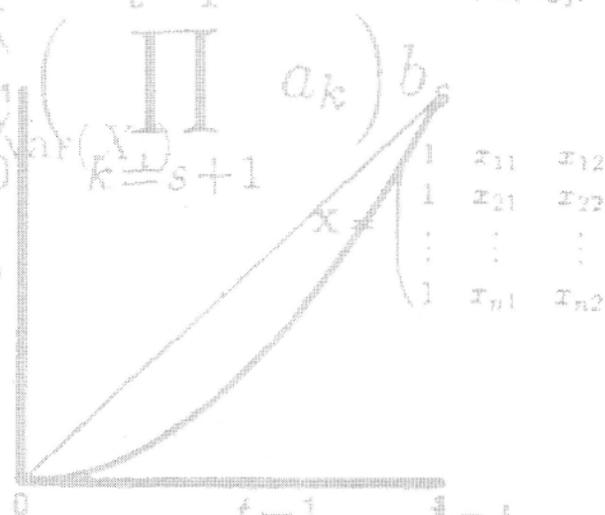
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Discussion Papers

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$$+ 2 \sum_{i>j} \sum_{j=1}^{n-1} \text{cov}(X_i, X_j)$$

$$\text{var}\left(\sum_{i=1}^n a_i X_i\right) = \sum_{i=1}^n a_i^2 \text{var}(X_i) + \sum_{i=1}^{t-1} \sum_{s=0}^{t-1} \left(\prod_{k=s+1}^{t-1} a_k\right) b_s$$



$$\text{var}\left(\sum_{i=1}^n a_i X_i\right) = \sum_{i=1}^n a_i^2 \text{var}(X_i) + \sum_{s=0}^{t-1} \left(\prod_{k=s+1}^{t-1} a_k\right) \sum_{i=1}^n (y_i - (ax_i + b))$$

STATISTICS NORWAY



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Decomposition of the Gini Coefficient by Income Components: Various Types of Applications and Interpretations

Abstract:

This paper aims at clarifying the notion "overall distributive effect" of an income component or a policy proposal and moreover discusses various approaches for assessing the distributional impact of the components of total income. We pay particular attention to the problem of evaluating the distributional consequences of including a new income component in the statistical income base. Our example is the value of unpaid household work, which statistically is new to the income base, although conceptually it is included in extended income or full income, so that individual time allocations are already reflected in data. In contrast, introducing a genuinely new income component (e.g. a new transfer payment) will lead to behavioral responses that should be accounted for in the distributional analysis. However, it is standard practice to ignore behavioral responses in official analyses of tax and benefit reforms (e.g. a new transfer payment) and to compare the Gini coefficients with and without the new income component given unchanged behavior. Rather than solely comparing the levels of the Gini coefficients we suggest that one should compare the *decompositions* of the Gini coefficients with and without the new income component. This result gives a clarification of the difference between contribution to inequality and (marginal) effect on inequality.

Keywords: Income distribution, Gini coefficient, decomposition, household production.

JEL classification: D31, D13.

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1. Introduction

In analyses of income inequality it is common practice to examine the contribution from various income components to overall income inequality by using decomposable measures of inequality. One popular approach is to use the Gini coefficient for measuring overall inequality and to use the related decomposition method to assess the contribution to inequality in the distribution of disposable income from various income components, such as, market income, public transfers and tax.

To motivate why it is of interest to decompose overall inequality by income components consider the following apparently simple question: Is the contribution to overall inequality from an equal-sized transfer to each income receiving unit equalizing or neutral? The answer to this question depends on how the term "equalizing/neutral contribution" is perceived. The standard approach compares the Gini coefficient with and without the transfer payment and is thus solely concerned with the consequences for overall inequality from introducing the transfer payment. Based on this approach, the income component in question is defined as equalizing if its inclusion in total income reduces inequality. However, it seems likely that changes in the level of one income component or introduction of a new income component lead to behavioral responses (indirect effects) so that the other income components may adjust simultaneously. Most studies, however, restrict their scope to the direct effects and even refer to them as overall effects. Motivated by this practice it may seem uncontroversial to evaluate the distributional impact of any income component by comparing inequality with and without the income component in question. In many cases, however, this approach may lead to confusing results (see Horvath (1980), Danziger (1980) and Betson and van der Gaag (1984)). For example, in assessing the contribution from wife's income to family income inequality we found, based on Norwegian data, that adding wife's income to husbands's income decreased inequality. By contrast, adding husband's income to wife's income also decreased inequality. Thus, this approach yields results that depend on the ordering of income components (see Lerman and Yitzaki (1985)) and moreover, presupposes that wife's (husbands's) labor supply decisions are made conditional on husband's (wife's) earnings. Empirical analyses of labour supply show, however, that husband's and wife's decisions concerning hours of work are made simultaneously, which suggests that these two income components should be treated symmetrically. Thus, decomposing family income inequality

with respect to the contributions from wife's and husband's incomes appears to be a more relevant approach than the (conditional) stepwise method when the objective is to compare the contribution of different income components to overall inequality. As noted the decomposition method provides a description of the contributions to inequality in family income from wife's and husband's earnings which acknowledges the simultaneous aspects of economic behavior. In contrast, the conventional stepwise method requires a hypothetical assumption of how family income would have changed without wife's income, respectively without husband's income. A similar critique can be raised against the widespread method of assessing the contribution of transfer payments to income inequality as the reduction/increase in inequality following from adding transfer payments to market income. However, even though we question the practice of using the stepwise method as basis for judging the distributional impact of an income component, we realize that comparing inequality with and without certain income components may be relevant and of interest for other reasons.

The purpose of this paper is to discuss various types of applications and interpretations of the decomposition of the Gini coefficient by income components. Our objective is to clarify what is meant by an equalizing/disequalizing *contribution to inequality*, and distinguish this from an equalizing/disequalizing *effect on inequality*. Within the decomposition framework we will argue that it appears appropriate to use the term contribution to inequality when describing income distribution per se, while the term effect on inequality should be reserved for cases that concern interventions in income distribution, be it a change in the level of an income component, a new policy proposal or alternatively, the introduction of a new income component.

The outline of the paper is the following: In Section 2 we discuss the standard application and interpretation of the decomposition of the Gini coefficient. Note, however, that this practice, see Kakwani (1977, 1980), has recently been criticized by Podder (1993) who states that this approach is faulty and yields misleading results. We question Podder's approach and emphasize the distinction between contributions to inequality and marginal effect on inequality from changes in a single income component. Section 3 deals with the introduction of a new income component, and demonstrates the importance of comparing the *decompositions* of the Gini coefficients with and without the new income component, in contrast to merely comparing the *level* of the Gini coefficient with and without the new income component. In Section 4 we apply this framework to analyze the impact of allowing

measured income to include the value of unpaid household work, illustrated by Norwegian time use data. In Section 5 we discuss the practice of evaluating the distributional impact of an income component by comparing inequality with and without the income component, and moreover seek to clarify the notion of overall distributive effect.

2. Inequality contributions versus marginal effects by income components

The purpose of inequality decompositions is to provide a description of each income component's contribution to overall inequality. Moreover, as distinct from the conventional stepwise approach the decomposition method provides important information about the process caused by the actual intervention in the income distribution, i.e. the process by which the preintervention distribution is mapped into the postintervention distribution. The intervention may, for instance, alter the ranking of units (individuals/households) within the distribution of total income and thus the interaction between each of the income components and total income, which concerns the fairness of the redistributive process. Decision makers may consider this type of information equally important as information about the magnitude of change in overall inequality due to the direct effect from the intervention.

There seems, however, to be controversies about application and interpretation of inequality decompositions. In this section we address Podder's critique of the standard use of the decomposition of the Gini coefficient. Note, however, that the conclusions reached are valid for the "natural" decomposition of any measure of inequality, provided that the contribution of an equally distributed income component to overall inequality is zero (see Shorrocks (1982)).

Assume that total income X is the sum of s income components

$$(1) \quad X = \sum_{i=1}^s X_i.$$

Let G be the Gini coefficient of the distribution of total income. As demonstrated by Rao (1969) and Kakwani (1977, 1980), G admits the following decomposition

$$(2) \quad G = \sum_{i=1}^s \frac{\mu_i}{\mu} \gamma_i,$$

where μ_i/μ is the ratio between the means of X_i and X , and γ_i is the conditional Gini coefficient of component i given the units' rank order in X and provides information about the interaction between component i and total income. Note that μ_i/μ is equal to the income share of X_i .

We call γ_i the concentration coefficient which is in accordance with Mahalanobis (1960). If every unit receives an equal amount of component i then the corresponding concentration coefficient (γ_i) is equal to zero which suggests that component i 's contribution to overall inequality is neutral rather than equalizing. Podder (1993) claims that this interpretation is not valid since "we know that an addition of a constant to all incomes decreases total inequality" (p. 53). Thus, it seems that Podder ignores the simultaneous aspects in judging the components' contributions to overall inequality and consequently deals with the income components in an asymmetric manner. By contrast, the decomposition (2) allows a symmetric treatment of the various income components' contributions to overall inequality, where

$$\frac{\mu_i}{\mu} \gamma_i$$

accounts for the contribution to inequality of component i . In order to avoid incorrect interpretations it is essential to observe that the sign of γ_i solely shows whether or not component i has contributed positively or negatively to overall inequality, but is silent about how a marginal increase in component i will affect overall inequality. This is a different question which can be answered by deriving the elasticity of the Gini coefficient (G) with respect to the mean (μ_i) of component i , provided that the remaining income components are kept fixed. The elasticity is established by straightforward differentiation, given unchanged concentration coefficients,

$$(3) \quad \frac{\partial \log G}{\partial \log \mu_i} = \frac{\mu_i}{\mu} \left(\frac{\gamma_i}{G} - 1 \right).$$

The elasticity (3) demonstrates that a small increase in component i will decrease overall inequality if the corresponding concentration coefficient is lower than the overall inequality.

In his critique of the conventional usage of the decomposition (2) Podder (1993) suggests that the interpretation of (2) ought to be made in terms of the marginal effects (3). This approach, however, suffers from several shortcomings. Firstly, the elasticity (3) is not really concerned with which income component has contributed to what in overall inequality, but rather with what would happen when one component at a time increases, given that the remaining components are kept fixed. Secondly, the sum of the marginal effects is by definition equal to zero, while the purpose of the decomposition is to identify each component's contribution to overall inequality. Finally, as will be demonstrated in Section 3, employing the marginal effect approach as single basis for interpreting the decomposition (2) can lead to confusing results since information about interactions is ignored.

Even though the elasticities do not provide appropriate information for assessing the contribution of each component to observed overall inequality, they yield important supplementary information to that obtained by decomposing overall inequality. It is, however, essential to distinguish between the components' contributions to overall inequality and how a marginal increase in a single component affects overall inequality. The following three examples demonstrate the importance of treating the concentration coefficients and the elasticities as supplementary quantities and not as alternative interpretations of one and the same quantity.

Table 1. Decomposition of the Gini coefficient with respect to income components. Three examples based on four income receiving units and two income components

| (i) $G = 0.242$ | | | | | | |
|-----------------|---|----|----|----|-----------------------------|-----------------------|
| X | 6 | 12 | 18 | 23 | Sign of concentr. coeff. | Sign of elasticity |
| X_1 | 4 | 8 | 12 | 16 | + | + |
| X_2 | 2 | 4 | 6 | 7 | + | - |

| (ii) $G = 0.208$ | | | | | | |
|------------------|---|----|----|----|-----------------------------|-----------------------|
| X | 6 | 10 | 14 | 18 | Sign of concentr. coeff. | Sign of elasticity |
| X_1 | 4 | 8 | 12 | 16 | + | + |
| X_2 | 2 | 2 | 2 | 2 | 0 | - |

| (iii) $G = 0.097$ | | | | | | |
|-------------------|----|----|----|----|-----------------------------|-----------------------|
| X | 11 | 14 | 16 | 18 | Sign of concentr. coeff. | Sign of elasticity |
| X_1 | 4 | 8 | 12 | 16 | + | + |
| X_2 | 7 | 6 | 4 | 2 | - | - |

According to Podder (1993) judgements about the contribution of each of the income components to overall inequality should solely be based on the elasticities of overall inequality with respect to the specific income components. Thus, Podder suggests that there is no need to call attention to the altering in sign of the concentration coefficient of a specific component if the corresponding elasticity does not alter in sign. However, as demonstrated by Table 1 the concentration coefficients provide essential information about the interaction between an income component and total income which is ignored by the elasticities. Table 1(i) illustrates a case where X_2 interacts positively with total income so that X_2 gives a disequalizing contribution. The reversal of X_2 in (iii) demonstrates the case of an equalizing contribution, whereas the constant X_2 in (ii) shows a neutral contribution to inequality.

Now, consider two income components where one (X_2) is considerably smaller than the other (X_1). By introducing an intervention that solely affects X_2 we see from Table 2 that overall inequality has only been slightly affected even though the redistributive structure of X_2 , as exhibited by the concentration coefficient, has changed significantly. In many cases this information may be considered more essential than information about the change in overall

inequality. For instance, when policy makers are judging the redistributive effects of various welfare arrangements such as child allowances, they seem to be primarily concerned with the redistributive structure of each of the welfare arrangements. In Norway the contribution from child allowances to overall inequality among families with children appears to be approximately neutral. Thus, in order to improve the redistributive impact of child allowances it has been proposed to make child allowances liable to taxation. The result of this specific intervention would roughly correspond to the result displayed by Table 2, i.e. the concentration coefficient of child allowances is heavily affected even though overall inequality is only slightly affected. Note that there are only minor changes in the elasticities.

Table 2. Decomposition of the Gini coefficient when the redistributive structure of one income component (X_2) is altered

| $G_0 = 0.234$ | | | | | | |
|---------------|------|------|-------|-------|---------------------------|------------|
| X | 4.7 | 8.7 | 12.7 | 16.7 | Concentration coefficient | Elasticity |
| X_1 | 4 | 8 | 12 | 16 | 0.250 | 0.064 |
| X_2 | 0.7 | 0.7 | 0.7 | 0.7 | 0 | -0.064 |
| $G_1 = 0.230$ | | | | | | |
| X | 4.80 | 8.75 | 12.65 | 16.60 | Concentration coefficient | Elasticity |
| X_1 | 4 | 8 | 12 | 16 | 0.250 | 0.081 |
| X_2 | 0.80 | 0.75 | 0.65 | 0.60 | -0.063 | -0.081 |

3. The distributional consequences of introducing a new income component

Introducing a new income component, or analogously, removing an income component from total income, first of all raises the issue of interpreting the behavioral consequences. Such a new income component could either be a public transfer payment, like a new type of child allowance or pension benefit, or represent an attempt to expand the statistical income base towards extended income or full income (Becker 1965). Full income is defined as potential income from all sources of time use. Extended income is defined as the sum of disposable income and the imputed value of unpaid household work. But in this case it must

be kept in mind that components of extended income that previously have been disregarded in the statistical income concept and in the analysis of income distribution, nevertheless are reflected in economic behavior. If a new transfer payment is introduced, or a previous transfer payment is removed, the effect on disposable income depends on the labor supply response and its effect on other income components. Hence, as will be further discussed in Section 5, evaluating the distributional impact of an income component by comparing, say, the Gini coefficient with and without the income component requires a specification of the behavioral context. Secondly, it remains to consider whether it is meaningful to add or remove the income component in question. A transfer payment and a fringe benefit may be given to or taken away from the income earners. In both cases the consumption possibilities are affected. However, this is not the case for e.g. imputed income of own dwelling. This income component may be increased (or decreased) in order to develop an appropriate income base for taxation, without changing the underlying consumption possibilities, namely that people live in their houses irrespective of whether such imputed incomes are added to or removed from the income basis. Note that we are not discussing how changes in taxation on dwellings affect the composition of consumption — we are merely pointing to the fact that introducing or disregarding a certain income imputation scheme does not mean that the source of this income suddenly appears or vanishes. This point, finally, brings us to the example of considering the imputed value of household work as an income component. People divide their time between paid work, unpaid work and leisure, and the goods and services produced in the household represent an extension of their consumption possibilities irrespective of whether an imputed value appears in the income base or not. Similarly, these consumption possibilities do not vanish if one for analytical purposes changes from including to excluding the value of household work in total income. Moreover, since people do their household work irrespective of its imputed value, we cannot meaningfully infer any behavioral consequences of "introducing" or "removing" the value of household work.

From a conceptual perspective we thus have that the value of unpaid household work already is contained in the underlying income concept, since the consumption possibilities it represents are present irrespective of definition of income. Thus, it must be kept in mind that the introduction of such an imputed income cannot be given a behavioral interpretation as in the context of introducing a "genuinely new" income component. To conclude this discussion, a more precise formulation of our question of "What is the distributional impact of

introducing this income component?" would be: "How shall we evaluate the distributional consequences of including an imputed income that represents consumption possibilities that were present although their imputed value was disregarded?" As long as we are aware of this conceptual difference and do not infer any behavioral interpretation by using the term "the distributional impact of", we find it relevant to examine the distributional consequences of broadening the measurement of income. To deal with this problem it appears useful to employ the decomposition method, not least since behavioral implications are avoided.

Let G be the Gini coefficient of disposable income, and \tilde{G} the Gini coefficient of extended income. Even though the difference between G and \tilde{G} cannot be interpreted as the contribution to inequality from the new income component, this difference forms the basis for a comparison of these two decompositions. This approach pays attention to the interactions between each of the income components and total income (extended income) by taking into account how these interactions are affected by the introduction of the new income component and thus how the impact of these interactions on overall inequality is changed.

Without loss of generality consider a situation with two income components X_1 and X_2 . According to (2) the decomposition of overall inequality G is given by

$$(4) \quad G = \frac{\mu_1}{\mu} \gamma_1 + \frac{\mu_2}{\mu} \gamma_2.$$

Now, introducing a new income component X_3 with positive mean μ_3 the decomposition of the overall inequality \tilde{G} is given by

$$(5) \quad \tilde{G} = \frac{\mu_1}{\tilde{\mu}} \tilde{\gamma}_1 + \frac{\mu_2}{\tilde{\mu}} \tilde{\gamma}_2 + \frac{\mu_3}{\tilde{\mu}} \tilde{\gamma}_3,$$

where \sim indicates that the mean (μ) of total income and the concentration coefficients γ_1 and γ_2 are affected by the introduction of the new income component. Note that $\tilde{\mu} = \mu + \mu_3$. The concentration coefficient $\tilde{\gamma}_3$ measures the interaction between the new income component and total income. As emphasized above the examination of how the new income component affects overall inequality should be based on a comparison of the decomposition results with and without the new income component. Therefore, consider

$$(6) \quad \tilde{G} - G = \mu_1 \left(\frac{\tilde{\gamma}_1}{\tilde{\mu}} - \frac{\gamma_1}{\mu} \right) + \mu_2 \left(\frac{\tilde{\gamma}_2}{\tilde{\mu}} - \frac{\gamma_2}{\mu} \right) + \frac{\mu_3}{\tilde{\mu}} \tilde{\gamma}_3.$$

Equation (6) demonstrates that the introduction of X_3 influences overall inequality both via its own concentration coefficient $\tilde{\gamma}_3$ and via the effect on the concentration coefficients $\tilde{\gamma}_1$ and $\tilde{\gamma}_2$ of the other income components. The last term in (6) accounts for the own effect which shows to give a negative contribution to the shift in overall inequality if the new income component has a negative concentration coefficient $\tilde{\gamma}_3$. However, even if $\tilde{\gamma}_3$ is positive, introducing X_3 may still lead to a reduction in income inequality, provided that the first two terms of (6) are sufficiently negative to outweigh the positive contribution from $\tilde{\gamma}_3$.

Terms one and two in (6) illustrate how the introduction of the new income component alters the influences of components X_1 and X_2 on overall inequality. Inspection of equation (6) shows that each of these components contributes to an equalizing shift in overall inequality if

$$(7) \quad \frac{\tilde{\gamma}_i - \gamma_i}{\gamma_i} < \frac{\tilde{\mu} - \mu}{\mu}, \quad i=1,2,$$

which means that component i contributes to reduce overall inequality if the relative change in its concentration coefficient is less than the relative change in total income.

To explain this further, note that the introduction of X_3 will reduce the income shares of X_1 and X_2 , and in general, the interaction between total income and X_1 and X_2 will change. Unless the decline in income shares is outweighed by an increase in the corresponding concentration coefficients, the contribution to overall inequality from the two original income components will be reduced. Thus, the introduction of X_3 may reduce overall inequality regardless of the sign of $\tilde{\gamma}_3$. This fact explains why it is important to consider both the new concentration coefficient and the change in the present concentration coefficients when evaluating the shift in overall inequality of introducing a new income component.

However, observe that even though the overall effect of a new income component leads to decreased inequality, a further (marginal) increase in this component may *increase* inequality. Such a situation will occur if $\tilde{\gamma}_3 > \tilde{G}$.

Referring to the distinction between *contribution to inequality* and *effect on inequality* we thus conclude that the contribution to inequality from X_3 is measured by the last term of the decomposition of \tilde{G} in (5), and its sign depends on the sign of the concentration coefficient $\tilde{\gamma}_3$. In contrast, the distributional consequences from introducing X_3 is measured by (6), and the difference between the decompositions of G and \tilde{G} consists not only of the contribution to inequality from X_3 , but also of how X_3 affects the interaction between total income and X_1 and X_2 . This framework is now illustrated by the following tables.

Table 3. Decomposition of the Gini coefficient G without the new income component

| $G = 0.208$ | | | | | | |
|-------------|---|----|----|----|---------------------------|------------|
| X | 6 | 12 | 18 | 23 | Concentration coefficient | Elasticity |
| X_1 | 4 | 8 | 12 | 16 | 0.250 | 0.168 |
| X_2 | 2 | 2 | 2 | 2 | 0 | -0.168 |

Table 4. Decomposition of the Gini coefficient \tilde{G} with the new income component

| $\tilde{G} = 0.138$ | | | | | | |
|---------------------|----|----|----|----|---------------------------|------------|
| \tilde{X} | 14 | 18 | 20 | 28 | Concentration coefficient | Elasticity |
| X_1 | 8 | 12 | 4 | 16 | 0.100 | -0.138 |
| X_2 | 2 | 2 | 2 | 2 | 0 | -0.100 |
| X_3 | 4 | 4 | 14 | 10 | 0.219 | 0.238 |

Tables 3 and 4 give illustrating examples of decomposition of inequality with and without the new income component. Referring to the discussion above we see that the reduction in inequality from G to \tilde{G} is solely due to the change in the concentration coefficients of X_1 and X_2 since $\tilde{\gamma}_3$ is positive. However, even though overall inequality is reduced, a further increase in X_3 will increase overall income inequality since $\tilde{\gamma}_3 > \tilde{G}$. The simple explanation behind this result is that the positive interaction between X_1 and total income has been weakened which means that reranking of X_1 has taken place. The poorest income earner becomes the second richest in terms of extended income after X_3 is introduced. Note that reranking issues have been considered particularly important in the context of horizontal equity, see e.g. Atkinson

(1980), Plotnick (1982) and Jenkins (1988). However, as demonstrated by Kakwani (1984), Lambert (1985), Jenkins (1986) and Aronsen and Lambert (1994), reranking is also an important issue in analyses of redistributive effects of tax systems, independent of its relevance to horizontal equity.

As an illustration of how a further increase in X_3 will work, assume that X_3 is increased by 50 per cent. The impact of this intervention is demonstrated by Table 5.

Table 5. Decomposition of the Gini-coefficient after a 50 per cent increase of X_3

| $\tilde{G} = 0.151$ | | | | | | |
|---------------------|----|----|----|----|---------------------------|------------|
| \tilde{X} | 16 | 20 | 27 | 33 | Concentration coefficient | Elasticity |
| X_1 | 8 | 12 | 4 | 16 | 0.100 | -0.141 |
| X_2 | 2 | 2 | 2 | 2 | 0 | -0.083 |
| X_3 | 6 | 6 | 21 | 15 | 0.219 | 0.224 |

Due to the higher income share of X_3 , the overall inequality increases from 0.138 to 0.151, even though the introduction of X_3 in Table 4 led to a decrease in overall inequality.

A particular aspect of the example displayed by Tables 3 and 4 is the reranking of income receiving units due to widening total income by including a new income component. By contrast, consider a case where the introduction of a new income component does not alter the ranking of units, i.e. the concentration coefficients of X_1 and X_2 are not affected by the introduction of X_3 . Hence, $\tilde{\gamma}_1 = \gamma_1$ and $\tilde{\gamma}_2 = \gamma_2$ which imply that (6) attains the following simple expression,

$$(8) \quad \tilde{G} - G = -\frac{\mu_3}{\tilde{\mu}}G + \frac{\mu_3}{\tilde{\mu}}\tilde{\gamma}_3 = \frac{\mu_3}{\tilde{\mu}}\left(\frac{\tilde{\gamma}_3}{G} - 1\right).$$

Note that (8) corresponds to the expression for marginal change in inequality given by (3). As long as the ranking of income receiving units is unchanged, a comparison of inequality with and without the new income component yields the same result as considering a marginal change in income. In this special case the consequences on inequality from introducing a new income component can be analyzed as a marginal effect on inequality. Equation (8) shows

that the effect via X_1 and X_2 when X_3 is included is always negative since it amounts to a reduction in the income shares of X_1 and X_2 and thus to a decline in their contributions to inequality. In other words the effect via X_1 and X_2 may decrease overall inequality even if the concentration coefficient $\tilde{\gamma}_3$ is positive, provided that $\tilde{\gamma}_3$ is less than G . An example illustrating this case is given by comparing Tables 3 and 6.

Table 6. Decomposition of the Gini coefficient \tilde{G} with the new income component

$$\tilde{G} = 0.179$$

| \tilde{X} | 10 | 15 | 20 | 25 | Concentration coefficient | Elasticity |
|-------------|----|----|----|----|---------------------------|------------|
| X_1 | 4 | 8 | 12 | 16 | 0.250 | 0.226 |
| X_2 | 2 | 2 | 2 | 2 | 0 | - 0.112 |
| X_3 | 4 | 5 | 6 | 7 | 0.114 | - 0.114 |

Since the concentration coefficient $\tilde{\gamma}_3$ is lower than inequality without X_3 ($G=0.208$), \tilde{G} attains an even lower value. Note that $\tilde{\gamma}_3 < \tilde{G}$ so that a further increase in X_3 will reduce overall inequality.

Table 7 illustrates an example where the new income component shows a negative interaction with total income, so that the effect via $\tilde{\gamma}_3$ contributes to the observed reduction in overall inequality.

Table 7. Decomposition of the Gini coefficient with the new income component

$$\tilde{G} = 0.129$$

| \tilde{X} | 10 | 13 | 16 | 19 | Concentration coefficient | Elasticity |
|-------------|----|----|----|----|---------------------------|------------|
| X_1 | 4 | 8 | 12 | 16 | 0.250 | 0.647 |
| X_2 | 2 | 2 | 2 | 2 | 0 | -0.138 |
| X_3 | 4 | 3 | 2 | 1 | -0.250 | -0.509 |

4. The value of unpaid household work - results based on Norwegian data

We will now apply the framework of comparing the *decompositions* of inequality with and without the new income component to actual data for the value of unpaid household work. With this approach we are able to measure how the introduction of a new income component influences the interactions between *all* income components and total income. This provides a new interpretation as compared to the traditional method of only comparing the levels of inequality with and without the new income component, see e.g. Bonke (1992) and Bryant and Zick (1985).

The value assessment of unpaid household work is based on data from the Norwegian Time Budget Survey 1990 (see Aslaksen and Koren (1993)). A number of valuation criteria have been applied in the literature, including direct valuation of goods and services bought to replace home produced goods and services, and indirect valuation of time used for unpaid work. Indirect valuation is based on wage rates for paid help in the home, either specialized help or general housekeeping, or on opportunity cost, i.e. one's own foregone wage rate. In line with recent national account estimates of unpaid household work in Norway we have used the wage rate for municipal home helper as the valuation criterion.

Table 8 gives the decomposition of the Gini coefficients of the distribution of disposable income with and without the value of unpaid household work.

Table 8. Decomposition of the Gini coefficients of the distribution of disposable income with respect to income before tax and tax and with respect to income before tax, tax and value of household work, for couples with children. 1990

| Gini coeff. | Income component | Inequality share | Income share | Concentration coefficient | Elasticity |
|---------------------|-----------------------------------|------------------|--------------|---------------------------|------------|
| $G = 0.222$ | Income before tax (X_1) | 1.498 | 1.380 | 0.241 | 0.118 |
| | Tax (X_2) | -0.498 | -0.380 | 0.291 | -0.118 |
| $\tilde{G} = 0.120$ | Income before tax (X_1) | 0.869 | 0.597 | 0.175 | 0.272 |
| | Tax (X_2) | -0.286 | -0.164 | 0.208 | -0.122 |
| | Value of household work (X_3) | 0.417 | 0.568 | 0.088 | -0.151 |

Table 8 shows that the concentration coefficients and income shares of income before tax and tax are substantially changed when unpaid household work is introduced. We see that the concentration coefficients are reduced from $\gamma_1=0.241$ to $\tilde{\gamma}_1=0.175$, and from $\gamma_2=0.291$ to $\tilde{\gamma}_2=0.208$. Due to the high income share of X_3 the income share of X_1 is reduced from 1.380 to 0.597 and the income share of X_2 is reduced in absolute terms from 0.380 to 0.164. We find that inequality is reduced when X_3 is introduced although the concentration coefficient of X_3 is positive, $\tilde{\gamma}_3=0.088$. We have that the difference $\tilde{G}-G = -0.102$ consists of an effect via X_1 and X_2 of -0.152 and an effect via X_3 of 0.050. This means that 150 per cent of the reduction in the Gini coefficient is explained by the changes in the concentration coefficients of X_1 and X_2 . This effect, which is due to reranking of X_1 and X_2 as well as to the high income share of X_3 , thus explains why the Gini coefficient is reduced when X_3 is introduced even though the interaction coefficient of X_3 is positive. We have that $\tilde{\gamma}_3 < \tilde{G}$ which means that a further marginal increase in X_3 will lead to a further reduction in inequality.

The value of household work amounts to 57 per cent of total income (extended income) and contributes to 42 per cent of inequality in extended income. This means that the inequality contribution is relatively smaller for household work than for the other income components. Household work has, compared to income before tax, a more favourable ranking

in terms of a less disequalizing effect on extended income.

Note that the distribution of the value of unpaid household work reflects the distribution of time allocated to household tasks, since time is valued equally for all units. An alternative approach is to use individual wage rates. If those with high incomes also spend much time in unpaid home activities, the actual distribution of the value of household work would be more unequal than our estimates indicate.

To conclude, our analysis shows that a mere inspection of the sign of the concentration coefficient does not give sufficient information about the effect on inequality from introducing a new income component. The value of unpaid household work has a positive concentration coefficient, $\tilde{\gamma}_3 = 0.088$, and hence a positive contribution to inequality. Yet we find that overall inequality declines when this income component is introduced, due to substantial weaker interaction between extended income and the other income components. This shows that the effect on inequality may be negative even if the contribution to inequality is positive and illustrates the importance of analyzing the decompositions with and without the new income component.

5. The overall distributive effect from different income components

To conclude the discussion of behavioral issues in Section 2 we now attempt to clarify the notion of overall distributive effect. A major issue in inequality analysis concerns the problem of assessing the distributive effects from different income components that add up to total income. In most applications this issue is approached by considering *marginal* changes of the income component in question. However, it seems intuitively appealing to define the *overall* distributive effect of a specific income component as the change in inequality that would follow — hypothetically or actually — from removing this income component from total income. Removing or introducing an income component due to changes in government policy has, however, behavioral consequences for the other income components. To be meaningful, the definition of overall distributive effect requires that the change in overall inequality captures both indirect (behavioral) effects and direct effects.

In official analyses of tax and benefit reforms the standard approach ignores the effects of behavioral responses. Due to this practice it is crucial for the interpretation of the analyses to clarify whether the intervention is hypothetical or actual. An example of a hypothetical

intervention in the income distribution would be to "remove" income taxes in order to assess the overall distributive effect of the income tax system by comparing the situation with and without income taxes. In contrast, an actual intervention in the income distribution corresponds to any given change in the actual tax/transfer system, such as a marginal change in a tax rate, or a tax reform, or eliminating or introducing new items of the tax/transfer system.

An actual intervention in the income distribution, with observed data from before and after the intervention, gives us an observational context where data reflect behavior both before and after the intervention. Thus, both indirect and direct effects can be assessed without relying on behavioral equations. In this situation the following notation is used. Let F_1 and F_2 be the distributions of income when a certain policy means is absent and present, respectively, and let $I(F_i)$ be the inequality in the distribution F_i , $i=1,2$, measured by some inequality measure I . Then the overall distributive effect on income inequality due to the policy means is given by

$$(a) \quad \text{Overall distributive effect} = I(F_2) - I(F_1),$$

whether it is considered as an introduction or a removal of a policy means. As indicated above the overall effect may be decomposed into a direct and an indirect effect. However, since we may consider the intervention as either introduction or removal of a policy means the definition of the direct and indirect effects depends on whether we consider F_1 or F_2 as a benchmark and point of departure. In most cases it appears, however, sensible to consider F_1 as the reference case and examine how F_1 is affected by the policy proposal. Let \tilde{F}_2 be the hypothetical income distribution that captures the direct effect given unchanged behavior. Then it follows that the direct effect can be defined by

$$(b) \quad \text{Direct effect} = I(\tilde{F}_2) - I(F_1).$$

Note that the definition (b) turns out to be in accordance with the conventional application and interpretation of tax/benefit models. From (a) and (b) it follows that the indirect effect is given by

$$(c) \quad \text{Indirect effect} = I(F_2) - I(\tilde{F}_2).$$

Now, let us consider a situation where a tax reform has been carried out, i.e. both F_1 and F_2 have been observed and (a), (b) and (c) can be assessed. Note, however, that the overall effect

from taxes may be interpreted as either the effect from introducing taxes or the effect from removing taxes. The latter case considers F_2 as a benchmark and suggests the following alternative definition of the direct and indirect effects,

$$(b^*) \quad \text{Direct effect} = I(F_2) - I(\tilde{F}_1),$$

where \tilde{F}_1 represents the hypothetical income distribution that captures the direct effect from removing taxes given unchanged behavior. From (a) and (b*) it follows that the indirect effect in this case is given by

$$(c^*) \quad \text{Indirect effect} = I(\tilde{F}_1) - I(F_1).$$

Since (b) and (b*) in most cases will take different values it is particularly important to clarify whether the intervention deals with the introduction or removal of a policy means. This problem occurs when we consider the impact of including a "new" income component into the statistical base for total income. The new income component may originate from an actual policy intervention, such as the introduction of a new public transfer payment. In this case the overall distributive effect may be decomposed either way. Alternatively, as in our context of household work, the "new" income component may represent an attempt to expand the income basis. By reviewing the preceding discussion we may conclude that neither F_1 nor \tilde{F}_1 exist in the case of household work, so that neither (b) nor (b*) are meaningful representations of the behavioral effects. This illustrates the importance of distinguishing between a theoretical and an empirical broadening of the income concept.

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