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INEQUALITY REDUCTION BY INCOME TAXES: JUST HOW MUCH? AN INVESTIGATION FOR THE NETHERLANDS, 1914-1973.

joop hartog [1)]

Abstract.

Data on the income distribution in the Netherlands since the introduction of the income tax in 1914 are used to calculate the extent of income redistribution through the progressive rate structure. Seven indexes of income equality are used, and their values after-tax are divided by the value before-tax. The extent of inequality reduction differs substantially between inequality indexes. Pearson and Kendall correlation coefficients of the time series are presented and again, the information diverges so widely that one may doubt the usefulness of the conventional summary statistics of income inequality.

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1. Introduction.

In most countries, the income tax is redistributive, that is, average tax rates rise with income. Naturally, one is inclined to ask how much redistribution of income is in fact accomplished[1]. This paper arose from an attempt to answer that question for the Netherlands in the years of existence of the income tax, that is, since 1914. One then has to select an income inequality measure. Since Champernowne (1974), it is well-known that such measures all have their own specific sensitivities to different segments of the income distribution. In fact, a large literature is developing, trying to specify the social welfare function (or weight function) associated with particular inequality indexes (see Bartels, 1977).

Selecting an inequality index thus comes down to selecting a weight function for the various income levels. Such a value judgment is beyond the economist's competence. The common solution is to calculate a variety of measures and escape the choice. It is then left to the policy makers to pick the measure they prefer on the grounds of their weight function. In practice, however, it may not be easy to translate policy maker's value judgments into a weight function, except for some extreme positions (such as Rawls' or Bentham's welfare function). In that sence, the difficulty has been solved by passing it on.

The present paper investigates how serious the problems are in a very relevant real-world situation. Income taxes are deliberately meant to redistribute incomes, and thus provide a natural testing ground. If different measures of income inequality all point to similar developments over time, then in an important empirical application, the problems are not too severe. If developments are very dissimilar, choices on the weight functions cannot be avoided.

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1) Another question is whether welfare is redistributed as well. If taxes are based on the principal of equal proportional sacrifice, the distribution of relative welfare is not changed. See Keller and Hartog (1977) for an application to the Netherlands, and Musgrave and Musgrave (1976) for a general discussion. For a discussion of the 'optimal income tax', see Atkinson and Stiglitz (1980).

2. Data.

The income tax was introduced in the Netherlands in 1914 and data collection started at the same time. The frequency distribution of incomes before taxes is known, as well as total income in each interval and the amount of income taxes paid. Hence, inequality measures can be calculated for income before and after deduction of income taxes. Inequality reduction can then be found from the ratio of the inequality index after tax to the index before taxes. The income concept, before taxes, is virtually equal to taxable income. That is, up to 1939 it is negligibly different from taxable income, whereas after 1946 it differs somewhat because some deductible items are not actually deducted (medical and educational expenditures, and donations). Incomes below the exemption level are not included in the data, and before 1946 this reflects a very sizable share of total income. The period has witnessed three fiscal regimes (the 1914, 1941 and 1964 regime), but they are very much alike in the respects that matter here[2]. The rates have gone up strongly however in the years between 1939 and 1946, and therefore, the prewar and the postwar period are studied separately.

The nature of the income tax function is illustrated in figure 1, depicting the average tax rate as a function of the logarithm of income in two years. The basic shape of the function has not changed, but it has become much steeper over the years. What then, will happen to measured inequality, if incomes are transformed through such a tax function? The inequality reduction rates as mentioned above were calculated for some conventional inequality indexes: the standard deviation σ, the standard deviation of the logarithm of incomes σ_{ln}, the coefficient of variation κ, the Gini coefficient, the Theil coefficient. Also, two measures of skewness were included: the third moment about the mean m_3 and the third moment relative to the second, $\tilde{m}_3 = m_3^6/\sigma^6$. The choice was guided by the popularity of the measures, and by the desire to have some measures particularly aiming at the top of the income distribution (the skewness), since this top is of predominant relevance for redistribution purposes. Note that m_3 and $\tilde{m}_3$ are measures of asymmetry rather than of inequality, and thus convey different information.

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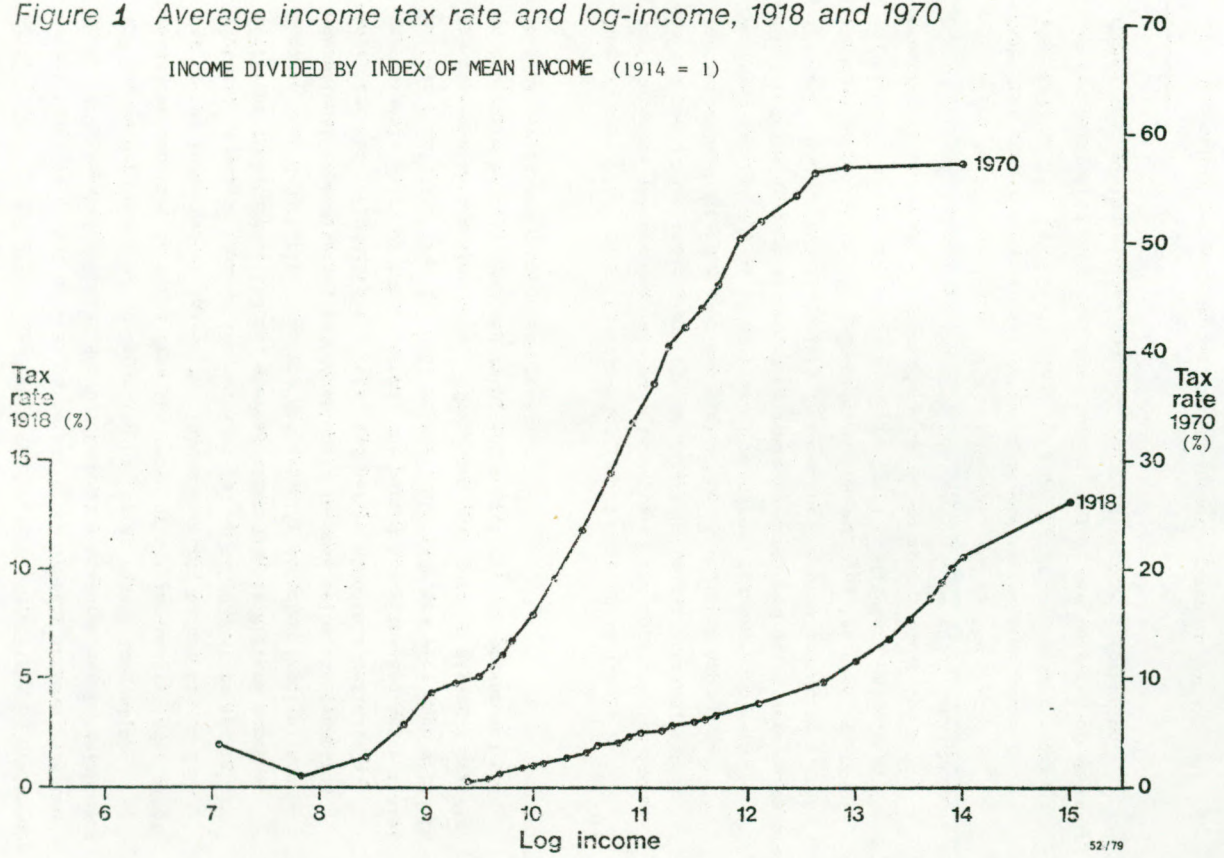
2) A detailed acknowledgement of the data is given in Hartog and Veenbergen (1978). That paper also gives an analysis of structural and cyclical development of income inequality since 1914.

Figure 1 Average income tax rate and log-income, 1918 and 1970



3. Results.

Table 1 presents some key results. Consider first the mean values. In the prewar period. the average tax rate on taxed incomes (i.e. ignoring incomes below the exemption level) in only about 2%[3]. The reduction in inequality[4] is modest, varying between an average of less than 1 and 12%, depending on which measure is chosen. After the war, the average tax rate has risen to almost 15%. Inequality reduction then varies between 10 and 55%. Note the large difference among the inequality indicators, even if one were to set the skewness measures apart. The ranking of the measures is very similar in both periods. From least to most inequality reduction, the postwar ranking is q_{ln}, Gini, Theil, κ, σ, $\tilde{m}_3$, m_3. Before the war only, the relative position of $\tilde{m}_3$ differed. These relative sensitivities for a given non-linear transformation are in line with expectations that can be derived a priori from weights implicit in each measure (Bartels, 1977) and from the simulations by Champernowne (1974). Since the income tax is progressive, measures with particular sensitivity for high incomes decrease most: m_3, $\tilde{m}_3$, σ as well as κ and Theil. Gini is more sensitive to middle incomes (Champernowne, 1974) and obsiously, σ_{ln} is rather insensitive to changes at the top. The results therefore should not be too surprising, but they clearly indicate the impossibility of a unique answer to the question on the magnitude of inequality reduction.

Although the magnitude of inequality reduction differs very much between measures, the time series might indicate similar secular patterns. The correlation matrix for the entire period 1914-1973 supported this view, with most coefficients above .94. However, considering the prewar and postwar periods separately, strongly reduced this resemblance, as will be clear from Table 1. In this table, the upper triangle presents the Pearson product-moment correlation coefficients, while the lower triangle gives the Kendall rank correlation coefficient. Generally, the association before the war is stronger than after the war. This is undoubtedly due to the increase in the income tax rates and

3) Note that this is the average over time of each year's average income tax rate.

4) Inequality reduction is measured as 1 minus the entry under 'mean' in Table 1. Hence, it measures by what proportion the inequality after taxes is smaller than the inequality before taxes.

in their progression after 1939. The deviation from a linear transformation was much stronger after 1939 than before and hence, the specific sensitivities of each measure came out much pronounced. The difference between prewar and postwar correlation can be dramatic, as exemplified by the correlation between σ and Gini: after the war its value is half its prewar value! Apparently, the relative sensitivity of inequality measures to redistribution also depends strongly on the extent of distribution.

The similarity between rank correlation and product-moment correlation is not very strong either. Generally, rank correlation coefficients are lower than product-moment correlation coefficients. In some cases, weak positive correlations even turn into weak negative (rank) correlations. There is in fact no association between the measures that holds out against the tax increase (comparing pre- and postwar) and against the change in type of correlation coefficient. For example, there is no combination of inequality reduction measures that has a coefficient of .80 or more in all four specifications (Pearson, Kendall, prewar, postwar). σ and Theil correlate at .80 or more in all but one specification: Kendall correlation, 1946-1973. The same applies to σ and K, but that is all. The lack of agreement between the alternative measures is also indicated by Kendall's coefficient of concordance, a measure of association between a number of rankings. This coefficient for all 7 measures is only .29, both before and after the war. In fact then, the results from different measures can barely be compared.

4. Conclusion.

Income tax rates are deliberately set to reduce income inequality. By just how much a given income tax function reduces income inequality cannot be specified unequivocally. The magnitude of inequality reduction depends strongly on the inequality index chosen. The development of inequality reduction over time is similarly strongly dependent on the index. In some cases, the coefficient of (rank) correlation is virtually zero! For large changes in inequality reduction, as in the transition from the prewar to the postwar income tax rates, the measures give very similar information. But for the smaller, year-to-year variations, the messages are different and conflicting.

Table 1. Post-tax inequality relative to pre-tax inequality by seven measures, 1914-1973: mean, standard deviation and correlation matrix.

1914-1939 (n = 26)

	mean	standard deviation	correlation coefficients[a]						
			σ_{ln}	Gini	Theil	κ	σ	$\tilde{m}_3$	m_3
σ_{ln}	.998	.002	-	.763	.711	.530	.633	-.121	.415
Gini	.980	.004	.727	-	.983	.818	.910	.060	.702
Theil	.943	.015	.695	.972	-	.891	.955	.175	.786
κ	.929	.021	.628	.722	.710	-	.981	.544	.966
σ	.908	.022	.722	.863	.839	.839	-	.394	.915
$\tilde{m}_3$	.932	.040	-.170	-.158	-.186	.097	-.075	-	.731
m_3	.887	.030	.419	.496	.466	.750	.608	.342	-
1946-1973 (n = 16)									
σ_{ln}	.940	.013	-	.862	.755	.140	.419	-.156	.096
Gini	.892	.015	.673	-	.763	.032	.422	-.235	.057
Theil	.707	.026	.351	.424	-	.632	.814	.019	.396
κ	.673	.034	-.018	-.051	.487	-	.883	.419	.702
σ	.574	.026	.309	.315	.717	.616	-	.319	.711
$\tilde{m}_3$	.494	.108	-.058	-.142	.075	.408	.367	-	.888
m_3	.452	.043	.125	.092	.358	.625	.650	.717	-

a) upper triangle: Pearson product-moment correlation coefficients
lower triangle: Kendall rank-correlation coefficients

The need to choose among indexes and to opt for a specific weight function is thus a very real need. As pointed out in the introduction, such choices are not easy. How to explain to a politician how he should choose between Theil and Gini? It is not at all evident that intuitive value judgments find their transformation into a matching inequality index. Also, searching for ever 'better' summary statistics of income inequality seems an ill-directed effort. Inevitably, information is lost, and one will have to choose which information that will be. A much better case can be made for measuring inequality solely in income deciles. In the present case, that would entail measuring the redistributive impact of the income tax for each decile separately. But that will be left for another occasion.

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