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MEANS-TESTED VERSUS UNIVERSAL TRANSFERS: ALTERNATIVE MODELS AND VALUE JUDGEMENTS*

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This paper illustrates the use of different criteria used to evaluate alternative tax and transfer systems. Means-tested and universal transfer systems are compared, using numerical examples involving a small number of individuals, in order to highlight the precise effects on incomes. The implications of fixed incomes and of endogenous incomes, using constant elasticity of substitution utility functions, are examined. Comparisons between tax systems involve fundamental value judgements concerning inequality and poverty, and no tax structure can be regarded as unambiguously superior to another. Judgements depend on the degree of inequality aversion and attitudes to poverty. However, in cases where means-testing is preferred, the desired tax or taper rate applying to benefits is substantially less than 100 per cent.

1 Introduction

The aim of this paper is to investigate approaches to the evaluation of tax and transfer systems, concentrating on the question of whether transfers should be universal or means-tested. The emphasis is on income testing, so that non-income differences between individuals, in the examples given, are treated as being irrelevant. Hence categorical or state-dependent benefits are also ignored; for broad discussions of means-testing versus universal benefits, see Atkinson (1995) and Mitchell *et al*. (1994).[1]

Those on the different sides of the debate have different value judgements and different basic frameworks of analysis. In very broad terms, the advocates of means-testing typically argue that the primary concern of a transfer system should be to alleviate poverty, so that universal benefits are judged to be wasteful and involve an excessive level of gross government revenue. Schemes are compared using several measures of 'target efficiency' which reflect the extent to which transfer payments are concentrated on the poor; on target efficiency measures, see

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[1]Analyses using specific models or approaches include Besley (1990), Kesselman and Garfinkel (1978), Sadka *et al*. (1982), Lambert (1988) and Creedy (1996).

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Beckerman (1979) and Mitchell (1991).[2] The framework of reference is usually one in which the distribution of income before taxes and transfers is fixed independently of the tax system in operation. Analyses of poverty are typically 'non-welfarist' in that they are based on summary measures involving the income distribution, rather than the distribution of utility.

On the other hand, advocates of universal benefits argue that taxes and transfers have a much wider redistributive role than poverty alleviation implies. The framework of analysis is more closely related to the 'optimal tax' literature, in which labour supply plays a crucial role. Hence, great stress is placed on the incentive effects arising from the high marginal tax rates involved in means-testing. Evaluation of alternative systems is usually 'welfarist' and based on the use of social welfare or evaluation functions defined in terms of individuals' utilities. The proponents of universal benefits usually argue that an emphasis on the gross level of government revenue is not appropriate in a tax and transfer system.

It is not obvious how alternative tax and transfer systems may be compared, where it is required to allow for both poverty and inequality in a social evaluation function. Atkinson (1987) has suggested that in this case a lexicographic ordering could be used, in which primary concern is attached to poverty reduction while schemes giving rise to the same degree of poverty (however measured) are compared using the type of welfare function used in the optimal tax literature. This approach allows for the use of both welfarist and non-welfarist measures in the evaluation procedure, since poverty measures are non-welfarist.

In this paper, the various issues involved in evaluating tax and transfer systems are discussed using simple numerical examples involving a small number of individuals. Such examples help to illustrate the contrasts between systems and evaluation approaches. Two basic cases are considered. In Section 2, the pre-tax distribution is assumed to be fixed. Section 3 turns to a framework in which the distribution of wage rates is fixed, but the labour supply and hence income of each individual varies in response to changes in the tax system. A flexible tax and transfer scheme, allowing for the complete range between universal benefits and means-testing with 100 per cent marginal tax rates (as in a minimum income guarantee), is presented. In Section 4 further numerical examples obtained using the model of Section 3 are discussed. Brief conclusions are drawn in Section 5.

[2]Target efficiency measures are not concerned with the extent to which poverty is actually reduced by a tax and transfer system and, despite the terminology, have nothing to do with *economic* efficiency.

2 Fixed Pre-tax Incomes

This section examines four alternative tax and transfer schemes using numerical examples involving just five individuals. This highlights the use of alternative criteria.

2.1 Four Alternative Tax Structures

Table 1 presents details of five hypothetical individuals under four different tax and transfer schemes. These are 'pure' transfer systems, so that gross revenue from taxation is exactly matched by gross expenditure on transfer payments. In schemes A, B and C the gross revenue raised by income taxation is 30, and the transfer payment systems are such that only those in poverty, judged by pre-tax income, receive benefits and none is raised above the poverty line. The individuals are ranked in ascending order of their incomes and it is assumed that the poverty level is equal to 40, so that individuals 1 and 2 are in poverty before taxes and transfers. The alternative schemes are as follows.

In scheme A, the income tax is such that the tax paid $T(y)$ on an income of y is given by

$$\begin{aligned} T(y) &= 0 && \text{for } y \leq 20 \\ &= 0.10(y-20) && \text{for } y > 20 \end{aligned} \tag{1}$$

Hence there is a single marginal tax rate of 0.10 applied to income measured in excess of a tax-free threshold of 20. In addition, there is a minimum income guarantee (MIG) such that those individuals with incomes, after the deduction of income tax, below 30 have their net incomes brought up to 30. This is usually referred to as a 'fully integrated' MIG.

Table 1
Alternative Tax and Transfer Schemes

		Net income with			
No.	*y*	*A*	*B*	*C*	*D*
1	10	30	20	28.33	36.15
2	20	30	40	31.66	42.31
3	60	56	56	56	66.92
4	100	92	92	92	91.54
5	200	182	182	182	153
P_0	0.4	0.4	0.2	0.4	0.2
P_1	0.25	0.1	0.1	0.1	0.0192
P_2	0.1625	0.025	0.05	0.0257	0.0018
G	0.472	0.375	0.386	0.377	0.290
$A(0.5)$	0.199	0.116	0.123	0.116	0.068

In scheme B the income tax is the same as in A, but the transfer payments are designed to minimize the number of people with net income below the poverty line; i.e. the headcount poverty measure is minimized. In C, the income tax is the same as in A but the transfer system has means-tested or 'tapered' benefits. Those with $y < 50$ receive a basic benefit of 25 which is reduced at a rate of 2/3 of pre-tax income. Hence net income z is given by

$$z = 25 + y\left(1 - \frac{2}{3}\right) \qquad (2)$$

This transfer system, given the pre-tax income distribution, exactly exhausts the 30 raised from income taxation imposed on the three richest individuals.

In scheme D, there is a universal benefit, or social dividend, of 30 which is received by all individuals. Income taxation is imposed at a fixed proportional rate on all income. With a gross revenue requirement of 150, the tax rate required is 0.3846. Hence there is a linear income tax system with net income given by

$$z = 30 + y(1 - 0.3846) \qquad (3)$$

2.2 *Comparisons among Tax Structures*

For each of the four tax and transfer schemes, Table 1 shows the net incomes along with several measures of poverty and inequality. The poverty measures are obtained using the class of measures defined by

$$P_\theta = \frac{1}{N} \sum_{y_i \le y_{\mathrm{p}}} \left(1 - \frac{y_i}{y_{\mathrm{p}}}\right)^\theta \qquad (4)$$

where y_{p} denotes the poverty line (assumed to be 40 in this example) and θ is a parameter. This is the class of poverty measures proposed by Foster *et al.* (1984). It can be shown that P_0 is the headcount measure giving the proportion of people with $y \le y_{\mathrm{p}}$, P_1 depends on the average income of those in poverty relative to the poverty line, and P_2 depends also on the coefficient of variation of those in poverty. The two inequality measures used are the Gini coefficient G and the Atkinson measure for a relative inequality aversion coefficient of 0.5, $A(0.5)$.

In comparing the four structures, it can first be argued that the gross revenue raised by income taxation is rather an arbitrary measure to take as a criterion. The linear income tax can be administered in two ways: either everyone is taxed at the proportional rate of 0.3846 in order to produce gross revenue of 150, or revenue is only obtained from those with incomes above the arithmetic mean, in which case the gross revenue is effectively 55.38 rather than 150. These have the same effect if there are no administrative costs of collecting taxation or of administering benefits. In practice the administrative costs of the various structures would be expected to vary, and it may be that they vary in proportion to the total (gross) revenue raised and disbursed. Furthermore, administrative costs are known to be higher for means-tested schemes.

The structures A to C all have target efficiency measures of 100 per cent, reflecting the fact that only those who have $y < y_p$ are better off after taxes and transfers and none has a net income exceeding the poverty line. However, poverty is not eliminated in any of the schemes, according to any of the poverty measures; the elimination of poverty is discussed below.

If target efficiency is thought to be a fundamental criterion, then the linear income tax of D is automatically ruled out. This criterion is essentially negative: it simply argues that a scheme is 'bad' if transfer payments bring recipients above the poverty line. A choice has to be made between structures A and C. This depends on which poverty measure reflects the value judgements of whoever is making the evaluation. The MIG of structure A would be chosen if P_2 is used. Although structure B is designed to minimize P_0 it does badly according to P_2. However, all three structures have the same value of P_1. Hence those who argue that the alleviation of poverty is the only legitimate role of a transfer system would be indifferent between the three structures A to C if they also hold value judgements which imply the use of the measure P_1. However, there may be people who attach primary importance to poverty reduction, but who have some aversion to inequality more widely perceived. This suggests the application of a lexicographic approach; i.e. a primary aim is to minimize poverty (for a given measure) and a secondary aim is then to minimize inequality among schemes which achieve the minimum poverty level. Here the choice depends on value judgements which are involved in the choice of inequality measure. Thus schemes A and C, the MIG and the modified MIG with tapered benefits, continue to tie when both P_1 and Atkinson's measure (with inequality aversion coefficient of 0.5) are used, but the MIG dominates if the Gini measure is used along with P_1.

The linear income tax of structure D performs very badly from the point of view of target efficiency since person 2's net income is above the poverty line and person 3 has a higher net income than gross income. Indeed, all those with $y < \bar{y}$ in this scheme are better off. It does not, however, eliminate poverty because the net income of person 1 is below y_p. Some people may believe that target efficiency is unimportant as it does not reflect the extent to which poverty is actually reduced. Table 1 shows that the linear income tax has lower poverty measures P_1 and P_2 than any of the other schemes. If P_0 is used, then D ties with B, but the lexicographic approach results in D being chosen because it has lower inequality measures. A concentration on inequality reduction as a sole criterion would, not surprisingly, give a preference for the linear income tax.

In comparing the four structures of Table 1, there is therefore no single scheme that can automatically be regarded as superior to any other. The evaluation inevitably involves value judgements, and such values involve complex issues relating to views about both poverty and inequality. Although the term target 'efficiency' has been used in the literature, the use of such measures really has nothing to do with economic efficiency or the actual amount of poverty reduction but involves the value judgement that transfers to the non-poor are 'bad', as are excessively generous payments to the poor. Efficiency considerations cannot really be applied in this context of a fixed pre-tax income distribution.

2.3 Zero Poverty Comparisons

The above discussion involved cases where value judgements were summarized by a lexicographic approach in which concern for poverty dominates, while inequality considerations are used to choose among systems which generate the same poverty level. Comparisons of inequality, for given poverty levels, may depend on the precise level of poverty achieved. The question arises, for example, whether the comparisons would be affected if poverty were eliminated altogether. Such comparisons are shown in Table 2, for the MIG and the linear income tax schemes, A and D respectively, modified as follows in order to reduce poverty to zero. These modified schemes are denoted A$'$ and D$'$.

In order to eliminate poverty with structure A, it is necessary to raise gross revenue of 50 from those above the tax-free threshold, so that a MIG can operate such that, for $y \leq 40$, net income is brought up to 40. This requires the choice of tax rate t such that, for $y \geq 20$,

$$T(y) = t(y - 20) \tag{5}$$

and revenue is equal to 50. With a total taxable income of 300 arising from the three richest individuals, this is achieved with $t = 0.1667$.

TABLE 2
COMPARISON WITH NO POVERTY

		Net income with	
No.	*y*	*A$'$*	*D$'$*
1	10	40.00	40.00
2	20	40.00	45.61
3	60	53.33	68.01
4	100	86.67	90.41
5	200	170.00	146.41
G	0.472	0.315	0.264
A(0.5)	0.199	0.082	0.056

The linear income tax must give the poorest person a net income of 40. This is achieved with a social dividend of, say, a and a marginal tax rate applied to all income of t; hence:

$$40 = a + 10(1 - t) \tag{6}$$

The government's budget constraint also requires that the social dividend can be financed from income taxation, and so

$$a = t\bar{y} \tag{7}$$

with $\bar{y} = 390/5$. The two simultaneous equations (6) and (7) can be solved to give $a = 34.41$ and $t = 0.44$.

The imposition of these schemes gives the net incomes and inequality measures shown in Table 2. It can be seen that the poorest four people are better off with the linear income tax, which involves heavier taxation of the richest person. Both inequality measures are lower for structure D′, the linear income tax. However, a judge who regards it as 'bad' to bring person 2's net income above 40 (the poverty line) would prefer the MIG. Hence some value judgements favour A′, while others favour D′. The value judgements involved in the choice of tax structure are essentially those involving interpersonal comparisons. A comparison which simply dismissed D′ because the marginal tax rate t is much higher than in A′ would appear to be arbitrary.

These examples help to illustrate how different value judgements can be applied to alternative tax structures.[3] However, the assumption that the pre-tax distribution of income remains constant, so that there are no incentive effects, is rather restrictive. With such an assumption it is possible always to eliminate inequality and, provided average income exceeds the poverty line, simultaneously to eliminate poverty. In practice, however, it may not be possible to eliminate poverty. The tax and transfer system may affect incentives so that the attempt to increase transfers is self-defeating. It is therefore necessary to consider such incentive effects.

3 Fixed Wage Rates

This section presents the framework used to compare the effects of tax and transfer schemes where individuals face fixed wage rates rather than fixed incomes. First, the basic results concerning labour supply in the case of constant elasticity of substitution (CES) preferences are presented in the absence of a tax scheme. Second, a modified form of MIG is introduced, having the flexibility to handle the range between a linear tax and means-testing using 100 per cent marginal tax rates.

[3]For further treatment of this case using a continuous income distribution, see Creedy (1995).

3.1 CES Utility Functions

This section introduces incentive effects by supposing that each individual faces a fixed pre-tax wage rate but can vary the proportion of time spent in work. It is assumed initially that each individual has the same tastes, described by the CES form of utility function, and chooses the consumption of goods, c, and the proportion of time spent in leisure, h, in order to maximize utility, $U(c, h)$, given by

$$U = [\alpha c^{-\rho} + (1-\alpha)h^{-\rho}]^{-1/\rho} \tag{8}$$

where $\rho > -1$ and $0 < \alpha < 1$. The elasticity of substitution, σ, is given by $1/(1+\rho)$. The marginal rate of substitution of leisure for consumption is given by

$$\left.\frac{\mathrm{d}c}{\mathrm{d}h}\right|_U = -\frac{1-\alpha}{\alpha}\left(\frac{h}{c}\right)^{-(1+\rho)} \tag{9}$$

Utility must be maximized subject to a budget constraint that requires the value of consumption to be equal to net (after tax and transfer) income. In the simplest case where there are no taxes or transfers, the price index is set equal to unity and the individual has a fixed non-wage income of g; this constraint requires that

$$c = w(1-h) + g \tag{10}$$

Hence interior solutions are obtained by equating (9) and the rate of substitution between c and h along the budget line, which in the absence of taxes is $-w$, giving c in terms of h:

$$c = h\left[\left(\frac{1-\alpha}{\alpha}\right)\frac{1}{w}\right]^{-\sigma} \tag{11}$$

Substituting (11) in (10) and rearranging gives h as

$$h = \Psi M\left(\frac{1-\alpha}{w}\right)^{\sigma} \tag{12}$$

where M is 'full income', the income obtained when all time is devoted to labour, and is equal to $w+g$, and Ψ is given by

$$\Psi = \left[\alpha^{\sigma} + w\left(\frac{1-\alpha}{w}\right)^{\sigma}\right]^{-1} \tag{13}$$

This tangency solution only applies when w is above a minimum wage, w_{L}, for which the individual works, i.e. for which $h < 1$. Using (12) this is found to be

$$w_{\mathrm{L}} = g^{1+\rho}\left(\frac{1-\alpha}{\alpha}\right) \tag{14}$$

For those who work, earnings are given by $w(1-h)$ or

$$y = w\left[1 - \Psi M\left(\frac{1-\alpha}{w}\right)^{\sigma}\right] \tag{15}$$

These results can be modified to allow for a tax and transfer system by suitable adjustment of the non-wage component and the wage rate, and suitable allowance for further kinks in the budget constraint; this is discussed in Section 3.2 for a modified MIG. In the simplest case, that of the linear income tax, w is replaced by $w(1-t)$ and g is replaced by a.

In examining the relationship between labour supply, $1-h$, and the wage rate (or the net of tax wage rate), two cases need to be distinguished. If $\sigma > 1$, labour supply increases continually as the wage rate increases, so the wage elasticity of labour supply is positive once w exceeds w_L. If $\sigma < 1$, labour supply eventually falls as the wage increases, so that (with w on the vertical axis and $1-h$ on the horizontal axis of a diagram) the labour supply curve can become 'backward bending'. If the non-wage income is zero, only the backward-bending part of the supply curve is relevant when $\sigma < 1$. Empirical results suggest a value less than unity.[4]

Care needs to be taken in the calibration of the model, in addition to the choice of the elasticity of substitution. For example, it is known that as σ approaches unity, (8) approaches the Cobb–Douglas form and α indicates the proportion of time spent working, in the absence of non-wage income and taxation.[5] But the appropriate value of α in the CES case depends on the units in which w is measured. In the no-tax case, with $g = 0$, rearrangement of (12) gives

$$\alpha = \left\{1 + \left[\left(\frac{h}{1-h}\right)w^{\sigma-1}\right]^{1/\sigma}\right\}^{-1} \tag{16}$$

It is therefore possible to specify a particular wage for which it is desired that labour supply should take a certain value, for a given value of the elasticity of substitution. These three variables can be substituted into (16) to obtain the required value of α. For example if $\sigma = 0.7$ and it is required that $h = 0.3$, when $w = 80$, the solution for α is 0.9564.

[4]For discussion of the CES in optimal tax calculations, see Stern (1976).

[5]If $g = 0$, the Cobb–Douglas case implies that h is independent of the wage rate faced. When non-wage income is positive, as in the case of a tax and transfer system, labour supply always increases as the net wage w increases (once w_L is exceeded, of course) and there is a linear relationship between y and w, unlike the non-linear expression in (15).

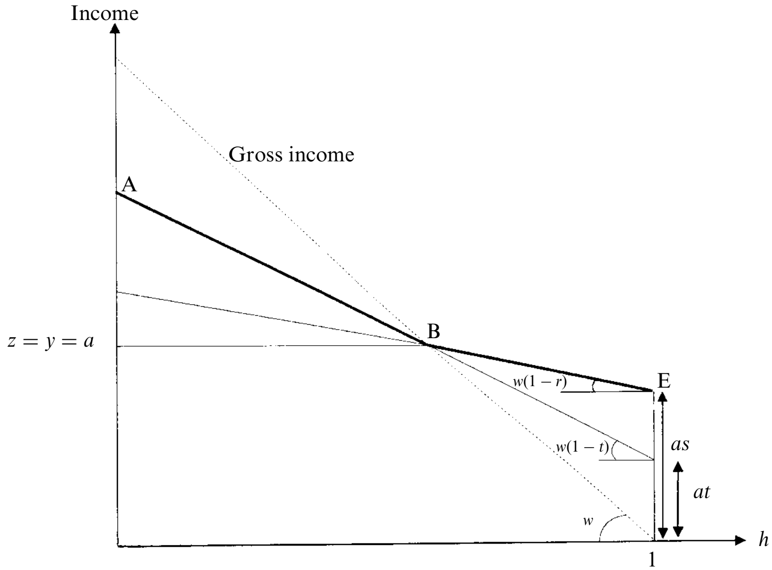

FIG. 1

3.2 *A Modified Minimum Income Guarantee*

A wide variety of alternative tax systems can be modelled by specifying a modified form of the MIG involving means-testing in the form of a taper. Consider the tax structure given by

$$\begin{aligned} \text{benefit} &= s(a-y) \quad \text{for } y \leq a \\ \text{tax} &= t(y-a) \quad \text{for } y > a \end{aligned} \tag{17}$$

Hence for those who pay tax ($y > a$) the tax system is just like the familiar tax function having a single marginal rate and tax-free threshold. For those with $y \leq a$, a benefit is received such that if $y = 0$ the individual receives the amount sa and the benefit is withdrawn at a marginal rate of s for each unit of income. This system is very useful for present purposes because it allows for the standard MIG at one extreme, where $s = 1.0$, and for the linear income tax (with a social dividend or universal benefit) when $s = t$.

The non-linear budget constraint produced by (17) has interesting implications for labour supply behaviour. The convex budget constraint is shown in Fig. 1 as the line ABE.[6] At point B, the value of net income is

[6]I am grateful to a referee for suggesting an improved version of this figure.

equal to the threshold income level, a. As w increases the budget constraint pivots about the point E. For very low values of w (below w_L, given by substitution into (14) with g replaced by ta), corner solutions are appropriate and no labour is supplied. As the wage is increased, two alternatives arise. One alternative, which occurs for very high values of s, is that the individual does not work for low wage rates, but at some wage rate $w = w_m$ jumps directly to section AB of the constraint. The wage rate w_m is such that an indifference curve is simultaneously tangential to the section AB and touches the corner, E, of the constraint. In this case (depending on the tax parameters and the utility function), the individual never simultaneously works and receives transfer payments.

The second alternative is such that as the wage increases from $w = w_L$ the individual moves away from the corner E along the section BE of the constraint, thereby both earning some wage income and receiving means-tested transfer payments. Then at some wage w_s the individual jumps to section AB; this occurs at a wage such that there is an indifference curve that is tangential to both the sections AB and BE simultaneously. Hence the point B is never chosen in practice.

The values of the wage thresholds, w_m and w_s, are given by the roots of the relevant equations obtained by writing the conditions under which either a tangency and corner solution are simultaneously attained or two tangency positions are attained. However, these equations are non-linear and therefore do not give rise to explicit solutions for the values of w_m and w_s. The values may be calculated for any set of preferences and tax parameters using an iterative procedure, such as Newton's method.[7]

4 Numerical Examples

The analysis of the modified MIG when allowance is made for incentive effects is much more awkward than when incomes are assumed to be fixed. First, a distribution of the wage rate for a given number of individuals must be specified. Then, in order to calculate the values of the tax parameters that are consistent with the assumption of a 'pure transfer' system, an iterative solution procedure must be used. It is first necessary to specify some value of the taper rate s and then to calculate, for a given tax rate t, the value of the tax threshold a which ensures that the government's budget constraint is satisfied; i.e. the tax revenue must be sufficient to pay for the transfer payments. This stage has to be done using a numerical search procedure which involves repeated trial calculations for alternative values of the tax threshold. This is because no explicit

[7]In the Cobb–Douglas case, the value of w_s can be obtained explicitly; see Creedy (1994). Lambert (1985, 1988) used this type of modified MIG with Cobb–Douglas preferences, but did not consider the possibility associated with the threshold w_m.

TABLE 3
LINEAR TAX: PRE- AND POST-TAX INCOMES

		$t = 0$	$t = 0.3$	
No.	w	y, z	y	z
1	63.04	45.86	39.14	49.68
2	66.28	48.01	41.29	51.18
3	70.91	51.08	44.34	53.31
4	72.74	52.29	45.55	54.16
5	78.23	55.89	49.14	56.68
6	132.52	90.25	83.85	80.97
7	134.35	91.38	84.99	81.77
8	152.80	102.64	96.46	89.80
9	154.48	103.65	97.50	90.53
10	259.07	164.74	160.25	134.45

algebraic solution is available, essentially because labour supply depends on the tax thresholds (along with the preference parameters) so that the threshold is required in order to calculate incomes. Only when incomes are available is it possible to check if the implied taxes and transfers exactly balance. Hence a trial and error process is needed.

The following examples are for a group of ten individuals, and their wage rates were selected at random from a log-normal distribution with mean and variance of logarithms of 4.5 and 0.5 respectively.[8] Each individual is assumed to have an elasticity of substitution, σ, of 0.7 and a value of α of 0.96. The poverty level is assumed to be 52.

4.1 Gross and Net Income Comparisons

The implications of the above assumptions for earnings in the case of a linear income tax are shown in Table 3 for tax rates of 0 and 0.3. The second column of the table shows the wage rates (obtained by selecting at random from the distribution specified above); these are used in all the following examples. In the absence of any tax and transfer system ($t = 0$), it can be seen that the first three individuals are in poverty, with incomes below the threshold of 52. The case where $t = 0.3$ has been selected for illustration because this turned out to be the optimal linear income tax for the standard 'optimal tax' problem, where the social welfare or evaluation function involves the maximization of

[8]The use of the log-normal distribution to specify wage rates is standard in optimal tax models. The number of individuals is higher than in the previous examples because non-convergence of the iterative sequence, used to obtain a for given t and s, can arise with very small numbers if, for a particular combination of t and s, one individual has a wage rate that is very close to the 'switching' wage w_s.

$$W = \frac{1}{10}\sum_{i=1}^{10}\frac{U_i^{1-\epsilon}}{1-\epsilon} \tag{18}$$

and ϵ, the constant relative inequality aversion coefficient, is set equal to 0.5. The welfare function (18) has an abbreviated form given by

$$W = \bar{U}[1 - A(\epsilon)] \tag{19}$$

where $\bar{U}$ is arithmetic mean utility and $A(\epsilon)$ is, as before, Atkinson's inequality measure.[9]

Table 3 shows the extent to which the 'optimal' linear income tax has target inefficiency. In the pure transfer system considered here, all individuals below the arithmetic mean have net incomes above their gross incomes, and individuals 3 to 5, who have gross wage incomes that would otherwise place them in poverty, have net incomes which bring them above the poverty line, even though in this case only those in poverty receive transfers.

The welfare function in (18) or (19) has, of course, no reference to poverty at all, and does not represent the social evaluation function of those who regard poverty minimization as the primary requirement of a tax system. It would be a coincidence if the tax rate of 0.3 were also to minimize poverty. Table 3 shows that the first two individuals remain in poverty, so $P_0 = 0.2$. It is not possible, by increasing t, to reduce P_0 further, because the resulting increase in the social dividend a is accompanied by reductions in labour supply. However, increasing t somewhat does result in reductions in both P_1 and P_2, until the labour supply effects dominate causing all measures to increase.[10]

The introduction of means-testing is designed to overcome the target inefficiency of universal schemes such as the linear income tax. Table 4 gives information about the gross and net incomes of each of the ten individuals under four different values of the taper rate s. In each case the tax rate t is the same, at $t = 0.3$, in order to restrict the table to reasonable proportions. It can be seen that the combination of a taper rate of 0.55 with a tax rate of 0.3 does not entirely eliminate target inefficiency because individual number 5 is raised slightly above the poverty line of 52. When s is raised to 0.65, target efficiency is 100 per cent; transfer payments are concentrated only on those below the poverty line and no one in poverty is given 'excessive' transfers.

The target efficiency, however, is obtained at a cost which is much more apparent in this context of variable labour supplies than when pre-tax incomes are assumed to be fixed. Even though each case illustrated in

[9]It is well known that the result of this kind of exercise depends on the cardinalization of the utility function used.

[10]These poverty measures are both minimized for the linear income tax system for $t = 0.45$.

TABLE 4
MODIFIED MIG: PRE- AND POST-TAX INCOMES, $t = 0.3$

		$s = 0.35$		$s = 0.55$		$s = 0.65$		$s = 0.75$	
No.	w	y	z	y	z	y	z	y	z
1	63.04	37.90	49.63	31.68	47.85	27.29	45.75	21.22	42.28
2	66.28	40.04	51.02	33.81	48.81	29.40	46.49	23.31	42.80
3	70.91	43.09	53.00	36.84	50.18	32.42	47.55	26.29	43.55
4	72.74	44.29	53.79	38.04	50.72	33.62	47.96	27.48	43.85
5	78.23	47.89	56.12	41.64	52.33	37.20	49.22	31.03	44.73
6	132.52	84.21	80.37	85.52	78.19	86.20	77.05	87.01	75.70
7	134.35	85.35	81.17	86.67	78.99	87.36	77.86	88.17	76.51
8	152.80	96.83	89.21	98.18	87.05	98.89	85.93	99.73	84.60
9	154.48	97.87	89.93	99.23	87.78	99.93	86.66	100.77	85.33
10	259.07	160.66	133.88	162.16	131.84	162.95	130.77	163.88	129.51

Table 4 involves the first five individuals simultaneously working and receiving transfers, the elimination of target inefficiency is accompanied by an increase in the number of those below the poverty line; P_0 is obviously equal to 0.5 for the higher values of the taper rate. Hence in each case shown in the table, w_s is relevant rather than w_m. For the four values of s shown (and $t = 0.3$) w_s takes values respectively of 102.01, 98.02, 92.32 and 84.81, while the corresponding values of w_L are 6.36, 14.03, 20.06 and 28.96. Hence in this example, where the lowest wage is 63.04, no one is at the no-participation corner.

The increase in the degree of targeting leads to the population being increasingly 'polarized' into two groups, because the targeting has its major effect on the labour supply of those facing relatively low wage rates. Indeed, as s is increased, the pre-tax incomes of those who face the tax rate $t = 0.3$ actually increase. This is explained by the fact that the threshold value a that can be supported by the tax system falls as s increases (for given t). The use of target efficiency as a criterion by which to judge a tax and transfer system, by entirely ignoring the outcomes in terms of either poverty or inequality, would appear to be rather narrow. The simplicity of the argument, when expressed in the context of a fixed pre-tax income distribution, disappears when incomes are endogenous.

4.2 *Poverty and Social Welfare Comparisons*

Turning to the evaluation of schemes in terms of *outcomes* rather than targeting, Table 5 shows summary measures for a range of values of the taper s and the marginal tax rate t. The summary measures are the three poverty measures defined above and the values of an abbreviated social welfare function of the form $W = \bar{U}(1 - I_U)$, where I_U denotes a measure of inequality of utility. The measures $W(A)$ and $W(G)$ denote values of W

Table 5
Poverty and Social Welfare

s	a	t	P_0	P_1	P_2	$W(A)$	$W(G)$
0.35	71.41	0.30	0.2	0.0064	0.0002	36.0086	32.0125
0.45	66.17	0.30	0.3	0.0091	0.0004	35.9303	32.1112
	68.94	0.40	0.2	0.0053	0.0002	35.8742	32.4084
	31.36	0.45	0.2	0.0044	0.0001	35.7766	32.4654
0.55	61.09	0.30	0.4	0.0201	0.0012	35.7065	32.0083
	64.07	0.40	0.4	0.0104	0.0005	35.6821	32.4164
	65.59	0.50	0.2	0.0068	0.0002	35.4612	32.5606
	36.17	0.55	0.2	0.0065	0.0002	35.2546	32.5174
0.65	55.69	0.30	0.5	0.0443	0.0042	35.2540	31.6057
	58.77	0.40	0.5	0.0293	0.0020	35.2565	32.1266
	60.64	0.50	0.5	0.0202	0.0011	35.0664	32.3831
	61.13	0.60	0.5	0.0178	0.0009	34.6051	32.3052
	39.48	0.65	0.5	0.0197	0.0010	34.2250	32.0976
0.75	49.30	0.30	0.5	0.0823	0.0137	34.3840	30.6707
	52.38	0.40	0.5	0.0646	0.0085	34.4020	31.3003
	54.52	0.50	0.5	0.0523	0.0056	34.2373	31.6825
	55.54	0.60	0.5	0.0464	0.0044	33.8176	31.7415
	55.04	0.70	0.5	0.0493	0.0050	32.9795	31.3134
	40.45	0.75	0.5	0.0556	0.0063	32.2925	30.8078
0.85	42.79	0.30	0.5	0.1098	0.0280	33.2811	29.4345
	43.46	0.40	0.5	0.1255	0.0316	32.5788	29.2730
	45.76	0.50	0.5	0.1101	0.0243	32.4139	29.7772
	47.27	0.60	0.5	0.1000	0.0200	32.0255	30.0068
	47.65	0.70	0.5	0.0974	0.0190	31.2743	29.8047
	46.06	0.80	0.8	0.1190	0.0240	29.7964	28.7849
	37.29	0.85	0.9	0.1669	0.0352	28.4780	27.6555

obtained using respectively the Atkinson inequality measure (with inequality aversion of 0.5 as above) and the Gini measure for I_U.[11] The case where $s = t$ refers to the standard linear income tax which has universal transfers.

First consider the use of only the social evaluation function defined without any reference to poverty, as in the standard 'optimal' tax problem. Here, with the modified MIG scheme, the problem is to find the optimal combination of s and t (with the associated value of a being determined by the revenue constraint). Hence the search is over two dimensions rather than a single dimension of the linear income tax considered above. It can be seen from Table 5 that $W(A)$ is maximized for the combination of $s = 0.35$ and $t = 0.3$. When the Gini measure is used, $W(G)$ is found to be

[11]The basic value judgements involved in the use of the Gini measure in an abbreviated welfare function of this type were explored by Sen (1973).

maximized for the combination of $s = 0.55$ and $t = 0.5$.[12] Calculations revealed that the optimal linear income tax rate in the case of the Gini-based evaluation function is 0.55. Hence a concentration on the distribution of utility would give support to a degree of means-testing of transfer payments, with the taper rate being slightly higher than the income tax rate applied to those with gross incomes above the threshold a. Investigations show that this result, support for a taper rate applying to transfers, depends on both the assumed distribution of wage rates and the degree of inequality aversion in the social evaluation function. For higher values of ϵ the linear income tax dominates the modified MIG; this is not surprising as more weight is attached to the lower range of the distribution. When a much larger population is used (consisting of several thousand random drawings from a log-normal wage rate distribution), the linear tax again appears to dominate.

The question then arises of how someone with a primary concern for poverty would evaluate the outcomes of the different systems. Table 3 shows how the increase in the taper s for given marginal tax rate t increases each of the measures of poverty. However, increasing t for a given value of s can, over a range, reduce each of the poverty measures. This means that, for higher values of the taper, there are combinations of s and t which give lower poverty measures than the corresponding values obtained with a linear tax with $t = s$: consider the values of P in Table 5 for the taper rates of 0.55 and above. Nevertheless, the tax system producing the minimum overall level of poverty depends on the specific poverty measure used. There are many combinations giving rise to a value of P_0 of 0.2, and so the adoption of a lexicographic approach would give the same result as the direct application of the social welfare function, of the previous paragraph, that ignores poverty. However, it can be seen from the table that the use of either P_1 or P_2 gives support for a linear income tax with a marginal tax rate of 0.45.

4.3 Heterogeneous Preferences

The above comparisons were made under the assumption, usually made in 'optimal tax' studies, that all individuals have the same preferences; they differ only in that each individual faces a different wage rate. However, it is possible to repeat the above calculations allowing the values of α to vary over individuals.[13] If α is thought to increase with w, this means that those with higher wages systematically also have a lower preference for leisure.

[12]Table 5 obviously reports only a very small number of the combinations that had to be examined, involving a very much finer grid division.

[13]Copies, with documentation, of the Fortran programs used to examine alternative tax structures and assumptions can be obtained from the author.

This in turn means that the distribution of wage income is more widely dispersed than in the examples shown above and the poverty measures are higher (except for very high values of t in the linear income tax). It is found that the use of universal transfers (as in the linear income tax) is even more likely to dominate the use of means-testing when a social evaluation function of the form of (19), or its equivalent using the Gini inequality measure, is applied. If the alternative assumption is made that the preference for leisure increases with the wage rate, then the distribution of wage income is much more compressed and poverty is very much less than in the above examples. The social welfare comparisons between schemes are little affected, however.

5 Conclusions

This paper has illustrated the use of different criteria to evaluate alternative tax and transfer systems. In particular, means-tested versus universal transfer systems were compared. The analysis proceeded by using numerical examples involving a small number of individuals, in order to highlight the precise effects on incomes. The implications of fixed incomes and of endogenous incomes, using CES utility functions, were examined. Comparisons between tax systems involve fundamental value judgements concerning inequality and poverty, and no tax structure can be regarded as unambiguously superior to another. Judgements depend on the degree of inequality aversion and attitudes to poverty. However, in those cases where means-testing is preferred, the desired tax or taper rate applying to benefits is only slightly less than the marginal tax rate applying to taxpayers, and is substantially less than 100 per cent.

References

Atkinson, A. B. (1987). 'On the Measurement of Poverty', *Econometrica*, Vol. 55, pp. 749–764.

Atkinson, A. B. (1995). *Public Economics in Action*, Oxford, Clarendon Press.

Beckerman, W. (1979). 'The Impact of Income Maintenance Programmes on Poverty in Britain', *Economic Journal*, Vol. 89, pp. 261–279.

Besley, T. (1990). 'Means Testing Versus Universal Provision in Poverty Alleviation Programmes', *Economica*, Vol. 57, pp. 119–129.

Creedy, J. (1994). 'Taxes and Transfers with Endogenous Earnings: Some Basic Analytics', *Bulletin of Economic Research*, Vol. 46, pp. 97–130.

Creedy, J. (1995). 'Taxes and Transfers: Target Efficiency and Social Welfare', *Economica*, Vol. 63, pp. S163–S174.

Creedy, J. (1996). *Fiscal Policy and Social Welfare*, Aldershot, Edward Elgar.

Foster, J., Greer, J. and Thorbecke, E. (1984). 'A Class of Decomposable Poverty Measures', *Econometrica*, Vol. 52, pp. 761–762.

Kesselman, J. R. and Garfinkel, I. (1978). 'Professor Friedman, Meet Lady Rhys-Williams: NIT vs CIT', *Journal of Public Economics*, Vol. 10, pp.179–216.

Lambert, P. J. (1985). 'Endogenising the Income Distribution: the Redistributive Effect, and Laffer Effects, of a Progressive Tax-benefit System', *European Journal of Political Economy*, Vol. 1, pp. 3–20.

Lambert, P. J. (1988). 'The Equity–Efficiency Trade-off: Breit Reconsidered', *Oxford Economics Papers*, Vol. 42, pp. 91–104.

Mitchell, D. (1991). *Income Transfers in Ten Welfare States*, Newcastle, Avebury.

Mitchell, D., Harding, A. and Gruen, F. (1994). 'Targeting Welfare: a Survey', *Economic Record*, Vol. 70, pp. 315–340.

Sadka, E., Garfinkel, I. and Moreland, K. (1982). 'Income Testing and Social Welfare, an Optimal Tax-transfer Model', in I. Garfinkel (ed.), *Income Tested Transfer Programs: the Case For and Against*, New York, Academic Press, pp. 291–313.

Sen, A. (1973). *On Economic Equality*, Oxford, Clarendon Press.

Stern, N. H. (1976). 'On the Specification of Models of Optimum Income Taxation', *Journal of Public Economics*, Vol. 6, pp. 123–162.