Measuring Income Tax Discrimination

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DISCUSSION PAPER
MEASURING INCOME TAX DISCRIMINATION

by

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ABSTRACT

We propose a procedure for measuring the effect of systematic discrimination in the income tax. Different socioeconomic groups are assumed to face different tax schedules. We show that a welfare loss is caused by the group-specificity of schedules, the dollar value of which is our measure of discrimination. Defining vertical equity as the dollar value of the tax system’s welfare superiority over an equal yield flat tax, discrimination equates to a loss in vertical equity. The Australian income tax is found to discriminate against wage and salary earners, causing a roughly one percent loss of social welfare in 1984. JEL Classification Numbers: D63, J71, H24.

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I. Introduction

Does the income tax discriminate against workers because of the tax breaks business people receive? How favourably are the homeowners treated? How costly are collection difficulties in the rural sector? In this paper, we provide a measurement framework to address such questions.

We assume that different socioeconomic groupings - such as the business people, the homeowners, the farmworkers as instanced above - face different income tax schedules. We focus on systematic tax discrimination between groups rather than upon capriciousness or assessment error at the individual level. We measure discrimination by the dollar value of the welfare loss which, we show, is necessarily caused when the income tax code comprises group-specific schedules, and vertical equity by the dollar value of the welfare gain which comes from the way these schedules tax people at different income levels.

This perspective integrates the tax system's vertical characteristic with its 'horizontal' one: discrimination equates to a loss in vertical equity. A distributional judgement parameter captures inequality aversion. The methodology is designed to reveal the impact effect of discrimination: the welfare loss caused by group-specificity in the tax code is evaluated given people's existing labour supplies. This is not to say that such discrimination is unintended, or sub-optimal when behavioural responses are taken into account. The social welfare function might not distinguish the workers from the business people, and yet discrimination could arise in the optimal tax scenario once the revenue constraint is imposed. Tax policies which have such short-run welfare costs may be designed to promote economic growth, and may thus represent the most efficient way in the longer term to meet revenue objectives and equity - but they are not perfectly equitable. Our measures capture the extent of this observed inequity, and can be
implemented without the need to model people's economic behaviour (supply elasticities, productivities, etc.).

The structure of the paper is as follows. In Section II, we briefly lay out the mathematical structure in terms of which the analytics will proceed. Section III contains the main results. In Section IV, we discuss issues of implementation, in particular focussing upon the choice of the socioeconomic groupings to be investigated, and upon the problem of classical horizontal inequity (unequal tax treatment of equals) within socioeconomic groups. In Section V we illustrate the potential of the methodology, using Australian Household Expenditure Survey data for 1984 to explore the question: does the Australian income tax discriminate between the workers and the rest (principally the entrepreneurs and those, like the pensioners and the very wealthy, who are living on unearned incomes), and to what extent? Section VI contains a summary and concluding discussion.

II. Analytical structure

Suppose that the population \( \Omega \) is divided into \( k \) mutually exclusive socioeconomic sub-populations or groups \( \Omega_i, 1 \leq i \leq k \). Let the population shares be \( a_i \), let the frequency density functions for pre-tax income \( x \) be \( f_i(x) \), the means \( \mu_i = \int x f_i(x) dx \), and the effective tax schedules \( T_i(x) \).\(^1\) Let \( g_i \) be the total tax ratio (fraction of all income taken in tax) in group \( \Omega_i \):

\[
\int T_i(x)f_i(x)dx = g_i\mu_i \quad 1 \leq i \leq k
\]

Differences between the \( T_i(x), 1 \leq i \leq k \), constitute discrimination. The tax code is the

\(^{1}\) Depending entirely on the particular perspective one wishes to take, the symbol \( x \) here can represent equivalent family income (in case the family is to be the income unit) or either money income or equivalent per capita income if the individual is to be the income unit. For the application to Australian data which is to follow, the income unit is the "equivalent adult" (see on), and income per equivalent adult is denominated in dollars.
bundle \( <T_1(x), T_2(x), \ldots, T_k(x)> \). The overall frequency density function for pre-tax income, \( f(x) \), is defined as:

\[
f(x) = \sum_i a_i f_i(x)
\]  

(2)

and the overall total tax ratio, \( g \), is given by:

\[
g = \frac{\sum_i a_i \mu_i g_i}{\sum_i a_i \mu_i}
\]  

(3)

Let the utility-of-income function for a social evaluator who measures welfare as average utility be:

\[
u_e(x) = \frac{x^{1-e}}{1 - e} \quad 0 < e \neq 1, u_1(x) = \ln x
\]  

(4)

where \( e \) captures inequality aversion.² The equally distributed equivalent income (henceforth e.d.e. income), call it \( x_i^* \) before tax in group \( \Omega_i \), is the one which, if everybody received it, would yield the existing welfare:

\[
u_e(x_i^*) = \int u_e(x) f_i(x) dx
\]  

(5)

Let \( y_i^* \) be the e.d.e. income for \( \Omega_i \) after application of tax schedule \( T_i(x) \):

\[
u_e(y_i^*) = \int u_e(x - T_i(x)) f_i(x) dx
\]  

(6)

and let \( x^* \) and \( y^* \) be the e.d.e. incomes for \( \Omega \) before and after application of the tax code:

\[
u_e(x^*) = \int u_e(x) f(x) dx = \sum_i a_i u_e(x_i^*)
\]  

(7)

and

\[
u_e(y^*) = \sum_i a_i \int u_e(x - T_i(x)) f_i(x) dx = \sum_i a_i u_e(y_i^*)
\]  

(8)

E.d.e. income levels will be used henceforth as dollar measures of welfare.

² See Atkinson (1970) and Lambert (1993), chapter 4, for more on this.
III. Tax discrimination and vertical equity

To assess the discrimination inherent in the tax code, we compare liabilities with those that would be determined by the average of the schedules \( T_i(x) \) at every income level \( x \). Thus, let \( \hat{T}(x) \) be defined by the equation:

\[
f(x)\hat{T}(x) = \sum a_i f_i(x)T_i(x) \quad \forall x
\]  

(9)

The schedule \( \hat{T}(x) \) raises the same revenue as the tax code and tells how, on average, the tax system treats people at different income levels. Let the e.d.e. income that would pertain after application of \( \hat{T}(x) \) be \( \hat{y}^* \), which is defined by:

\[
u_e(\hat{y}^*) = \sum a_i \int u_e(x - \hat{T}(x))f_i(x)dx
\]  

(10)

The central proposition and insight of our paper is that tax discrimination is welfare-reducing. Welfare in the distributions of income after application of the tax code and of \( \hat{T}(x) \) are \( y^* \) and \( \hat{y}^* \) respectively. The formal result is this:

**Theorem 1**: If \( T_i(x) \equiv T_2(x) \equiv \ldots \equiv T_k(x) \quad \forall x \), then \( \hat{y}^* = y^* \). Otherwise, \( \hat{y}^* > y^* \).

**Proof**: By (9), \( x - \hat{T}(x) = \sum [a_i f_i(x)/f(x)](x - T_i(x)) \), and then by Jensen’s inequality, \( u_e(x - \hat{T}(x)) \geq \sum [a_i f_i(x)/f(x)]u_e(x - T_i(x)) \) since \( u_e(x) \) is strictly concave. The result follows after cross-multiplying by \( f(x) \) and integrating: see (8) and (10). Only if there were no differences in tax treatment at any income level, viz. if \( T_i(x) \equiv T_2(x) \equiv \ldots \equiv T_k(x) \quad \forall x \), would Jensen's inequality fail to be strict somewhere and then \( \hat{y}^* = y^* \). Q.E.D.

This result stems from the averaging which takes place in the derivation of \( \hat{T}(x) \).
and does not depend on convexity of the component tax schedules (although this may be a reasonable modelling assumption). The extent of the welfare loss in dollars engendered by differential tax treatment forms our measure $D$ of the discrimination characteristic of the tax code:

$$D = \hat{y}^* - y^* > 0$$  (11)

To put it another way, $D$ reveals the gain in welfare which is available to society if discrimination in taxation would be eliminated.

Vertical equity measures the improvement in distribution which a tax system brings relative to a proportional or 'flat' tax raising the same revenue and leaving relative income differentials unaffected. For the tax code $< T_1(x), T_2(x), \ldots, T_k(x) >$, denote by $V_{TC}$ the dollar value of this welfare improvement:

$$V_{TC} = y^* - x^* [1 - g]$$  (12)

This follows because the total tax ratio $g$ is the rate of the equal yield flat tax.³ Similarly, let $V_{AS}$ be the vertical equity characteristic of the averaged schedule $\hat{T}(x)$ :

$$V_{AS} = \hat{y}^* - x^* [1 - g]$$  (13)

This follows because $\hat{y}^*$ is the e.d.e. income level after application of $\hat{T}(x)$, recall (10), and because the averaged schedule $\hat{T}(x)$ has the same total tax ratio $g$ as the tax code. The result which ties the two concepts, discrimination and vertical equity, together is this:

**Theorem 2:** $V_{TC} = V_{AS} - D$.

**Proof:** Substracting (12) from (13), the difference is $D$ by (11).  *Q.E.D.*

³ By (4) and (5), $u_e(x^*[1-g]) = \int u_e(x[1-g])f(x)dx$ : thus $x^*[1-g]$ is the e.d.e. income after proportional tax at rate $g$. 
Discrimination $D$ can thus be interpreted as the loss of vertical equity attributable to group specificity of schedules in the tax code. If the code were to be replaced by the averaged schedule $\hat{T}(x)$, there would be a welfare increase of $D$ dollars per head ($V_{TC} \to V_{AS} = V_{TC} + D$). A tax system which is on average progressive ($V_{AC} > 0$) could nonetheless exert a negative influence on distribution if it contained too much discrimination ($V_{TC} < 0$ if $D > V_{AS}$).

This integration of discrimination and vertical equity considerations into a common measurement system is not without drawbacks. As a referee pointed out to us, one might be indifferent to vertical redistribution but have a strong aversion to discrimination: yet in Theorem 2 these two issues are conflated. If, indeed, one did have a strong aversion to discrimination but a low aversion to inequality, say, then one could select two different welfare functions (values of the parameter $e$), one for measuring discrimination and the other for measuring vertical equity. The resulting measure $D$ of discrimination (say computed for $e=e_1$) would not then be linked by Theorem 2 with the measures $V_{TC}$ and $V_{AS}$ of actual and 'averaged' vertical equity (computed for $e = e_2 < e_1$): rather, $V_{AS} - V_{TC}$ reveals in this case how discrimination would be valued by someone for whom $e = e_2$ was appropriate for discrimination measurement. Hence our $D$-measure and $V$-measures can stand apart: the analyst is not deprived of a real degree of ethical freedom.

The e.d.e. income approach also permits investigation of the sources of vertical equity, which arises from the way the tax code operates between and within groups, and of who would benefit, and by how much, from the removal of discrimination. In the

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4 See Fellman (1976) or Jakobsson (1976). $V_{AS}$ will also be positive if $\hat{T}(x)$ single-crosses the equal-yield flat tax once from below, a weaker condition than progression (Hemming and Keen, 1983). $V_{AS} < 0$ if the tax system is on average regressive and $V_{AS} = 0$ if it is on average flat.
notation of Section II, the vertical equity of the schedule $T_i(x)$ is:

$$V_i = y_i^* - x_i^*[1 - g_i]$$  \(14\)

This measures post-tax welfare in group $\Omega_i$ relative to that after equal-yield flat tax at rate $g_i$. If flat taxes in all groups $\Omega_i$ at rates $g_i$ were applied, the resulting welfare loss within groups would not equate with that, measured by $V$, which would occur if the tax code were replaced by a flat tax at rate $g$. Let $z^*$ be the overall e.d.e. income after flat taxes at rates $g_i$, $1 \leq i \leq k$:

$$u_z(z^*) = \sum a_i \int u_x(x[1 - g_i])f_i(x)dx$$  \(15\)

The welfare loss in moving from the tax code to flat taxes at rates $g_i$, $1 \leq i \leq k$ can be written:

$$W = y^* - z^*$$  \(16\)

and the welfare loss in moving from these flat taxes at rates $g_i$ to a common flat tax at rate $g$ is:

$$B = z^* - x^*[1 - g]$$  \(17\)

These may be interpreted as the within and between-group components of vertical equity:

$$V_{TC} = W + B$$  \(18\)

The between-groups component $B$ can be positive or negative; it records the welfare effect when the flat tax rates in groups go up and down (from $g_i$ to $g$, $\forall i$).\(^5\) The within-groups component $W$ is an average (in utility if not dollar terms) of the component vertical equities, and will be positive if, for example, the component schedules $T_i(x)$ are

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\(^5\) Even if there is no discrimination, $T_1(x)$, $T_2(x)$, ..., $T_k(x)$, $\forall x$, the within-group total tax ratios $g_i$ will in general differ (being higher than $g$ in rich groups, for example, and lower in poor ones, if the common schedule is progressive).
progressive. \(^6\)

The welfare effects within groups of replacing the operative schedules \(T_i(x)\), \(1 \leq i \leq k\), by the non-discriminatory \(\hat{T}(x)\) can be written:

\[
D_i = \hat{y}_i^* - y_i^*
\]  

(19)

where \(\hat{y}_i^*\) is the e.d.e. income in \(\Omega_i\) after application of \(\hat{T}(x)\). In utility terms, discrimination \(D\) is the population-share weighted average of the \(D_i\). \(^7\) The groups \(\Omega_i\) for which \(D_i > 0\) would be the gainers, and those for which \(D_i < 0\) the losers, from the elimination of discrimination.

IV. Implementation issues

Tax liabilities typically depend on many attributes, only some of which can be modelled as group-specific - for example, consider family-size-related exemptions and the different tax treatment of urban and rural incomes in lesser-developed countries. \(^8\) If group-specific attributes provided the only sources of differential tax treatment, one could inspect the tax law to select the sub-populations \(\Omega_i\) and conduct discrimination analysis directly. \(^9\) But taxes typically depend on individual characteristics and behaviour too. For example, tax relief for life insurance premia and mortgage interest depend on expenditure and therefore on individual preferences. \(^10\)

\(^6\) That is to say, \(u_e(y^*) - u_e(z^*) = \sum_i a_i [u_e(y_i^*) - u_e(x_i^{e[1-g_i]})]\), whilst \(W = y^* - z^*\) and \(\sum_i a_i V_i = \sum_i a_i [y_i^* - x_i^{e[1-g_i]})]\).

\(^7\) That is, \(u_e(\hat{y}_i^*) - u_e(y_i^*) = \sum_i a_i [u_e(\hat{y}_i^*) - u_e(y_i^{e})]\).

\(^8\) Further examples are the tax abatement for new immigrants in the former Southern Rhodesia and the tax schedule for Bantus which used to apply in South Africa during apartheid.

\(^9\) For example, to investigate whether a tax system with exemptions discriminates on the basis of family size, one would use equivalent incomes. Let \(a_i\) be the exemption for a family of size \(i\), and let \(R(.)\) specify tax in terms of taxable income. The tax code becomes the bundle \(< T_1(x), T_2(x), ..., T_k(x) >\) where \(T_i(x) = R(z_i x - a_i)/z_i\) and \(z_i\) is the income deflator for families of size \(i\).

\(^10\) As further examples, consider childcare costs and charitable giving. In the UK, the cross-section
For most applications, the candidate groupings \( \Omega_i, 1 \leq i \leq k \), for the investigation of potential discrimination will be defined not by tax law but in pursuit of some broader socioeconomic agenda.\(^{11}\) Then the component functions \( T_i(x) \) in the tax code of our model must be interpreted as *effective* schedules:. some form of averaging or smoothing of the tax-income relationships in sub-population microdata must be undertaken prior to analysis. This will take out within-group horizontal inequity (HI), leaving intact between-group HI arising from group-specificity in the tax code. We discuss the relevance of some recent measures of classical HI in Section VI.

Write \( \omega \in \Omega_i \) if income unit \( \omega \) from subgroup \( \Omega_i \) is present in the sample, and let \( x^\omega \) and \( t^\omega \) be \( \omega \)'s pre-tax income and tax. The effective tax \( T_i(x) \) on each income \( x \) represented in the \( \Omega_i \) sub-sample may be estimated by averaging taxes \( t^\omega \) across the subset \( \{ \omega \in \Omega_i : x^\omega = x \} \), and thereby the \( V_i, 1 \leq i \leq k \), and \( V_{TC} \) may be derived. To estimate the \( D_i \) and \( D \), the values \( \hat{T}(x) \) as defined in (9) are needed at each \( x \) represented in the sample *from any sub-population*, for which we need to know \( T_i(x) \) \( \forall i \). If equals from different subgroups are lacking or under-represented in the sample, bias may arise in estimating \( \hat{T}(x) \) from (9): this is the identification problem, which besets the measurement of HI generally. It can be ameliorated somewhat by partitioning the observations into close equals groups (*i.e.* selecting a very small bandwidth and estimating effective taxes within bands). An alternative approach is to use non-parametric regression to estimate the effective schedules \( T_i(x) \). The Nadarya-Watson

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\(^{11}\) Even though the tax law may not appear to discriminate against any particular group, the impact may nevertheless be discriminatory, *e.g.* when tax is levied on individuals but welfare is derived in part from living arrangements.
estimator of expected post-tax income conditional on pre-tax income $x$ would serve the purpose. This is defined as:

$$T_i(x) = \left[ n^{-1} \sum_{u \in \Omega_i} K_h(x - x^o) u^\delta \right] / \left[ n^{-1} \sum_{u \in \Omega_i} K_h(x - x^o) \right]$$

(20)

where $n$ is size of the $\Omega_i$ sub-sample, $K_h(u) = h_n^{-1} K(u/h_n)$ and $K(\cdot)$ is the kernel (local weighting) function with scale factor (bandwidth) $h_n$.¹² Econometric analysis would be needed to determine the statistical significance of findings using all of these approaches, but this goes beyond the scope of the present study and is a topic for future research.

V. Illustrative application: Australia 1984

The Australian income tax is levied on individual incomes net of a fixed personal exemption and certain allowances and deductions, and there are also tax credits.¹³ Inspection of the tax code does not tell us whether this is a just tax system (recall note 11). Is there de facto discrimination between the workers and the rest (principally the entrepreneurs and those, like the pensioners and the very wealthy, who are living on unearned incomes), and to what extent? One might suspect it, since the entrepreneurs typically receive income-related tax breaks, flattening the bite of progression, and the elderly may also get special allowances. Our measurement system can be applied to investigate this question.

Our data comes from the Australian Household Expenditure Survey (HES) for

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¹² $K(\cdot)$ is continuous, bounded and symmetric and $K(\tau) d\tau = 1$. See Härdle (1990).

¹³ Allowances include the child care and child disability allowances, disaster relief payments, employment entry payments, pharmaceutical allowances paid under social security, rent assistance and telephone allowance. Deductions include pension contributions for the self-employed and investments in the Australian film industry. Wage earners have access to some work-related deductions. Taxpayers who claim excessive deductions are audited, along with others selected randomly. Credits include the dependent spouse rebate (higher for those with children, a sole parent rebate, a zone rebate (for living in remote and isolated areas), an overseas forces rebate and a rebate for medical expenses. There is no rebate for children, but a means-tested family allowance exists.
1984, a nation-wide survey covering 4492 households. To form \textit{per capita} distributions from household incomes\textsuperscript{14} and taxes, we use a generalization of the Buhmann \textit{et al.} (1988) equivalence scale, in which the importance of children and economies of size are specified parametrically. Letting $A$ be the number of adults in the household, $C_1$ the number of children aged 5 years or less, $C_2$ the number of children between 6 and 14 years, and $C_3$ the number of children between 15 and 17, the number $N$ of "equivalent adults " in the household takes the form:

\[ N = (A + \gamma_1 C_1 + \gamma_2 C_2 + \gamma_3 C_3)^\theta \]  

(21)

and is used to deflate household income and tax into dollars per equivalent adult per week. This parametric form permits robustness of results to be checked by sensitivity analysis. For our purposes, which are illustrative only, we used fixed values $\theta = 0.8$, $\gamma_1 = 0.6$, $\gamma_2 = 0.7$ and $\gamma_3 = 0.8$.

We partitioned the HES sample into two mutually exclusive groups, $\Omega_1$ comprising those with wage and salary as the predominant source of income and $\Omega_2$ the rest.\textsuperscript{15} Per equivalent adult mean incomes were $\mu_1 = $252.14 and $\mu_2 = $157.84 per week; mean taxes were $\mu_1 g_1 = $48.91 and $\mu_2 g_2 = $20.52. The total tax ratios were $g_1 = 19.40\%$, $g_2 = 13.00\%$ (and overall, $g = 17.46\%$). Wage and salary households could be expected to pay a larger proportion of their income in tax because of their generally higher incomes, and because of distributional differences,\textsuperscript{16} but they may also be

\textsuperscript{14} The main components of income in the HES are wages and salary, government benefits, workers compensation, interest and investment income, property income, alimony, scholarships, pensions and self-employment income.

\textsuperscript{15} The total population covered by the HES was about 14.1 million of whom 8.3 million lived in households in which wage and salary was predominant.

\textsuperscript{16} We found less inequality of income among wage and salary households than among the others.
discriminated against. To investigate this, we selected sixty close equals groups, on the basis of per equivalent adult pre-tax income, and estimated the tax schedules $T_i(x)$ and $\hat{T}(x)$ by averaging. Imposition of the common schedule $\hat{T}(x)$ on both groups (no discrimination) would reduce the tax rate for $\Omega_1$ to $\hat{g}_1 = 18.55\%$, and raise it for $\Omega_2$ to $\hat{g}_2 = 14.96\%$. These no-discrimination rates are still conditioned by the mean income and distributional differences between groups, but the directions of change, from $g_i$ to $\hat{g}_i$, suggest the presence of discrimination operating against the wage and salary earners.

[TABLE 1 ABOUT HERE]

As Table 1 shows, wage and salary earners would indeed benefit from the removal of discrimination: their after-tax welfare would increase, while that of the other households would decrease ($D_1 > 0, D_2 < 0$). The welfare loss due to discrimination for group $\Omega_1$ increases monotonically with inequality aversion $e$, whilst the welfare gain for group $\Omega_2$ reduces. This suggests that the unequal tax treatment of the two groups affects the poor more than the rich. The overall loss of welfare due to discrimination is very small: for $e = 2$, it is only 5 cents per taxpayer.

[TABLE 2 ABOUT HERE]

The vertical equity indices $V_{TC}$ and $V_i (i = 1,2)$, shown in Table 2, confirm that the Australian income tax system is indeed progressive, reducing income inequality appreciably both overall and within groups. Not unexpectedly, the magnitudes increase
with inequality aversion. Moreover, for all values of $e$, $V_2 > V_1$, suggesting that $\Omega_2$ experiences more progression than $\Omega_1$; such a finding despite the higher mean income level in $\Omega_1$ can only be accounted for by distributional differences (see note 16) and by discrimination. The between-group contribution $B$ to $V_{TC}$ is positive for all $e$, and small, suggesting that the tax is unambiguously inequality-reducing (progressive) in its effect between the groups, though mildly. As already pointed out, the much larger within-group contribution $W$ is an 'average' of $V_1$ and $V_2$.

The welfare loss due to discrimination, $D$, is small compared to the welfare gain, $V_{TC}$, arising from the vertical action of the Australian income tax. The two indices are commensurate: $D$ is the increment to $V_{TC}$ that could be achieved if tax discrimination were eliminated. According to our estimates, $D$ is no more than 1% of $V_{TC}$ for all values of $e$. This finding is reassuring, but it could, of course, be quantitatively insignificant given the problems of statistical inference we have pointed to. Could discrimination be a non-issue in the Australian income tax? Further investigation would be needed to confirm this, for example using more robust estimation techniques and different partitions of taxpayers into mutually exclusive groups.

VI. Concluding remarks

Group-specificity of schedules has a social welfare cost (Theorem 1), which can be equated to a loss of vertical equity (Theorem 2). Our measures reveal which group or groups face more progression, and which group(s) would benefit from the removal of discrimination and by how much. Such insights can, of course, depend significantly on

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17 Percentage versions of the $V_i$ can be shown analytically to increase with inequality aversion. Duclos's (1995a) performance indicator $\tau_i$ for the schedule $T_i(x)$ is defined by $(1- \tau_i)y_i^* = x_i^*(1-g_i)$, and is proved to increase with $e$ in Duclos (1995b). The percentage welfare superiority of $T_i(x)$ over equal yield flat tax is $\%V_i = V_i/[x_i^*(1-g_i)] = \tau_i/(1-\tau_i)$ from (14), which therefore increases with $e$. $V_i$ itself may not: $V_i = \tau_iy_i^*$ and $y_i^*$ falls as $e$ increases.
the inequality aversion posture of the social evaluator; a distributional judgement parameter permits account to be taken of this, and enables robustness of results to be checked.

Discrimination between groups is a systematic form of horizontal inequity (HI). Classical approaches conceptualize HI as an individual level phenomenon (e.g. generated by differences in expenditure patterns, poor tax design, capriciousness and assessment error among sets of households with the same pre-tax living standards). We have set aside, in our model, such differences in tax treatment within socioeconomic groups, specifying the tax code as a bundle of effective schedules in order to focus on systematic discrimination between groups. Jenkins (1988) advises confining the measurement of HI to that occurring within socioeconomic groups, because of comparability problems between groups; our structure and welfare measures complement his. Aronson et al. (1994) and Lambert and Ramos (1997) provide global indices that capture HI as dispersion of post-tax income among pre-tax equals, around values implied by an effective tax schedule; these indices would provide a handle on the differences in tax treatment within socioeconomic groups that our model does not take into account.

The e.d.e. income approach of this paper is purpose-designed to track discriminatory welfare effects between socioeconomic groups. To illustrate our

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18 Denote by \(I_0\), \(I_T\) and \(I_S\) inequality before tax, after tax, and after the yield-equivalent schedule which averages tax payments at each \(x\). As the identity \([I_0 - I_T = (I_0 - I_S) - (I_T - I_S)]\) shows, a loss of redistributive effect (RE) may occur if post-tax incomes differ among pre-tax equals. In Aronson et al. (1994) and Lambert and Ramos (1996), the Gini and mean logarithmic deviation are used to implement this identity, each of which is amenable to decomposition analysis. \([I_T - I_S]\) becomes in each case an aggregate of the (local) inequality introduced by the tax system into every set of pre-tax equals (with an additional reranking contribution in the case of the Gini). If the Atkinson (1970) index is used in the identity, the result in our Theorem 2, \(V_{TC} = V_{AS} - D\), can be derived, but decomposition across sets of pre-tax equals is not possible.
methodology, we investigated whether the Australian income tax in 1984 discriminated against the wage and salary earners, and found that such discrimination caused a roughly one percent loss of social welfare, which is small. The welfare costs of other concessions in other income tax systems (*e.g.* in favour of rural at the expense of urban dwellers) may or may not be small when set beside the welfare gain arising from the progressive stance of the tax system generally.
REFERENCES


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<td>-2.51</td>
</tr>
<tr>
<td>e = 1.5</td>
<td>0.06</td>
<td>3.46</td>
<td>-2.03</td>
</tr>
<tr>
<td>e = 2.0</td>
<td>0.05</td>
<td>3.95</td>
<td>-1.40</td>
</tr>
</tbody>
</table>

Table 1: Discrimination in the Australian Income Tax 1984

<table>
<thead>
<tr>
<th></th>
<th>All taxpayers</th>
<th>Wage/salary earners</th>
<th>All others</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V_Tc</td>
<td>B</td>
<td>W</td>
</tr>
<tr>
<td>e = 0.0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>e = 0.5</td>
<td>2.66</td>
<td>0.50</td>
<td>2.16</td>
</tr>
<tr>
<td>e = 1.0</td>
<td>5.06</td>
<td>1.10</td>
<td>3.96</td>
</tr>
<tr>
<td>e = 1.5</td>
<td>7.28</td>
<td>1.76</td>
<td>5.52</td>
</tr>
<tr>
<td>e = 2.0</td>
<td>9.50</td>
<td>2.43</td>
<td>7.06</td>
</tr>
</tbody>
</table>

Table 2: Vertical equity characteristics of the Australian Income Tax 1984