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Indirect Tax Reform and the Role of Exemptions

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Abstract

This paper examines the question of whether indirect tax rates should be uniform, using four different modelling strategies. First, marginal tax reform is examined. This is concerned with the optimal direction of small changes in effective indirect tax rates and requires considerably less information than the calculation of optimal rates. Second, the welfare effects of a partial shift from the current indirect tax system in Australia towards a goods and services tax (GST) are considered, with particular emphasis on differences between household types and the role of exemptions. Third, in view of the stress on a distributional role for exemptions of certain goods from a GST, the potential limits to such redistribution are considered. The fourth approach examines the extent of horizontal inequity and reranking that can arise when there are non-uniform tax rates. These inequities arise essentially because of preference heterogeneity.

JEL classification: H24, H31.

I. INTRODUCTION

This paper examines the role of exemptions in indirect taxation. There are strong limitations to any analysis of only one part of the complete tax and transfer system; it is the overall effect that matters. However, a separate analysis is warranted in view of the importance attached to indirect taxes. Indeed, there has been an extensive heated debate in Australia concerning the reform of indirect

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This paper draws on earlier work by the author. In particular, Sections III, IV and V use some material from Creedy (1999a, 1998b and 1998c). Section II uses the approach described in detail in Creedy (1999b) but reports new empirical results using more recent data. The research was supported by several Australian Research Council grants. The author is grateful to Rosanna Scutella for providing the effective tax rates for the Household Expenditure Survey (HES) commodity groups, Glenys Harding for research assistance with the HES data, and Sheila Cameron and two referees for comments on an earlier draft.

taxation and the partial movement towards a general consumption tax, in the form of a goods and services tax (GST). Even in countries that have relied for some years on a value added tax (VAT) system, attempts to change the nature of exemptions usually involve intense debate; an example is the extension of VAT to domestic fuel in the UK.

Differences of opinion are to be expected. Indeed, the configuration of tax rates is irrelevant only if judges are indifferent to the distribution of welfare and, in addition, if all own-price and cross-price elasticities of demand are zero. In an optimal tax framework, there is no presumption in favour of uniformity; the conditions under which the maximisation of a social welfare function gives rise to uniform indirect taxes are strong and unlikely to hold.[1] However, faced with the enormous difficulty of computing a set of optimal taxes, there is often a presumption in favour of uniformity on the grounds of the large administrative and compliance costs of differentiation.

Arguments are usually made for exemptions on distributional grounds.[2] These arguments (along with the special pleading that must be expected) have dominated the recent debate in Australia. A consumption tax imposed at a uniform rate on *all* goods and services has no redistributive effect since the real incomes of all households are reduced by the same proportion. A consumption tax is most progressive, or inequality-reducing, when it taxes most heavily those goods that form a systematically higher proportion of the budgets of high-expenditure households. This lies behind the argument that some goods, such as food, should be exempt from a general consumption tax. But there is a cost of such redistribution, since the tax rate imposed on other goods must be higher to raise the same revenue, and this may lead to large excess burdens. Rational debate requires information about both the costs and the benefits of such differentiation.

This paper reviews the results of several modelling strategies designed to examine different aspects of the role of exemptions, using 1993 Household Expenditure Survey (HES) data, which are the latest available in Australia. Section II considers, instead of optimal tax rates, the more modest problem of marginal tax reform, which is concerned with the optimal direction of small changes in effective indirect tax rates. Reforms are examined under alternative assumptions about distributional judgements. Section III examines the welfare effects of the Australian pre-2000 indirect tax system, a hypothetical partial shift towards a GST and the exemption of food.[3] Section IV considers the potential

[1]This is essentially a second-best problem in view of the impossibility of taxing endowments. For example, with identical preferences, a fixed wage rate distribution and a linear income tax, uniformity is optimal if Engel curves are linear and the marginal rate of substitution between goods is independent of leisure; see Stern (1990).

[2]In addition, sumptuary taxes (based on merit good arguments) or environmental taxes are often imposed, leading to further non-uniformities.

[3]The new tax system started on 1 July 2000, the beginning of the 2000–01 tax year.

limits to redistribution using exemptions and differential rates. Finally, Section V considers the extent of horizontal inequity and reranking arising from non-uniform tax rates because of preference heterogeneity. First, the following two subsections describe the effective pre-2000 tax rates in Australia and the measurement of demand responses.

1. Effective Indirect Tax Rates

Indirect taxes in Australia consist of a complex set of taxes using different tax bases and imposed at various stages of the production process. There are many indirect taxes, each with its own legislation and administering department, which may be at federal, state or local level; see Johnson et al. (1997, pp. 14–17, 22–4). These taxes include wholesale sales tax, excise, financial institutions duty, payroll tax, land tax, stamp duties, municipal rates and primary production tax. Hence, computation of the effective rates requires the construction of a complex tax incidence model.

The rates used here were computed by Scutella (1997), allowing for all the inter-industry transactions involved and assuming that taxes are fully shifted forward at each stage. These rates were obtained for the 113 categories in the Australian input–output matrix for 1993. The commodity groups used in the input–output matrix are different from those used in the HES, which are used below to provide information about households' expenditure patterns. In

TABLE 1

Pre-2000 Effective Indirect Tax Rates

No.	*Expenditure group*	*Effective tax-exclusive* ad valorem *rate,* t_i
1	Current housing costs	0.1437
2	Electricity, gas and other fuels	0.0956
3	Food and non-alcoholic beverages	0.1289
4	Spirits, beer and wine	0.4224
5	Tobacco	2.1510
6	Clothing and footwear	0.0731
7	Furniture and appliances	0.1201
8	Postal and telephone charges	0.0993
9	Health services	0.0603
10	Motor vehicles and parts	0.3126
11	Recreational items	0.1677
12	Personal care products	0.1441
13	Miscellaneous	0.1644
14	House-building payments	0.1296

particular, the HES uses only 14 categories, so that any mapping must be approximate.[4]

Table 1 gives the HES categories along with the effective tax rates relating to indirect tax revenue raised in 1993. The table gives the values of effective tax-exclusive *ad valorem* rates, t_i. These rates are far from transparent; for example, the effective rate on food and non-alcoholic beverages amounts to 13 per cent. It is doubtful that the order of magnitude of this effective rate is widely appreciated, in view of the complexity and lack of 'visibility' of these taxes.

2. Demand Responses

It is desirable to allow for consumers' responses to tax and price changes. This is important not only for the calculation of tax rates required to achieve revenue-neutral changes, but also for the analysis of the welfare effects of changes. This presents a severe problem in Australia because of the paucity of data. Researchers in Australia do not have access to a time series of household expenditure data, and the available time-series consumption data are aggregative and cover few commodity groups.

The demand elasticities used below were obtained using a result established by Frisch (1959) for directly additive utility functions, which relates own- and cross-price elasticities to total expenditure elasticities, budget shares and the elasticity of the marginal utility of income (the so-called 'Frisch parameter'). There are well-known criticisms of the use of additivity; for example, it does not allow for complements. Where welfare changes are obtained, these are based on the linear expenditure system (LES), a special case of an additive utility function. In view of these strong assumptions, the results must be treated with caution.[5] The alternative is to make the unrealistic assumption that demand patterns are fixed when prices change.

The approach involves a set of price elasticities being computed for each of a range of total expenditure groups for several household types, following the general approach suggested in Creedy (1998a) and described briefly in the Appendix.[6] Instead of using a single set of parameters, estimates of the LES are obtained for each household type for each of a number of total expenditure groups. Households within each group are assumed to have the same

[4]Two HES items — superannuation contributions and mortgage repayments — have been excluded from the present analysis on the grounds that they are closer to saving.

[5]General equilibrium effects are also ignored here. Changes in factor prices could, in principle, counteract the welfare effects of commodity price changes. For example, a tax imposed on a good that comprises a high proportion of total expenditure of low-wage households may involve, through output and factor substitution effects, and depending on relative factor intensities, a compensating rise in the incomes of those households.

[6]The suite of programs, under the title of Demand And Welfare Effects Simulator (DAWES), is available from the author.

preferences, but these are allowed to vary between groups.[7] Hence, a very large number of elasticities are computed.

II. MARGINAL TAX REFORM

This section examines the optimal direction of marginal tax reforms from an existing system, following the approach of Ahmad and Stern (1984 and 1991); see also Madden (1995 and 1996). It is based on the use of a social welfare function, representing explicit value judgements.

1. Marginal Revenue Cost

Social welfare is expressed as $W = W(U_1,...,U_H)$, where U_h is the utility of household h, for $h = 1, ..., H$. Let x_{hi} denote the consumption of good i (for $i = 1, ..., n$) by household h and y_h the total expenditure of household h. If τ_i is the tax imposed on each unit of good i, then aggregate tax revenue is $R = \Sigma_{h=1}^{H} \Sigma_{k=1}^{n} \tau_k x_{hk}$.

The marginal revenue cost (MRC), ρ_i, of adjusting the tax rate on good i is

$$(1) \qquad \rho_i = -\frac{\partial R / \partial \tau_i}{\partial W / \partial \tau_i}.$$

The rule for optimal tax reform is to lower τ_i relative to τ_j if ρ_i is less than ρ_j. This can be expressed in terms of expenditures and cross-price elasticities as

$$(2) \qquad \rho_i = \frac{\sum_{h=1}^{H} p_i x_{hi} + \sum_{h=1}^{H} \sum_{k=1}^{n} t_k^* \eta_{hki} p_k x_{hk}}{\sum_{h=1}^{H} v_h p_i x_{hi}},$$

where η_{hki} is household h's elasticity of demand for good k with respect to the price of good i (p_i) and t_k^* is the ratio of the tax to the tax-inclusive price. Hence, t_k^* is the tax-inclusive *ad valorem* rate.[8] The term v_h is the social marginal utility of household h; it measures the increase in W resulting from a change in household h's total expenditure; that is, $v_h = (\partial W / \partial U_h)(\partial U_h / \partial y_h)$.

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[7]If all households have identical tastes, additivity implies that optimal indirect tax rates are uniform. However, this does not arise in the present context because of the allowance for heterogeneity of expenditure patterns between groups.

[8]It is possible to rewrite equation (2) in terms of the aggregate demand for good i, X_i. The change in revenue is $p_i X_i + \Sigma_k \tau_k \eta_{ki} p_k X_k$, where η_{ki} is the aggregate cross-price elasticity. However, in the following analysis, the elasticities are allowed to vary with household total expenditure.

The expression for ρ_i in equation (2) looks simple compared with the requirements of optimal tax calculations, but it cannot be applied easily to actual tax structures. The three components — that is, the tax rates, demand elasticities and welfare weights — are discussed in the next subsection.

2. Components of the MRC

Equation (2) requires a set of effective tax rates imposed on final consumers. Table 1 gives tax-exclusive rates, t_i, though equation (2) requires the values of tax-inclusive rates; these are obtained using $t_i^* = t_i/(1+t_i)$.

The social welfare function is usually specified in terms of each household's total expenditure, y_h, rather than utility, and the contribution to social welfare of household h is specified as $y_h^{1-\varepsilon}/(1-\varepsilon)$, where ε is the inequality aversion coefficient; on the use of total expenditures rather than utilities, see Banks, Blundell and Lewbel (1996). This implies that $v_h = y_h^{-\varepsilon}$. The implications of adopting alternative values of ε are examined.[9] The value of ε measures the degree of concavity of the function $y_h^{1-\varepsilon}/(1-\varepsilon)$ and therefore reflects the extent to which an income transfer from a richer to a poorer person improves social welfare.

The computation of demand elasticities uses the assumptions described briefly above and in the Appendix. Equation (2) involves only changes in demand evaluated at the current position, instead of complete information about the demand functions. Hence, the results are unlikely to be strongly influenced by the demand system used. Comparisons of the implications of using alternative demand systems, carried out by Decoster and Schokkaert (1990), Madden (1996) and Ray (1997), show that similar results are obtained for different systems.

3. Empirical Results

The marginal revenue costs for the HES categories are presented in Table 2 for inequality aversion coefficient values of 0, 0.3 and 1.2. The highest value of ε represents a substantial degree of inequality aversion.[10]

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[9]In practice, v_h was calculated as $(y_h/10000)^{-\varepsilon}$, where y_h is weekly total expenditure in cents. The adjustment simply affects the absolute values of ρ, but only their relative values are of significance in considering marginal tax reform.

[10]Consider two individuals such that $y_2 = 2y_1$ and suppose that \$1 is taken from person 2, but in attempting to transfer this to person 1, something is lost. A judge with $\varepsilon = 0.3$ would be prepared to make the transfer so long as person 1 gets at least 81 cents (obtained using $(dy_1/dy_2)|_W = -(y_2/y_1)^{-\varepsilon}$). A judge with $\varepsilon = 1.2$ would be prepared to make the transfer so long as person 1 gets at least 44 cents.

TABLE 2

Marginal Indirect Tax Reform

Expenditure group	ε = *0*		ε = *0.3*		ε = *1.2*	
	P	r_ρ	ρ	r_ρ	ρ	r_ρ
Current housing costs	0.8570	4	0.3780	3	0.0255	3
Electricity, gas and other fuels	0.8573	5	0.3665	1	0.0223	1
Food and non-alcoholic beverages	0.8582	7	0.3810	5	0.0263	5
Spirits, beer and wine	0.8386	2	0.3830	6	0.0297	8
Tobacco	0.8757	14	0.3708	2	0.0234	2
Clothing and footwear	0.8729	13	0.4155	12	0.0361	12
Furniture and appliances	0.8658	11	0.4177	13	0.0378	13
Postal and telephone charges	0.8598	9	0.3795	4	0.0256	4
Health services	0.8641	10	0.3877	7	0.0280	6
Motor vehicles and parts	0.8380	1	0.3976	9	0.0344	10
Recreational items	0.8569	3	0.4039	10	0.0343	9
Personal care products	0.8583	8	0.3893	8	0.0287	7
Miscellaneous	0.8575	6	0.4093	11	0.0360	11
House-building payments	0.8718	12	0.4662	14	0.0630	14

Since only the relative values of the marginal welfare costs are important in determining the preferred directions of tax reforms, Table 2 also indicates the ranking of ρ, denoted r_ρ, from lowest to highest values. Following the rule of lowering the tax rate for those commodity groups with relatively low values of the marginal revenue cost, ρ_i, the results in Table 2 suggest, for example, reforms of raising effective indirect taxes for tobacco in the absence of inequality aversion and of lowering the rate for positive values of ε. The first case is dominated by the low efficiency costs of taxing tobacco, while the second case is dominated by the behaviour of the budget shares. Tax on this commodity is, in practice, also affected by other well-known arguments, such as those relating to external effects and merit goods.

Other changes in the ranking as ε is increased from zero to a positive level include motor vehicles and recreational items, where efficiency effects alone suggest reductions in relative tax rates but allowance for inequality aversion implies tax rate increases. The results are influenced by the pattern of budget shares; these items form a systematically higher proportion of the budgets of higher income groups. It is therefore clear that judges with no aversion to inequality would disagree with people having positive aversion, over the appropriate pattern of marginal tax reforms, depending on the precise degree of aversion. Health services is another example of a commodity group where efficiency considerations suggest an increase in the effective tax rate, whereas equity effects suggest a relative reduction, with a ranking of 6 for ε = 1.2. Food has approximately the middle rank of 7 when ε is zero, and this falls for positive

inequality aversion; however, despite its importance in the policy debate, food does not have the lowest rank even for high values of ε.

Further analysis showed that, in some cases, the ranking becomes stable once very low values of ε are passed; the ranks of electricity, gas and other fuels and of food and non-alcoholic beverages move down, while those of furniture and appliances, recreational items and miscellaneous move upwards. Hence, in the case of these categories, a wide range of judges, from those having low to those having high degrees of aversion to inequality, would display substantial agreement about the direction of marginal tax reforms required to increase social welfare. The recent debate may therefore be said to reflect these results.

III. WELFARE EFFECTS OF NON-MARGINAL REFORMS

This section moves from marginal reforms to examine the welfare effects of large indirect tax changes. Special attention is given to the effects on different types of household. The welfare measure used is the equivalent variation, which measures the amount, after the tax change, that the household would be prepared to pay to return to the old prices.[11] The variation in the ratio EV/y, as total household expenditure, y, varies, provides a useful indication of tax progressivity. In particular, if the tax change causes all prices to increase in the same proportion, so that $\dot{p}_i = \dot{p}$ for all i, it can be shown that $EV/y = \dot{p}/(1+\dot{p})$ for all y (see the Appendix).

1. Different Household Types

There are many different types of household, but in view of the small number of observations, not all of these could be examined. The types of household distinguished are listed in Table 3. The nine household types shown in the table comprise about 75 per cent of all households in the HES. Summary measures of the distributions of total weekly expenditure within each household category — the lower and upper quartiles and the median — are shown in Table 3.

Suppose that, from an initial situation in which there are no indirect taxes, the rates shown in Table 1 are imposed. The proportional price change arising from the imposition of a new tax is simply $\dot{p}_i = t_i$, for all $i = 1, ..., n$. Using the approach described in the Appendix, these rates produce the equivalent variations reported in Table 4 for each household type and range of values of y, expressed in dollars per week. Blank cells in the table arise where households

[11] If prices change from p_0 to p_1, the equivalent variation is $EV = E(p_1,U_1) - E(p_0,U_1)$, where $E(p,U)$ is the minimum expenditure required to achieve utility level U at prices p. Total expenditure, $y = E(p_1,U_1)$, is assumed to remain unchanged.

TABLE 3

Distribution of Households

Type no.	*Household type*	*Sample size*	*Distribution of total weekly expenditure*		
			Lower quartile	Median	Upper quartile
1	All households	7,590	336	556	845
2	Couple, no children	1,430	407	606	8,785
3	Couple, no children, at least one retired	450	242	327	448
4	Couple, one dependent child	586	505	656	904
5	Couple, two dependent children	790	515	708	996
6	Couple, three or more dependent children	540	531	717	983
7	Single parent, one dependent child	190	270	354	478
8	Single parent, two or more dependent children	187	300	397	525
9	Single person, not retired	1,000	214	337	528
10	Single person, retired	620	131	181	249

TABLE 4

Equivalent Variations and *EV/y* by Household Type and Total Expenditure

y *($)*	*Household type*									
	1	2	3	4	5	6	7	8	9	10
	Equivalent variation ($ per week)									
200	34	34	30	41			37	37	39	30
400	70	69	63	75	68	66	70	70	73	60
600	102	102	94	102	97	101	95	95	102	90
800	134	132	127	131	124	131		127	128	
1,000	164	162	159	159	153	162			154	
1,200	207	192		205	195	205			200	
1,400	235	233		230	220	223				
	EV/y									
200	0.170	0.170	0.150	0.205			0.185	0.185	0.195	0.150
400	0.175	0.173	0.158	0.188	0.170	0.165	0.175	0.175	0.183	0.150
600	0.170	0.170	0.157	0.170	0.162	0.168	0.158	0.158	0.170	0.150
800	0.168	0.165	0.159	0.164	0.155	0.164		0.159	0.160	
1,000	0.164	0.162	0.159	0.159	0.153	0.162			0.154	
1,200	0.173	0.160		0.171	0.163	0.171			0.167	
1,400	0.168	0.166		0.164	0.157	0.159				

Notes: Blank cells arise where households were not observed at these levels. See Table 3 for listing of household types.

were not observed at these levels. Comparisons of the absolute welfare change between household types, for the same total expenditure level, can be made by moving along a given row of the table.

The values for couples without children (types 2 and 3) correspond closely to those obtained for all household types combined (type 1), but the other household types show somewhat different results. The largest absolute losses of those in the lower expenditure groups are experienced by couples with one dependent child (type 4). By comparison, the losses experienced by couples with relatively higher total expenditure, but with two dependent children (type 5), are lower than those for other household types. Households consisting of a single retired person (type 10) are generally concentrated in the lower expenditure groups, yet the absolute welfare loss is lower than for any other households in comparable groups.

The ratio *EV/y* rises only for the very lowest expenditure groups, but generally falls slightly as expenditure rises over the bulk of expenditures and then becomes stable. However, for couples with no dependent children and at least one retired person (type 3), the ratios rise gradually over the observed range of total expenditures, indicating a slightly progressive effect. It is neutral for single retired people (type 10). For couples with one dependent child (type 4), the ratio begins higher in the lower expenditure ranges and falls more rapidly as total expenditure rises. For couples with three or more dependent children (type 6), the ratio is slightly smaller for those in the lower and higher total expenditure groups. Hence, despite differences among household types, the indirect taxes are slightly regressive (except for the two retired household types 3 and 10).

2. Alternative Reforms

Rather than attempting to consider the precise (and highly complex) reforms that took place in Australia in July 2000, this paper is concerned with the more general issues relating to the role of non-uniformities. Consider an alternative indirect tax system whereby many of the pre-2000 indirect taxes are eliminated and replaced with a uniform goods and services tax imposed on most goods and services. Instead of eliminating all indirect taxes, wholesale taxes, payroll taxes, financial institutions taxes, stamp duty and petrol excise tax are replaced by a broad-based goods and services tax (GST).[12]

(a) Effective Tax Rates

The effective tax rates arising from the remaining indirect taxes are shown for each expenditure group in Table 5 under the column ‘Remaining’; these were obtained using the method described by Scutella (1997). The GST is imposed in

[12]The taxes that are replaced by a GST are the same as those considered by Johnson et al. (1998).

TABLE 5

Tax Rates for Alternative Reforms

No.	*Expenditure group*	*Remaining*[a]	*Reform A*	*Reform B*
1	Current housing costs	0.0852	0.0852	0.0852
2	Electricity, gas and other fuels	0.0411	0.1642	0.1972
3	Food and non-alcoholic beverages	0.0468	0.1699	0.0468
4	Spirits, beer and wine	0.2842	0.4073	0.4403
5	Tobacco	2.0835	2.2066	2.2396
6	Clothing and footwear	0.0209	0.1440	0.1770
7	Furniture and appliances	0.0211	0.1442	0.1772
8	Postal and telephone charges	0.0249	0.1480	0.1810
9	Health services	0.0201	0.1432	0.1762
10	Motor vehicles and parts	0.0436	0.1667	0.1997
11	Recreational items	0.0824	0.2055	0.2385
12	Personal care products	0.0220	0.1451	0.1781
13	Miscellaneous	0.0716	0.1947	0.2277
14	House-building payments	0.0246	0.1477	0.1807

[a]Effective tax rates arising from the remaining indirect taxes.

addition to these rates. In practice, it is hard to tax all goods and services. In view of the difficulty of taxing the imputed rents of owner-occupied housing, the major untaxed category is current housing costs.[13]

Reform A considered below has a uniform consumption tax applied to all other items.[14] The GST rate for this reform was found by trial and error to be 12.31 per cent. This ensures revenue neutrality, allowing for the fact that differential price changes lead to substitution in consumption. For this purpose, the elasticities obtained for all households combined were used. The calculation of aggregate revenue necessarily took into account only goods and services consumed domestically, ignoring exports. The rates used here may therefore be expected to be slightly lower than would be required in practice. The overall effective rates for reform A are also shown in Table 5.

In reform B, food is also exempt from the GST.[15] The associated reduction in the tax base means that, to ensure revenue neutrality, the tax rate imposed on non-exempt goods must be increased to 15.61 per cent, giving the effective rates shown in Table 5. The same method can be applied to any tax reform.

Emphasis is given to the once-and-for-all price changes and associated welfare changes resulting from a policy change from the pre-2000 system of

[13]Other categories that are often exempt include second-hand goods, gambling and financial transactions. However, the level of aggregation of commodity groups in the HES does not allow for separate consideration of these.

[14]An issue arises as to whether a GST would be applied to alcohol and tobacco in addition to the existing taxes on these goods. The following analysis assumes that it would be applied, in contrast with Johnson et al. (1998).

[15]A distinction is, in practice, usually made between home-consumed and other food.

Table 1 to each reform in turn. In obtaining the price changes resulting from a tax change, suppose the effective tax rate for a particular expenditure category changes from t_1 to t_2 as a result of the policy change. The resulting proportionate price change is equal to $(t_2–t_1)/(1+t_1)$.

(b) Welfare Changes

The equivalent variations for each of the household types, measured in dollars per week, are shown in Table 6 for a shift from the current system to reform A. The negative values of *EV* indicate gains from the change. These equivalent variations give some indication of the extent to which it may be desired to increase transfer payments, such as the age pension, following such a reform.

The results for all households combined conceal some interesting differential effects. The column for all households (type 1) shows that the gains or losses do not exceed $2 per week for any total expenditure level, although the results for separate household types show that the absolute losses can be higher. The largest absolute losses are experienced by couples with two or more children (types 5 and 6) in the higher total expenditure groups, although within these categories the ratio *EV/y* is small and declines slightly. Low-total-expenditure couples with one dependent child (type 4) gain slightly. Within the lower total expenditure

TABLE 6

Welfare Changes for Reform A: Equivalent Variations and *EV/y*

y *($)*	*Household type*									
	1	2	3	4	5	6	7	8	9	10
	Equivalent variation ($ per week)									
200	1.4	1.5	2.5	–0.4			0.6	0.6	–0.4	2.4
400	1.2	1.7	4.4	0.9	2.1	1.9	0.4	1.7	–2.1	0.6
600	1.2	1.5	4.7	1.4	3.2	3.2	0.6	–0.8	–2.9	0.9
800	1.2	1.1	0.8	1.0	3.9	4.2		–1.1	–3.4	
1,000	1.2	0.7	1.0	–0.5	4.6	5.3			–2.7	
1,200	1.2	0.5		–2.5	5.0	6.4			–3.2	
1,400	0.8	–0.3		–1.1	4.8	6.1				
	EV/y									
200	0.007	0.008	0.013	–0.002			0.003	0.003	–0.002	0.012
400	0.003	0.004	0.011	0.002	0.005	0.005	0.001	0.004	–0.005	0.002
600	0.002	0.003	0.008	0.002	0.005	0.005	0.001	–0.001	–0.005	0.002
800	0.002	0.001	0.001	0.001	0.005	0.005		–0.001	–0.004	
1,000	0.001	0.001	0.001	–0.001	0.005	0.005			–0.003	
1,200	0.001	0.000		–0.002	0.004	0.005			–0.003	
1,400	0.001	–0.000		–0.001	0.003	0.004				

Notes: Blank cells arise where households were not observed at these levels. See Table 3 for listing of household types.

groups, couples with at least one person retired (type 3) experience the largest absolute losses; these are therefore also the largest relative losses. Single-person non-retired households (type 9) gain from such a tax shift. Single-parent households (types 7 and 8) with relatively higher total expenditure also experience small gains from such a shift.

The effects of a shift from the current system to reform B are shown in Table 7. By exempting food and increasing the GST rate accordingly, none of the higher total expenditure groups gains, while many of the lower total expenditure groups gain. However, for couples with at least one person retired (type 3), the gains are small and the losses in the middle total expenditure groups are relatively high compared with other demographic types. For couples with one dependent child (type 4), the losses among the higher total expenditure groups are relatively lower than those for other household types. Single-person non-retired households (type 9) are affected by the exemption of food: a shift to reform B involves gains for the lower total expenditure groups and high losses for the middle and higher groups.

An important result is that welfare losses are substantially higher when moving to reform B because of the higher tax rates involved. This reflects the fact that the tax burden increases disproportionately with the absolute value of

TABLE 7

Welfare Changes for Reform B: Equivalent Variations and *EV/y*

y *($)*	*Household type*									
	1	2	3	4	5	6	7	8	9	10
	Equivalent variation ($ per week)									
200	–1.1	–1.7	–0.8	–3.1			–1.7	–2.6	–2.0	0.5
400	–1.5	–0.7	1.7	–2.6	–2.3	–5.0	–1.3	–2.5	–1.9	3.3
600	–0.3	0.8	4.4	–0.6	–1.0	–2.5	3.2	1.0	1.1	4.9
800	1.5	3.8	8.8	1.0	2.7	1.0		1.3	5.6	
1,000	3.7	7.1	11.0	3.1	5.3	3.4			13.0	
1,200	6.4	10.0		5.1	8.9	7.8			15.4	
1,400	11.2	15.9		10.9	17.9	18.5				
	EV/y									
200	–0.006	–0.009	–0.004	–0.016			–0.009	–0.013	–0.010	0.003
400	–0.004	–0.002	0.004	–0.007	–0.006	–0.013	–0.003	–0.006	–0.005	0.008
600	–0.001	0.001	0.007	–0.001	–0.002	–0.004	0.005	0.002	0.002	0.008
800	0.002	0.005	0.011	0.001	0.003	0.001		0.002	0.007	
1,000	0.004	0.007	0.011	0.003	0.005	0.003			0.013	
1,200	0.005	0.008		0.004	0.007	0.007			0.013	
1,400	0.008	0.011		0.008	0.013	0.013				

Notes: Blank cells arise where households were not observed at these levels. See Table 3 for listing of household types.

the tax rate. Rational policy analysis requires that the redistributive gains arising from exemptions are explicitly traded off against the higher efficiency costs of taxation. This aspect is usually absent from popular debate and is considered in the following subsection.

3. Social Evaluations

An overall evaluation of a tax change can be made using a specified social welfare or evaluation function, expressed in terms of the distribution of equivalent incomes.[16] Equivalent income is defined as the income (here, total expenditure) level, y_e, that, at a set of reference prices, gives the same utility as the actual set of prices. The following results use pre-tax prices as reference prices, and the calculation of equivalent income is described in the Appendix.

Consider, for example, the social welfare function used in Section II, where, in this case, welfare per person, W, is

$$(3) \qquad W = \frac{1}{N}\sum_{i=1}^{N}\frac{y_{e,i}^{1-\varepsilon}}{1-\varepsilon},$$

with N being the number of individuals and ε being the inequality aversion of the judge. This can be rewritten as

$$(4) \qquad W = \frac{y_{ede}^{1-\varepsilon}}{1-\varepsilon},$$

where y_{ede} is the equally distributed equivalent value — that is, the equally distributed value that gives the same social welfare as the actual distribution. It can be shown that

$$(5) \qquad y_{ede} = \overline{y}_e\left[1 - A(\varepsilon)\right],$$

where $\overline{y}_e$ is the arithmetic mean and $A(\varepsilon)$ is Atkinson's inequality measure of equivalent income, where, by definition, $A(\varepsilon) = 1 - y_{ede}/\overline{y}_e$. Instead of using equation (4), it is more convenient to write an abbreviated form of the welfare function simply as y_{ede} as in equation (5), since it expresses the same trade-off between mean equivalent income and its equality, or the trade-off between equity and efficiency, that the judge finds acceptable. In this case, a 1 per cent increase in equality is viewed as being equivalent to a 1 per cent increase in mean income. Alternative forms of the welfare function are used below. For example, welfare rationales are available for the use of equation (5) along with

[16]An initial analysis might first examine the generalised Lorenz curves for the distributions of equivalent incomes to see if standard dominance results apply; see Lambert (1993).

the Gini and extended Gini inequality measures substituted for the Atkinson measure.[17] The extended Gini is defined, for $v \geq 1$, by

$$(6) \qquad G(v) = -\frac{v}{\overline{y}} \operatorname{cov}\left\{y, [1 - F(y)]^{v-1}\right\}.$$

Since an overall evaluation, combining households of differing compositions, is required, it is necessary to obtain equivalent income *per equivalent adult*. There is an enormous literature on the topic of equivalence scales and it is recognised that the choice of scales cannot escape the use of value judgements. However, the following analysis uses a very simple adjustment, based on Johnson, Manning and Hellwig (1995), who discuss alternative scales used in Australia. The first adult is given a weight of 1, the second adult is given a weight of 0.6 and each child is given a weight of 0.3. For household types 2 to 10, the numbers of equivalent adults were set respectively to 1.6, 1.6, 1.9, 2.2, 2.6, 1.3, 1.7, 1 and 1.

Summary measures of the distribution of equivalent income per equivalent adult are shown in Table 8, for alternative structures. Results are given for low and high values of inequality aversion, and in the case of the extended Gini measure, $G(v)$, the value $v = 2$ corresponds to the standard Gini. The effect of the pre-2000 system of indirect taxes is to increase all measures of inequality slightly. A revenue-neutral shift to reform A produces a small increase in inequality and a reduction in social welfare. As more exemptions are introduced,

TABLE 8

Distributions of Equivalent Income per Equivalent Adult

ε	y_{ede}	A(ε)	v	G(v)	$\overline{y}_e\,[1-G(v)]$
		No taxes			
0.10	352.73	0.0168	1.10	0.0579	338.01
1.60	274.39	0.2352	2.60	0.3983	215.88
		All indirect taxes: pre-2000			
0.10	294.72	0.0172	1.10	0.0587	282.28
1.60	228.34	0.2386	2.60	0.4018	179.37
		Reform A			
0.10	294.60	0.0174	1.10	0.0590	282.13
1.60	227.70	0.2405	2.60	0.4036	178.80
		Reform B			
0.10	294.96	0.0169	1.10	0.0581	282.60
1.60	229.49	0.2352	2.60	0.3990	180.34

[17]On alternative abbreviated welfare functions, see Lambert (1993).

the overall effect is to reduce inequality further and to increase social welfare for all degrees of inequality aversion and using both the Atkinson and Gini measures. Hence, in terms of the trade-off discussed above, the reduction in inequality is judged to outweigh the efficiency losses arising from the higher tax rate required when food is exempt, even for the low value of inequality aversion. However, the changes in all cases are small.[18]

The question arises of whether these results conceal differences for the separate household types. Calculations for separate household types (not reported here) revealed that the current system of indirect taxes produces a very slight fall in inequality among households consisting of couples with no children and at least one person retired and among single retired people.[19] For all other types of household, the inequality measures of income per equivalent adult increase while social welfare measures, as expected, decrease. Reform A lowers social welfare and increases inequality slightly for all degrees of inequality aversion for all household types except for single non-retired people. Within this latter group, there is an improvement in social welfare *despite* the slight rise in inequality. The exemption of food reduces inequality across all household types for all inequality measures. It also raises social welfare in all cases except couples with no children and single non-retired people. For the latter group, an increase is observed only if inequality aversion is sufficiently large. However, for the lowest value of inequality aversion considered, the exemption of food lowers social welfare, compared with the pre-2000 system, for couples without children and for the two types of retired households.[20]

IV. THE LIMITS TO REDISTRIBUTION

In the previous section, the exemption of food was found to introduce a small amount of redistribution to the indirect tax structure, and this outweighs efficiency costs so long as there is a small degree of aversion to inequality. This is consistent with the suggestion that indirect taxes provide a blunt instrument for redistribution: for example, see Stern (1990, p. 102) and Chisholm, Freebairn and Porter (1990, p. 150).[21] This section looks at the question of how much

[18]This is associated with the flattening of the *EV/y* profile observed earlier.

[19]Reference may again be made to the profiles of *EV/y* found earlier for these household categories.

[20]It was found that the additional exemption of health services actually lowers social welfare in many cases. For couples with three or more dependent children, both single-parent groups and single non-retired people, social welfare falls compared with reform B unless inequality aversion is very high, except for single parents with two or more children where even an aversion of 1.6 does not produce an increase. This is associated with the fact that budget shares for health expenditure do not decline systematically as total expenditure increases, for some household types.

[21]Sah (1983) considers the use of commodity taxes and subsidies (negative taxes) in order to improve the welfare of the worst-off individual, subject to the government budget constraint. He obtains an upper limit in terms of the maximum budget share of the worst-off as a ratio of the minimum average budget share in the economy.

redistribution can be achieved using consumption taxes, by considering the implications of adopting extreme forms of indirect taxation.

One obvious limitation on the ability of indirect taxes to influence inequality is that virtually all broad commodity groups are consumed by all types of households and at all total expenditure levels. In practice, it would be possible to find certain luxury goods that are most likely to be consumed only by high-income households. Like high marginal income tax rates at very high incomes, these are not likely to produce much revenue or have much overall impact on inequality. Differentiation by narrow commodity groups or brand names would involve considerable administrative problems.

In addition, households with high total expenditure have relatively more ability to substitute away from more highly taxed commodity groups; the expenditure over which they have more discretion (or supernumerary expenditure) is a higher proportion of total expenditure for such groups. This is true of the LES demand system used here. It also weakens the case for imposing high tax rates on goods that form a higher proportion of the budgets of households with high total expenditure.

1. Budget Shares and Tax Structures

The argument relating to indirect tax progressivity and variations in budget shares with total expenditure can be restated more formally as follows. The total consumption tax, T, paid by an individual with total expenditure of y is $T = y\Sigma_{i=1}^{n} t_i^* w_i$, where w_i is the budget share of good i. The elasticity of T with respect to y provides one indication of the progressivity of the tax system; it is given by[22]

$$\eta = 1 + \frac{\sum_{i=1}^{n} t_i^* w_i (e_i - 1)}{\sum_{i=1}^{n} t_i^* w_i}, \tag{7}$$

where the $e_i = 1+(dw_i/dy)(y/w_i)$ are total expenditure elasticities.

An increasing budget share is equivalent to $e_i > 1$, and since $\eta > 1$ for a progressive tax structure, equation (7) indicates that goods with total expenditure elasticities greater than 1 should be taxed most heavily in order to obtain the greatest progressivity. However, some progressivity can be obtained even if taxes are imposed on some goods for which $e_i < 1$ at some income levels. Furthermore, the elasticities vary with y. Examination of the HES data reveals that, in those cases for which $e_i > 1$ at all levels of y, the elasticity declines as y

[22]The elasticity is also the ratio of the marginal tax rate to the average tax rate. It is in fact the Musgrave–Thin measure of liability progression.

increases.[23] This again provides a constraint on the progressivity of an indirect tax structure, since the tax rate has to be set independently of individuals' total expenditure levels.

The budget shares fall consistently in the cases of: current housing costs; electricity, gas and other fuels; food and non-alcoholic beverages; postal and telephone charges; health services; and personal care products. An extreme attempt to make the indirect tax structure progressive would therefore not tax these commodity groups. The budget shares rise with total expenditure in the cases of: clothing and footwear; furniture and appliances; motor vehicles and parts; recreational items; miscellaneous; and house-building payments. These groups would therefore be taxed in any system attempting to reduce inequality. In the cases of alcohol and tobacco, the budget shares initially rise before falling, so that the effects of taxes on these groups are ambiguous.

2. Alternative Tax Structures

Based on the variations in budget shares, consider three hypothetical tax structures, shown in Table 9. In case 1, a uniform consumption tax of 0.15 is

TABLE 9

Alternative Revenue-Neutral Tax Structures

No.	*Expenditure group*	*Tax structure 1*	*Tax structure 2*	*Tax structure 3*
1	Current housing costs	0.15		
2	Electricity, gas and other fuels	0.15		
3	Food and non-alcoholic beverages	0.15		
4	Spirits, beer and wine	0.15		
5	Tobacco	0.15		
6	Clothing and footwear	0.15	0.30	0.30
7	Furniture and appliances	0.15	0.30	0.30
8	Postal and telephone charges	0.15		
9	Health services	0.15		
10	Motor vehicles and parts	0.15	0.40	0.30
11	Recreational items	0.15	0.20	0.30
12	Personal care products	0.15		
13	Miscellaneous	0.15	0.20	0.30
14	House-building payments	0.15	0.40	0.30

[23]This is consistent with the elasticities converging towards unity, though the convergence may not be uniform. The budget shares are also affected by the tax structure, since $\dot{w}_i = t_i + \Sigma_r e_{i,r} t_i$, where $e_{i,r}$ is the cross-price elasticity of demand for good i with respect to a change in the price of good r.

imposed on all goods and services.[24] This has no redistributive effect but the resulting revenue is treated as the benchmark for comparing the other tax structures, which are revenue-neutral. The tax rates were calculated using an iterative search procedure, having specified which groups are exempt and the relative levels of the other tax rates. If t_i denotes the *ad valorem* tax-exclusive consumption tax rate imposed on good i, then the proportional increase in the price of the good, $\dot{p}_i$, is obtained using $\dot{p}_i = t_i$.

In structures 2 and 3, only those goods whose budget shares rise with income are taxed. Structure 2 has relatively higher taxes imposed on those groups for which the shares increase relatively faster with income. Structure 3 has a uniform tax of 30 per cent on each non-exempt category. In each case, the same total revenue is obtained as in case 1, allowing for substitution in consumption. The exemption of eight commodity groups means that, after applying the iterative search procedure, the tax rate must be doubled to ensure revenue neutrality.[25] These two structures have far more selectivity than has been suggested in practice.

The equivalent variations for the alternative tax structures, for a range of levels of weekly total expenditure (in dollars), are shown in Table 10. For structure 1, which imposes a uniform rate of $t_i = 0.15$ for all i, $\dot{p}_i = \dot{p} = 0.15$ for all i, and $EV / y = \dot{p}/(1+\dot{p}) = 0.13$ for all values of y. Under structures 2 and 3, the ratio EV/y increases as y increases, which is consistent with an inequality-reducing effect.[26] The effect of moving from the uniform selective structure (3)

TABLE 10

Ratio of Equivalent Variations to Total Expenditure

y *($)*	*Tax structure 2*	*Tax structure 3*
200	0.075	0.078
400	0.098	0.102
600	0.116	0.118
800	0.128	0.129
1,000	0.138	0.138
1,200	0.147	0.145
1,400	0.160	0.157

[24]Uniform taxation is not optimal even though additive preferences are assumed, because of the assumption of heterogeneity. In practice, it is very difficult to tax all goods (for example, imputed rents from owner-occupied housing).

[25]It was purely coincidental that the alternative structures involve such convenient rates. Starting from a different uniform rate in case 1 would give less convenient numbers for the other cases.

[26]The revenue is the same in all comparisons, so inequality reduction and disproportionality of tax payments (tax progressivity) move in the same direction.

TABLE 11

Equivalent Income per Equivalent Adult

ε	y_{ede}	A*(ε)*	v	G*(v)*	$\bar{y}_e$ *[1–G(v)]*
		Uniform taxes			
0.10	562.08	0.0212	1.10	0.0646	537.17
1.60	394.33	0.3133	2.60	0.4472	317.48
		Tax structure 2			
0.10	563.01	0.0193	1.10	0.0611	539.03
1.60	407.57	0.2901	2.60	0.4295	327.52
		Tax structure 3			
0.10	562.95	0.0195	1.10	0.0615	538.84
1.60	406.59	0.2919	2.60	0.4313	326.54

to the non-uniform structure (2) is that the ratio *EV/y* increases more rapidly as *y* increases, but this difference is small, despite the fact that some rates are increased, while others are reduced, by 10 percentage points.

Values of inequality and social welfare (based on equivalent incomes per equivalent adult, as discussed earlier) are shown in Table 11. It can be seen that structures 2 and 3 give rise to lower values of inequality *and* higher social welfare. The inequality reduction therefore outweighs the reduction in average equivalent income per equivalent adult as the tax becomes more progressive. However, for all degrees of inequality aversion, the reduction in inequality is small, considering the substantial differences between the tax structures.

V. VERTICAL AND HORIZONTAL EQUITY

The previous sections have emphasised the use of exemptions to generate vertical redistribution. However, differential indirect taxes can also give rise to horizontal inequity and reranking effects. Horizontal inequity relates to the unequal treatment of equals, whereby those with equal incomes pay different amounts of tax. Reranking refers to the unequal treatment of unequals, where the rank order of households with different pre-tax incomes is not the same as the rank order of their post-tax incomes. The reranking arises because of differences in the budget shares of households with similar levels of total expenditure.

This section examines the orders of magnitude of the three different components of redistribution. This analysis does not allow for demand changes, because it is essential to preserve the full variation in household budget shares. It is their heterogeneity that influences the horizontal inequity and reranking effects, and preference functions cannot be estimated for individual households.

1. A Decomposition of Redistribution

Suppose that the tax and transfer system is such that net or post-tax expenditure, x, is given by $x = y–T(y)$. Divide the population into N groups. Within each group, individuals have similar pre-tax values of y, y_k for $k = 1, ..., N$. Groups are ranked in ascending order, with $y_1 < y_2 < ... < y_N$. Aronson, Johnson and Lambert (1994) show that the reduction in the Gini measure of inequality, L, is given by[27]

$$(8) \qquad L = \left(G_y - G_0\right) - \sum_{k=1}^{N} \theta_k G_k - R \,,$$

where G_y is the Gini measure of pre-tax income; G_0 is the between-groups Gini measure of post-tax expenditure, obtained by replacing every post-tax expenditure within each group by the arithmetic mean; θ_k is the product of the population share and the post-tax expenditure share of those in group k; and G_k is the Gini measure of inequality of post-tax expenditure of those in group k. The term, R, is a measure of reranking, equal to $G_x–C_x$, where C_x is the concentration measure.[28] The possibility of reranking of individuals, when moving from the pre-tax to the post-tax expenditure distribution, introduces an unequal treatment of unequals which is contrary to the vertical redistribution intended by the form of the tax function; see Atkinson (1979) and Plotnick (1981). The first two terms measure vertical redistribution, V, and horizontal inequity, H, respectively; hence $L = V–H–R$.[29]

In practice, few exact pre-tax equals are observed in survey data, so the decomposition in equation (8) cannot be applied directly. If groups of near-equals are used, this decomposition must be modified; for example, in the first term, it is necessary to replace G_y with a corresponding between-groups measure, obtained (like G_0) by replacing individual values in each group of near-equals with the mean value. Further complications arise with the measure of horizontal inequity. This issue is examined in detail by van de Ven, Creedy and Lambert (1998), who show that the measured vertical effect initially increases as the class width is increased, and then falls after reaching a maximum. This suggests a strategy whereby the class width used to combine individuals into groups of near-equals is chosen as the value that maximises the estimated vertical effect. The reranking measure, R, can be obtained directly using the ungrouped values

[27]Aronson et al. (1994) examine income taxes. The decomposition is applied to indirect taxes in Belgium by Decoster, Schokkaert and Van Camp (1997a and 1997b).

[28]The concentration index, C_x, of x is similar to the Gini inequality measure, where the ranking of individuals by y is maintained.

[29]This decomposition extends that produced by Kakwani (1977), who shows that $L = \{g/(1–g)\}K–R$, where g is the ratio of aggregate tax to aggregate income, $K = C_t–G_y$ and C_t is the tax concentration index. Hence, K is a measure of the disproportionality of tax payments which combines the horizontal and vertical effects.

and is therefore not affected by the choice of class width. The horizontal effect can then be obtained using $H = V–R–L$.

2. Empirical Results

This subsection considers the pre-2000 tax system and reform B, examined in Section III, where food and current housing costs are exempt from a GST. Separate demographic groups are identified, so there is no need to use equivalence scales. The inequality reductions for each of the household types, when moving from total gross expenditure to consumption net of indirect taxes, are shown in Table 12. The negative values for the pre-2000 system indicate, as expected, that it is slightly inequality-increasing, except for the two types of retired households (types 3 and 10). Reform B is inequality-reducing.

The decomposition of the redistributive effect of indirect taxes into vertical, horizontal and reranking effects was computed for the pre-2000 system and for tax reform B. The results, presented in Table 13, show the three components of the reduction in inequality resulting from the indirect tax structures, along with the percentage contributions of each to the total. In cases where the indirect taxes produce positive redistribution ($L > 0$) (such as household types 3 and 10), the percentage contribution of vertical redistribution must exceed 100. For each tax structure and household type, the class width used in grouping households into near-equals varied between about $22 and $30 per week (using the strategy described above).

The results in Table 13 demonstrate that there are substantial differences between household types in the proportional contributions of vertical redistribution, horizontal inequity and reranking. Horizontal inequity generally contributes less than one percentage point to the inequality change, but reranking

TABLE 12

Redistributive Effect for Different Household Types

No.	*Household type*	*Inequality reduction*	
		Pre-2000	Reform B
1	All households	–0.0013	0.0020
2	Couple, no children	–0.0021	0.0017
3	Couple, no children, at least one retired	0.0018	0.0057
4	Couple, one dependent child	–0.0017	0.0015
5	Couple, two dependent children	–0.0013	0.0026
6	Couple, three or more dependent children	–0.0027	0.0027
7	Single parent, one dependent child	–0.0013	0.0011
8	Single parent, two or more dependent children	–0.0020	0.0042
9	Single person, not retired	–0.0038	0.0016
10	Single person, retired	0.0029	0.0057

TABLE 13

Decomposition of Redistribution for Alternative Tax Structures

Household type	V	*Per cent*	*100*H	*Per cent*	*100*R	*Per cent*
			Pre-2000 taxes			
1	–0.0009	71.39	0.0008	0.66	0.0351	27.94
2	–0.0017	80.55	0.0001	0.05	0.0402	19.39
3	0.0025	132.84	0.0024	1.32	0.0582	31.53
4	–0.0013	76.29	0.0024	1.45	0.0416	25.16
5	–0.0010	75.77	0.0020	1.51	0.0341	25.74
6	–0.0024	87.56	0.0004	0.13	0.0344	12.57
7	–0.0008	64.17	0.0031	2.42	0.0489	38.25
8	–0.0016	79.29	0.0038	1.92	0.0368	18.79
9	–0.0032	84.91	0.0013	0.35	0.0584	15.44
10	0.0036	123.46	0.0036	1.27	0.0640	22.19
			Reform B			
1	0.0022	112.95	0.0002	0.09	0.0255	12.86
2	0.0020	116.46	0.0001	0.05	0.0286	16.41
3	0.0063	110.59	0.0062	1.08	0.0543	9.51
4	0.0018	122.15	0.0017	1.14	0.0314	21.01
5	0.0028	108.71	0.0009	0.35	0.0213	8.36
6	0.0029	109.30	0.0000	0.00	0.0247	9.30
7	0.0017	148.25	0.0073	6.40	0.0476	41.85
8	0.0046	111.06	0.0071	1.69	0.0391	9.36
9	0.0020	128.62	0.0020	1.26	0.0433	27.36
10	0.0064	111.97	0.0105	1.84	0.0579	10.13

Note: See Table 12 for listing of household types.

is substantial.[30] For household types 3 and 10, where at least one person is retired, the current system involves positive redistribution. However, it would be substantially larger without the negative effect of the reranking, which reduces redistribution by 32 per cent for type 3 and by 22 per cent for type 10.

The largest amount of reranking and horizontal inequity under the pre-2000 system is among single parents with one dependent child (type 7). For these households, the introduction of a general consumption tax that exempts current housing costs and food was found to have the smallest redistributive effect, of 0.0011. From Table 13, this arises because of the substantial amount of reranking and horizontal inequity, which together form a negative contribution of 48 per cent of redistribution.

[30]Horizontal inequity has also been found to be very low for income taxation, but reranking produced by income taxes is much lower than reranking in the present context. See Creedy and van de Ven (2001).

The other households for which the exemptions produce relatively small positive redistributions are couples with one dependent child (type 4) and single non-retired people (type 9). Table 13 reveals that this low redistribution arises because of the large negative effect of reranking. Indeed, the exemption of food increases the percentage contribution of reranking among single non-retired people (though the absolute reranking measure falls slightly). Single parents with two or more dependent children (type 8) have little reranking, and the redistributive effect of exempting food is relatively large for them; see Table 12. For the pre-2000 system, which is regressive for most household types, the extent of reranking is substantial. Reform B increases progressivity as a result of the exemption of food, but involves an increase in the absolute amount of horizontal inequity for half of the household types (even though their percentage contributions decline in most cases). This makes the overall redistributive effect of the additional exemption less than it otherwise would be.

These results demonstrate the important role played, in particular, by reranking. The combined negative effect on inequality reduction (or, in the case of the pre-2000 system for most household types, inequality increase) of the horizontal inequity and reranking effects is not trivial. The redistributive argument for non-uniformity of indirect tax rates is based on variations in *average* budget shares as total household expenditure increases. However, the heterogeneity in expenditure patterns (among households with similar demographic characteristics and total expenditure levels) has been found to play an important but neglected role.

VI. CONCLUSIONS

This paper has implemented four modelling strategies to examine the role of non-uniformities, particularly exemptions, in indirect tax structures. The analyses were based on the Australian pre-2000 tax system and several hypothetical reforms, using household budget data. Three of the four strategies allowed for demand responses to price changes in evaluating tax rates required for revenue-neutral reforms. Welfare changes, where reported, were based on the use of the linear expenditure system. Exemptions or tax reductions designed to introduce progressivity involve taxing less heavily those goods for which the total expenditure elasticity is less than unity, so that budget shares fall as total expenditure increases. These require higher tax rates (than in a uniform system) to be imposed on other goods, so that efficiency costs of redistribution need to be considered. Equity and efficiency trade-offs were examined using a range of assumptions about inequality aversion and the form of a social welfare function.

First, marginal tax reforms, concerning the optimal direction of small changes in effective indirect tax rates, were examined. A small amount of inequality aversion was found to generate support for marginal reductions in tax rates on food and domestic fuel.

Second, the welfare effects of a partial shift towards a GST were considered. The exemption of food shifts the welfare gains to the lower and middle total expenditure groups, the highest gains being experienced by couples with three or more dependent children. The absolute welfare losses in the higher-total-expenditure households increase substantially. Nevertheless, the equity effects of exempting food were found to outweigh the efficiency costs arising from the higher rates, given a small degree of inequality aversion. Exemptions beyond that of food produce effects that are much more equivocal.

Third, the potential redistributive abilities of non-uniform indirect taxes were examined. There are strong limitations in view of the fact that virtually all households consume some goods in all broad commodity groups, and elasticities ultimately tend to unity as total expenditure rises. Exemptions were found to provide a 'blunt redistributive instrument'.

The fourth strategy examined the extent of horizontal inequity and reranking that, because of preference heterogeneity, can arise with non-uniform tax rates. The pre-2000 system was found to produce a substantial amount of reranking. Indirect tax reform, which involves a degree of flattening of the structure even with food exempt, reduces the percentage contribution of horizontal inequity and reranking to the overall redistribution, for most household types.

A consistent result is that only a small amount of inequality aversion is sufficient to generate support (an increase in social welfare) for the exemption of food from a general consumption tax, despite the efficiency costs involved. The results obviously relate to the analysis of indirect taxes independently of other redistributive taxes and transfer payments. In contrast with indirect taxes, the direct tax system offers a much sharper redistributive instrument and has been found to involve less reranking and horizontal inequity. Hence, the possibility that the direct tax system may generate the required degree of redistribution with lower efficiency costs than exemptions would need to be considered in a more comprehensive analysis.

The limitations imposed by the need to make strong assumptions regarding consumer responses, in order to overcome data deficiencies, must be kept in mind. However, it is inevitable that popular debate concerning exemptions tends to be dominated by rhetoric and special pleading, where value judgements and assumptions are seldom made explicit. Disputes may also be related to uncertainty regarding the effects of a large-scale reform to the tax structure. There is thus some value in attempting to provide information, while recognising limitations, about the potential orders of magnitude involved, using the alternative types of strategy discussed here.

APPENDIX
UTILITY, DEMAND ELASTICITIES AND WELFARE

This appendix describes the method used to obtain demand elasticities and welfare changes using the linear expenditure system (LES), applied separately for a range of demographic groups (though the following notation generally omits the additional subscript).

1. Demand Elasticities and Utility

The first stage is to obtain, for each household type, a set of average budget shares, w_{ki}, for each consumption category, i, and a range of total expenditure groups, k. The total expenditure elasticities are obtained using the variations in budget shares for each commodity group. However, the observed variability in budget shares gives rise to some negative total expenditure elasticities. This can be overcome by smoothing the data. The approach used was first to carry out a series of ordinary least squares regressions of the form

$$\text{(A1)} \qquad w_{ki} = a_i + b_i \ln y_k + c_i \left(\frac{1}{y_k} \right)$$

for each commodity group (and household type), where the values of y_k correspond to the arithmetic mean values of total expenditure in each group, k. The form in equation (A1) provides a reasonably good fit for most groups and ensures that the predicted weights add to unity.

The second stage is to compute own- and cross-price elasticities, e_{ii} and e_{ij}, (again for each total expenditure group and household type) using Frisch's (1959) results for additive demand systems. The expressions require the use of the elasticity of the marginal utility of total expenditure with respect to total expenditure, ξ, often referred to as the 'Frisch parameter'. If δ_{ij} denotes the Kroneker delta, such that $\delta_{ij} = 0$ when $i \neq j$ and $\delta_{ij} = 1$ when $i = j$, Frisch showed that the elasticities can be written as

$$\text{(A2)} \qquad e_{ij} = -e_i w_j \left(1 + \frac{e_j}{\xi} \right) + \frac{e_i \delta_{ij}}{\xi} .$$

It is necessary to make use of extraneous information about the way in which the Frisch parameter varies with total expenditure. A flexible specification, which extends the logarithmic form used by Lluch, Powell and Williams (1977), for the variation in ξ_k with y_k is given by

$$\text{(A3)} \qquad \ln\left(-\xi_k\right) = \phi - \alpha \ln\left(y_k + \theta\right) .$$

By a process of trial and error, values of 9.2, 1.05 and 177 respectively for ϕ, α and θ were found to produce appropriate values of ξ. However, in view of the role played by the Frisch parameters and the lack of a really firm foundation for the values used, it is important to carry out a range of sensitivity analyses. Alternative sets of values, giving relatively steep and flat profiles, were used but the main results were found to be similar to those reported above.

The third stage involves obtaining parameters of the LES direct utility function (again for each total expenditure group and household type):

$$\text{(A4)} \qquad U = \prod_i (x_i - \gamma_i)^{\beta_i} ,$$

where x_i is the consumption of good i, γ_i is the committed consumption of good i, $0 \leq \beta_i \leq 1$ and $\Sigma_i \beta_i = 1$. The own-price elasticity, e_{ii}, is given by

$$\text{(A5)} \qquad e_{ii} = \frac{\gamma_i (1 - \beta_i)}{x_i} - 1 .$$

The total expenditure elasticity of good i, e_i, is

$$\text{(A6)} \qquad e_i = \frac{\beta_i y}{p_i x_i} ,$$

where y is total expenditure and p_i is the price of good i. Having obtained the total expenditure elasticities from the smoothed budget shares, the corresponding values of β_i at each total expenditure level were obtained using equation (A6), whereby $\beta_i = e_i w_i$. Using the values of own-price elasticities as described in the second stage above, equation (A5) can be used to solve for $p_i \gamma_i$, the committed expenditures for each good.

2. Equivalent Variations

As before, the various parameters vary with y, but the additional subscript is suppressed for convenience. Defining the terms A and B respectively as $\Sigma_i p_i \gamma_i$ and $\Pi_i (p_i / \beta_i)^{\beta_i}$, the indirect utility function for the LES, $V(p,y)$, is

$$\text{(A7)} \qquad V = \frac{y - A}{B} .$$

The expenditure function, $E(p,U)$ — the minimum expenditure required to achieve U at prices p — is found by inverting equation (A7) and substituting E for y to get

(A8) $E(p,U) = A + BU$.

If the vector of prices changes from p_0 to p_1, the equivalent variation, EV, is $EV = E(p_1,U_1)–E(p_0,U_1)$. Substituting for E using equation (A8) gives

(A9) $EV = y - \left(A_0 + B_0 U_1\right)$.

Substituting for U_1, using equation (A7) into equation (A9) and rearranging gives

(A10) $$EV = y - A_0\left[1 + \frac{B_0}{B_1}\left(\frac{y}{A_0} - \frac{A_1}{A_0}\right)\right].$$

The term A_1/A_0 is a Laspeyres-type price index, using γ_is as weights. The term B_1/B_0 simplifies to $\Pi_i (p_{1i} / p_{0i})^{\beta_i}$, which is a weighted geometric mean of price relatives. These two terms can be expressed in terms of the $\dot{p}$s.[31] If all prices change by the same proportion, $\dot{p}_i = \dot{p}$ for all i, and equation (A10) becomes

(A11) $$\begin{aligned}\frac{EV}{y} &= 1 - \frac{B_0}{B_1} + \frac{A_0}{y}\left(\frac{B_0}{B_1}\,\frac{A_1}{A_0} - 1\right)\\ &= 1 - \frac{B_0}{B_1} = 1 - \frac{1}{1+\dot{p}} = \frac{\dot{p}}{1+\dot{p}},\end{aligned}$$

since $B_1/B_0 = A_1/A_0 = 1+ \dot{p}$.

3. Equivalent Incomes

Equivalent income, following King (1983), is the value, y_e, that, at some reference set of prices, p_r, gives the same utility as the actual income level. In this context, income and total expenditure are synonymous. Hence, y_e is defined by $V(p_r,y_e) = V(p,y)$. Using the expenditure function gives

(A12) $y_e = E\left(p_r, V(p,y)\right)$.

For the linear expenditure system, this gives

[31]Since $p_{1i} = p_{0i}(1+\dot{p}_i)$, and defining $s_i = p_{0i}\gamma_i/\Sigma_i p_{0i}\gamma_i$, it can be shown that $A_1/A_0 = 1+\Sigma_i s_i\,\dot{p}_i$ and $B_1/B_0 = \Pi_i (1+\dot{p}_i)^{\beta_i}$.

$$\text{(A13)} \quad y_e = \sum_i p_{ri}\gamma_i + \left\{\prod_i \left(\frac{p_{ri}}{p_i}\right)^{\beta_i}\right\}\left\{y - \sum_j p_j\gamma_j\right\}.$$

If pre-change prices are used as reference prices, so that $p_{ri} = p_{0i}$ for all i, the post-change equivalent income is the value of actual income (total expenditure) after the change less the equivalent variation; that is, $y_{1e} = y_1 - EV$.

In general, the equivalent income function is not guaranteed to be concave, leading to the problem that its use in a social welfare function could lead the latter to favour disequalising transfers. Blackorby and Donaldson (1988) show that concavity requires quasi-homotheticity. This assumption is satisfied by the LES.[32]

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[32]Homothetic utility functions are positive monotonic transformations of linear homogeneous utility functions for which $U(\theta x) = \theta U(x)$.

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