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Indirect Tax Exemptions and the Distribution of Lifetime Income: A Simulation Analysis*

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This paper uses a simulation model to compare the lifetime consequences of a revenue neutral partial shift towards a consumption tax, involving exemptions, with its cross-sectional effects. Exemptions of goods consumed proportionately more by lower income groups reduce the inequality of the distribution of net lifetime consumption by more than in the cross-sectional case. However, the tax shift increases lifetime inequality by more than it increases cross-sectional inequality, and the net effect is that exemptions cannot compensate for the income tax change. Concern with inequality is most appropriately handled by raising transfer payments rather than introducing exemptions.

I Introduction

This paper investigates the effects on lifetime income inequality of indirect tax exemptions in the context of a revenue-neutral partial shift away from income taxation towards a general consumption tax. In popular debates it is often argued that a general consumption tax is regressive, but most countries which have a Value Added Tax system exempt several goods, such as food, which form a relatively higher proportion of the total expenditure of the relatively poorer households. Such exemptions introduce a small amount of progressivity into the indirect tax structure. Their effectiveness in a cross-sectional context has been examined in Creedy (1992) where it was found that tax shifts that are both revenue and distribution neutral can be devised. The effects of using a two-rate indirect tax structure, whereby goods that form a higher proportion of expenditure of the relatively rich are taxed at a higher rate, has been examined in Creedy (1993). The general conclusion from the cross-sectional studies is that exemptions provide rather a 'blunt instrument' in terms of the reduction in inequality. The present paper therefore considers the question of whether the same conclusion applies in the lifetime context.

In popular debates on consumption taxes, much stress is often placed on the role of differential saving rates. For example, when considering the distributional effects of a consumption tax, the *Draft White Paper* suggested that 'The regressivity of increasing the burden of consumption taxes depends for the most part on the variation in saving ratios with household income' (1985, p. 257). However, this argument ignores the point that savings are eventually spent and so will at some time incur the tax. Furthermore, if there is no interest income tax the present value of taxes paid is not affected by the timing of payments. Some people argue, however, that if a proportion of lifetime savings are not consumed in retirement, but are left as a bequest, then they should somehow be regarded as 'escaping' taxation and generating regressivity (if the bequests are a higher proportion of the wealth of the richest people). But they do not in fact escape taxation. Nevertheless, if the value judgement is taken that the lifetime consumption by each cohort should

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be considered as the appropriate concept when examining inequality, bequests are clearly equivalent to a type of 'self inflicted' (progressive) tax. Considered as part of a multi-tax system, exemptions will still introduce progressivity within a general consumption tax system. In order to avoid these complexities, and the associated need to consider at least three generations when dealing with bequests, the assumption is made in the following analysis that there are no bequests. It is, however, important to stress that this assumption can in no sense be described as 'driving' the results, because the emphasis is more narrowly on the *impact of exemptions* on the lifetime inequality of consumption.

Earlier studies of taxation in a life-cycle framework include Davies *et al.* (1984), Poterba (1989), Casperson and Metcalf (1993) and Fullerton and Rogers (1993), though only Casperson and Metcalf examine the role of exemptions in a broad-based consumption tax (using current consumption as a proxy for lifetime income, as does Poterba). A very detailed study of the complex structure of wholesale sales taxes in Australia and their incidence is provided by Harding (1993). These authors largely follow Davies *et al.* in suggesting that income taxes are less progressive and consumption taxes (without exemptions) are less regressive in a life cycle than on an annual basis. However, it is important to recognize that in such comparisons, neither the pre-tax distribution nor the tax revenue are kept constant across cases, and it is easy to produce counter-examples. Furthermore, the studies use the term 'progressivity' whereas, except for Harding (1993), they concentrate on inequality measures, although inequality and progressivity may not (and often do not) move in the same direction when total revenue changes; see Lambert (1993). An important feature of the present study is that it compares the effectiveness of exemptions as part of a revenue neutral change in the tax mix. Kennedy (1990) discusses the spurious conclusions that can be made if revenue neutrality is not imposed.

Section II gives details of the simulation process. Section III outlines the structure of the taxes investigated, specifically a reduction in income tax revenue combined with the introduction of a consumption tax, and Section IV reports the simulation results. Conclusions are drawn in Section V. The effects of alternative assumptions about saving patterns are examined in the Appendix.

II Income and the Life Cycle

The approach adopted is to consider a single cohort of males who enter the labour market in the same year and retire at age 65, although they do not all die in the same year. This section describes the model used to simulate the lifetime incomes.

Generating Earnings Profiles

In the absence of longitudinal data it is necessary to simulate individual earnings profiles. This section explains the simulation method. Throughout the paper, the coefficient of variation and Atkinson (1970) measure are calculated as measures of inequality. This section presents measures for the pre-tax simulated distribution of earnings. Individuals' earnings are modelled as consisting of a systematic component which follows the growth pattern of the geometric mean of earnings in each age group and a random component which introduces a measure of earnings mobility. Relative earnings are defined as the ratio of earnings y_{it} to geometric mean earnings m_t in the age group t, that is, y_{it}/m_t. Let u_{it} be a random variable which is distributed independently of income and previous proportional changes, then if $z_{it} = \log(y_{it}/m_t)$ the generating process can be written:

$$z_{it} - z_{i,t-1} = u_{it} \quad (1)$$

If u_{it} has a constant variance of σ_u^2 and if σ_t^2 denotes the variance of z_{it} then (1) implies that:

$$\sigma_t^2 = \sigma_0^2 + t\sigma_u^2 \quad (2)$$

and the variance of the logarithms of income in each year grows linearly over time. Therefore, information on the variance of earnings in different age groups provides estimates of (2).

The geometric mean of earnings in each age group follows the typical parabolic pattern. Let μ_t denote the logarithm of the geometric mean income in age group t, then:

$$\mu_t = \mu_0 + \theta t - \delta t^2. \quad (3)$$

In calibrating the model for present purposes, a high level of aggregation was used, although the same approach could be applied to particular groups. Estimates of the parameters in (2) and (3) were jointly obtained using an iterative method based on maximum likelihood in Creedy (1991), using data for all males (irrespective of marital status) who obtained income predominantly from wages and salaries, from the Australian Bureau of Statistic *Income Distribution Survey* 1985/8; they are reported in Table 1. The 1985/86 value of μ_0 was adjusted to its corresponding 1984/85 value in order to align it with the 1984 data used in the later sections. The 1984/5 value is 9.612 − 0.0385 + 0.00086 = 9.57436.

The cross-sectional age profile of earnings on which the estimates are based will be representative of a cohort only when factors other than age that affect earnings are absent. While it is difficult, if not impossible, to account for many of these factors it is possible to account for productivity growth in a simple way. If it is assumed that every worker in the cohort benefits equally from productivity growth, then the rate of growth can simply be added to the parameter θ. This adjustment raises lifetime earnings but does not significantly affect the inequality measures. An annual growth rate of 0.025 was used.

To generate lifetime earnings profiles for a set of individuals, rewrite (1) as:

$$y_{it} = y_{i,t-1} \exp\{(\mu_t - \mu_{t-1}) + u_{it}\} \qquad (4)$$

This can be used to generate the y_{it}'s given a set of random variates from an $N(0, \sigma_u^2)$ distribution. To generate y_{i1}, earnings in the first year of working life (set at age 20), suppose that v_i is randomly selected from the standard normal distribution, $N(0,1)$, and use $y_{i1} = \exp(\mu_1 + v_i\sigma_u)$.

Throughout the paper it is assumed that the inflation rate is 0.07, the nominal interest rate is 0.10 and the nominal growth of earnings is 0.095 (given by 0.07 + 0.025). Given these assumptions and parameter values, Table 2 shows the present value of gross earnings, using the nominal interest rate for discounting purposes, generated from the nominal earnings profiles of 2000 simulated individuals. It is necessary to work in terms of nominal rather than real values, because interest income tax is based on such values.

TABLE 1
Parameter Values for Age–Earnings Profiles

σ_0^2	σ_u^2	μ_0	θ	δ
0.1817	0.00575	9.612	0.0385	0.00086

Source: Creedy (1991)

TABLE 2
Simulated Earnings Profiles

	Coeff. of Variation	Atkinson (1.2)	and (2)
Present value of gross earnings	0.5679	0.1539	0.2433

Note: The Atkinson (1.2) and (2.0) measures are for inequality aversion parameters of 1.2 and 2.0 respectively; see Atkinson (1970).

Differential Mortality

Due to the lack of data on differential mortality, the age at death is assumed to vary systematically with annual average real earnings relative to the (geometric) mean earnings, such that those with relatively high lifetime earnings tend to live longer. Only those who survive to retirement are considered so there are no deaths before the age of 65. Following Creedy (1982), the relationship assumed to exist between earnings and the number of years of retirement is:

$$d_i = d + \beta\log(x_i/x_g) + e_i \qquad (5)$$

where d_i is the number of years person i survives after retirement, d is the average of d_i's, x_i is person i's annual average earnings, x_g is the geometric mean value of the x_i's, and e_i is a random variable distributed as $N(0,\sigma_e^2)$. The values of x_i and x_g were obtained from the lifetime earnings simulations. The value of d was set at 14 years to give an expectation of life of 79 years. After a little experimentation, a value of 8 for β and 50 for σ_e^2 were found to give a very good fit to the Australian survival curve for males.

Savings and Retirement Consumption

In order to calculate the amount of consumption tax paid both before and after retirement it is necessary to model individual's saving patterns, and this is discussed further in Section IV. What is not saved is spent and the expenditure on non-exempt good incurs consumption tax. Savings are accumulated and then spent in retirement. As noted in Section I, it might be argued that this type of study should model inheritances and bequests explicitly, on the grounds that the relatively wealthy leave larger bequests and thereby avoid consumption taxation. However, any bequests will ultimately be spent and will therefore attract consumption taxation. Some people may perhaps wish to make the value judgement that only consumption during an individual's own life is relevant in considering inequalilty. There is clearly no unambiguously 'correct' approach to this issue.

It is assumed that in retirement, each person takes a constant real amount each year from accumulated savings to spend. This does not constitute a constant yearly level of consumption in the presence of interest income tax since in later years as the level of wealth is run down, less interest income tax is paid and this allows a higher level of consumption. This approach avoids the computational difficulties associated with calculating the real amounts that would allow a constant level of consumption. If W is the accumulated value of savings at retirement, L is the period of retirement, A is the constant annual amount in real terms, and r_r is the real rate of interest, then, where $v = 1/(1 + r_r)$, A is calculated as:

$$A = Wr_r/[1 - v^L]. \quad (6)$$

Although the assumption of no bequests may be important for other types of study of lifetime taxation, it is not crucial for the present paper. The emphasis here is on the role of exemptions in a lifetime context, rather than the more difficult problem of attempting to provide a comprehensive analysis of lifetime redistribution.

III Taxes and Transfers

Income Taxation

Data from 1984 are used in establishing expenditure patterns, so the 1984/85 Australian income tax structure is chosen as the basic structure with which others will be compared, and is shown in Table 3. The earning simulations apply to all males (irrespective of occupation, location or household type) who obtain income predominantly from wages and salaries. In calculating income taxation, the tax structure in Table 3 is applied directly to their earnings. Hence no attempt has been made to adjust taxable incomes by allowing for the wide range of allowances available.

The after-income-tax distributions differ depending on whether interest income is taxed and assumptions as to saving behaviour. In addition, a rate must be set at which the tax brackets are indexed. Since 1983 the Australian income tax structure has not been indexed and as a result there has been a significant amount of 'bracket creep'. However, as the simulations cover a long period, it is more reasonable to model some positive indexation rate.

Table 4 presents inequality measures for the base case where all individuals are assumed to save 5 per cent of their disposable income and the tax brackets are indexed at the rate of inflation. Comparing these figures with those in Table 2, all three measures of inequality are lower after the income tax payments have been made, reflecting the progressivity of the income tax structure. The indexation assumption is varied in Section IV and different saving assumptions are investigated in the Appendix.

TABLE 3
Income Tax Rates and Thresholds: 1984/85

Threshold ($)	Marginal Tax Rate
4595	0.2667
12500	0.30
19500	0.46
28000	0.4733
35000	0.5533
35788	0.60

TABLE 4
Present Value of Income After-Income-Tax

Coeff. of Variation	Atkinson (1.2 and 2)	
0.4049	0.0862	0.1406

The Consumption Tax Structure

Exempting various commodity groups from the consumption tax is the major method of introducing progressivity to a tax structure, and is used in all countries in the EC. It is well established that the proportion of income spent on food declines as income increases so that food is typically exempt. When modelling the consumption tax, five possible structures were considered, depending on the goods exempt from tax and their effects on inequality were investigated. The alternative structures are described in Table 5.

The consumption tax paid is affected by the proportion of income spent on exempt goods. If v denotes the consumption tax rate, q denotes total expenditure and $r(q)$ the proportion of expenditure on exempt goods, then $V(q)$, the consumption tax paid, can be written:

TABLE 5
Tax-Exempt Categories

Structure	Categories
0	No exemptions
1	Food
2	Food + Fuel and Power
3	Food + Medical Care and Health
4	Food + Fuel and Power + Medical Care and Health
5	Food + Current Housing

TABLE 6
Consumption Tax Structures

Structure	α	γ	ψ
0	0.00	—	—
1	177.51	0.653	12131.60
2	154.59	0.634	8554.00
3	109.66	0.591	11388.00
4	102.41	0.580	8158.80
5	13.58	0.374	3208.40

Source: Creedy (1992)

$$V(q) = [v/(1 + v)][1 - r(q)]q. \quad (7)$$

The following function has been found to provide a reasonable approximation to documented spending patterns:

$$r(q) = \alpha/(q + \psi)^{\gamma}. \quad (8)$$

It is therefore necessary to obtain estimates of the parameters of $r(q)$ for each of the structures in Table 5. A decision must be taken with regard to the population group used for estimation, since the parameters in (8) would be expected to vary for different household types. The allowance for different household structures would involve the additional need to model changing household composition over the life cycle. The approach taken here is to estimate (8) using information relating to all households combined. This is suitable for a preliminary investigation, but a more detailed analysis would obviously wish to allow for further disaggregation. Table 6 gives parameter values taken from Creedy (1992), where they were estimated using an iterative maximum likelihood approach on cross-sectional data for all households. No attempt has been made to allow for variations in expenditure on exempt goods with age.

The growth in nominal earnings over time makes it necessary to index the consumption tax parameters. The following equations were used to adjust the parameters every year, in order to allow for growth at the rate, g.

$$\alpha_{+1} = \exp\{\log \alpha + \gamma \log(1 + g)\} \quad (9)$$

$$\psi_{+1} = \psi(1 + g) \quad (10)$$

The simulation model makes it possible to change the income tax structure and calculate, using an iterative search procedure, the consumption tax rate for any structure that gives aggregate revenue neutrality in terms of the present value of tax payments by the cohort.

A Guaranteed Minimum Income

Transfers are modelled using a minimum income guarantee, which provides a basic minimum real level of consumption. The effects of transfer payments are complicated because they interact with income and consumption taxes. If an individual's after-income-tax income falls below the minimum level, b, then the individual receives transfer payments that bring income up to the basic minimum. When a consumption tax is introduced, or its structure changed, it is important to adjust the level of social transfers appropriately. It is of interest that in proposing alternative forms of general consumption tax in Australia, the major parties have found it difficult to convince the various interest groups that such adjustments would in fact be made. The required increase in the transfer payment is not, however, straightforward. Suppose the minimum level of income is adjusted to give the same real level of consumption after a consumption tax has been introduced. It is not enough simply to calculate the amount of consumption tax paid on b and reimburse that amount. The consumption obtained by this reimbursement is itself subject to consumption tax in addition to that already paid, so the individual would not be fully compensated. What is required is that b^*, the adjusted value of b, must equal the original value, plus the consumption tax paid on b^*, so:

$$b^* = b + b^* \{1 - r(b^*)\}\{v/(1 + v)\} \quad (11)$$

and whenever the consumption tax structure is changed an iterative procedure is used to solve this non-linear equation.

IV Simulation Results

The simulation results reported in this section were obtained under the assumptions of an inflation rate of 0.07, a growth of nominal earnings of 0.095, and an interest rate of 0.10. Unless otherwise stated, interest is taxed as part of income, the tax brackets are indexed at the inflation rate of 0.07 and all individuals save 5 per cent of their disposable income. The change in the tax structure investigated is a switch from the 1984/85 income tax structure shown in Table 3 with no consumption tax, towards a combination of an income tax and a general consumption tax. The consumption tax rate is calculated for each structure so as to give revenue neutrality in terms of the present value of taxes paid by the cohort. The income tax structure chosen for comparison with the 1984/85 income tax structure is shown in Table 7. The smaller marginal tax rates in the top two brackets ensure that it collects less revenue than the 1984/85 structure of Table 3. The reduction in the top marginal rates of income tax is one of the stated objectives of a shift in the tax mix. The shift to the structure of Table 7 implies that, for the cohort considered here, all the inequality measures of income, after income tax, increase. It should be stressed that this result does not necessarily occur for other age-earnings profiles. Furthermore, although the new tax structure has been chosen to display a smaller rate of increase in the average tax rate than the 1984/85 structure, not all measures of progressivity will necessarily judge the new structure to show less progressivity.

The Role of Exemptions

As explained above, the use of exemptions for various commodity groups introduces progressivity into the consumption tax system. This section investigates the extent to which the exemptions can compensate for the increase in inequality arising from the income tax change, in both cross-sectional and lifetime contexts. The first stage is to apply the income tax structure of Table 7 to obtain cross-sectional comparisons. The results in the absence of a minimum income guarantee are shown in Table 8, based on a simulated income distribution from a lognormal distribution with mean and variance of log-income of 10 and 0.5 respectively. The corresponding life-cycle results are shown in Table 9, and the exemption classes correspond to those in Table 5. The consumption tax rate increases with the extent of the exemptions so as to maintain revenue neutrality. Comparing the cross-sectional results with those over the life cycle, it can be seen that when a life-cycle approach is taken the inequality of the distribution of net consumption is lower than that calculated over the cross-section. However, an absolute comparison like this is not informative because the pre-tax income distributions and tax revenue are not the same in each case. The comparisons investigated here are between the *relative* effects of introducing exemptions in the cross-sectional and lifetime contexts, in terms of the percentage changes in the inequality measure.

TABLE 7

An Alternative Income Tax Structure

Threshold ($)	Marginal Tax Rate
5000	0.18
10000	0.28
20000	0.40
30000	0.50
40000	0.55

As expected, exemptions reduce inequality. Exempting food (category 1) has the largest effect on inequality in both the cross-section and over the life cycle. The exemption of current housing when added to food exemptions (category 5) has the next biggest effect. Further exemptions decrease the inequality measure only slightly. In the cross-section the introduction of the consumption tax (with no exemptions) and the change in the income tax structure results in an increase in Atkinson's inequaltiy measure of net consumption, I(1.2), of 4.26 per cent, while over the life cycle, the increase in I(1.2) is 5.92 per cent. The decrease in inequality, as measured by I(1.2), associated with the exemption of food from the consumption tax in the cross-section is 1.07 per cent whereas in the lifetime context it is 1.31 per cent.

The change in the tax mix involves a bigger increase in inequality over the life-cycle than in the cross-section. However, exemptions decrease the inequality of net consumption by a greater amount over the life-cycle than they do in the cross-section. The results relating to the exemptions are explained by the fact that, as the consumption tax has a bigger effect on inequality

TABLE 8

Cross-Sectional Results: Inequality of Net Consumption

Tax Structure	Consumption Tax Rate	C. of V.	Inequality Measures I(1.2)	I(2.0)
1984/85 income tax	0	0.5610	0.1619	0.2625
Table 7 & Consumption Tax with Exemptions as in Table 5				
0	0.070	0.5791	0.1688	0.2726
1	0.080	0.5752	0.1670	0.2698
2	0.083	0.5742	0.1664	0.2689
3	0.085	0.5745	0.1667	0.2694
4	0.088	0.5735	0.1660	0.2684
5	0.095	0.5735	0.1660	0.2683

TABLE 9

Life-Cycle Results: Inequality of Net Lifetime Consumption

Tax Structure	Consumption Tax Rate	C. of V.	Inequality Measures I(1.2)	I(2.0)
1984/85 income tax	0	0.4049	0.0862	0.1406
Table 7 & Consumption Tax with Exemptions as in Table 5				
0	0.0714	0.4194	0.0913	0.1482
1	0.0933	0.4161	0.0901	0.1462
2	0.0982	0.4150	0.0896	0.1455
3	0.0991	0.4155	0.0899	0.1459
4	0.1043	0.4144	0.0894	0.1452
5	0.1127	0.4144	0.0894	0.1451

over the life-cycle than in the cross-section, the effect of relieving those on lower incomes from some of the burden of the tax is greater. It should be noted that although the exemptions are more effective over the life-cycle than in the cross-section, their inequality reducing effect is nevertheless rather small and does not offset the increase in inequality imposed by the tax change. Hence consideration should be given to using supplementary means of support in addition to exemptions for those on lower incomes when a consumption tax is introduced. Hence, the effect of the minimum income guarantee is discussed further below.

Saving Sensitivity Analysis

This section examines the effect the saving decision has on the distributive outcomes of a tax structure. The saving decision affects the role of the tax system when there is an interest income tax. The effectiveness of exemptions is found to be relatively insensitive to the saving decision. Only the results for no exemptions (category 0) and food exempt (category 1) are shown because the further exemptions cause little change.

Table 10 presents results for alternative constant saving propensities. Higher savings attract more interest income tax, so moving from a saving rate of 5 per cent to a saving rate of 15 per cent the better-off make greater tax payments and the inequality of the post-tax distribution declines. This is shown by the decrease in all measures of inequality as the saving rate increases, under all three tax structures shown. But the question remains of whether the saving pattern affects the role of exemptions.

TABLE 10

Inequality of Net Lifetime Consumption with Alternative Saving Rates

Tax Structure		Saving Assumptions $s = 0.05$	$s = 0.010$	$s = 0.15$
1984/85	C.of V.	0.4049	0.4026	0.4002
	I(1.2)	0.0862	0.0850	0.0837
Income Tax	I(2.0)	0.1406	0.1385	0.1362
	CT Rate	0	0	0
Table 7 with	C. of V.	0.4194	0.4173	0.4152
consumption tax	I(1.2)	0.0913	0.0901	0.0889
0	I(2.0)	0.1482	0.1461	0.1440
	CT Rate	0.0714	0.0736	0.0760
	C. of V.	0.4161	0.4140	0.4117
1	I(1.2)	0.0901	0.0889	0.0877
	I(2.0)	0.1462	0.1442	0.1421
	CT Rate	0.0933	0.0968	0.1006

The inequality increasing impact of the tax shift increases slightly as the saving rate increases. The coefficient of variation increases by 3.58 per cent when all individuals save 5 per cent of their income, but increases by 3.65 per cent when the saving rate is 10 per cent and by 3.75 per cent when the saving rate is 15 per cent. The Atkinson coefficients follow similar patterns. As the change in the tax mix involves the lowering of the top income tax rates, this offsets the inequality effect associated with those on higher incomes saving more and paying more interest income tax. At the higher saving rates, the decrease in the interest income tax paid is greatest and so the inequality effect of the tax change is greatest. This is also indicated by the higher consumption tax rates needed to ensure revenue-neutrality as the saving rate increases. However, the effect of the exemptions varies very little across the saving assumptions.

The effect of eliminating the interest income tax was examined when saving varied with both age and income, and details are given in the Appendix. The presence of an interest income tax considerably increases the equality of the post-tax income distribution when saving is assumed to vary positively with income. Abolishing interest income tax results in an increase in inequality in all cases. Saving patterns of individuals do not affect the distribution of post-tax income at all once interest income tax is abolished, because of the assumption that all savings are ultimately spent. The change in the tax mix has a smaller effect on inequality once the interest income tax is removed. Those on higher incomes save more and so pay more interest income tax. When the top marginal rax rates are decreased in the tax switch, those on higher incomes are benefited more than those on lower incomes and so the inequality of the income distribution increases. When there is no interest income tax, those who are on higher incomes and who save more are not disadvantaged and so when the top income tax rates are dropped their gain is not as large as it would have been if they were paying interest income tax. The result is a smaller increase in the inequality of the income distribution.

The Minimum Income Guarantee

A minimum income guarantee is another means of compensating those on lower incomes for the decrease in purchasing power associated with the introduction of a consumption tax. Section III explained how the transfer payment is calculated to ensure a constant minimum level of purchasing power. Two decisions need to be made when administering a minimum income guarantee. First, the value of the guarantee must be set, and then the rate at which this is to be indexed must be decided. Normally this involves a choice between the rate of inflation and the rate of growth of nominal earnings.

Table 11 explores the effect of different

TABLE 11

Inequality of Net Lifetime Consumption with Different Minimum Income Guarantees

Tax Structure		Minimum Income Guarantee (1984 $) $5000	$8000	$10 000
1984/85 Income Tax	C. of V.	0.3915	0.3697	0.3402
	I(1.2)	0.0816	0.0695	0.0566
Table 7 with consumption tax	C. of V.	0.4045	0.3810	0.3495
	I(1.2)	0.0859	0.0727	0.0589
0	I(2.0)	0.1389	0.1147	0.0916
	CT Rate	0.0714	0.0723	0.0741

minimum incomes, given in 1984 dollars; they may be compared with an average income of approximately $15 500. The indexation rate is set at the rate of growth of nominal earnings, and saving is assumed to be constant at 5 per cent. As expected, inequality decreases as the minimum income guarantee increases and the consumption tax rate increases to cover the increase in social security payments. More importantly, the decrease in inequality is much more pronounced than that associated with any combination of exemptions. This suggests that compensating people with transfer payments is a more effective mechanism than the use of exemptions.

Another consequence of the minimum income guarantee is that it introduces a way in which saving can affect the life-cycle pattern of income other than through interest income tax payments. The level of saving affects an individual's interest income and so can influence the ability to qualify for the minimum income guarantee. In this case, the distributional consequences of the saving pattern cannot be determined without the knowledge of the structure of the transfer payment.

The effectiveness of exemptions under a minimum income guarantee was also considered. It was found that exemptions in the presence of a minimum income guarantee have a much smaller effect on lifetime inequality. This result reflects the fact that those on low incomes are already compensated by the minimum income guarantee. This result suggests an alternative policy. The use of exemptions with the consumption tax means that, for revenue neutrality, the indirect tax rate must be higher than otherwise. The question arises of whether it would be more effective (in terms of reducing inequality) to increase the value of the minimum income guarantee and eliminate the exemptions, while keeping the indirect tax rate fixed. Experiments show that lifetime inequality would indeed be lower than when exemptions are used. However, especially given experience in Australia, it may be difficult for governments to convince many people to accept such a tax change, with uncertainty concerning the future level of benefits. It seems likely that some exemptions, particularly of food, will continue to be used by those countries adopting a general consumption tax.

V Conclusions

This paper has shown that the lifetime consequences of a revenue neutral partial shift towards a consumption tax involving exemptions are different from those associated with a cross-sectional view. The results show that the tax shift examined has a larger effect on inequality over the life cycle than in the cross-section. The effectiveness of consumption tax exemptions in reducing inequality differs under a lifetime perspective relative to the cross-section. Over the lifetime, exemptions are less effective in reducing inequality than in a cross-section. They reduce the inequality in the distribution of net lifetime consumption *more* than in the cross-sectional case but as the tax shift itself involves a bigger increase in inequality over the lifetime, they cannot compensate for the income tax structure change. In addition, if coupled with a minimum income guarantee whose real value is held constant, exemptions cause an even smaller decline in inequality. A concern with inequality is most appropriately handled by the use of higher transfer payments rather than by the extensive use of exemptions.

Nevertheless, given the difficulty of convincing interest groups that the minimum income level will in fact be increased sufficiently, it seems likely that some exemptions, particularly of food, will continue to be used. Recent experience in the UK has also illustrated the difficulty of removing an exemption (domestic fuel), even though, as the present results show, it is a very 'blunt' redistributive instrument.

Appendix

Alternative Savings Assumptions

Few data on savings over the life cycle are available, so this appendix considers the sensitivity of the results to a range of assumptions. The *Draft White Paper* gave saving ratios by family type and income, ranging from −10 per cent at very low incomes to 17.5 per cent at very high incomes. These figures are used as bench marks when applying different functional forms to the saving-income relationship below. The model does not allow for negative saving; those who would otherwise dissave are assumed to spend all of their income but do not borrow. This is an area that deserves further investigation.

The propensity to save is allowed to vary with income using the saving functions B1, B2 and B3 below, which correspond to 1989 income figures because *Household Expenditure Survey* 1989 was used as a guide. The values were adjusted back five years to give a 1984 figure which is used in the simulations. When calculating saving over the lifetime the values were indexed every year, using the rate of growth of nominal earnings. If Y represents post-income-tax income; the assumptions are:

$$B1 : s = 0.18 - 2000/Y$$
$$B2 : s = 0.33 - 5000/Y$$
$$B3 : s = 0.38 - 8000/Y$$

Assumption B1 generates saving rates ranging between 5 per cent and 13 per cent for Y between $15 000 and $40 000. B2 has rates between 0 per cent and 20.8 per cent for the same income range. Equation B3 in conjunction with the no-dissaving rule has individuals with Y up to $21 000 spending all their income and saving rates rising to 18 per cent for Y of $40 000.

The above assumptions do not allow for saving ratios to vary with age. Williams (1980) reports average propensities to save for households with heads less than and above 44 years. The older households tend to save more, the exception being young couples without children. This pattern is confirmed for the US by Bosworth, Burtless and Sabelhaus (1991), who show a pattern consistent with 'humped' savings. The following assumptions C1 and C2 exhibit this humped shape, where both start at a saving rate of 0 per cent at age 20 and peak at 15 per cent. C1 and C2 peak at age 55 and 45 years respectively. Where, t = age − 20, the assumptions are:

$$C1 : s = 0.00857t - 0.0001224t^2$$
$$C2 : s = 0.012t - 0.00024t^2$$

Results for the 'B' assumptions are in Table A1. Moving from assumption B1 to B3 the degree to which saving increases with earnings increases. With an interest income tax it might be expected that inequality

Table A1

Inequality of Net Lifetime Consumption with Saving as a Function of Income

Tax Structure		Saving Assumption B1	B2	B3
1984/85	C. of V.	0.3886	0.3663	0.3625
	I(1.2)	0.0798	0.0726	0.0735
Income Tax	I(2.0)	0.1304	0.1196	0.1224
	CT Rate	0	0	0
Table 7 with consumption tax:	C. of V.	0.4046	0.3831	0.3772
	I(1.2)	0.0853	0.0779	0.0780
0	I(2.0)	0.1386	0.1276	0.1290
	CT Rate	0.0711	0.0688	0.0654
	C. of V.	0.4015	0.3806	0.3749
1	I(1.2)	0.0842	0.0770	0.0771
	I(2.0)	0.1369	0.1262	0.1276
	CT Rate	0.0936	0.0909	0.0860

TABLE A2

Inequality of Net Lifetime Consumption with Saving as a Function of Age

Tax Structure		Saving Assumption C1	C2
1984/85	C. of V.	0.4015	0.4018
	I(1.2)	0.0847	0.0846
Income Tax	I(2.0)	0.1379	0.1378
	CT Rate	0	0
Table 7 with consumption tax	C. of V.	0.4162	0.4165
	I(1.2)	0.0898	0.0897
0	I(2.0)	0.1456	0.1455
	CT Rate	0.0737	0.0741
	C. of V.	0.4129	0.4131
1	I(1.2)	0.0886	0.0885
	I(2.0)	0.1437	0.1435
	CT Rate	0.0972	0.0976

would decrease moving toward assumption B3 because those on higher incomes are saving relatively more, and affected to a greater extent by the interest income tax. This pattern is exhibited by the coefficient of variation but the Atkinson coefficients decrease from assumption B1 to B2 but increase from B2 to B3.

Assumption B1 gives saving rates greater than both B2 and B3 at lower levels of income but significantly lower rates at higher levels. The difference between the inequality measures can be explained by the different weighting they give to various parts of the income range. Although B3 allows for greater variation of saving with income it generates lower saving figures than B2 until an income level of $60 000. In the presence of interest income tax B2 disadvantages those on high-to-middle range incomes more than B3, and the Atkinson measure puts more weight on the middle range of incomes than those at the very high end (who under B3 save more than under B2 and so who would pay more interest income tax). The coefficient of variation is more sensitive to changes in the higher incomes. Assumption B1 results in the most inequitable distribution for all measures because it has those on very low levels of income saving more than under the alternative assumptions. In addition, those on incomes over $20 000 save less under B1 than under B2 and those on incomes over $30 000 save less than under both alternative assumptions. Allowing saving to vary with income increases the inequality increasing effect of the tax switch because the reduction in income tax rates reduces the effect of the interest income tax payments.

As shown in Table A2, the difference between assumptions C1 and C2 have little effect on the distribution of after-tax income. The Atkinson measures again move in the opposite direction to the coefficient of variation for similar reasons as those discussed above. In comparison with the flat rate saving assumptions, post-tax income decreases. As the age-saving profiles follows, to a certain extent, the growth of earnings over the lifetime, assumptions C1 and C2 result in saving, and hence interest income tax payments, partly varying with income. This would explain the reduction in inequality under these assumptions. The effect of the tax switch is similar in magnitude to that when saving is at a flat rate.

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