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

LISA CAMERON
Princeton University, New Jersey

and

JOHN CREEDY
University of Melbourne, Parkville, Victoria 3052

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 distribu- 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 be considered as the appropriate concept when examining inequality, bequests are clearly equivalent to a type of 'self inflicted' (progressive) tax

II Income and the Life Cycle

The approach adopted is to consider a single 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

if not impossible, to account for many of these factors it is possible to account for productivity

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

TABLE 2

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:

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

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

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 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

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

correspond to those in Table 5. The consumption tax rate increases with the extent of the exemptions so as to maintain revenue neutrality. Com-

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 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 Income Tax	C.of V.	0.4049	0.4026	0.4002
	I(1.2)	0.0862	0.0850	0.0837
	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
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	I(2.0)	0.1482	0.1461	0.1440
	CT Rate	0.0714	0.0736	0.0760
1	C. of V.	0.4161	0.4140	0.4117
	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

effect on inequality once the interest income tax

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:

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

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:

$$\text{C1} : s = 0.00857t - 0.0001224t^2$$
$$\text{C2} : s = 0.012t - 0.00024t^2$$

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

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

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

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.

REFERENCES

Atkinson, A.B. (1970), 'On the Measurement of Inequality', *Journal of Economic Theory* **2**, 244–63.

Australian Treasury (1985), *Reform of the Australian Tax System*, Draft White Paper.

Bosworth, B., Burtless, G. and Sabelhaus, J. (1991), 'The Decline in Saving: Evidence from Household Surveys', *Brookings Papers on Economic Activity* **1**: 1991, 183–241.

Casperson, E., and Metcalf, G. (1993), 'Is a value added