The Role of a Tax-Free Threshold: Tax Policy Design and Simulating its Abolition in Australia*

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Abstract

This paper examines the role of the tax-free income tax threshold in a complex tax and transfer system consisting of a range of taxes and benefits, each with their own taper rates and thresholds. Considering a range of tax and benefit systems, particularly those having benefit taper rates whereby some benefits are received by income groups other than those at the bottom of the distribution, it is suggested that a tax-free threshold is not a necessary requirement to achieve redistribution. Four alternative policy changes, each involving the elimination of the tax-free threshold in Australia and designed to achieve approximate revenue neutrality, were examined using the Melbourne Institute Tax and Transfer Simulator. A range of implications were examined, including labour supply responses to tax changes, and the effects of policy changes on inequality and social welfare. The results demonstrate that it is possible to eliminate the tax-free threshold under approximate overall revenue and distribution neutrality, but that it is impossible to improve labour supply incentives at the same time. In order to achieve improved incentives, either revenue or distribution neutrality has to be sacrificed.

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1 Introduction

This paper examines the role of a tax-free threshold in income tax structures. Such a threshold, below which the income tax rate is zero, is a feature of many tax systems and was initially motivated largely by equity considerations. However, this feature is not required in an integrated tax and transfer structure. Those countries without a tax-free threshold usually have some kind of tax rebate to deal with distributional objectives in low-income ranges, and the simultaneous payment of income tax and receipt of benefits is a feature of modern tax and transfer systems which can only be avoided by introducing tax-free thresholds at a very high level. This paper considers alternative structures, concentrating on revenue-neutral comparisons. Simply eliminating a tax-free threshold without introducing complementary adjustments to other features of the tax structure would have undesirable budgetary and distributional impacts.[1] Without imposing revenue-neutrality, alternative policies cannot be properly compared.[2]

After discussing general issues regarding the design of tax and transfer systems with and without a tax-free threshold, this paper reports policy simulations for Australia in which elimination of the threshold is combined with adjustments to tax rebates, as well as marginal income tax rates. The reforms include a flattening of the income tax rate structure, which is often suggested by those who are in favour of cutting the tax-free threshold. The simulations allow for potential labour supply responses using the Melbourne Institute Tax and Transfer Simulator (MITTS).[3] A range of inequality and welfare effects are reported. Such simulations can contribute to rational policy analysis, as quantitative orders of magnitude are crucial and labour supply effects may be substantial.

In policy debates on tax and welfare reform, the tax-free threshold is often seen as a crucial equity component. Criticism of a lack of indexation of the threshold is accompanied by arguments in favour of raising it to a level which ensures that no individual in receipt

[1] This statement, as in many policy debates, clearly attaches much weight to the *status quo*, whereby the existing sytem is implicitly judged to have desirable properties.

[2] For example, Saunders (2006, p. xxvi) argues that, 'At the same time as the top marginal rate is reduced, the tax-free threshold should be raised to a level above the welfare minimum (subsistence) level ... it would mean that all taxpayers enjoyed a substantial tax cut'. He does not mention compensating changes to other forms of revenue or expenditure along with this revenue-reducing reform, so it is unclear how this policy change would be financed and what the impact of this alternative revenue-generating process would be.

[3] This is described briefly in Appendix A and in detail in Creedy *et al.* (2002). Creedy and Kalb (2006) describe some of the more recently introduced features of MITTS, and Kalb and Lee (2007, 2008) report updated wage and labour supply estimates underlying the labour supply responses in the behavioural simulations.

of transfer payments actually pays income tax.[4] However, in a structure with many means-tested benefits involving taper, or benefit withdrawal, rates such that some benefits are not confined to the lower-income ranges, this could prove difficult to achieve. What really matters in a complex multi-tax and transfer structure is the overall redistributive effect.[5] Raising the threshold in order to help low-income groups actually has a low 'target efficiency' in that it involves at least the same absolute gains by those subject to higher marginal tax rates. Different sides of the debate are clearly recognised in the summary by Freebairn (1998, p. 67), who suggested that,

> Removing the tax-free threshold for many taxpayers would enable funding lower marginal tax rates, and hence lower efficiency costs. But equity concerns almost certainly will require the addition of a means tested threshold or grant. Withdrawal of the grant can only mean higher effective marginal rates, and greater distortions, for those on low and middle incomes. Given the distribution of tax payable with the present system, and stated intentions not to disadvantage those on low incomes, it is difficult to envisage a tax rate schedule without a tax-free threshold which is not regressive.

However, as the following analysis shows, careful consideration of practical design aspects of taxes and transfers, using a microsimulation model, makes it possible to achieve an elimination of the tax-free threshold which is both approximately distribution and revenue neutral, although marginal effective tax rates for middle to higher incomes are increased.

In order to place the debate regarding the role of the tax-free threshold in perspective, Section 2 examines early views when income taxation was first introduced. In structures containing few – if any – transfer payments and a large number of individuals below the threshold who were considered to be at a subsistence level, and where income tax revenue formed a relatively low proportion of total tax revenue, the threshold played an important

[4] For example, Saunders and Maley (2006, p. 113) argue that, 'The principled case for raising the threshold is that workers should be allowed to earn and retain enough money to meet their own subsistence needs before any tax is taken away from them.' However, the principle involved (whether of a basic value judgement or an efficiency criterion) is not actually mentioned. A similar argument for raising the threshold was made by Veit-Wilson (1999), who showed that in practice in the UK there had been no coordination between those responsible for tax thresholds and those responsible for setting benefit levels.

[5] An early clear statement of this view was made by Hicks (1946, p. 150) who dated its realisation from the last quarter of the 19th century: 'Instead of regarding each tax separately, and attempting the impossible task of choosing only those taxes which would pass all the tests, it was suddenly realized that any desired distributional result could be obtained by a compensatory strucutre of taxes, in which the faults of one would be offset by the virtues of another'. Hicks then made the point that expenditures, as well as taxes, also need to be taken into account.

role. However, unlike current systems, the tax structure was designed to achieve proportionality at higher income levels.[6] Section 3 considers alternative tax and transfer systems, paying attention to the need to make revenue-neutral comparisons. The role of tax rebates is examined, along with the possibility of achieving a revenue- and distribution-neutral change involving abolition of the tax-free threshold. Policy simulations for Australia are reported in Section 4, using the Melbourne Institute's behavioural microsimulation model MITTS. Conclusions are in Section 5.

2 Early Views on Income Taxation

In early discussions on income tax, considerably more attention was given to the subject of differentiation by income source rather than the question of progression.[7] Indeed, the use of different tax rates according to the source of income (particularly with regard to 'permanent' and 'temporary' incomes) was discussed 'with a sophistry comparable only to that of later scholastic logic' (Shehab, 1953).[8] Attitudes to progression were influenced by the dominance of an 'ability to pay' view of the role of taxation, concentrating on the sacrifice made. This is in contrast with a 'benefit' or quid pro quo view according to which taxation should relate to the benefits obtained from the resulting tax-financed activity.[9] Given the huge importance for the classical economists of the concept of a 'subsistence' level, and since there was no significant system of transfer payments (as relief to the poor involved entry to the dreaded 'workhouse') it is not surprising that there was virtually universal support for the idea of a tax-free income range. But, other than the acceptance of such a range, there was little acceptance of a redistributive role for income taxation.[10] Clarification of the utilitarian arguments relating to decreasing marginal utility – which imply progression

[6] This involved a variety of rate 'degression' discussed in Section 2.

[7] Five separate schedules for different sources, operated in the UK from 1803, when the income tax was first introduced as a temporary revenue-raising measure during the Napoleonic Wars. They lasted for 150 years.

[8] In the UK, much of the discussion was associated with various Select Committees appointed by Gladstone during his long attempt to repeal the income tax reintroduced by Peel in 1842. Later, debate was stimulated by two Royal Commissions (Colwyn, 1920; Radcliffe,1955). For a survey of the history of public finance, see Creedy (1984), and for a collection of writings on taxation, see O'Brien (1999).

[9] Some people argued that these were equivalent because the state provided the protection and rights under which all incomes are obtained, while others believed that benefits were too difficult to assign.

[10] Sabine (1980, p. 130) states, 'Until 1894 its only real concession to equity was a comparatively high threshold', and Blum and Kalven (1953, p. 4) suggest that, 'it is almost unanimously agreed that some exemption keyed to at least a minimum subsistence standard of living is desirable'. It should also be remembered that tax rates were initially very low, there was no pay-as-you-go collection mechanism and income declarations were difficult to monitor.

only under special conditions – was not provided until the work of Cohen Stuart (1889) and Edgeworth (1897).

A simple 'equal sacrifice' approach was taken, particularly by Mill (1848), in the context of an 'ability to pay' approach. He provided an early argument for the use of a single tax rate applied to all incomes measure in excess of the subsistence level, and in this he was strongly supported by McCulloch (1845).[11] This system gives rise to an increasing average tax rate for those above the threshold, so that despite a constant marginal tax rate it is progressive (and inequality reducing). However, the principle that the tax-free threshold should apply to all incomes was not actually adopted in the UK until after the Royal Commission of 1920: see Shehab (1953, pp. 93, 246) for details. The system in use for many years involved taxation of gross income above the threshold, but with a gradual 'shading in' of the tax rate until the point where a fixed rate applied.[12] Hence many higher-income taxpayers were subject to a constant marginal and average tax rate. Another similar system involves a gradual reduction in the tax-free threshold as income increases, until it is 'exhausted' and the tax is proportional. Hence the UK system for many years was more strictly described, using the now unfamiliar term, as 'degressive' rather than progressive,[13] although it implied increasing average rates over a range.[14]

As redistribution came to be accepted as a legitimate role of government, most income tax schemes not only applied a common tax-free threshold to all income levels (as well as introducing various personal 'allowances', often positively related to income), but also introduced a progressive ('graduated') tax rate scale.[15] The income tax structure also came to exist alongside a complex range of (usually means-tested) transfer payments. The latter feature means that there is often an overlap between the tax and benefit systems, so that many benefit recipients are also liable to pay income tax. The overlap has in turn led to the introduction of tax 'rebates', also subject to what are variously called taper, withdrawal or abatement rates. In attempts to improve the 'target efficiency' of tax and transfer systems,

[11] The later utilitarian approaches redefined Mill's 'equal sacrifice' to mean 'equal marginal sacrifice', thus implying minimum aggregate sacrifice.

[12] This is similar to the current Australian low income tax offset, where low-income individuals in essence receive additional tax-free income, which is taken away at higher income levels by increasing the marginal tax rate.

[13] On degression, see for example Bastable (1903, pp. 316-317), de Viti de Marco (1936, pp. 289-290). Goode (1964, p. 226) refers to a 'vanishing exemption'.

[14] Cassel (1901) later suggested that the tax-free threshold should actually increase as income increases, because expenditure on necessities increases, while still maintaining a structure that can be described as being progressive.

[15] This often involved a large number of marginal rates, increasing to very high levels. An historical overview of the Australian system is given in, for example, Groenewegen (1990).

effective marginal tax rates (allowing for all tax rates and tapers) are typically highest for the low-income benefit recipients, although their average tax rates are negative.

An increase in the tax-free threshold, while moving some individuals out of the tax 'net', provides a benefit to all taxpayers so that, as a way of helping the poor, it is not well-targeted. Furthermore, in a tax and transfer system consisting of a range of taxes and benefits, what matters is the overall effect rather than that of a single tax, so it is far from clear that the role of the tax-free threshold corresponds to its original one of helping low-income individuals at a subsistence level. The fact that many benefit reforms are introduced independently without full consideration of the overall effects can easily lead to unintended consequences, such as discontinuities in the relationship between gross and net income and ranges where marginal tax rates can exceed 100 percent.

In modern tax and transfer systems it is therefore by no means unusual for individuals both to pay income tax (which for some people is partly compensated by income tax rebates) and receive benefits.[16] Given the presence of income tax rebates, the need for a tax-free threshold is not as strong as formerly. The simplest tax and transfer system is an integrated 'basic income – flat tax' structure (or BI–FT) which has no role for a tax-free threshold but instead combines a universal (non-means-tested) basic income with a proportional tax applied to all income.[17] Nevertheless, although there has been a general movement towards flatter rate scales over the last 15 or so years, very few countries have adopted an income tax structure without a tax-free threshold. An exception is New Zealand. However, the use of personal allowances meant that there was an effective tax-free threshold from the introduction of the income tax in 1891 until 1972. There is now a relatively broad base, with a range of tax rebates for low incomes, a combination of different means-tested transfer payments and a progressive, or graduated, marginal income tax rate structure. For discussion of the tax reform changes in New Zealand, see Stevens (1990).

In Australia, where there has been limited indexation of tax thresholds over many years[18], there have been calls to increase the tax-free threshold as a way of helping low-income groups. But, as mentioned above, such an increase (unnecessarily) gives the same support

[16] Bastable (1903, p. 319) suggested that 'In any country where legal provision is made for poor relief, it would seem that to tax those at the point of minimum subsistence would be simply to drive them into the ranks of pauperism, and to take with one hand in order to give back with the other'. But there is no longer anything unusual about giving with one hand while taking with another.

[17] For an extensive discussion of this option, see Atkinson (1996).

[18] In Australia, no indexation has taken place from 2000/2001 up to 2003/2004, when the tax thresholds were increased slightly, and again in 2004/2005. In 2005/2006 and 2006/2007 larger increases were introduced, particularly for the top two tax thresholds. The tax-free income threshold has not changed since 2000/2001. Before the July 2000 change, there was no indexation over a long period.

to higher-rate taxpayers. The question is how might elimination of the Australian tax-free threshold be achieved with minimal impacts on lower-income groups? One alternative may be to abolish the tax-free income range and replace this with a similar amount in rebates for lower income individuals. The remaining funds could be used to pay for a reduction in the middle income tax rates to compensate those on middle and higher incomes (outside of the range of the new rebate) at least partly. Such a policy change could be expected to result in labour supply effects, since high-level rebates extend further up the income scale and thus lead to higher effective marginal rates for all people who have income in the extended rebate withdrawal range. In addition, higher taxes are expected for high income groups if the increase in tax base is not sufficient to allow tax rates to be reduced by a large enough amount to compensate each individual fully for the loss of the tax-free income range.

Determining a revenue-neutral policy change that abolishes the tax-free income range is complex, as is the determination of potential labour supply responses with a range of effects working in opposite directions. A proper analysis requires a microsimulation model to evaluate the hypothetical policy options and enable full inclusion of all aspects of the reform. However, before reporting policy simulations using a behavioural microsimulation model for Australia, the following section considers some basic aspects of integrated tax and transfer systems.

3 Comparison of Alternative Tax Structures

This section considers, using a simple framework, the potential implications of a reform involving elimination of the tax-free threshold in a range of different income tax systems. In particular, it raises the question of whether a revenue-neutral and distribution-neutral reform is possible in principle, and considers potential labour supply responses and welfare implications arising from alternative reforms. This discussion assists in designing sensible policy options for investigation, using a microsimulation approach.

Subsection 3.1 discusses the case of income tax in isolation, while subsection 3.2 introduces transfer payments in the simplest possible system, that of a proportional income tax combined with a basic income. Variations involving means-tested benefits are then examined in subsections 3.3 and 3.4. Means-tested transfer payments form an important part of the tax structures of many countries.

3.1 Income Tax Only

Consider first the income tax system in isolation, and suppose that initially there is only one (positive) marginal tax rate of t and a tax-free threshold of a.[19] Hence income tax paid on an income of y, denoted $T(y)$, is given by:

$$\begin{array}{ll} T(y) = t(y-a) & y > a \\ T(y) = 0 & y \leqslant a \end{array} \tag{1}$$

For taxpayers, the average tax rate is $t(1-a/y)$, which clearly increases towards t with increasing y. Marginal and average rates for this income tax structure are illustrated in Figure 1. This system has an increasing average tax rate and is thus progressive, for incomes over a. Overall it is inequality reducing (the inequality of post-tax is less than that of pre-tax income) so long as a is not too high.[20] It is this characteristic that provides the basic motivation for the use of a tax-free threshold. Indeed, when income tax was first introduced, there were typically no transfer payments. However, in modern systems with many different types of benefit, what matters is the overall effect, rather than the effect of a single tax in isolation.

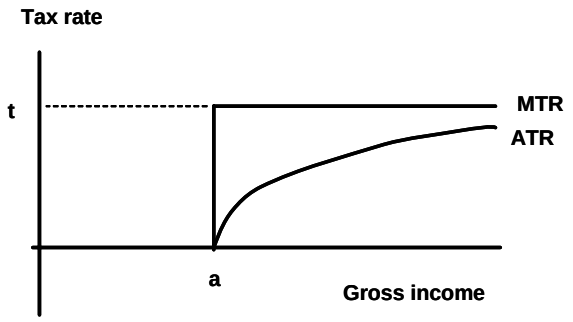

Figure 1: Marginal and Average Tax Rates with a Tax-free Threshold

In fact, the income tax with a tax-free threshold shares characteristics of a combined tax and transfer scheme. This is because, for taxpayers, net (after income tax) income, z, is:

$$z = at + (1-t)\,y \tag{2}$$

[19] A system of personal allowances is equivalent to a tax-free threshold, though allowances may vary by household size and composition.

[20] If t is held constant and a is increased, inequality gradually falls. However, if for already high tax-free thresholds a, the threshold is further increased, very few people remain to pay tax, so that inequality increases, since the post-tax distribution again moves closer to the pre-tax distribution. For inequality to fall continuously, the tax rate must be increased as a is increased.

For $y > a$, this income tax system is equivalent to a BI–FT tax and transfer system (a linear tax) with a basic income of at and a flat tax rate t. This characteristic provides a motivation for eliminating the tax-free threshold. With a tax-free threshold, any attempt to help the very low paid taxpayers – those close to, but above, the threshold – by raising the threshold and taking them out of the 'tax net' is accompanied by a simultaneous increase in the implicit transfer given to all taxpayers. Furthermore, if there is marginal rate progression and increasing the threshold shifts all the other income tax thresholds up by the same amount as the tax-free threshold increase, then the increase is highest for the higher rate-payers. A further motivation for eliminating the tax-free threshold is that the accounting period and the unit of analysis are no longer relevant.[21]

Expected total revenue per person from the income tax, R, is:

$$R = t \int_a^{\infty} (y - a)\, dF(y) \tag{3}$$

where $F(y)$ is the distribution function of pre-tax income and $0 \leqslant y < \infty$. This can be written as $R = t\bar{y}G(a)$ where $\bar{y}$ is expected income $\int_0^{\infty} y dF(y)$ and:

$$G(a) = \{1 - F_1(a)\} - \frac{a}{\bar{y}}\{1 - F(a)\} \tag{4}$$

and $F_1(a)$ denotes the first moment distribution function, that is the proportion of total income in the population obtained by those with income below a.[22] Clearly, $G(0) = 1$, and a proportional, or flat, tax raises $R = t\bar{y}$ per person.

Eliminating the tax-free threshold therefore obviously increases the revenue raised from the income tax. A revenue-neutral elimination of the threshold allows a reduction in the constant marginal tax rate, now applying over all $y > 0$, to be made. If the new rate is denoted t', then:

$$t' = tG(a) \tag{5}$$

However, such a change involves a move from a progressive income tax to one having a constant average rate t'. This affects the income distribution, benefiting high-income individuals relative to lower-income individuals.

Some progression can be re-introduced by the explicit introduction of a transfer payment or rebate which is given to low-income individuals, or a transfer applying over the whole

[21] Considerable energy is involved in treating the accounting period for tax purposes as a single year, when individuals have fluctuating incomes and other circumstances during the year, and are subject to pay-as-you-go tax collection.

[22] The function $G(.)$, and extensions, has a fundamental role in the analysis of tax and transfer systems; see Creedy (1996).

range of incomes. In principle it would be possible to eliminate the tax-free threshold while retaining precisely the same relationship between gross and net income, by giving a transfer of at to all those with $y > a$, and introducing a means tested benefit of $B(y) = ty$ for those with $y < a$. This is effectively a tax rebate which cancels the effect of the income tax. Such a change in administration would make no sense where there is no well-developed tax administration, poor monitoring of incomes, a large number of individuals in the lower income groups, and low tax revenue. It is thus not surprising that a 'degressive' system was used in the UK for many years in order to achieve proportionality for the higher-income groups: a tax rebate (taking with one hand and giving with the other) would have been extremely cumbersome. However, in the modern context, a rebate for low-income groups is feasible as one component of a range of income transfers.

3.2 Basic Income–Flat Tax System

Instead of a means-tested benefit, consider the use of an unconditional basic income; that is, a BI–FT system. Suppose a non-means-tested transfer payment of b is introduced, and the flat-tax rate is t^*. Net income for all individuals is thus:

$$z = b + (1 - t^*)\, y \tag{6}$$

This system is unambiguously progressive as total tax paid, $T(y) = t^* y - b$, and the average tax rate, $t^* - b/y$, increases over the whole range of income. The latter is initially negative, becomes zero at $y = b/t^*$ and asymptotically approaches t^* as y increases. Average and marginal rates for this structure are shown in Figure 2. With its negative tax for incomes below b/t^* and with its higher tax rate t^* (compared to t in the previous section), this system is clearly more progressive than the income tax alone so the reform is not distribution-neutral.

To ensure that a reform, involving replacement of the income tax in subsection 3.1 with the linear tax, is revenue-neutral, consider total net government revenue per person. This becomes:

$$R^* = t^* \bar{y} - b \tag{7}$$

and the new tax rate is given by:

$$t^* = \frac{b}{\bar{y}} + tG(a) \tag{8}$$

Everyone receives b rather than only those above a receiving an implicit transfer of at, so it is not possible to have $b = at$ and $t = t^*$ without reducing total net revenue. Thus it is

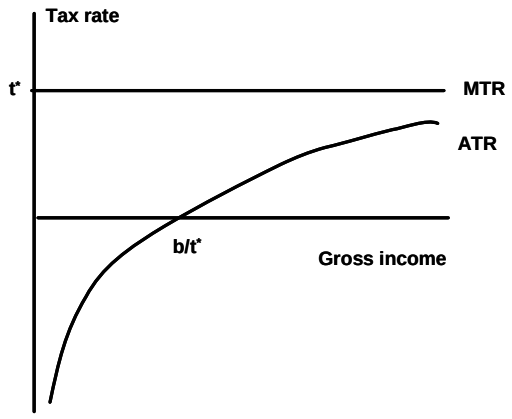

Figure 2: Tax Rates in the Linear Tax Structure

possible to have a revenue-neutral but not a distribution-neutral reform involving a move from a tax-free threshold to a basic income with a flat tax.

The above results apply for a fixed distribution of pre-tax income. However, in addition to distributional effects, the reform may also be expected to have labour supply effects. This complicates matters further; for example to remain revenue neutral, further adjustments to the tax parameters b and t^* would be required. The direction of the labour supply effects is ambiguous and needs to be determined empirically. High-income groups face a lower marginal rate if $t^* < t$, giving rise to a substitution effect, while at the same time also facing an income effect. Due to the income effect of receiving a basic income b and the higher marginal tax rate t^*, the labour supply of some of those previously having an income $y < a$ is likely to fall, in some cases to the non-participation corner of the budget constraint.

3.3 Income Tax with a Minimum Income Guarantee

Consider now an income tax having a tax-free threshold of a combined with a minimum income guarantee such that all those with y below a have their net income brought up to the level a. Hence, for $y < a$, benefits are given by $B_1(y) = a - y$ and the MIG involves means-testing with a taper rate of 100 percent. The relationship between net and gross income is shown in Figure 3 as the line ABC.

Suppose the tax-free threshold is eliminated but the MIG still guarantees a minimum income of a for those with $y < a$. Hence for $y < a$:

$$z = y - ty + B_2(y) = a \tag{9}$$

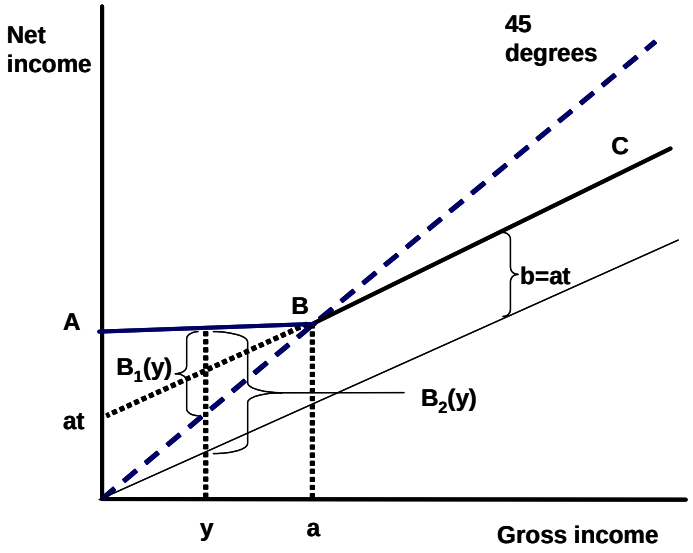

Figure 3: A Minimum Income Guarantee

and benefits are given by:

$$B_2(y) = a - (1-t)\,y \tag{10}$$

Abolishing the tax-free income, therefore involves a reduction in the benefit taper rate, from 1 to $1-t$, to allow for the fact that each extra dollar of income also attracts income tax. Of course, the overall effective marginal tax rate continues to be 100 percent. Those with $y > a$, who initially receive an implicit transfer of at while being taxed implicitly at the flat rate of t on all their income, can now be given an explicit unconditional basic income of $B(y) = b = at$.

Hence in this special case it is possible to combine the elimination of a tax-free threshold with a slight reform of the benefit structure in order to maintain precisely the same relationship between net and gross income. This involves a relatively minor change in administration in view of the fact that means testing was initially applied to low-income groups, thereby requiring an existing sophisticated tax and benefit structure. The change is revenue- and distribution-neutral and would simply be a change in the administrative arrangements.

However, elimination of the tax-free threshold is motivated by a desire to flatten the income tax structure and to take away the implicit transfer given to those higher-income individuals who pay tax. An alternative reform, instead of maintaining the effective status quo of the MIG with a tax-free threshold, might not introduce a basic income for tax payers but, keeping the MIG at the level a, extend the income range over which individuals

are entitled to the means-tested benefit. Suppose the tax-free threshold is eliminated, the marginal and average income tax rate applying to everyone becomes t' and the MIG is received by all those with income below y_T, where $y_T > a$. This is illustrated in Figure 4.

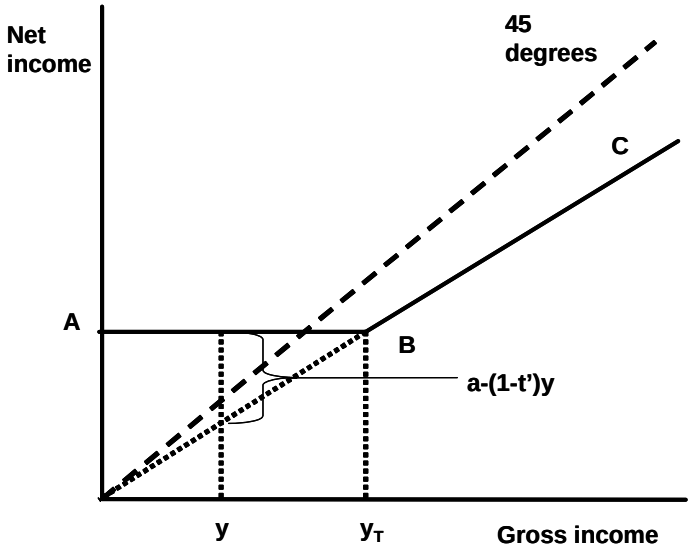

Figure 4: An Alternative Reform

For continuity in the relationship between z and y it is required to have:

$$a = (1 - t')\, y_T \tag{11}$$

so that:

$$y_T = \frac{a}{1 - t'} \tag{12}$$

The above reform is clearly not distribution-neutral. However, it can be made revenue-neutral. Consider the effect on the tax rate t', needed to achieve revenue neutrality given a fixed distribution of y. Under the pre-reform tax structure, suppose that non-transfer expenditure of E per person must be financed from the income tax system, in addition to the MIG. The government's budget constraint is thus:

$$E + \int_0^a (a - y)\, dF(y) = t \int_a^\infty (y - a)\, dF(y) \tag{13}$$

It can be shown, using the expression $G(a)$ from (4), that:[23]

$$t = \frac{E/\bar{y} + \{G(a) - (1 - a/\bar{y})\}}{G(a)} \tag{14}$$

[23] When $a = 0$, and there is no MIG nor a tax-free threshold, this reduces to the simple expression, $t = E/\bar{y}$.

Under the reformed system, the government's budget constraint becomes:

$$E + \int_0^{a/(1-t')} \{a - (1-t')\, y\}\, dF(y) = t'\bar{y} \tag{15}$$

After some re-arrangement, this can be written as:

$$t' = 1 + \frac{E/\bar{y} - \left\{1 - \frac{a}{\bar{y}} F\left(\frac{a}{1-t'}\right)\right\}}{1 - F_1\left(\frac{a}{1-t'}\right)} \tag{16}$$

This expression does not provide a closed-form solution for t' as it is highly nonlinear, with terms in both integrals F and F_1 depending on t', along with their limits of integration. However, it seems likely that $t' < t$.

In practice the above results would be modified by labour supply responses to the change in the tax structure, since the expressions assume a fixed distribution of y. The extension in the range of y for which means testing applies (with a taper rate of $1 - t'$) means that more lower-income individuals, who previously simply paid income tax, now receive means-tested benefits and thus face a higher marginal tax rate (since in practice $t' < 0.5$ and the taper rate exceeds the income tax rate). Hence their labour supply is likely to fall. Higher income individuals face a lower marginal tax rate if $t' < t$, giving rise to a substitution effect in favour of higher labour supply, and simultaneously there is an income effect in the same direction because of the elimination of the implicit transfer of at. The overall effect at the population level is thus unclear.

3.4 A Modified Minimum Income Guarantee

In practice, tax and transfer systems do not usually have the simple MIG form examined in the previous subsection. Benefits typically have a taper rate s, where $t < s < 1$, and a range of 'free' income before the taper begins to apply. Furthermore, the receipt of the transfer payment extends beyond $y = a$. A simplified form of tax and transfer system, referred to as a modified MIG, is shown in Figure 5, where the relationship between net (after-tax-and-transfer) income and gross income is shown by the piecewise-linear schedule ABCD. The diagram concentrates on the lower ranges of the income distribution. To reduce the number of parameters involved, the form illustrated assumes that the taper-free range of the benefit is the same as the tax-free range of the income tax structure, equal to a. Although in practice, tax and transfer systems are usually highly complex, with numerous overlapping benefits, each with its own thresholds, the simple form shown in Figure 5 is a reasonable approximation, which captures the issues relevant to a more complex system.

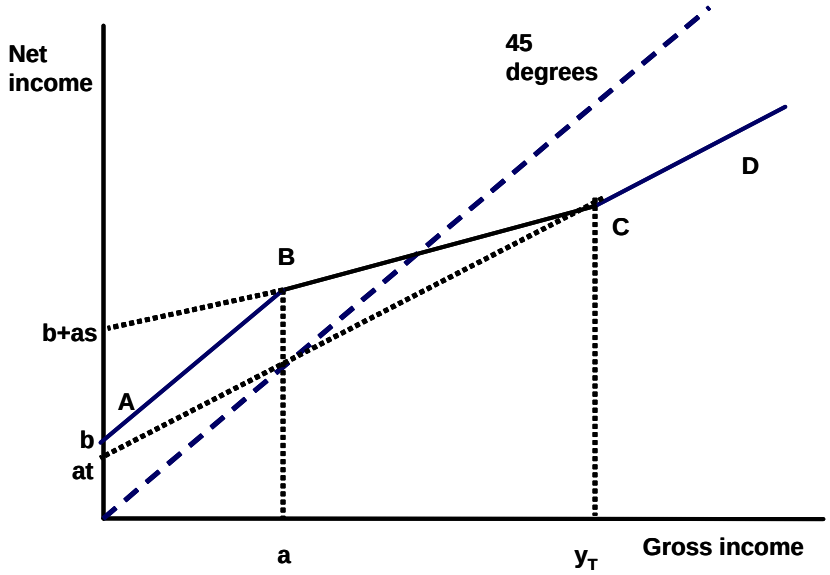

Figure 5: A Modified Minimum Income Guarantee

In the pre-reform situation, suppose the benefit received when $y = 0$ is equal to $B(0) = b$. As continuity is imposed on the relationship, the point B in Figure 5 must correspond to a net income of $z = a + b$. Furthermore the segment BC, when continued to the net income axis, must have an intercept of $b + as$.[24] Furthermore, the threshold income y_T, above which the means-tested benefit is exhausted and individuals only pay income tax, is given by:

$$at + (1 - t) y_T = (b + as) + (1 - s) y_T \tag{17}$$

so that:

$$y_T = a + \frac{b}{s - t} \tag{18}$$

For those between B and C, the net transfer, defined as the difference between their net income z and their income after the payment of income tax alone, is given by:

$$\begin{aligned} z - y + T(y) &= \{b + as + (1 - s) y\} - \{at + (1 - t) y\} \\ &= b - (s - t)(y - a) \end{aligned} \tag{19}$$

For this tax and transfer system the government's budget constraint is therefore given by:

[24] This is because it must be the case that if q is the intercept, $a + b = q + a(1 - s)$, which can be solved for q.

$$E + b\int_0^a dF(y) + \int_a^{a+b/(s-t)} \{b - (s-t)(y-a)\} dF(y) = t\int_{a+b/(s-t)}^{\infty} (y-a)\, dF(y) \quad (20)$$

This is clearly highly nonlinear because t affects the limits of integration.

A reform involving the elimination of the tax-free threshold in the income tax could maintain the same benefits – that is the range ABC – while also extending the point C to the right until it meets the new lower taxed-income line. In order to maintain the section AB, individuals, who previously paid no tax as they were below the tax-free threshold, would need to receive a tax rebate of ty. This means, as in the previous subsection, that more people face the higher effective marginal tax rate; that is, more people are subject to the means-tested taper rate. This system is shown in Figure 6.

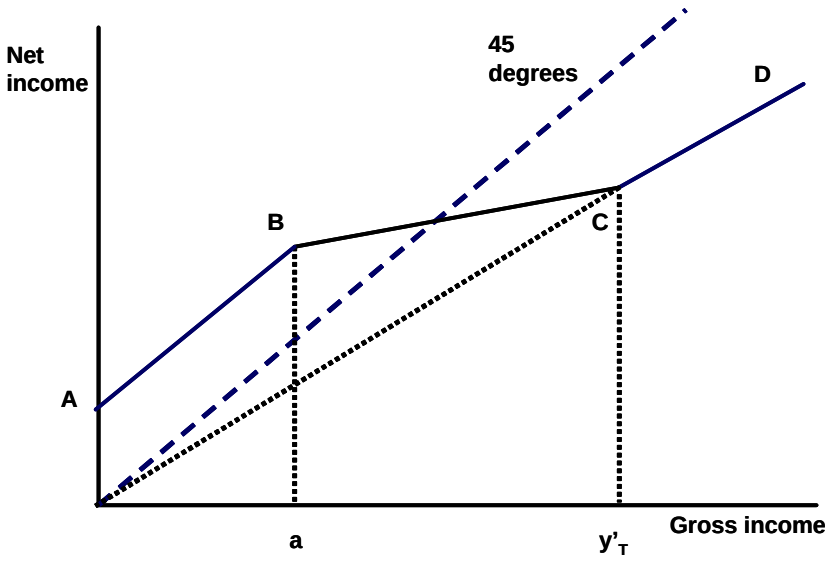

Figure 6: The Modified MIG without a Tax-Free Threshold

Again the reform is not distribution-neutral. The overall effect on net income inequality is not obvious given the existence of three distinct income ranges, so that within- and between-group components are relevant.

The condition required for revenue-neutrality is complex in this case, again because of the nonlinearities involved. Suppose that the marginal income tax rate is changed to t'

when the tax-free threshold is abolished. The new threshold, y'_T, becomes:[25]

$$y'_T = \frac{b + as}{s - t'} \tag{21}$$

The net transfer received by those with pre-tax incomes between a and y'_T becomes:

$$\begin{aligned} z - y + T(y) &= b + as + (1 - s)\, y - (1 - t')\, y \\ &= b + as - (s - t')\, y \end{aligned} \tag{22}$$

and this is higher than in the pre-reform situation because their after-income-tax income is lower as a result of the elimination of the tax-free threshold. As mentioned above, those with $y < a$ receive a tax rebate in addition to the basic income b. Hence the new government budget constraint is:

$$\begin{aligned} &E + \textstyle\int_0^a \{b - (1 - t')\, y\}\, dF(y) + \\ &\textstyle\int_a^{(as+b)/(s-t')} \{b + as - (s - t')\, y\}\, dF(y) \quad = \quad t' \textstyle\int_{(as+b)/(s-t')}^{\infty} y dF(y) \end{aligned} \tag{23}$$

Again a closed-form solution for t' is not available.

The labour supply implications of this type of piecewise-linear tax and transfer system are complex, particularly because of the non-convexities in individuals' budget sets arising from the reduction in the effective marginal tax rate as entitlement to the means-tested benefit is exhausted.[26]

Again the above results are likely to be modified by labour supply responses to the tax reform. Their overall effect is unclear *a priori* as it depends on the initial distribution of income and the balance of income and substitution effects. This reform involves a minimum of changes – adjusting t while keeping net incomes of the low-income people unchanged – and of course it would be possible to modify other parameters.

4 Policy Simulations for Australia

The previous section shows that, even in simple stylised structures, it is not easy to design policy changes involving elimination of the tax-free threshold which are both revenue and distribution neutral. This may be further complicated by labour supply responses. Furthermore, arguments for cutting the threshold are often accompanied by proposals for flattening the income tax rate structure, adding a further complication. Practical policy analysis

[25] It is required to have $(b + as) + (1 - s)\, y'_T = (1 - t')\, y'_T$, which can be solved for y'_T.

[26] See Creedy and Kalb (2006, 2005a) for discussion of labour supply modelling in continuous and discrete hours models.

requires the use of a behavioural microsimulation model, capable of dealing with the full complexity of the many elements of the tax and transfer system and the considerable degree of population heterogeneity, as well as labour supply behaviour. It is also useful to consider a range of implications of the policy changes for which summary measures can be computed. This provides information which people can use to form their own judgements.

The Melbourne Institute Tax and Transfer Simulator (MITTS) provides such a policy tool, and is used in this section to examine the effects of several hypothetical policy changes in Australia, each involving the abolition of the tax-free threshold. See Appendix A for a brief summary of the model. The Survey of Income and Housing Costs (SIHC) for 2003/2004 was used as the database in the analyses in this paper. Hence the tax and benefit changes examined apply to rates and thresholds in that year. The alternative policy changes are described in subsection 4.1. The main aggregate summary measures are reported in subsection 4.2, and subsections 4.3 and 4.4 consider labour supply and welfare changes respectively.

4.1 Description of the Hypothetical Policy Changes

Four alternative policy changes were examined, each involving the elimination of the tax-free threshold. In finding the (approximately) revenue neutral tax rates, a process of trial and error was necessary. Only integer tax rates were considered.[27] Adjustments were made to the rates, rather than the tax thresholds. The income tax structures and other features of the four policies are listed in Table 1, which gives the marginal tax rates applying between the relevant thresholds in the current structure and in the four alternative policies considered. Detailed descriptions of each of the four policy changes follow in sections 4.1.1 to 4.1.4. These involve adjustments to the Low Income Tax Offset and Pension Rebate, the details of which are described in Appendix C.

4.1.1 Policy 1

First, the tax-free threshold is eliminated and everyone earning less than $21,600 in 2003/04 is compensated with an additional Low Income Tax Offset of $1,020 (added to the $235 that was available in 2003/04). This policy corresponds to going from Figure 5 to Figure 6 in

[27] The costs of reducing separately each of the marginal tax rates by one percentage point were found to be approximately 1.4 billion dollars for the 17 per cent tax rate, 1.5 billion dollars for the 30 per cent tax rates, 200 million dollars for the 42 per cent tax rate and 500 million dollars for the 47 tax rate. These are only indicative values at the margin and they assume fixed labour supply. The cost of further reducing the marginal tax rates is not expected to be linear.

Table 1: Marginal Tax Rates (Per Cent) and Other Features of Each Policy

	Income range	Initial tax rate	Rates in policy: 1	2	3	4
1	0 - 6000	0	17	17	17	17
2	6000 - 21600	17	17	17	17	17
3	21600 - 52000	30	27	28	30	29
4	52000 - 62500	42	42	38	30	29
5	over 62500	47	47	47	31	30
Availability of additional features:						
	Extended Low Income Tax Offset		yes	yes	no	no
	Pension Rebate top-up		no	yes	no	no

Section 3.4. This off-set of $1,020 corresponds to 17 per cent of $6,000, which under Policy 1 is paid in additional tax. The remaining excess revenue collected from the higher-income earners is used to reduce the middle income tax rate from 30 to 27 per cent. This policy change is designed to be approximately revenue neutral under fixed labour supply. Assuming fixed labour supply, the amount of Pension Rebates decreases by $19.6 million for couples. Furthermore, 63,000 fewer individuals receive it.[28] This arises from the fact that unlike other rebates, excess Pension Rebate (relative to income tax payable) can be transferred from one partner to the other within a couple family. This is done without taking other rebates into account.[29] Based on the 2003/04 SIHC sample, 127,000 persons on an individual gross income below $21,600 are expected to experience a decrease in their individual net income following the decrease in their Pension Rebate.[30] This is due to the fact that less Pension Rebate can be transferred to them by their partner after the tax increase.

Although some individuals are expected to be worse off after the elimination of the tax-free threshold, the fact that as many as 127,000 of them would have an individual income below $21,600 is an unexpected result. This is of concern because the aim of this policy change is to eliminate the tax-free threshold, while making sure low-income earners are fully compensated through the extension of the Low Income Tax Offset. This is an example of the type of interaction between tax and benefit structures that is not immediately obvious when considering separate components.

[28] These aggregate figures are obtained by multiplying the samples numbers by their sample weights, provided by the SIHC.

[29] See Appendix C for details. For details of the wide range of benefits in Australia, see Australian Government Department of Family and Community Services (2004). For details on taxes and rebates, see Australian Taxation Office (2006).

[30] The unweighted number in the SIHC is 187.

4.1.2 Policy 2

The second policy change is a small variation on Policy 1 which attempts to compensate for the reduction in the Pension Rebate for some low-income couples under Policy 1. It is difficult to compensate the pension recipients who lose income without overcompensating other income units or applying arbitrary changes. In Policy 2, the Low Income Tax Offset is increased as in Policy 1. In addition, the extra revenue generated from the elimination of the tax-free threshold is used to provide low-income partnered pension recipients with a Pension Rebate top-up, even though this means some other pension recipients are overcompensated as a result. The Pension Rebate, which is $304 per year for couples, is increased by $1,020 to compensate them. This benefits only partnered pension recipients. The remaining extra revenue is less than in Policy 1. Therefore, the middle income tax rate can only be reduced from 30 to 28 per cent. The remaining extra revenue is enough to lower the 42 per cent tax rate to 38 per cent. Again, the policy change is designed to be approximately revenue neutral under fixed labour supply.

4.1.3 Policy 3

The third policy change considers the elimination of the tax-free threshold accompanied by a reduction in the top two tax rates without increasing the Low Income Tax Offset. This policy is similar to the reform presented in Figure 4 in Section 3.3, although that was based on a simplified tax and transfer system. The 42 per cent tax rate is reduced to 30 per cent and the 47 per cent tax rate is reduced to 31 per cent. This ensures that the policy change is approximately revenue neutral under fixed labour supply. Only high-income earners benefit from these tax cuts and the amount provided is unbounded, depending only on taxable income. As a result, very high income earners could be compensated by much more than they lost as a result of the elimination of the tax-free threshold.

4.1.4 Policy 4

The simulation results presented below show that, although Policy 3 is revenue neutral with fixed labour supply, the allowance for labour supply responses produces a substantial increase in total net revenue. This is because Policy 3 generates a substantial increase in labour supply, which translates into a large increase in net government revenue. In Policy 4, this extra revenue is used to reduce the three top income tax rates further, so that revenue neutrality is restored after allowing for labour supply responses. The 30 and 42 per cent

tax rates are each reduced to 29 per cent and the 47 per cent tax rate is reduced to 30 per cent.

4.2 Summary of Aggregate Effects of Policy Changes

Table 2 summarises the aggregate results for each of the four policies examined, separately for four demographic groups. Separate econometric estimates of preference functions are available within MITTS for each of the demographic groups. For couples, the first figure for average hours change relates to the male partner while the second figure is for the female partner.

Aggregate effects of the policy changes are calculated by adding all equivalent variations (EV), compensating variations (CV) and net incomes across all income units, using the survey weights provided with the SIHC data to obtain population level results. A positive value for the compensating or equivalent variation indicates a welfare loss. In terms of social evaluations, the focus on aggregate amounts can be regarded as equivalent to the assumption of zero relative inequality aversion.

The results show that Policies 1 and 2 imply very small changes. This is because low-income households are almost fully compensated by the additional Low Income Tax Offset. As a result, their labour supply responses are negligible and both policy changes are approximately revenue neutral under both fixed and flexible labour supply assumptions. In Policy 1, couples appear to be the only demographic group losing from the policy change in terms of aggregate net income and welfare. As explained in Section 4.1.1, this is due to the Pension Rebate being held constant. In addition, they are more likely to be on a higher income than other groups and are therefore less likely to be fully compensated. By contrast, couples are the only demographic group to see an increase in their aggregate net income and welfare under Policy 2 because they are the only demographic group to benefit from the increase in the Pension Rebate (and some couples are actually overcompensated). In addition, they also benefit more from the reduction in the fourth tax rate, since they tend to have higher incomes than other demographic groups.

The results for Policies 3 and 4 show that labour supply responses are expected to be substantial if the elimination of the tax-free threshold is accompanied by reductions in the top tax rates instead of an increase in the Low Income Tax Offset. Labour supply responses are discussed in more detail in the next subsection. Following the large increase in labour supply, Policy 3, which is approximately revenue neutral under fixed labour supply, leads to a significant increase in net government revenue. Aggregate net income and welfare

Table 2: Summary of Aggregate Results (Million Dollars per Year)

	Couples	Single men	Single women	Single parents	All
Policy 1					
Change in:					
Net govt revenue (fixed labour supply)	92	-32	-38	-9	13
Net govt revenue (variable lab. sup.)	61	-29	-33	0	-1
Average hours (in hours per week)	0.00/0.00	0.01	0.01	0.05	0.01
Aggregate net income	-130	30	37	18	-44
Compensating variation	91	-32	-38	-9	11
Equivalent variation	91	-32	-38	-9	12
Diff b/w net inc change and EV (in %)	-30.3	6.3	2.8	-52.2	-73.9
Policy 2					
Change in:					
Net govt revenue (fixed labour supply)	-113	86	54	12	40
Net govt revenue (variable lab. sup.)	-163	69	47	-5	-53
Average hours (in hours per week)	-0.03/-0.07	-0.02	-0.01	-0.03	-0.01
Aggregate net income	41	-112	-68	-20	-159
Compensating variation	-119	86	54	11	33
Equivalent variation	-118	86	54	12	34
Diff b/w net inc change and EV (in %)	187.2	-22.7	-20.3	-43.1	-78.8
Policy 3					
Change in:					
Net govt revenue (fixed labour supply)	-1,595	573	824	372	174
Net govt revenue (variable lab. sup.)	0	910	1,023	419	2,352
Average hours (in hours per week)	0.30/-0.05	0.28	0.24	0.13	0.17
Aggregate net income	4,477	-25	-516	-319	3,617
Compensating variation	-2,108	573	807	367	-362
Equivalent variation	-1,868	573	837	374	-84
Diff b/w net inc change and EV (in %)	-58.3	2165.7	62.1	17.4	-97.7
Policy 4					
Change in:					
Net govt revenue (fixed labour supply)	-3,302	246	637	319	-2,100
Net govt revenue (variable lab. sup.)	-1,574	611	850	391	278
Average hours (in hours per week)	0.34/0.00	0.32	0.26	0.22	0.21
Aggregate net income	6,536	362	-302	-244	6,352
Compensating variation	-3,875	246	618	313	-2,699
Equivalent variation	-3,597	246	652	322	-2,377
Diff b/w net inc change and EV (in %)	-45.0	-167.9	116.1	31.8	-62.6

increase for couples but other demographic groups are worse off after the policy change (the only exception is an increase in aggregate net income for single men under Policy 4). This indicates that couples benefit more than other demographic groups from the decreases in the top tax rates.

Summary information regarding winners and losers by income unit decile, while taking into account the predicted labour response, is reported in Table 3 for Policies 1 and 4. There is a sharp contrast between Policy 1, in which low income households are compensated, and Policy 4, in which they are not compensated. Under Policy 1, virtually none of the income units in the bottom three deciles lose, while the proportion of losers goes up with income level. In Policy 1 for high-income households, the elimination of the tax-free threshold is not entirely compensated by the tax cuts. The net income gains for low-income households are achieved through an increase in labour supply (see the next subsection), which explains the limited welfare gains. By contrast, the decrease in net income for high-income households is partly caused by a reduction in labour supply, which limits their welfare losses.

The picture is quite different under Policy 4. A large number of low-income households lose from the policy change in terms of net income, because they are no longer compensated through an increase in the Low Income Tax Offset. Furthermore, the reduction in net income for households in the bottom deciles underestimates their welfare loss due to the increase in labour supply. The main winners are high-income households. They benefit the most from the reductions in the top tax rates. The gains are particularly large for the households belonging to the top decile.

4.3 Labour Supply Response

Table 4 summarises the labour supply responses by males and females for Policies 1 and 4. Under Policy 1, the increase in the labour supply of low-income households is influenced mainly by the reduction in the middle income tax rate from 30 to 27 per cent. For higher-income deciles this effect is likely to be offset by the impact of the elimination of the tax-free threshold, as the additional rebate is withdrawn at a rate of 4 per cent. Hence, so that the proportions of individuals reducing their labour supply become larger than the proportions of those increasing their labour supply. Middle-income households also face a higher effective marginal tax rate since the increased Low Income Tax Offset is tapered out over a larger range of their income.

Under Policy 4, the increase in the labour supply of low-income households is a result of the uncompensated elimination of the tax-free threshold, which has a direct negative impact

Table 3: Winners and Losers by Income Unit Decile

Decile[a]	Percentage of population who:			Ave. change in adult-equivalent (in $/year)		Number of individuals (000s)
	Lose[b]	Stay equal	Win[b]	Net inc	EV	
Policy 1						
1	0.0	80.3	19.7	32.08	-0.06	1,188
2	0.0	90.2	9.8	10.95	-0.25	1,569
3	0.7	73.6	25.8	20.11	-6.98	1,836
4	11.8	37.1	51.1	2.61	3.93	2,322
5	28.9	10.4	60.7	-5.80	7.82	2,207
6	33.1	4.0	62.9	38.89	-38.81	2,122
7	39.7	1.2	59.1	21.26	-28.02	2,204
8	48.7	1.1	50.1	1.55	-13.23	2,108
9	68.3	2.5	29.2	-51.64	28.31	1,973
10	89.2	0.4	10.4	-102.31	71.15	1,986
Total	34.1	25.7	40.3	-4.45	1.96	19,516
Policy 4						
1	53.1	38.6	8.3	-269.68	481.07	1,188
2	61.7	36.8	1.6	-169.05	222.59	1,569
3	77.8	19.5	2.7	-349.93	456.68	1,836
4	91.7	4.4	3.9	-393.27	610.18	2,322
5	85.4	0.8	13.8	-432.04	679.14	2,207
6	77.0	0.2	22.9	-131.86	502.35	2,122
7	71.4	0.0	28.6	62.55	308.12	2,204
8	66.4	0.1	33.5	208.28	130.62	2,108
9	48.5	0.4	51.1	917.52	-547.99	1,973
10	13.7	0.2	86.1	5,668.39	-5,222.93	1,986
Total	66.1	7.9	26.2	526.28	-243.87	19,516

Notes: a) Income unit deciles are based on net income unit income per adult equivalent (before the policy change).

b) Winners are individuals whose net income unit income per adult equivalent goes up by more than $1 per year. Likewise, losers experience a decrease in their net income unit income per adult equivalent of more than $1 per year.

Table 4: Labour Supply Responses by Income Unit Decile

	Men				Women			
	Change in hours (per cent)			Number	Change in hours (per cent)			Number
Decile	Less	None	more	(000s)	Less	None	more	(000s)
Policy 1								
1	0.0	81.5	18.5	552	0.0	85.7	14.3	524
2	0.0	94.3	5.7	601	0.1	94.2	5.7	772
3	0.4	93.8	5.8	574	0.3	90.1	9.6	754
4	5.5	89.0	5.5	700	1.3	89.7	9.0	833
5	9.9	85.9	4.3	701	3.1	88.0	8.9	779
6	9.2	87.8	3.1	729	5.2	87.4	7.4	713
7	14.7	81.9	3.4	756	11.7	79.4	8.9	739
8	16.0	80.7	3.3	805	13.8	78.7	7.5	750
9	21.7	75.0	3.2	811	19.6	74.0	6.4	744
10	18.1	79.0	2.9	891	20.3	76.1	3.6	753
Total	10.6	84.3	5.1	7,122	7.7	84.4	8.0	7,361
Policy 4								
1	3.4	53.1	43.5	552	1.3	66.1	32.7	524
2	0.9	88.1	11.0	601	0.6	93.0	6.4	772
3	2.7	78.5	18.8	574	3.1	82.1	14.8	754
4	8.4	68.5	23.1	700	7.6	76.8	15.6	833
5	12.2	60.4	27.4	701	16.3	58.8	24.8	779
6	12.9	54.0	33.1	729	17.5	55.5	27.0	713
7	22.0	43.8	34.2	756	28.0	42.5	29.4	739
8	23.5	45.4	31.2	805	30.4	40.5	29.1	750
9	19.0	46.3	34.7	811	29.2	43.5	27.2	744
10	22.1	52.1	25.9	891	31.9	45.8	22.3	753
Total	13.8	57.6	28.5	7,122	16.9	60.6	22.5	7,361

on their net income. Moving up in the income distribution, both decreases and increases in labour supply arise for large proportions of the population. The decrease in tax rates means that at high income levels, the income effect allows individuals to maintain their level of net income while working fewer hours. However, there is a substitution effect leading to an increase in labour supply due to the lower marginal tax rates. The combination of these two effects leads to the mixed picture regarding the labour supply responses of high-income households presented in the table.

4.4 Inequality and Welfare Changes

The four policies discussed in this analysis are also expected to affect income distribution and welfare; in particular, Policy 3 and Policy 4 appear likely to affect these two measures. As explained in Appendix A, MITTS uses a discrete hours labour supply model. Appendix B briefly describes the method of computing welfare changes for each individual in a discrete hours context.[31] The behavioural simulations produce a frequency distribution of post-reform hours for each individual, conditional on the individual's optimal pre-reform hours being equal to observed (discretised) hours. This flows on to the welfare calculation, so that consequently a frequency distribution of welfare changes is obtained for each individual, from which the expected welfare change is then calculated as the arithmetic mean value. Again, this is the mean of a conditional distribution.

This information can be used to obtain excess tax burdens and marginal welfare costs for each income unit. Direct comparisons of welfare changes and net income changes can also be made.[32] Population-level evaluations of welfare necessarily involve value judgements, so that a decision must be made regarding the social evaluation method. Any evaluation for a broad group of income units necessarily involves comparisons of units of different size and composition. Value judgements concern three aspects: the welfare metric, the definition of the unit of analysis and the form of the social welfare function to be used. The latter is closely related to value judgements regarding inequality aversion and the implied inequality measure. Different values of inequality aversion are used in the analyses in this paper. The reported results are based on the use of money metric utility per adult equivalent, using the Whiteford equivalence scales reported by Binh and Whiteford (1990), and using the

[31] More detail on the approach can be found in Creedy and Kalb (2005b) and in Creedy, Hérault and Kalb (2007).

[32] For individuals whose labour supply is fixed, for example those who are not in the labour market, the money measure of the welfare change is equal to the net income change.

individual as the unit of analysis.[33]

The steps in the social evaluation are as follows. For each income unit, the initial money metric utility, M_0, is obtained, using pre-reform taxes as 'reference prices'; this is equal to full income under the pre-reform system. Given the approach used to calculate EV and CV, taking into account the non-linearity and non-convexity of the budget constraint, M_0 is calculated in a way that is consistent with this approach. For each income unit, the net income at 80 hours of work by all adult members of the income unit under pre-reform taxes is calculated. Assuming that 80 hours is the maximum number of hours that can be worked per week, this net income represents full income for the income unit. Then, given the expected equivalent variation, EV, resulting from the reform, expected post-reform money metric utility is computed as $M_1 = M_0 - EV$.

For each income unit, the adult equivalent size, s, is obtained using equivalence scales, and this in turn is used to compute money metric utility per adult equivalent, m_{ji}, where j refers to the tax structure and i refers to the income unit. The distributions of pre-reform and post-reform money metric can be used to calculate social evaluations.

In computing inequality measures with the individual as the unit of analysis, each value of m_{ji} is weighted by the actual number of persons in the income unit, n_i. This paper uses Atkinson's inequality measure, $A(\varepsilon)$, where ε is the degree of relative inequality aversion. The inequality measure is expressed as 1 minus the ratio of the equally distributed equivalent value to the arithmetic mean. The equally distributed equivalent value is the value which, if obtained by everyone, gives the same social welfare as the actual distribution. Using an additive welfare function based on constant relative inequality aversion, the equally distributed equivalent value, y_{ede}, is in general, for a set of values y_i, for $i = 1, \ldots, N$, equal to:

$$y_{ede} = \left(\frac{1}{N} \sum_i y_i^{1-\varepsilon} \right)^{1/(1-\varepsilon)} \tag{24}$$

In the present context an adjustment must be made for the weighting by the number of persons in each household. Results can be obtained for a range of inequality aversion parameters, ε. Finally, social welfare in each system is obtained using the abbreviated welfare function, $W_j = \bar{m}_j (1 - A(\varepsilon))$, which is associated with the Atkinson inequality measure (and where $\bar{m}_j$ is the arithmetic mean value of the money metric utility per adult equivalent, m_{ji}). It is then possible to compare results based on money metric utility with those obtained using net incomes in the social welfare function.

[33] It is recognised that the results can be influenced by the choice of adult equivalence scales and unit of analysis, but these are of secondary importance here.

The first four columns in Table 5 provide information about the effects of the four policies on inequality, using a range of Atkinson measures and the Gini inequality index, based on both net income and the money metric measure of utility. As expected, the changes are fairly small under Policies 1 and 2. Only a minor decrease in inequality is observed, which is due to the reduction in net income for some high-income households. Note that the use of net income produces somewhat higher reductions in inequality than the use of money metric utility. This arises due to the failure to value leisure time in measures based on net income only. In contrast, the changes associated with Policies 3 and 4 are much more substantial. As expected, both policies generate large increases in inequality. For the same reason as in Policies 1 and 2, the use of net income produces higher increases in inequality than the use of money metric utility.

Table 5 shows that the magnitude of the percentage increases in Atkinson's index decreases with increasing relative inequality aversion. As the inequality aversion parameter decreases, the Atkinson index becomes more sensitive to changes in the upper end of the income (or money metric) distribution, where the changes are the largest in absolute terms. As a result, the changes in the Atkinson index become larger. This also explains why the Atkinson index is more sensitive to ε in policies 3 and 4, where the top tax rates are lowered, resulting in the largest absolute changes at the upper end of the distribution.[34]

Measures of social welfare, using the iso-elastic social welfare function associated with the use of the Atkinson inequality measure, are given in the last four columns of Table 5. Social welfare is virtually unchanged under Policies 1 and 2. There is a small decline for the lowest value of the inequality aversion parameter but at higher levels of relative inequality aversion, the slight decrease in inequality offsets the minor reduction in aggregate net income, which results in a very small increase in social welfare.

Similar to the effect on inequality, Policies 3 and 4 also generate much larger changes on social welfare. Both policies improve social welfare at the lowest level of relative inequality aversion and the improvements are highest for the measures based on net income. In contrast, social welfare decreases at the highest level of relative inequality aversion because the increase in net income (or money metric utility) no longer offsets the widening of the income distribution sufficiently.

Policy 4 increases social welfare more (or decreases it to a lesser extent) than Policy 3. This is due to the additional government expenditure in Policy 4, spending the additional government revenue generated by the increase in labour supply, due to the abolished tax-

[34] On the other hand, if changes at the bottom end of the income range are larger than changes at the top end, the absolute percentage changes should increase with epsilon.

Table 5: Inequality and Social Welfare Measures

	Atkinson's index				Mean	Social Welfare		
	$\varepsilon = 0.2$	$\varepsilon = 0.8$	$\varepsilon = 1.4$	Gini	value	$\varepsilon = 0.2$	$\varepsilon = 0.8$	$\varepsilon = 1.4$
Pre-reform								
Money metric	0.0177	0.0630	0.1018	0.2186	55,972	54,980	52,444	50,273
Net income	0.0267	0.1008	0.1669	0.2851	27,307	26,577	24,556	22,750
Post-reform								
Policy 1								
Money metric	0.0177	0.0630	0.1017	0.2184	55,970	54,980	52,446	50,277
Change (%)	-0.11	-0.11	-0.10	-0.06	0.00	0.00	0.00	0.01
Net income	0.0267	0.1004	0.1663	0.2845	27,303	26,575	24,561	22,761
Change (%)	-0.35	-0.35	-0.34	-0.18	-0.02	-0.01	0.02	0.05
Policy 2								
Money metric	0.0177	0.0630	0.1017	0.2184	55,967	54,977	52,444	50,275
Change (%)	-0.12	-0.12	-0.12	-0.08	-0.01	-0.01	0.00	0.01
Net income	0.0266	0.1002	0.1661	0.2842	27,294	26,567	24,558	22,761
Change (%)	-0.50	-0.51	-0.50	-0.30	-0.05	-0.04	0.01	0.05
Policy 3								
Money metric	0.0194	0.0686	0.1100	0.2280	56,047	54,957	52,200	49,882
Change (%)	9.73	8.89	8.02	4.34	0.13	-0.04	-0.47	-0.78
Net income	0.0316	0.1158	0.1876	0.3061	27,632	26,759	24,432	22,447
Change (%)	18.02	14.92	12.42	7.39	1.19	0.69	-0.50	-1.33
Policy 4								
Money metric	0.0196	0.0691	0.1107	0.2289	56,216	55,116	52,331	49,991
Change (%)	10.47	9.64	8.76	4.75	0.44	0.25	-0.22	-0.56
Net income	0.0319	0.1170	0.1895	0.3078	27,834	26,946	24,577	22,559
Change (%)	19.26	16.11	13.54	7.97	1.93	1.39	0.09	-0.84

Note: Money metric and net income are per adult equivalent. Social Welfare is the equally distributed equivalent level of money metric utility or net income.

free threshold and reduced top tax rates, to reduce the top tax rates further. However, inequality also increases more under Policy 4, because middle- and high-income households benefit most from the further reduction in the tax rates, increasing the gap between them and low-income households.

5 Conclusions

This paper has examined the role of the tax-free income tax threshold in a complex tax and transfer system consisting of a range of taxes and benefits, each with their own taper rates and thresholds. When considering the introduction of income taxation in societies which had no significant transfer payments and with many individuals regarded as being at a subsistence level, it is not surprising that a tax-free threshold was used. However, particularly in the UK, a 'degressive' rate structure was used to produce proportionality at the higher-income levels: progressivity was not a primary objective of the tax system. Considering a range of tax and benefit systems, particularly those having benefit taper rates whereby some benefits are received by income groups other than those at the bottom of the distribution, for which a sophisticated revenue collection and benefit payment system is in place, it was suggested that a tax-free threshold is not a necessary requirement to achieve redistribution. The simultaneous payment of tax and receipt of benefits does not generate excessive difficulties. What matters is the overall effect of the system.

Four alternative policy changes, each involving the elimination of the tax-free threshold in Australia and designed to achieve approximate revenue neutrality, were examined using the Melbourne Institute Tax and Transfer Simulator. A range of implications were examined, including labour supply responses to tax changes, and the effects of policy changes on inequality and social welfare.

The first two policies ensure that low-income individuals are fully compensated through an extension of the Low Income Tax Offset. In addition, the extra revenue raised from higher incomes as a result of the extension of the tax base was used to reduce the middle (marginal) income tax rate. Both policies were close to being both revenue neutral and distribution neutral, with only high-income households experiencing a decrease in net income. As a result of the small changes, labour supply incentives hardly changed and therefore labour supply remained nearly the same as before the policy change.

The third and fourth policies also eliminated the tax-free threshold and at the same time aimed to flatten the marginal tax rate structure. These policies did not compensate low-income individuals at all, but instead reduced the top tax rates. Again the policies were

close to revenue neutral (the third policy under fixed labour supply and the fourth after allowing for labour supply responses) but, as expected, they were no longer distribution neutral. The lowest-income households are affected the most negatively, and some of the high-income households are much better off after the policy change. As a result of the large changes in net income, large labour supply responses are also observed. Both increases and decreases are predicted, with the average effect being an increase, and the predominant effect for low-income individuals also being an increase in labour supply. The cost of this increased labour supply is higher inequality and a decrease in social welfare when evaluated at medium to high levels of relative inequality aversion.

The results therefore demonstrate that it is possible to eliminate the tax-free threshold under approximate overall revenue and distribution neutrality, but that it is impossible to improve labour supply incentives at the same time. In fact, not much changes in the first two policies which are revenue and distribution neutral. In order to achieve improved incentives, either revenue or distribution neutrality has to be sacrificed.

Appendix A: The Melbourne Institute Tax and Transfer Simulator

This appendix provides a brief description of the Melbourne Institute Tax and Transfer Simulator (MITTS), a behavioural microsimulation model of direct tax and transfers in Australia. Since the first version was completed in 2000, it has undergone a range of substantial developments. MITTS is based on the Australian Survey of Income and Housing Costs (SIHC), a representative sample of the Australian population, containing detailed information on labour supply and income from different sources, in addition to a variety of background characteristics of individuals and households. All results are aggregated to the population level using the household weights provided with SIHC. Pre-reform net incomes at alternative hours levels are based on the MITTS calculation of entitlements, not the actual receipt. Furthermore, MITTS applies only income tests, as there is at present no asset imputation in the model. All major social security payments and income taxes are included in MITTS, ensuring a reasonable approximation to net income by MITTS.

MITTS consists of two components. MITTS-A is the arithmetic tax and benefit modelling component and provides, using the wage rate of each individual, the budget constraints that are crucial for the analysis of behavioural responses to tax changes. For those individuals in the data set who are not working, an imputed wage is obtained. MITTS-B examines the effects of any specified tax reform, allowing individuals to adjust their labour supply. Behaviour is based on quadratic preference functions where the parameters are allowed to vary with individuals' characteristics. Individuals are considered as being constrained to select from a discrete set of hours levels. For singles, 11 discrete points are distinguished. For the couples in the labour supply estimation, two sets of discrete labour supply points are used. The female hours distribution covers a wider range of part-time and full-time hours than the male distribution, which is mostly divided between non-participation and full-time work. Therefore, women's labour supply is divided into 11 discrete points, whereas men's labour supply is represented by just 6 points. The joint labour supply of couples is estimated simultaneously, unlike a popular approach in which female labour supply is estimated with the spouse's labour supply taken as exogenous. Thus for couples there are 66 possible joint labour supply combinations.

Simulations are probabilistic, as utility at each hours level is specified as the sum of a deterministic component (depending on hours worked and net income) and a random component. Hence MITTS generates a probability distribution over the discrete hours

levels. The self-employed, disabled, students and those over 65 have their labour supply fixed at observed hours. Simulations begin by recording the discrete hours level for each individual that is closest to the observed hours level. The deterministic component of utility is obtained using the parameter estimates of the quadratic preference function. To generate the random component, a draw is taken from the distribution of the error term for each hours level (an Extreme Value Type I distribution). The utility-maximising hours level is found by adding the two components of utility for each hours level and choosing the hours with the highest utility. Draws from the error terms are taken conditionally on the observed labour supply; that is, they are taken in such a way that the optimal pre-reform labour supply is equal to the actually observed labour supply. As a result, post-reform labour supply is simulated conditional on the observed pre-reform labour supply. A user-specified number of draws is produced.

For the post-reform analysis, the new net incomes cause the deterministic component of utility at each hours level to change, so using the same set of draws from the calibration stage, a new set of optimal hours of work is produced. This gives rise to a probability distribution over the set of discrete hours for each individual under the new tax and transfer structure. Post-reform labour supply is based on the average value over the draws. This is equivalent to calculating the expected hours of labour supply after the change, conditional on starting from the observed hours before the change. In computing tax and revenue levels, an expected value is also obtained after the policy change.

Appendix B: Welfare Changes in Discrete Hours Framework

Individuals are restricted to hours levels $h_1, ..., h_H$ and the utility function and net incomes at each point are known. The optimal number of hours is obtained by calculating utilities at H points, each of which is treated as a corner solution. Let U_j^k denote utility obtained from hours level h_k and tax and transfer system j. A similar convention is used when referring to virtual non-wage income, μ, and virtual wages, w, except that an additional subscript is needed to refer to the discrete hours level to which the virtual values relate.[35] Hence the virtual wage, $w_{0,j}^k$ is the slope of indifference curve U_0^k at the discrete hours point h_j. Similarly, $\mu_{0,j}^k$ is the corresponding virtual non-wage income, which is represented by the

[35] Any position can be regarded as being generated by a linear virtual constraint $c = wh + \mu$, where c is consumption (assumed to be equal to net income).

intercept on the net income axis of the tangent to the indifference curve, U_0^k, at the discrete hours level h_j.

Consider Figure 7, where four discrete hours levels are available. The original optimal position is at point A on indifference curve, U_0^3, corresponding to h_3 hours of work. A tax reform causes the optimal position to shift to B on indifference curve U_1^2, involving h_2 hours of work. The virtual linear budget constraints associated with A and B are defined by the pairs $\left(\mu_{0,3}^3, w_{0,3}^3\right)$ and $\left(\mu_{1,2}^2, \mu_{1,2}^2\right)$ respectively.[36] The standard compensating variation is the difference between the net incomes at points D and B, but labour supply between h_1 and h_2 hours of work is not available, so U_0^3 cannot be reached. In addition, even if the labour supply point were available, the nonlinearity and nonconvexity of the budget constraint may make the actual compensation required at this point different from the distance between D and B. At h_2 hours of work, at least the difference between the net incomes at points E and B is required although it is not necessarily the minimum compensation needed when hours of work are allowed to vary over the discrete points available. It may be possible to work $h_i \neq h_2$ hours and reach indifference curve U_0^3 with a smaller increase to net income than the distance BE.

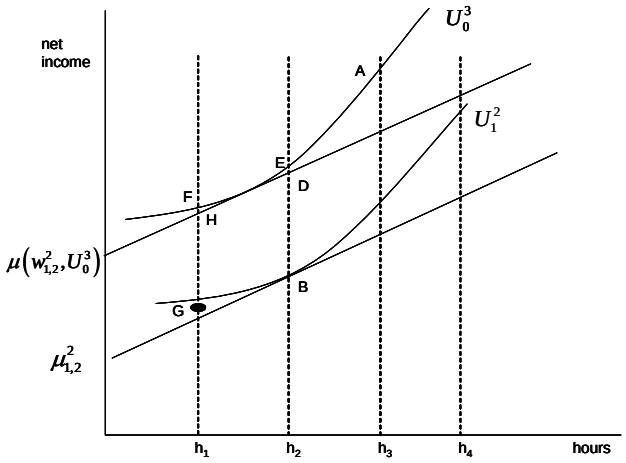

Figure 7: Compensating Variation in Discrete Hours Labour Supply Context

The virtual wage corresponding to h_2 at point E on U_0^3, and $\mu_{0,2}^3$ represents the associated virtual income.[37] To determine the compensating variation, the distance between the current

[36] For each hours point, h_j, c_j^0 and c_j^1 can be determined, after which $U\left(c_j^0, h_j\right)$ can be calculated. Then $w_{0,i}^i$ is the virtual wage in the optimal point h_i associated with utility level U_0^i and $\mu_{0,i}^i = c_i^0 - w_{0,i}^i h_i$.

[37] Determine $c_{0,2}^3$ needed to reach U_0^3 in h_2 by solving for c in $U\left(c, h_2\right) = U_0^3$ and then use $\mu_{0,2}^3 = c_{0,2}^3 - w_{0,2}^3 h_2$.

budget constraint and net income required to reach the original utility level U_0^3 must be determined at all labour supply levels. For example, if net income at h_1 in system 1 is at point G (which is above the virtual linear budget constraint associated with B), it is possible that the distance between G and F is smaller than that between B and E. Even if G were slightly below the virtual budget line through B, it is possible for the compensating variation to be lower than if hours were fixed at h_2, depending on the distance FH compared with ED. Point G is the combination of net income on the actual budget constraint under the post-reform tax system and hours level h_1, so the indifference curve through this point is labelled U_1^1. At G, the compensation required to reach U_0^3 is the length GF, given by:

$$\begin{aligned} CV &= \left\{\mu_{0,1}^3 + w_{0,1}^3 h_1\right\} - \left\{\mu_{1,1}^1 + w_{1,1}^1 h_1\right\} \\ &= \left\{\mu_{0,1}^3 - \mu_{1,1}^1\right\} + \left\{w_{0,1}^3 - w_{1,1}^1\right\} h_1 \end{aligned} \tag{B.1}$$

The appropriate compensation is the minimum of this type of difference, over all discrete hours points. This procedure requires only the calculation of net income corresponding to a specified hours level and indifference curve, for a limited number of different hours levels.

Appendix C: Rebates

In Australia, a number of rebates (or offsets) are available to reduce the tax payable for specific groups. The rebates can only be used to offset taxes that are payable; they cannot be paid. Rebates reduce the tax payable by a certain amount rather than the taxable income. This appendix discusses the two rebates that are most relevant in the four policy changes analysed in this paper: the Pension Rebate and the Low Income Tax Offset.

C.1: The Pension Rebate

All recipients of taxable social security and Veterans Affairs service pensions, including the parenting payment (single), may be eligible for the pensioner rebate. Once taxable income reaches a threshold of y_T the rebate is shaded out at 12.5 cents for each dollar above the threshold. The maximum rebate level is calculated as the difference between the threshold level of income, y_T, and the tax-free (or first) threshold y_{TFT} (AU$6,000 per year) multiplied by the lowest marginal tax rate, τ_L (17 per cent). Thus the maximum rebate, $\max PR$, is given by:

$$\max PR = \tau_L(y_T - y_{TFT}) \tag{C.1}$$

The threshold amount is the sum of the maximum annual base pension payable, P_B, plus the income-free area for the pension per person, P_F/n (where n is 1 or 2, depending on whether the individual is single or partnered). These two amounts differ depending on the type of pension and the composition of the household. Thus:

$$y_T = P_B + P_F/n \tag{C.2}$$

The pensioner rebate is thus calculated as:

$$\begin{array}{rll} PR & = \max PR & \text{if } y < y_T \\ & = \max[0, \max PR - 0.125(y - y_T)] & \text{if } y \geq y_T \end{array} \tag{C.3}$$

Partnered pensioners can transfer the unused portion of their rebate to their partner if the partner has a tax liability. However, the calculation of the unused portion of their rebate does not take the presence of other rebates into account. If the amount of the Pension Rebate is less than the amount of income tax to be paid, no transfer takes place.

In the first two policies, y_{TFT} is kept at AU$6,000 since the Low Income Tax Offset takes over the role of the tax free income range for low-income households. The tax rate in the first income range is in effect raised from 0 to 17 per cent, while keeping the first tax threshold, although there is no longer a tax rate change at this level. The problem under Policy 1 arises because low-income individuals transfer less rebate to their partners, since they start paying tax from the first dollar of earnings. Although the additional tax payment is compensated by the increased Low Income Tax Offset, the pension rebate calculation does not take into account this increased Low Income Tax Offset and assumes that the low-income individual pays enough tax to offset the Pension Rebate against. At the final stage of rebate calculation, when all rebates are added together, there is more rebate than tax payable for these low-income individuals. As a result, less than the full sum of rebates is paid out and the higher income partner does not benefit to the same extent as before from a transfer in the Pension Rebate, resulting in a decrease in net income.

C.2: The Low Income Tax Offset

Individuals with annual taxable income below AU$21,600 are entitled to the Low Income Tax Offset (LITO). The maximum level of the rebate is AU$235 per year and is reduced by 4 cents for every dollar of taxable income above the threshold. Denoting the individual's income by y, the annual amount of Low Income Tax Offset is calculated as:

$$\begin{array}{rll} LITO & = \$235 & \text{if } y < \$21,600 \\ & = \max[0, \$235 - 0.04(y - \$21,600)] & \text{if } y \geq \$21,600 \end{array} \tag{C.4}$$

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