Designing Direct Tax Reforms: Alternative Approaches

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Abstract

How high should the top personal income tax rate be? Is there an 'optimal' structure of tax rates and thresholds? Despite numerous value judgements being required to answer such questions, this paper suggests that 'rational policy analysis' principles can nevertheless be applied to support policy advice on these and other direct tax design questions. It is argued that the economic models thought suitable as the basis for tax analysis vary according to the precise ways in which the policy question is formulated; the underlying behavioural responses to taxation expected across the tax-paying population; the precise definitions of key variables such as income inequality; and the specification of policy objectives such as redistribution, revenue-raising or tax efficiency.

1 Introduction

Students of public finance are typically introduced to a wide range of simple theoretical tax models.[1] These are valuable in introducing central concepts (such as tax incidence and excess burdens), along with generating an awareness of interdependencies and different methods of analysis. They stress the nature of constraints on policy choices, and help to develop intuition and an appreciation of common fallacies and general results, in the few cases where they apply. Those who later become professional economists, for example as public sector policy analysts, are faced with the practical challenge of offering advice to ministers, or contributing to the wider policy debate, where it rapidly becomes clear that a different kind of analysis is required. For reliable advice in practice, it often becomes necessary to be able to model the details of complex tax and transfer systems, and to deal with the considerable population heterogeneity observed in practice.

There is an additional serious complication, which should also be clear from theoretical training: that policy recommendations cannot be free of value judgements.[2] Faced with this problem, particularly when government ministers and others seldom articulate their value judgements clearly, there is a central role for 'rational policy analysis'. That is, instead of simply making a single recommendation, it is important to consider the implications of adopting a range of explicit value judgements, thereby presenting alternative results as clearly as possible.[3] Different 'consumers' are then equipped to make their own policy choices.[4]

In the context of tax and transfer policy the need for rational policy analysis is particularly important. Tax is a perennial topic of debate, and these debates often generate more heat than light. Subjective preferences are conflated with positive analysis, giving rise to confused or inconsistent policy prescriptions. This is especially likely where the objectives and outcomes of policy reform are not made clear, or where arbitrary constraints are imposed on policy choices.[5]

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[1] They are described as being simple only in terms of tax structures examined: for example, the general equilibrium model used to examine tax incidence is far from simple.

[2] Care must be taken when suggesting that a policy change produces only an improvement in efficiency, when implicitly using the Pareto Criterion, since this is itself a Value Judgement.

[3] The discussion is not therefore concerned with what have come to be called 'positive political economy' issues relating, for example, to the actual behaviour of governments, how decisions are made in practice, and the analysis of voting outcomes.

[4] This type of approach was articulated in the famous book by Robbins (1935), in which he clarified the valuable role economists can play in analysing policies in which value judgements are central.

[5] The New Zealand Government's Tax Working Group report (TWG, 2019) provides a recent, but not uncommon, example. The remit from the government to the TWG was 'to assess the structure, fairness and balance of the tax system' (TWG, 2019, p.7). In particular, it was encouraged to investigate reform involving the tax treatment of capital gains as a means of redressing perceived 'unfairness'. Yet it was prohibited from considering changes to the income tax structure as another means of using the tax system to address that unfairness. The Group's unanimous response was to recommend the introduction of a highly

In choosing a framework with which to evaluate a tax system, or proposed reforms, an important starting point concerns the type of economic model which can usefully be employed. Thus, various reviews of tax policy in a number of countries in recent years have begun by setting out principles or frameworks within which the merits of individuals tax or tax system designs can be assessed.[6] The purpose of this paper is more specific: to review the frameworks or models that are available to facilitate rational policy debate over income tax policies. All models are subject to limitations, since they necessarily involve a number of abstractions from reality, and are designed for specific purposes. They cannot therefore be expected to provide information about all possible responses to, and effects of, tax changes. Analyses therefore usually need to be presented with appropriate caveats (and suggestions regarding those which are expected to be most important).

Illustrations are given in the context of the New Zealand income tax, but many of the modelling and policy choice issues discussed have a much wider applicability. The paper seeks to clarify policy objectives and outcomes so that analyses can shed light on the merits of alternative reform options. It addresses the question of what kinds of information can usefully be presented when formal tax reform proposals are being considered. The personal income tax is the tax most often tasked with addressing equity aspects within the tax system, and is also recognised to have direct efficiency consequences. In order to focus on a particular concrete example, special attention is given to changes in the top marginal income tax rate and the income threshold above which that rate applies.

Such changes have been given considerable attention in recent tax debates in New Zealand and elsewhere, with the appropriate amount of tax levied on the 'top 1 per cent' (or top 0.1 per cent) of taxpayers becoming something of a fixation in popular inequality debates and related academic studies. Focus on the top income tax rate and threshold often derives from the mistaken view that tax rate progression (which reflects the extent to which *marginal* rates increase as taxable income increases) is necessary for income redistribution. Rather, it is the combined effect of different taxes and social transfer payments – rather than simply the income tax schedule – and their impact on *average* tax rates which ultimately matters for redistribution.[7]

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progressive capital gains tax, yet without any consideration of how far fairness or progressivity objectives might be achieved instead (or as well as) through income tax or social transfers reform. This TWG should not be confused with the Victoria University Tax Working Group, which reported early in 2010; see Buckle (2010) and https://www.wgtn.ac.nz/sacl/centres-and-institutes/cagtr/twg.

[6]Examples of such reviews in the last decade include the Victoria University Tax Working Group review (Buckle, 2010) and the New Zealand Government Tax Working Group (TWG, 2018, 2019) for New Zealand; the Mirrlees Review (Mirrlees, 2011) for the UK; the Henry Review (Austrlian Treasury, 2009) and Australian Treasury (2015) for Australia.

[7]Social transfers can mostly be modelled as analogous to negative income taxes and can have the important effect of producing negative average tax rates over a significant range of incomes. It is therefore also necessary

The remainder of the paper is organised as follows. Section 2, first considers how a 'revenue calculator' can be used to assess a proposal to raise the top marginal income tax rate and income threshold in a revenue-neutral way. In the New Zealand case this is available from the NZ Treasury website, but most countries' fiscal authorities or tax research institutions have such calculators.[8] The paper then discusses the use of two microsimulation models – arithmetic and behavioural – to compare reforms involving top marginal rate and threshold changes. A particular advantage of microsimulation models is that they enable detailed examination of potential effects of specified tax and transfer changes, and a wide range of evaluation methods, thereby allowing people to assess outcomes based on their own judgements.

The next two sections discuss different approaches to identifying 'optimal' directions for tax reform. One strand, discussed in Section 3, is based on a behavioural microsimulation model. Since there is no such thing as an objectively optimal tax structure or reform, behavioural microsimulation modelling makes no attempt to solve for such an optimum. Instead, it can be used to search systematically for reforms involving movements which represent welfare improvements (suitably defined), starting from the actual structure. Governments in practice do not have a 'blank canvas' on which to set out an optimal policy, but must make adjustments to an existing system. Therefore, it is argued that the microsimulation approach provides a practical tool for designing tax policy reforms, based on a range of transparently stated value judgements.

An alternative approach to tax design, examined in Section 4, eschews detailed structural modelling and the complexities of population heterogeneity, and makes use of the Feldstein (1995) concept of the elasticity of taxable income, ETI. This approach focusses instead on the combined effect of various responses to tax reform, observed in the form of resulting changes to declared taxable incomes. In this case, the optimal top tax rate can be evaluated via the equity, efficiency and revenue trade-offs associated with those taxable income changes across the taxpayer income distribution. The difficulties involved with specifying an appropriate evaluation function are also discussed in this section. Section 5 provides numerical examples, applied to the New Zealand tax structure and income distribution. Some general tax design and modelling conclusions are drawn in Section 6.

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to differentiate marginal rate progression from the concept of tax progressivity (which reflects the extent to which *average* tax rates increase as incomes increase) and income redistribution reflected in a reduction in net income inequality. The latter also depends crucially on the taxable income distribution, since this determines the number of individuals in the different tax brackets.

[8]Income tax and benefit calculators or microsimulation models have been developed for a number of countries, such as at the US National Bureau of Economic Research (TAXSIMl), the UK Institute for Fiscal Studies (TAXBEN), the Melbourne Institute in Australia (MITTS) and EUROMOD for European Community countries.

2   The Top Income Tax Rate and Threshold

The current income tax structure in New Zealand is shown in Table 1.[9] A distinguishing feature of this income tax is that there is no tax-free income range, so that the first rate of 10.5 per cent applies from the first dollar, although various rebates also apply. Hence, the marginal income tax rates, particularly in the lower-income ranges, do not reflect effective marginal tax rates in view of the existence of a range of means-tested benefits with various taper or abatement rates. In addition, child-based family tax credits are paid to families with children, based on household income levels and (in some cases) hours of work. These refundable tax credits (they are paid as a lump-sum transfer even when no taxable income is earned) serve to reduce the average tax rate for families with children, and generate negative average rates for the lowest 3 to 4 deciles of the taxable income distribution.[10]

Table 1: The New Zealand Income Tax Structure

No.	Income threshold (in NZ$)	Marginal tax rate (per cent)
1	1	10.5
2	14,000	17.5
3	48,000	30.0
4	70,000	33.0

2.1   A Tax Calculator

A desirable feature of a proposed tax structure change is that it is revenue-neutral or, more strictly, deficit-neutral, otherwise there is an implicit but unspecified additional expenditure or tax change involved. Of course, a tax change may be explicitly designed to raise net revenue, to be used for some other type of expenditure policy, such as infrastructure spending. In that case, the full costs (including efficiency costs in terms of excess tax burdens) need to be evaluated, for comparison with measures of the expected benefits of the spending policy. Therefore, a crucial characteristic of any policy design tool, or model, is that it should be capable of providing information about aggregate expenditure and revenue, so that those making proposals can either reasonably argue that net-revenue is unchanged, or provide precise details of revenue changes. Such a feature, while a necessary requirement, is clearly

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[9]This has remained constant since 2011/12.

[10]For example, OECD data show that for a family with two children and two income earners (one earning average income the other earning 33 per cent of average income), their average income tax rate was 10.8 per cent in 2018, the second lowest out of 37 OECD countries. For a single earner on 67 per cent of average income and two children, the average tax rate was the lowest in the OCED at -20.5 per cent. See https://www1.compareyourcountry.org/taxing-wages.

not sufficient since it does not provide information about how the policy proposal meets a range of broader policy objectives.

In quantifying a possible balance of top tax rate and threshold changes, one recent proposal used the New Zealand Treasury's revenue calculator (formally, the *Aggregate Personal Income Tax Revenue Estimate Tool*) to call for an increase in both the top tax rate and the associated income threshold.[11] The *Revenue Estimate Tool* is an easy-to-use Excel file that allows anyone to examine the net income tax revenue effects of a range of rate and threshold changes.[12] It also provides information, in the form of a graph, on variations in average and marginal tax rates facing individuals over a wide range of income. However, it considers only the personal income tax, excludes family-based and other tax credits and does not consider the possible implications for social benefit payments of income tax reforms. It also provides no measures of, for example, distributional effects.

The proposal was to raise the top marginal income tax rate from 33 to 34.5 per cent which allows the top threshold to be increased from \$70,000 to \$90,000 while maintaining constant the aggregate income tax revenue.[13] The rationale given for this proposal is that fiscal drag, arising from income growth with unchanged tax thresholds, means that an increasing number of people have moved into the top tax bracket. Yet a correction for fiscal drag would require all thresholds to be increased, so it is not clear why the proposal focussed only on the top marginal rate. No reference to progressivity or income inequality was made, although it was stressed that, of those people formerly in the top threshold, all those with taxable incomes above \$70,000 and below \$130,000 would be better off.[14]

A key difficulty with such tax calculator-based proposals is that they merely identify reform possibilities. They do not allow consideration of wider implications that are necessary for rational policy debate. In addition, without inclusion of the main tax credits and social welfare payments, the resulting average tax rates, especially at the lower end of the income distribution, can represent a misleading apparent quantification of the progressivity of the broader income tax and transfer system. It does not consider labour supply or other responses to any tax changes assumed: as such, it provides an indication of broad orders of

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[11]The proposal was discussed in an article in June 2019 by New Zealand journalist Tom Pullar-Strecker, in consultation with Geof Nightingale, a PwC tax partner and member of the 2019 Tax Working Group. See: https://www.stuff.co.nz/business/113361003/raising-top-tax-rate-by-just-15-would-pay-for-big-hike-in-the-70000-threshold.

[12]See: https://treasury.govt.nz/publications/model/aggregate-personal-income-tax-revenue-estimate-tool

[13]A process of trial and error is required to search for combinations of tax parameters giving revenue neutrality: Appendix A shows how comparisons of revenue neutral changes to the top income tax rate can easily be made, using very little summary information. In fact, using the Treasury *Tool* shows that the top threshold can be increased to \$91,000 for revenue neutrality.

[14]For a new threshold of \$91,000, mentioned in the previous footnote, the income for which the average tax rate is unchanged is \$133,000.

magnitude. Nevertheless, the Treasury *Revenue Estimate Tool* enables rapid comparisons of the implications for average tax rates and total revenue of alternative rate structures, for a fixed taxable income distribution.

2.2 Microsimulation Modelling

For practical policy advice that is based on the full complexities both of the tax and transfer system and the nature of population heterogeneity, a tax microsimulation model can provide a valuable tool. Such a model, based on a large cross-sectional micro-dataset, is able to compute a range of summary measures for the existing, or 'base' tax structure, and hypothetical or proposed reforms to taxes or benefits. The present section provides illustrative results using two complementary models, TaxWell-A and TaxWell-B, which were developed within the New Zealand Treasury. The first model produces 'arithmetic' simulations with no behavioural responses, while the second model produces 'behavioural' simulations which allow for labour supply (hours) responses to tax changes.[15] Further information on these microsimulation models is provided in Appendix B.[16]

An increase in the top income tax threshold has the effect of reducing the marginal tax rate for some individuals, and this may be expected to increase their labour supply (although this is ambiguous given that income effects and substitution effects operate in opposite directions). However, another group of individuals face a higher marginal rate. The overall effect on labour supply cannot be known *a priori*, since it depends on whether increases are outweighed by decreases in hours worked.

Using TaxWell-B, and a process of trial and error, it was found that a combination of an increase in the top marginal rate to 34.5 per cent and a top threshold of $94,800 is approximately net-revenue neutral.[17] This threshold is larger than the one produced by the *Revenue Estimate Tool.* Table 2 shows that the unchanged net revenue is associated with tax increases for some demographic groups (couples and sole parents) and reductions in net revenue for single individuals. When labour supply responses are not modelled, the higher threshold produces a reduction in net revenue of $6.6m. This demonstrates the value of a behavioural model in providing guidance as to the likely overall direction of change produced by labour supply responses: the threshold can be somewhat larger than suggested by an arithmetic model. However, the use of a behavioural model must always be qualified

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[15]Responses other than labour supply are not included but are incorporated within the elasticity of taxable income models described in Section 4.

[16]The Treasury has developed a new arithmetic model, labelled TAWA (Tax and Welfare Analysis), but no longer maintains a behavioural model.

[17]The database used is the 2015/2016 Household Economic Survey (the last year for which the model was supported).

by the caveat that it deals only with the supply side of the labour market, and ignores other responses which may arise, including, for example, household formation, fertility, migration or tax avoidance.

Table 2: Aggregate Net Revenue Effects

| | Couples | Single | | Sole | Total |
		male	female	parents	
Without labour supply responses:					
Increase in net revenue ($m)	3.6	-2.1	-5.8	-2.4	-6.6
With labour supply responses:					
Increase in net revenue ($m)	6	-1	-4	1	1
Per cent of sample	46	24	22	8	100

The establishment of a combination of tax parameters which satisfy the constraint of net revenue neutrality is merely a starting point for analysis. It is necessary to consider whether the reform is likely to meet certain objectives. Tax reform can often be described as subject to a 'status quo bias' because politicians are reluctant to see a substantial number of losers. Valuable information about the distribution of gainers and losers can be obtained with the microsimulation model. Concern may also be with overall summary measures of inequality.[18]

This raises many questions, concerning the welfare metric and inequality measures used, along with the unit of analysis. One initial decision relates to the metric used to measure the 'welfare' of individuals: examples are given using net income and 'money metric utility' per adult equivalent person, say m_i.[19] Consider the use of an overall evaluation, or 'social welfare' function, $\widetilde{W}$, which is additive and reflects constant relative inequality aversion, ε, of the form:

$$\widetilde{W} = \frac{1}{1-\varepsilon}\left(\frac{1}{n}\sum_{i=1}^{n}m_i^{1-\varepsilon}\right) \tag{1}$$

This is the form associated with Atkinson's inequality measure, $A(\varepsilon) = 1 - m_{ede}/\bar{m}$, where m_{ede} measure the equally-distributed equivalent value, equal to $\left(\frac{1}{n}\sum_{i=1}^{n}m_i^{1-\varepsilon}\right)^{1/(1-\varepsilon)}$. Social welfare is most conveniently obtained using the abbreviated form of the function in (1), given by:

$$W = \bar{m}\left(1 - A(\varepsilon)\right) \tag{2}$$

The use of the abbreviated form, showing the trade-off between 'equity and efficiency', is convenient because it ensures that W is positive for all values of ε.[20]

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[18]In many contexts, poverty reduction aims are relevant. However, in the present case poverty effects are negligible without adjustment to lower income thresholds and benefit/tax credit levels and abatement rates.

[19]These are generally referred to as 'welfarist' measures (they depend in some way on indivuals' utilities),

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Table 3: Atkinson Inequality Measures for Demographic Groups: Net Income and Money Metric Utility Per Adult Equivalent Person

	Net income			Money metric utility		
	Before	After	% Change	Before	After	% Change
$\varepsilon = 0.2$						
Couple	0.0410	0.0408	-0.66	0.0478	0.0477	-0.31
Couple+dependents	0.0414	0.0409	-1.17	0.0444	0.0442	-0.57
Single	0.0576	0.0576	-0.09	0.0578	0.0577	-0.06
Sole parents	0.0242	0.0243	0.23	0.0280	0.0280	-0.01
All	0.0475	0.0472	-0.60	0.0500	0.0499	-0.31
$\varepsilon = 0.8$						
Couple	0.1618	0.1613	-0.35	0.1971	0.1968	-0.17
Couple+dependents	0.1528	0.1519	-0.61	0.1704	0.1699	-0.30
Single	0.2876	0.2876	0.00	0.3030	0.3030	-0.01
Sole parents	0.0871	0.0874	0.31	0.1004	0.1004	0.04
All	0.1957	0.1952	-0.26	0.2137	0.2134	-0.14
$\varepsilon = 2.0$						
Couple	0.5924	0.5923	-0.02	0.6879	0.6879	-0.01
Couple+dependents	0.4102	0.4098	-0.11	0.5300	0.5298	-0.04
Single	0.8728	0.8729	0.01	0.9159	0.9195	0.00
Sole parents	0.1824	0.1830	0.33	0.2136	0.2138	0.06
All	0.7048	0.7048	0.00	0.7914	0.7914	0.00

For illustrative purposes, Table 3 reports changes in Atkinson's measure of inequality for several values of relative inequality aversion, ε, and two different welfare metrics, net income and money metric utility (MMU). The derivation of money metric utility follows the method proposed by Creedy *et al.* (2011). In each case the metric is in terms of values per adult-equivalent person, using the individual as the unit of analysis. The adult equivalent size, s, is computed using the following parametric scales, $s = (n_a + \theta n_c)^{\delta}$ where n_a and n_c are respectively the number of adults and children in the unit, θ is the weight attached to children and δ represents the extent of economies of scale. The illustrations below use $\delta = 0.8$ and $\theta = 0.6$.[21] It is clear from these results that the reform has only a small effect on inequality, and for sole parents it is inequality-increasing for some cases. As inequality aversion increases, the overall redistributive effect falls, becoming negligible for the higher value of $\varepsilon = 2$. This is because the higher aversion to relative inequality means that less

but alternative 'non-welfarist' approaches can also be used (reflecting, for example, poverty incidence).

[20] Since W in (2) is effectively the value of m_{ede}, it has a convenient interpretation and comparison with $\bar{m}$.

[21] On equivalence scales and the unit of analysis, see Creedy and Sleeman (2005) and references cited therein.

weight is given to the higher incomes, which are the focus of the reform considered here. Typically the use of net income per adult equivalent person suggests a greater redistributive effect than of MMU. This arises from the fact that net income, unlike MMU, does not include a monetary value on the reduction in hours of leisure for those who increase their labour supply.

These results are purely illustrative but they show that such a reform to the top marginal rate bracket likely has a very small redistributive effect. If the aim of reform is to generate more redistribution, a more complex set of changes would be needed. Of course, it cannot automatically be assumed that further increases in the top tax rate would be desired, since it is possible that the adverse incentive effects on top income earners, while perhaps reducing inequality further, would outweigh the equity gains. An inequality-adverse judge, trading-off equity and efficiency, must carry out a sensitive balancing act. Again, a behavioural microsimulation model can provide the kind of detail needed. Consideration of the trade-offs involved in decision making leads naturally to the question of whether movement towards an optimal structure, in some well-defined sense, can be determined. This is discussed in the following Section.

3   Optimal Marginal Reforms

This section turns to consideration of tax reforms which move towards an optimal structure. One strand of simple (in terms of tax and population structures) optimal tax model, following from the seminal paper by Mirrlees (1971), makes no pretence to be a practical policy tool. Rather, it largely provides a pedagogic tool for understanding the complex interdependencies involved. Individuals make choices based on a given tax structure, while governments in turn are considered to set the tax structure to maximise an explicit social welfare or evaluation function, of the type discussed above, reflecting the preferences of a hypothetical independent judge.[22] The government and the many individuals in the economy are considered simultaneously to solve their respective constrained optimisation problems. Even the very simplest type of model requires numerical solution methods.[23] In addition, a

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[22]The judge selects the tax structure to maximise the welfare function, while individuals select their labour supply to maximise utility. The value of a transfer payment is determined by the need to satisfy a government budget constraint. This budget constraint involves a requirement to raise a given amount of non-transfer expenditure per person, but the optimal tax models usually consider this as involving a 'black hole', in that the benefits of the resulting expenditure do not enter either individuals' utility functions or the welfare function of the judge.

[23]The simplest case is of a proportional income tax combined with a universal or basic income, where individuals differ only in their wage rates, having identical preferences. The government maximises an additive, Paretean welfare function in terms of individuals' utilities and reflecting inequality aversion. For references to special cases where explicit solutions are available, and an approximation in the case of the

commonly cited general result from such models – that the highest income earner should face a zero marginal tax rate – provides no practical guidance for setting top marginal income tax rates and thresholds.

Like the standard optimal tax models, a (more complex) structural approach to individuals' behaviour is taken, in the context of a behavioural tax microsimulation model, such as the TaxWell-B model used above. Attempting to use such a model to solve for an optimal structure within the universe of possible structures is impractical, since these models are designed only to evaluate small changes from an existing base tax structure. However, it is possible to examine a more limited range of policy reforms in order to assess the *direction* of small policy adjustments to a given structure. Here the welfare or evaluation function must be specified explicitly, and the approach can be used to examine the implications of adopting different value judgements.

The approach involves examining (absolute values of) the changes in welfare per dollar of revenue, $|\Delta W/\Delta R|$, for increases and decreases in each marginal tax rate by one percentage point. For example, following the approach initially proposed by Creedy and Hérault (2012), Creedy *et al.* (2019) use TaxWell-B to consider a range of tax reforms to the NZ income tax rates and thresholds. Tables 4 and 5 show results from this exercise for four values of inequality aversion, ε.

Table 4: Values of $\left|\frac{\Delta W}{\Delta R}\right|$ Using Money Metric Utility

	Increase in t				Reduction in t			
	$\varepsilon = 0.1$	$\varepsilon = 0.2$	$\varepsilon = 0.8$	$\varepsilon = 1.4$	$\varepsilon = 0.1$	$\varepsilon = 0.2$	$\varepsilon = 0.8$	$\varepsilon = 1.4$
t_1	1.369	1.379	1.371	1.570	1.333	1.342	1.332	1.521
t_2	1.397	1.367	1.091	0.850	1.349	1.319	1.052	0.818
t_3	1.356	1.290	0.855	0.537	1.276	1.214	0.805	0.504
t_4	1.262	1.153	0.614	0.319	1.284	1.173	0.623	0.322

To appreciate what the different values of ε imply, the well-known 'leaky bucket' experiment can be used. Consider taking \$1 from someone in the top tax bracket with \$100k, and making a transfer to someone in the bottom tax bracket with \$10k, so that $y_2/y_1 = 10$, For values of ε of 0.1, 0.2, 0.8 and 1.4, the leaks that would be tolerated are respectively 20, 37, 84 and 96 cents.[24] If the \$1 taken from the person with \$100k is used to make a transfer to

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linear income tax, see Tuomala (1985) and Creedy (2009). Brewer *et al.* (2010) provide further discussion of the optimal tax structure implied by the Mirrlees model in context of the UK tax and welfare benefit system.

[24]The higher value of ε therefore approaches 'extreme' inequality aversion, where the 'judge' is willing simply to confiscate income from the richest person. With $\varepsilon = 3$, the leak tolerated is 99.9 cents, virtually the whole of the \$1 taken from person 2.

someone in the second tax bracket with, say, \$25k, the leaks tolerated for the same values of ε are respectively 13, 24, 67 and 86 cents.

As stressed earlier, a desirable property of policy reform evaluations is that they should be revenue neutral. This is satisfied in the present case, since each change is calculated *per dollar* of additional net revenue. For the optimal direction of reform, it is then necessary to combine the lowest welfare cost per dollar when increasing revenue with the highest welfare gain per dollar when reducing revenue. Consider first the evaluation of tax rate changes shown in Table 4. The welfare gains and losses for the lowest inequality aversion parameter of $\varepsilon = 0.1$ suggests that a revenue neutral reform that increases the social welfare function could be achieved by raising t_4 and reducing t_2. This minimises welfare losses ($\Delta W/\Delta R = (-)1.262$) and maximises welfare gains ($\Delta W/\Delta R = (+)1.349$). For aversion parameters of $\varepsilon = 0.2$ and higher, the results also suggest raising t_4 but simultaneously lowering t_1, rather than t_2.

Table 5: Values of $\left|\frac{\Delta W}{\Delta R}\right|$ for Income Threshold Changes

	Increase				Decrease			
	$\varepsilon = 0.1$	$\varepsilon = 0.2$	$\varepsilon = 0.8$	$\varepsilon = 1.4$	$\varepsilon = 0.1$	$\varepsilon = 0.2$	$\varepsilon = 0.8$	$\varepsilon = 1.4$
a_2	1.353	1.357	1.287	1.229	1.344	1.349	1.287	1.240
a_3	1.283	1.230	0.852	0.559	1.390	1.334	0.931	0.616
a_4	1.403	1.226	0.946	0.679	1.360	1.284	0.814	0.488

Table 5 presents absolute values of marginal welfare changes per dollar of revenue, resulting from changes of \$1000 to the income thresholds in the tax schedule. Marginal changes are not considered in the case of the lowest threshold, $a_1 = 1$, as there is no tax-free income range. For threshold changes, it is necessary to look for the highest value of $|\Delta W/\Delta R|$ when thresholds are increased, since this involves welfare gains as some people are moved into a lower-rate bracket. When thresholds are reduced, this involves welfare losses as some people are moved into a higher-rate tax bracket, so it is necessary to look for the lowest value of $|\Delta W/\Delta R|$. A low value of $\varepsilon = 0.1$ implies raising a_4 and reducing a_2. For $\varepsilon = 0.2$ and higher, the preferred policy is to raise a_2 and reduce a_4. Higher inequality aversion therefore implies moving more people into the top-rate bracket, and more people into the bottom tax bracket. Only the lower aversion parameter of 0.1 implies moving some people out of the top tax bracket.

Using the information provided in Tables 4 and 5, it is possible to extract combinations of rate and threshold changes that give rise to the largest welfare gains per dollar of revenue (for rate reductions and threshold increases) and the smallest welfare losses (for rate increases and threshold reductions). These are shown in Table 6. Hence, for the lower inequality aversion

Table 6: Values of $\left|\frac{\Delta W}{\Delta R}\right|$ for Combinations of Rate and Threshold Changes

$(\alpha = 0.8)$	Threshold		Marginal rate	
$\varepsilon = 0.1$				
Biggest gain	Raise a_4:	1.403	Reduce t_2:	1.349
Smallest loss	Reduce a_2:	1.344	Raise t_4:	1.262
$\varepsilon = 0.2$				
Biggest gain	Raise a_2:	1.357	Reduce t_1:	1.342
Smallest loss	Reduce a_4:	1.284	Raise t_4:	1.153

of $\varepsilon = 0.1$, the biggest gain arises from raising the income threshold, a_4, and combining this with the smallest loss, obtained by raising the top marginal rate, t_4. By contrast, for higher inequality aversion of $\varepsilon = 0.2$, the biggest welfare improvement arises from combining a rise in the threshold, a_2, (giving the biggest gain) with a rise in the top rate, t_4 (giving the smallest loss). The extent of inequality aversion therefore influences the choice of group to be shifted to a lower-tax bracket.

4 Optimal Top Tax Rates and the ETI

It was mentioned in the introduction that the starting point of standard structural optimal tax models is a social welfare, or evaluation, function expressed in terms of all individuals' utilities. The value judgements of the hypothetical judge, the nature of the tax and transfer system, and the government's budget constraint are explicit, and results depend, *inter alia*, on the nature of the distribution of income-earning abilities.

A more recent non-structural alternative approach, first proposed by Feldstein (1995), is to use a summary measure of behavioural responses, the elasticity of taxable income (ETI), η, which measures the responsiveness of taxable income to changes in the net-of-tax rate; that is, one minus the tax rate.[25] In addition to any changes in taxable incomes due to labour supply (earnings) changes, the ETI includes changes due to tax avoidance or evasion, changes in remuneration packages that involve shifts towards lower taxed components such as fringe benefits, and in gross wages such as job promotion choices.

It can be shown that, under certain conditions, it is possible to express optimal tax rates in terms of this elasticity; see Feldstein (1999), Saez (2001) and Chetty (2009). In this case, a social welfare function is not fully specified. Instead, the hypothetical judge is assumed to take a view only about the value of additional government tax-financed expenditure

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[25] Feldstein (1995) first specified the elasticity in this way so that the ETI, $\{dy/d(1-t)\}\{(1-t))/y\}$ would be positive if, as expected, $dy/dt < 0$.

resulting from the extra revenue from a small tax increase.[26] The additional expenditure is not explicitly divided into transfer and other expenditure. Indeed, no explicit redistribution mechanism is considered and the optimal rates are determined independently of any revenue requirements. The independent judge also forms a view about the weight attached to the loss of welfare resulting from the small tax increase. The relevant expressions can be seen as follows.

4.1   The ETI and Optimal Tax Formulae

Suppose, for simplicity, that decisions regarding income thresholds have already been made, so that concern is only with the marginal rates.[27] Value judgements are reflected in two terms. First, the social marginal valuation, SMV, measures the weight attached to the loss of welfare suffered by those in the relevant tax bracket as a result of a small tax increase. Second, the marginal value of public funds, $MVPF$, is the value, attributed by the judge, to the extra tax-financed expenditure resulting from the small tax increase. The optimal tax rate in a bracket is that rate for which the marginal benefit of a further tax increase matches the marginal cost. Hence, where MR is marginal tax revenue, and EV is the welfare change measured in terms of the equivalent variation, the first-order condition is:

$$(EV)\,(SMV) = (MR)\,(MVPF) \tag{3}$$

The left-hand side is the marginal cost, while the right-hand side is the marginal benefit, of the tax increase.[28] The efficiency cost of a marginal tax increase can be expressed in terms of the marginal excess burden per dollar of extra revenue, MWC. Thus the condition can

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[26]Perhaps understandably, the report in Mirrlees (2011) often conflates the two approaches, suggesting that the use of reduced-form elasticities is in the Mirrlees tradition. The two approaches share the concept of an optimum based on value judgements, allowance for incentive effects, and the ability to express the optimum in terms of an equi-marginal condition.

[27]A more general approach in which the tax rate can vary continuously over the whole income range is discussed in Saez (2001) and in Brewer *et al.* (2010).

[28]This differs from the approach initially set out by Saez (2001). Instead of using the marginal welfare cost, he used a decomposition of marginal revenue into mechanical and behavioural terms, M and B respectively (where B is negative). Then $MR = M + B$ and it is known that $EV = M$. Rearranging (3) as $Mg = M + B$ gives the first-order condition as $M(1-g)+B = 0$: see Saez (2001, p. 210). For the revenue-maximising rate, $MR = 0$ and $M = -B$. This is why Brewer *et al.* (2010, p. 102) refer to this rate as 'balancing mechanical and behavioural effects'. When discussing optimal rates Brewer *et al.* (2010) write the condition, using the present notation, as $M + B - gM = 0$. In their discussion, the value of $MVPF$ is implicitly set at 1; an allusion to this is in Brewer *et al.* (2010, p. 166, n.75). Hence the term gM is effectively $(M)(SMV)$ and as $EV = M$ this is the change in 'social welfare' resulting from a small tax rate change – the left hand side of (3). In their own notation, Brewer *et al.* write the social welfare change, $-gM$, as dW, and their condition is written as $dM + dB + dW = 0$. In discussing appropriate values of g, they consider only the variation in the welfare loss.

be converted into one involving the MWC, by first rewriting (3) as:

$$\left.\frac{EV}{MR}\right|_{\tau_{opt}} = \left.\frac{MVPF}{SMV}\right|_{\tau_{opt}} \tag{4}$$

By definition MWC is the marginal excess burden, $EV - MR$, divided by marginal revenue, thus:

$$MWC = \frac{EV}{MR} - 1 \tag{5}$$

so that (3) becomes:

$$\left.MWC\right|_{\tau_{opt}} = \left.\frac{MVPF}{SMV}\right|_{\tau_{opt}} - 1 \tag{6}$$

It may be expected that public tax-financed projects are subject to decreasing marginal valuation, and the value of, SMV, is likely to depend on the tax bracket being considered.

For example, consider the simplest case where the rate being examined is the top rate in a multi-tax structure. Let g denote the reciprocal of $\left.\frac{MVPF}{SMV}\right|_{\tau_{opt}}$, and let α_T denote the ratio of average income in the top bracket, $\bar{z}_T$ to the difference between that average and the effective top income threshold, a_T. Tax paid by those with taxable income, z, in the top bracket is written as $\tau(z - a_T)$.[29] Furthermore, it can be shown that $MWC = \eta\alpha_T\tau/\{1 - \tau(1 + \eta\alpha_T)\}$, so that substituting and re-arranging (6) gives the optimal top marginal rate, $\tau_{H,opt}$ as:[30]

$$\tau_{H,opt} = \frac{1 - g}{1 - g + \eta\alpha_T} = \left(1 + \frac{\alpha_T\eta}{1 - g}\right)^{-1} \tag{7}$$

Furthermore, substituting for $\alpha_T = \bar{z}_T/(\bar{z}_T - a_T)$ gives the alternative expression:

$$\tau_{H,opt} = \left\{1 + \left(\frac{\eta}{1 - g}\right)\left(\frac{\bar{z}_T}{\bar{z}_T - a_T}\right)\right\}^{-1} \tag{8}$$

Hence the revenue elasticity, $\bar{z}_T/(\bar{z}_T - a_T)$, plays an important role, along with the elasticity of taxable income and the 'social value of additional revenue' term, g. As g approaches 1 (the judge only cares about marginal welfare losses for top-rate taxpayers), the optimal top rate approaches zero for positive η. As the elasticity of taxable income approaches zero, the optimal rate approaches 1 since, in this case, there are no behavioural responses to the small tax increase. For the extreme case where g is zero, the judge places no weight on the marginal welfare losses for top-rate taxpayers, and the optimal top tax rate is the same as the rate which maximises revenue from those taxpayers. Equation (8) also shows that the

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[29]Creedy and Gemmell (2013) show that $\alpha_T = \bar{z}_T/(\bar{z}_T - a_T)$ is the revenue elasticity, $\eta_{T,z}$, at mean income in the bracket.

[30]On the marginal welfare cost in this context see Saez *et al.* (2012, p. 8), and the derivation in Creedy (2015, p. 232).

optimal rate depends on the elasticity of taxable income and the revenue effect of a change in taxable income, $\bar{z}_T / (\bar{z}_T - a_T)$. As the latter increases, becoming very large as $\bar{z}_T$ is close to the threshold, the optimal rate falls.

Analogous results for optimal tax rates below the top rate can also be obtained. Consider the optimal value for a lower marginal tax rate, τ_L: it is sufficient to consider a two-rate structure, since it is easily extended to the multi-rate form. Information is needed only about average income within the tax bracket, average income of those above the tax bracket, and the relative sizes of the two groups. Using the condition in (6), along with the definition, $\alpha_L = \bar{z}_L / (\bar{z}_L - a_L)$, the optimal rate, $\tau_{L,opt}$, must satisfy:

$$\tau_{L,opt} = \left\{ 1 + \left(\frac{\eta}{1-g} \right) \left(\frac{N_L \bar{z}_L}{N_H (a_H - a_L) + N_L (\bar{z}_L - a_L)} \right) \right\}^{-1} \tag{9}$$

In general, Creedy (2015) shows that the optimal rate in any tax bracket, given the previous choice of thresholds, is expressed as:

$$\tau_{k,opt} = \left\{ 1 + \left(\frac{\eta_k}{1 - g_k} \right) \Phi_k \right\}^{-1} \tag{10}$$

where Φ_k is the ratio of the total income of those whose income falls into the kth tax bracket, to that of the total income to which the rate τ_k is applied.

These results show the influence on optimal tax rates of both behavioural responses to tax changes (measured by η) and the nature of the income distribution, in addition to the 'social valuation' term, g. The optimal rates thus involve quite limited income distribution characteristics: substantial changes in the distribution below a threshold have no effect on optimal rates above that threshold. However, it is possible that such changes could affect those tax rates via the choice of g.

It is possible to consider the condition under which, given the thresholds, rate progression (increasing marginal tax rates) is suggested. For the two rates considered here, using (8) and (9), it can be seen that $\tau_{H,opt} > \tau_{L,opt}$ if:

$$\frac{1 - g_H}{1 - g_L} > \frac{\bar{z}_H}{\bar{z}_L} \left\{ \frac{N_H}{N_L} \left(\frac{a_H - a_L}{\bar{z}_H - a_H} \right) + \left(\frac{\bar{z}_L - a_L}{\bar{z}_H - a_H} \right) \right\} \frac{\eta_H}{\eta_L} \tag{11}$$

Since $\bar{z}_H > \bar{z}_L$ and it is likely that $\eta_H > \eta_L$ (higher rate taxpayers are more responsive to marginal rate changes than lower rate taxpayers), rate progression requires g_H to be sufficiently smaller than g_L, depending on the relative sizes of the groups and the thresholds in relation to the mean incomes within brackets. Importantly, simply attaching a lower value to the marginal welfare losses of higher-income groups is not sufficient to generate increasing marginal rates.

4.2 Imposing Value Judgements

In the case of optimal reforms discussed in the previous Section, value judgements are made explicit via the evaluation, or social welfare, function used: that is, the illustrations used an additive, Paretian form, with constant relative inequality aversion and with a welfare metric defined as money metric utility per adult equivalent person.[31] It was a simple matter to examine results for different values of the inequality aversion coefficient. Alternative forms of welfare function can be also used, and results compared.

In the context of optimal tax rates calculated using the elasticity of taxable income, examining sensitivity to value judgements means considering the effects of alternative values of the ratio $g = SMV/MVPF$. This raises the question of how to interpret different orders of magnitude, and is complicated by the paucity of structure in the reduced form ETI model. For example, it is difficult to relate g to conventional distributional judgements.[32] The type of welfare function discussed earlier cannot be applied directly to this reduced-form context.

Nevertheless it is worth exploring a comparable form of welfare function in an attempt to clarify decisions regarding g, which can otherwise appear to be rather arbitrary.[33] First, suppose the welfare metric is taxable income. Second, since pre-defined tax brackets are specified (concern is only with setting the marginal rates), suppose W is written as a weighted function of mean taxable income in each bracket, so that:

$$W = \left(\frac{1}{1-\varepsilon}\right) \sum_{k=1}^{K} N_k \bar{z}_k^{1-\varepsilon} \tag{12}$$

The task is to relate specified values of ε to values of g which can then be applied to each tax bracket. In the absence of explicit structural modelling of a redistributive role for taxation, the top marginal tax rate may be thought to involve a transfer from the N_K individuals in the top bracket to the N_1 individuals in the first bracket. Here, the associated value of g, in this case g_K, can be regarded as the (absolute) slope of the 'social indifference curve' relating $\bar{z}_K$ and $\bar{z}_1$ values for which social welfare is unchanged. Thus, differentiation gives:

$$g_K = - \left.\frac{d\bar{z}_1}{d\bar{z}_K}\right|_W = \left(\frac{N_K}{N_1}\right)\left(\frac{\bar{z}_1}{\bar{z}_K}\right)^{\varepsilon} \tag{13}$$

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[31]Value judgements also relate to the unit of analysis. Here, this has been taken to be the individual, although the 'equivalent person' could be used instead.

[32]Little guidance concerning the choice of g is given by Saez (2001), Brewer *et al.* (2010) and Mirrlees (2011). As mentioned earlier, Brewer *et al.* (2010) simplify considerably by setting the value of $MVPF$ equal to one, and concentrate discussion on the effects of different values of SMV. The Mirrlees (2011) report gives most emphasis to the revenue maximising rate in the top tax bracket, which is 'equivalent to placing a zero value on their (marginal) welfare' (p. 65).

[33]Indeed, most illustrations of the approach restrict attention to the top marginal rate and report only the revenue-maximising value, for which $g = 0$. Such a strong asumption represents a rather extreme form of inequality aversion in which the welfare of top tax rate payers (facing the tax rate increase) is given zero weight in the social evaluation.

Having set ε, as guided by the 'leaky bucket' experiment described earlier, (13) can be used to obtain g_K.

In the case of the penultimate tax bracket, increasing τ_{K-1} can be regarded as taking tax revenue from those both in the $(K-1)$th bracket and the Kth bracket, and redistributing to those in the first bracket. Hence the value of g corresponding to a given ε is obtained by totally differentiating W with respect to $\bar{z}_K$ and $\bar{z}_{K-1}$, imposing equal absolute changes so that $d\bar{z}_K = d\bar{z}_{K-1}$, whereby:

$$g_{K-1} = -\left.\frac{d\bar{z}_1}{d\bar{z}_{K-1}}\right|_W = \left(\frac{N_{K-1}}{N_1}\right)\left(\frac{\bar{z}_1}{\bar{z}_{K-1}}\right)^{\varepsilon} + \left(\frac{N_K}{N_1}\right)\left(\frac{\bar{z}_1}{\bar{z}_K}\right)^{\varepsilon} \tag{14}$$

Thus a fixed value of ε implies that $g_{K-1} > g_K$. Nevertheless, as seen from (11) this is not sufficient to guarantee rate progression.

5 Numerical Examples of Optimal Top Tax Rates

The previous section demonstrated that identifying an optimal top tax rate using the ETI reduced-form approach requires evidence on the empirical value of the elasticity of taxable income as well as judgements regarding inequality aversion, as represented by ε or the social weight, g_k, attached to taxpayers in different tax brackets. This section provides illustrative examples in the context of the New Zealand income tax structure.

5.1 Selecting Values of g_K

To see how assumed aversion to inequality translates into implied values of g_K associated with taxpayers in the top tax bracket, the formula in (13) can be applied to New Zealand taxpayer data. Table 7 shows values of g_K, using (13), where the top tax bracket includes individuals earning incomes above $a_K = \$70,000$. Two alternative possible definitions of the top tax bracket are also shown: where $a_K = \$150,000$ and $a_K = \$200,000$. Values of the components N_K, N_1, $\bar{z}_K$, $\bar{z}_1$, used in Table 7 are based on Inland Revenue taxable income data for 2018.[34]

Columns 2 and 3 of the table show that, for the current NZ top tax bracket, with $a_K = \$70,000$, there are approximately twice as many taxpayers as in the first tax bracket ($N_K/N_1 = 2.07$), while the ratio of average incomes, $\bar{z}_1/\bar{z}_K = 0.025$. This arises because the average income in the lowest tax bracket, $\$1 - \$14,000$ is very low at $\bar{z}_1 = \$3,006$, while $\bar{z}_K = \$120,424$. These ratios become very small if the top tax bracket is set at

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[34]These data are publicly available at https://www.classic.ird.govt.nz/aboutir/external-stats/revenue-refunds/income-distrib-individual-customers/income-distrib-individ-customers.html.

Table 7: Values of g_K for Alternative Top Tax Brackets

Tax bracket	No. of taxpayers	Taxable income ($m)	N_K/N_1	$\bar{z}_1/\bar{z}_K$	g_K $\varepsilon = 0.2$	$\varepsilon = 0.4$	$\varepsilon = 0.6$
> \$70,000	716,210	86,249	2.070	0.025	0.990	0.473	0.226
> \$150,000	110,650	29,345	0.320	0.101	0.131	0.053	0.022
> \$200,000	56,110	20,019	0.162	0.008	0.062	0.024	0.009
\$1 − \$14,000	345,970	1,040					

$a_K = \$200,000$. In this case top tax rate payers would be only about 16 per cent of the numbers in the first tax bracket, while average income in the first bracket would be only around 8 per cent of average top bracket incomes (where now $\bar{z}_K > \$350,000$).

The three right-hand columns of the table show values of g_K for three values of inequality aversion: $\varepsilon = 0.2$, 0.4, and 0.6.[35] Recall that an interpretation of g_K in this case is as the social value (as determined by a independent judge) of spending that dollar on taxpayers in the bottom tax bracket, is funded by raising an extra dollar of revenue from taxpayers in the top bracket, by increasing τ_K. Table 7 shows that for $\varepsilon = 0.2$, $g_K = 0.990$. This implies that overall social welfare would be *reduced* by raising τ_K, and redistributing the revenue to the lowest rate taxpayers, if the welfare of top rate taxpayers were weighted at *less than* 0.99. In other words, despite the significant aversion to inequality, such a tax change, with almost any weighting less than one on the utility of higher income earners, would lead to overall welfare losses. This partly reflects the fact in this case that there are more than twice as many top rate taxpayers affected adversely from such a reform than those who benefit from the transferred revenue ($N_K/N_1 = 2.07$).

However, this weighting is substantially reduced if the top tax rate is applied instead to those earning over \$150,000 or over \$200,000. Table 7 shows that, for those cases, and where $\varepsilon = 0.2$, $g_K = 0.131$ or 0.062 respectively for the two top income groups, and values are further reduced for greater aversion to inequality of $\varepsilon = 0.4$, or 0.6. These g_K values imply that relatively low-to-modest weights (greater than 0.131 or 0.062) could be given to top earners' utility losses associated with an increase in τ_K and it would still be social welfare improving to undertake the reform. However, applying zero or very low weights to top earners, as much of the research literature addressing optimal top tax rates does, seems unduly extreme (see, for example, Saez, 2001, pp. 212-213), especially in NZ where almost 20 per cent of income taxpayers were in the top tax bracket in 2018.

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[35]In this case, for the top tax bracket of $a_K = \$70,000$, and a ratio $\bar{z}_K/\bar{z}_1 \simeq 40$, the leaky bucket experiment implies that with $\varepsilon = 0.2$ (0.4) a judge is willing to accept a leak of 52 (77) cents for every \$1 of income transferred from an average top bracket person to an average first bracket person. These values are obtained such that, for $\Delta z_2 = -1$, $\Delta z_1 = -(z_2/z_1)^{-\varepsilon}$ with the leak given by $1 - \Delta z_1$. These therefore represent relatively high aversion to inequality (as measured by the leak or 'efficiency cost') in this case.

5.2   Optimal Top Tax Rates

Sections 4 showed that, given a range of possible values of g_K, together with values of η and the revenue elasticity in New Zealand, equation (8) can be used to identify the optimal top tax rate, $\tau_{K,opt}$. This is a topic that has been the subject of much debate in New Zealand, especially since the rate was reduced from 39 per cent to 33 per cent by the National government in the major 2010 tax reform, and with the Labour-led government mandating their Tax Working Group in 2018-19 not to consider changes to any income tax rates.

To apply equation (8) requires values of α_K, g_K and η. In this case, for a top threshold of \$70,000, $\alpha_K = \bar{z}_K / (\bar{z}_K - a_K)$ equals 2.388 ($= 120,424/(120,424 - 70,000)$) and Table 8 shows values of $\tau_{K,opt}$ for alternative values of g_K and η.

Table 8: Optimal Top Tax Rates for Values of g_K and η

	g_K					
η	0.0	0.2	0.4	0.6	0.8	0.999
0.0	1.00	1.00	1.00	1.00	1.00	1.00
0.2	0.68	0.63	0.56	0.46	0.30	0.0021
0.4	0.51	0.46	0.39	0.30	0.17	0.0010
0.6	0.41	0.36	0.30	0.22	0.12	0.0007
0.8	0.34	0.30	0.24	0.17	0.09	0.0005
1.0	0.30	0.25	0.20	0.14	0.08	0.0004

To assess possible optimal top income tax rates in New Zealand it is useful to compare the values in Table 8 with the current top rate as a benchmark. Though the current top personal income tax rate is 33 per cent, these optimal tax rate models are predicated on an assumption that the only tax on income is via the personal income tax schedule. However where there is a general consumption tax, such as New Zealand's Goods and Service Tax (GST), this rate must be added to the personal income tax rate to obtain the 'effective' top income tax rate, τ'_K; that is $\tau'_K = \tau_K + v/(1+v)$, where v is the (tax-exclusive) rate of GST.[36] With $v = 0.15$, this implies $\tau'_K = 0.46$.[37] It can be seen from Table 8 that for $\tau_{K,opt}$ to exceed 0.46, then combinations of $\eta < 0.2$ and $g_K < 0.6$ are required. Alternatively if zero weight is attached to the utility of top earners ($g_K = 0$), then approximately $\eta < 0.5$ is required to yield $\tau_{K,opt} > 0.46$.

The non-linear properties of the trade-offs between η and g_K, are illustrated in Figure

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[36] Ideally, other consumption taxes, such as commodity-specific excise taxes, should also be added to the top personal income tax rate. However, these are relatively small, and 'effective' rates vary across individuals depending on their marginal expenditure patterns, such as their marginal fuel, alcohol and tobacco consumption. The value of $\tau'_K = 0.46$ used below therefore represents a lower bound estimate.

[37] This is $\tau'_K = 0.52$, when using the pre-2010 top personal income tax rate of 39 per cent.

1 which plots values of $\tau_{K,opt}$ (vertical axis) for alternative combinations of η and g_K (with g_K on the horizontal axis). This clarifies that to obtain $\tau_{K,opt} > 0.46$, either g_K has to be very low or η has to be very low. However if $\eta < 0.2$, then an optimal top income tax rate in excess of 0.46 becomes possible provided $g_K < 0.7$ (approximately). If recent empirical estimates of η for New Zealand top rate taxpayers of around 0.4 to 0.6 are accepted, this implies that the current top tax rate of 0.46 is close to or above the optimal rate.

Of course a higher top income tax rate applied to those earning much greater income levels than the current top threshold of \$70,000, could yield different results if different values of η and g_K are attached to those higher earners. Nevertheless, with around 20 per cent of New Zealand income taxpayers currently earning over \$70,000, attaching an especially low value of g_K to this group would seem particularly inappropriate.[38] These conclusions are reinforced if $\tau'_K = 0.52$ is considered as a benchmark.

A number of estimates of η for New Zealand taxpayers are available; see, for example, Carey *et al.* (2015), Creedy *et al.* (2017), Alinaghi *et al.* (2019). Based on evidence from Alinaghi *et al.* (2019) of taxpayer bunching around the \$70,000 top tax threshold, New Zealand estimates of η for the self-employed, who are disproportionately represented among top rate taxpayers [*check*], are around 1.0 for recent years, but around 0.2 for all top rate taxpayers including wage earners. Following the 2001 tax reform that raised the top rate to 39 per cent, η estimates range from 0.8 to 1.0 for the self-employed, and from 0.25 to 0.35 for all top rate taxpayers; see Alinaghi *et al.* (2019, p.12).

The range of possible optimal top tax rates discussed in this section serve to circumscribe the earlier results on welfare improving tax reforms using Taxwell-B presented in section 2.2. The latter suggested broadly consistent support for raising the top tax rate, t_4, from 33 per cent, whilst lowering t_1 or t_2, based on fairly wide ranges of several model parameters. However, by focusing exclusively on labour supply responses, the model cannot capture the additional responses captured within the elasticity of taxable income concept. Taxwell-B is designed to consider employees' work hours responses and therefore excludes the self-employed. It may therefore provide a better guide to welfare improving reforms with respect to wage earners, while the ETI approach provides greater insight in the context of high income individuals with greater non-wage income sources and tax planning options, and/or self-employed individuals for whom non-labour income responses are likely to be more relevant.

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[38] In the US literature, where these optimal tax models have been estimated while setting $g_K = 0$, the top income earners considered have typically been the top 1 or 0.1 percent of all incomes.
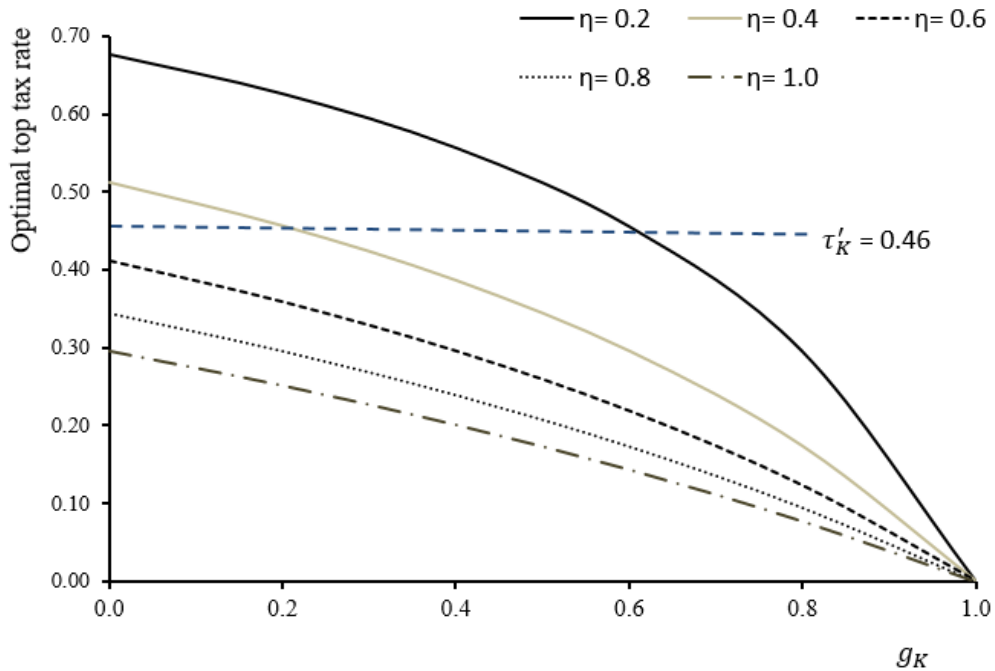
Figure 1: Optimal Top Income Tax Rates

6 Conclusions

This paper began by suggesting that the principles underlying rational policy analysis can be applied to support policy advice regarding the income tax structure, by considering the implications of adopting a range of clearly specified value judgements. It was argued that those economic models which are considered to be suitable as the basis for tax analysis vary according to the precise ways in which the question is formulated, the underlying behavioural responses to taxation expected across the taxpaying population, definitions of key variables such as income inequality, and the precise specification of policy objectives such as redistribution, revenue raising or tax system efficiency.

It is important to recognise that different tax models have different strengths and limitations, such that selection of the appropriate model or models must first consider carefully the precise tax policy question of interest and the context in which it is to be applied so that, for example, acceptable and unacceptable modelling assumptions can be distinguished. Unsurprisingly, there is no single 'perfect model'. Two key aspects of model choice are whether there are single or multiple objectives for the (current or proposed) tax regime, and which, if any, behavioural responses by taxpayers to the tax structure are expected. For example, where interest is purely with tax revenue raising or identifying revenue-neutral reforms, the

simplest form of tax model – an arithmetic tax calculator such as the New Zealand Treasury's *Revenue Estimate Tool* – may be sufficient, at least as a first attempt to answer the question. However, since almost all changes to income tax structure can be expected to induce some behavioural responses by taxpayers that will affect revenue raising, model outcomes even for this single objective can be misleading if these are ignored.

Similarly, almost all revenue-neutral (and many non-neutral) reforms to the income tax structure involve changes in distributional outcomes and it would be rare for policy makers to be unconcerned with this additional objective. Hence, practical tax policy advice almost always needs to include both summary information on income inequality or poverty impacts, and detailed distributional results such as the extent and characteristics of gainers and losers from proposed reforms to current settings. These inevitably introduce potential trade-offs among objectives such that the metrics adopted to identify progress towards them (such as inequality or poverty reductions) and how precisely achievement of those objectives are traded-off, become vital aspects of tax modelling exercises and hence policy advice choices.

It was argued, for example, that tax model approaches to the specification of both household utility functions and social welfare functions can be quite different and these differences can be important for judgements over whether a particular reform is preferable to some alternative. These aspects are rarely made explicit in policy advice to politicians considering tax reforms (or effects of the current system), yet they need to be communicated in suitable ways if those politicians are seeking to identify 'improvements' to the tax system. For example, the behavioural tax microsimulation model illustrations in Sections 2.2 and 3 highlighted three important aspects. Firstly, it is important of acknowledge the role and extent of inequality aversion (by a 'judge') for estimated inequality outcomes of tax reform. The 'consumers' of simulations need to see the implications of adopting a range of aversion parameters.

Secondly, summary inequality measures, such as the Atkinson index, may reveal little change when the top tax rate is altered but this can be consistent with more substantial effects on specific sub-sets of taxpayers. Hence, choices over *whose* inequality or poverty is measured and targeted in tax modelling exercises are crucial for policy reform conclusions. Thirdly, when addressing tax settings at relatively low income levels, interactions between the tax and social welfare benefit system cannot be ignored, whether the focus is on the efficiency, revenue raising or redistributional properties of the system. To address such tax policy questions behavioural tax-transfer microsimulation provides by far the best available tool, since it is able to capture numerous aspects of the heterogeneity that is typically observed across relevant taxpayers as well as the complex details that characterise welfare and tax systems.

In selecting suitable tax models, careful attention to behavioural response assumptions is also important. As this paper has demonstrated, where labour supply responses are the most relevant – for example, among low-to-middle wage earners or specific demographic groups – microsimulation models based on careful calibration of household labour supply choices by heterogenous individuals provide quantification of outcomes that are both more detailed and more reliable than simpler, more aggregated approaches. However, such models cannot capture non-labour supply responses such as those associated with various types of tax planning or evasion.

This has been shown to be particularly relevant for higher income earners and for the self-employed. In those cases, estimates of elasticities of taxable income provide more comprehensive, and potentially more accurate, measurement of responses. However, these are subject to their own limitations; for example, they are based on a simple optimising model in which a specific form of utility function is applied to all individuals to generate a simple reduced-form estimating equation. This renders outcomes regarding optimal tax rates, such as the optimal top marginal rate in New Zealand considered in Section 5, subject to a quite specific interpretation, and with effects on overall social welfare captured by one simple parameter, g_K.

An obvious but important conclusion regarding all of the above models used as part of rational tax policy analysis, as with economic models more generally, is that they provide useful frameworks for thinking through key issues in policy design or reform in alternative contexts. They can also confirm or correct intuitive reasoning. Further, given a clearly specified set of conditions or suitable assumptions, they can answer specific tax design questions, for example by quantifying efficiency-equity trade-offs, as well as providing more general insights. However, it should be clear that such models are not in general capable of generating unambiguous tax design 'blueprints' nor unambiguous tax reform conclusions. Rather, suitably applied to tax policy advice they should help tax policy makers be clear about their policy objectives, more explicit about resulting trade-offs, and more aware of otherwise implicit value judgements that underlie the process of identifying tax reforms that they wish to characterise as 'improvements'.

Appendix A: Revenue-Neutral Changes in The Top Rate and Threshold

If concern is only with revenue-neutral changes in the top rate and threshold, 'back of the envelope' calculations can be made as follows. Consider an individual facing a standard multi-step income tax function, with income thresholds of a_k, and marginal tax rates above each threshold of τ_k, (that is between a_k and a_{k+1}) for $k = 1, ..., K$ (with a_{K+1} infinitely large). Suppose the individual's income is $y > a_K$. Suppose that the tax paid on income below a_K is equal to T_K. Given that only reforms to the top tax bracket are being considered, the precise structure below a_K does not need to be specified. The tax paid by the individual, $T(y)$, is:

$$T(y) = T_K + \tau_K (y - a_K) \tag{A.1}$$

Now suppose the income threshold for the top bracket is raised to $a_{K,1}$, and the top marginal tax rate is raised to $\tau_{K,1}$. If $y > a_{K,1}$, the new tax paid by the individual, $T_1(y)$, is:

$$T_1(y) = T_K + \tau_{K-1} (a_{K,1} - a_K) + \tau_{K,1} (y - a_{K,1}) \tag{A.2}$$

The value of income, y^*, for which the average tax rate in the top bracket is unchanged, can be obtained as follows. The increase in a_K means that all those between a_K and y^* face a lower average tax rate, while those above y^* face a higher average rate. It is clear that $y^* > a_{K,1}$, because, even for those facing a higher marginal rate, a greater proportion of their taxable income is subject to the lower (unchanged) marginal rate in the penultimate bracket. Equating (A.1) and (A.2), and rearranging, gives:

$$y^* = \frac{a_{K,1} (\tau_{K,1} - \tau_{K-1}) - y_K (\tau_K - \tau_{K-1})}{\tau_{K,1} - \tau_K} \tag{A.3}$$

The nature of a revenue-neutral reform can be examined by considering the new (higher) top marginal tax rate needed to achieve a given (higher) threshold. This can be obtained as the solution to a simple equation requiring little summary information. First, let N and N_K denote, respectively, the total number of taxpayers and the number below the initial top bracket threshold of a_K, and let $\bar{y}_K$ denote the initial average income of those in the top bracket. Initial total revenue, R, is thus expressed as:

$$R = N_K T_K + \tau_K (\bar{y}_K - a_K)(N - N_K) \tag{A.4}$$

After the introduction of a new top tax rate, suppose the number of people below the new threshold is $N_{K,1}$ and $\tilde{y}_{K,1}$ is the average taxable income of those above the new threshold,

$a_{K,1}$. Let $\widehat{y}$ denote the average income of those whose income falls between the old and the new top threshold, and who therefore face the previous penultimate marginal rate.

The new total tax revenue, R_1, is thus:

$$
\begin{aligned}
R_1 \;=\; & N_K T_K + \tau_{K-1}\left(\widehat{y} - a_K\right)\left(N_{K,1} - N_K\right) \\
& + \tau_{K-1}\left(a_{K,1} - a_K\right)\left(N - N_{K,1}\right) + \tau_{K,1}\left(\widetilde{y}_{K,1} - a_{K,1}\right)\left(N - N_{K,1}\right) \quad\text{(A.5)}
\end{aligned}
$$

Equating (A.4), and (A.5), and writing $P_K = N_K/N$, and so on, as the proportion of the population rather than the absolute number, the required tax rate for revenue neutrality is found to be:

$$
\tau_{K,1} = \frac{R_K - \tau_{K-1}\left(\widehat{y} - a_K\right)\left(P_{K,1} - P_K\right) - \tau_{K-1}\left(a_{K,1} - a_K\right)\left(1 - P_{K,1}\right)}{\left(\widetilde{y}_{K,1} - a_{K,1}\right)\left(1 - P_{K,1}\right)} \quad\text{(A.6)}
$$

where $R_K = \tau_K\left(\overline{y}_K - a_K\right)\left(1 - P_K\right)$. This requires information only about the proportions of people below the old and new top income thresholds, along with the three average incomes; that is, the averages in the old and new top brackets, and the average of those who move out of the old top bracket.

This simplifies slightly to:

$$
\tau_{K,1} = \frac{R_K - \tau_{K-1}\left[\widehat{y}\left(P_{K,1} - P_K\right) + a_{K,1}\left(1 - P_{K,1}\right) - a_K\left(1 - P_K\right)\right]}{\left(\widetilde{y}_{K,1} - a_{K,1}\right)\left(1 - P_{K,1}\right)} \quad\text{(A.7)}
$$

Appendix B: The NZ Treasury's Microsimulation Model

The Treasury's behavioural microsimulation model used here is based on the Melbourne Institute Tax and Transfer Simulator (MITTS), a simulation model for Australia: see Creedy *et al.* (2002). The basis of the labour supply modelling is a structural model where individuals are assumed to be able to work a number of discrete hours only. Each individual maximises a utility function whose arguments are net income and leisure. Couples maximise a joint utility function. There is a deterministic component of utility: this takes a quadratic form where parameters depend on a range of individual and family characteristics. In addition, a random component is added, reflecting 'optimising errors', so that each discrete hours level has associated with it a probability level for each person.

TaxWell is a non-behavioural (or arithmetic) microsimulation model developed by the New Zealand Treasury. It contains the details of the social security and personal tax system and produces analyses at individual, family and household level. It utilises the Household Economic Survey (HES), a cross-sectional dataset collected by Statistics New Zealand. The Treasury's behavioural model, TaxWell-B, uses information for each sample individual, provided by TaxWell, on disposable incomes at the specified range of discrete hours labour supply levels before and after the reform, along with the individual and household characteristics. TaxWell-B thus uses estimated parameters of the deterministic component of preference functions on which the behavioural responses are based.

TaxWell-B assumes a 100 per cent take-up rate for welfare benefits. This may lead to some overestimation of expenditure on the different payments in both pre-reform and post-reform situations. However, as the policy changes do not expand eligibility, the simulated percentage changes reported here are not expected to be biased. All persons for whom labour supply is modelled, except sole parents, are potentially eligible for Unemployment Benefits (UB). Sole parents are eligible for DPB. The income-test rules are then applied to calculate actual benefit levels.

The budget constraints for each individual, giving net incomes at each discrete hours level, clearly require knowledge of hourly wage rates. For workers these are directly observed. However, they are unobserved for non-workers in survey data. For these individuals, it is therefore necessary to impute their wage rates using wage equations which correct for potential sample selection bias. Wage equations were estimated separately for partnered men, partnered women, single men, single women and sole parents. The behavioural responses generated by TaxWell-B are based on the use of quadratic preference functions allowing for observed and unobserved heterogeneity. For couples, labour supplies are jointly determined.

A policy simulation involves comparing the observed hours level of each individual in the

base HES sample, having the pre-reform tax and benefit structure, with the distribution of hours (over the discrete points) generated by the post-reform tax structure and net incomes. It is important to ensure that the observed hours in the pre-reform case can be regarded as an optimal position for each individual. For this reason a 'calibration' process is used to select a set of random draws from the distribution of the stochastic component of utility which are used for post-reform computations. This is described briefly as follows.

The behavioural simulation procedure for each individual or couple begins by converting the observed working hours to the closest discrete working-hours level. Then, given the parameter estimates of the preference functions (using a range of characteristics of individuals to allow for observed heterogeneity), the deterministic components of utility for each hours level are calculated for the net incomes generated by the pre-reform tax and transfer system. Then a set of random draws is taken from the Type-I extreme-value distribution. For each set of draws (one for each discrete hours level) the utility-maximising hours level is determined by adding the random draw to the deterministic component of utility for each discrete working-hours level and determining the hours level giving maximum total utility. The sets for which observed and optimum hours in the pre-reform situation are equal are retained for use in the post-reform evaluation.

The retained draws are then used to determine the distribution of optimal hours levels after the reform, for each individual. Hence the resulting distribution for each individual after the reform is the conditional probability distribution, given that the individual is at observed discretised hours initially. To obtain sufficient information regarding the post-reform hours distribution over the available discrete hours levels for each individual, a number of such sets of draws are obtained (and retained): in the simulations reported below, this number of sets is 100. The calibration approach ensures that the results before the reform are comparable between TaxWell and TaxWell-B (except that TaxWell does not discretise the hours levels before the reform). Labour supply for some groups is held constant: these are retirees, self-employed, full-time students, disabled and others.

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