

# The Elasticity of Taxable Income in New Zealand

Iris Claus, John Creedy and Josh Teng

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The Elasticity of Taxable Income in New Zealand

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# Abstract

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This paper reports estimates of the elasticity of taxable income with respect to the net-of-tax rate for New Zealand taxpayers. The relative stability of the New Zealand personal income tax system, in terms of marginal rates, thresholds and the tax base, provides helpful conditions for deriving these estimates. The elasticity of taxable income was estimated to be substantially higher for the highest income groups. Generally it was higher for men than for women. Changes in the timing of income flows for the higher income recipients were found to be an important response to the announcement of a new higher-rate bracket. The marginal welfare costs of personal income taxation were consistent across years, being relatively small for all but the higher tax brackets. For the top marginal rate bracket of 39 per cent, the welfare cost of raising an extra dollar of tax revenue was estimated to be well in excess of a dollar. Furthermore, for the top bracket the marginal tax rate was often found to exceed the revenue-maximising tax rate.

**JEL CLASSIFICATION**

H24 Public Economics - Taxation, Subsidies, and Revenue - Personal Income and Other Nonbusiness Taxes and Subsidies  
H31 Public Economics - Fiscal Policies and Behaviour of Economic Agents - Household

**KEYWORDS**

Income taxation; Taxable income; Elasticity of taxable income; Excess burden of taxation.

## Executive Summary

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1. This paper provides estimates for New Zealand of the extent to which taxable incomes change as a result of people responding to changes in the marginal tax rate they face.
2. The measure used to summarise behavioural responses is the 'elasticity of taxable income'. This measures the proportional change in taxable income resulting from a proportional change of one per cent in the net-of-tax marginal tax rate (the latter is defined as one minus the marginal tax rate).
3. Results were obtained using a special dataset constructed from a large random sample of New Zealand taxpayers. The data covered the changes in the income tax structure which came into effect in 2001, in particular the introduction of a new 'top' income tax bracket.
4. Two approaches were used to estimate elasticity values for different groups of taxpayers. First, the introduction of an additional top marginal tax rate bracket provided a useful policy change as a natural experiment. Secondly, the stability of the tax structure over more recent years enables the effect of fiscal drag, in shifting some individuals into a higher marginal tax rate bracket, to be considered.
5. In examining changes in taxable income, it was found that some responses to tax changes involve the timing, rather than the total amount, of taxable income declared, particularly in anticipation of announced changes taking effect.
6. The estimated elasticity of taxable income is substantially higher for the highest income groups. Indeed for lower deciles of the income distribution, the elasticity was found to be negligible.
7. Generally the elasticity was higher for men than for women, but this is largely because the taxable incomes of men are systematically above those of women.
8. The marginal welfare costs (the excess burden of the tax per extra dollar of revenue raised) of personal income taxation were consistent across years, being relatively small for all but the higher tax brackets. For the top marginal rate bracket of 39 per cent, the welfare cost of raising an extra dollar of tax revenue was found to be well in excess of a dollar.
9. The elasticity, of around 0.5, has important implications for revenue raising. In a non-proportional tax structure, an elasticity well below 1 can result in a reduction in revenue.
10. Further work will examine the potential revenue effects of tax changes as well as using alternative estimation techniques.

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# The Elasticity of Taxable Income in New Zealand

## 1 Introduction

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This paper reports new estimates for New Zealand of the elasticity of taxable income with respect to the marginal net-of-tax rate. This elasticity aims to capture, in a reduced-form relationship, all potential responses to income taxation in a single elasticity measure, without the need to specify the structural nature of the various adjustment processes involved; early contributions are by Lindsey (1987) and Feldstein (1995, 1999). These adjustments include, as well as labour supply changes, income shifting between sources which are taxed at different rates, and tax evasion through non-declaration of income. The elasticity of taxable income has the added attraction that, under certain assumptions, it can easily be used to obtain a measure of the excess burden of income taxation. The only previous estimates for New Zealand, produced by Thomas (2007), relate to the 1986 tax changes.

Given the difficulty of constructing and estimating structural models dealing with the different types of adjustment, along with the data requirements, the popularity of the elasticity of taxable income is not surprising. The widespread use of the measure is indicated by the fact that a recent survey of estimates, by Saez, Slemrod and Giertz (2012), includes 111 references. However, it must be recognised that this ability to 'cut through' considerable complexity is not without significant costs. In particular, the strong – and usually untested – assumption is usually made that there are no income effects of tax changes, since this considerably simplifies the calculation of welfare costs. This implies a special quasi-linear form of the utility function: for an introduction to the basic analytics, see Creedy (2010).<sup>1</sup> It means, for example, that a change in the marginal tax rate in a lower tax bracket than the one occupied by an individual has no effect on taxable income. Furthermore, a simple constant elasticity specification of the relationship between taxable income and the net-of-tax rate is typically used, as in the present paper. Furthermore, in obtaining empirical estimates there is the ever-present danger of attributing changes in income to changes in the marginal net-of-tax rate, when they may have arisen for other unobserved reasons as part of a general process of relative income dynamics. In addition, the elasticity is in practice affected by, for example, the costs of income shifting between sources and time periods, along with detailed tax regulations other than simply the marginal rates. These influences cannot be captured in a reduced-form approach. Hence, any estimates must be treated with caution.

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<sup>1</sup> It is worth recognising that the elasticity is not a fixed parameter. It depends on, for example, the ease of forming trusts or being incorporated. The effects of increasing and decreasing tax rates may not therefore be symmetric.



Despite these problems, the more recent New Zealand tax structure provides a good context for attempting to estimate an elasticity. The estimates are obtained using a special dataset, constructed using a random sample of administrative data collected by the New Zealand Inland Revenue. The details of the sample method and the variables obtained are provided in Appendix A. In 2001 there was a change involving only a single tax rate change: this was the introduction of a top marginal income tax rate of 39 per cent for higher-income earners who previously faced a 33 per cent rate, and corporate and trust rates remained unchanged. An elasticity can thus be obtained by comparing the income shares of those who were affected by the tax change and those who were not affected. This necessarily relates only to those at the top end of the income distribution. There was subsequently a relatively long period during which there were no changes in the income thresholds or the marginal tax rates. The existence of fiscal drag makes it possible to apply a difference-in-difference approach, by distinguishing treatment and control groups respectively in terms of those individuals who were sufficiently close to an upper income threshold that they moved into a higher tax rate bracket, and those who remained in the same bracket. This approach can therefore be extended to relatively lower income ranges. A feature of the results presented here, shared by a number of studies for other countries, is that they indicate quite substantial values (in excess of 0.5) of the elasticity of taxable income for high-income individuals. This finding clearly contrasts with those studies which have concentrated on estimating labour supply elasticities. Hence disincentive effects on high-income groups of tax rate increases cannot easily be dismissed.

The basic concept is introduced in Section 2, which describes the estimation methods used in later sections. Section 3 briefly discusses the marginal rate structure of New Zealand's income tax system. This has remained relatively stable since the middle 1990s. A major change was made in 2001, when a new top marginal rate was introduced. From 2001 until 2008, no threshold or marginal rate changes took place. Hence, a policy change and the existence of fiscal drag provide two alternative approaches to estimating the elasticity. Section 4 concentrates on estimates obtained by considering the introduction of the 39 per cent rate, and Section 5 examines the implications of fiscal drag, whereby some individuals experience a change in their marginal rate on moving into a higher tax bracket. Brief comparisons with other estimates are made in Section 6. Welfare effects are considered in Section 7. Further background details regarding welfare effects for all tax brackets are given in Appendix B. Brief conclusions are in Section 8.

## 2 The Elasticity and Estimation

The central concept examined here is the elasticity,  $\eta$ , of declared income,  $z$ , with respect to the net-of-tax rate,  $1 - \tau$ , which is the net-of-tax income per marginal dollar of pre-tax income (Lindsey, 1987). It is defined as:

$$\eta = \frac{1 - \tau}{z} \frac{dz}{d(1 - \tau)} \quad (1)$$

This elasticity captures all responses to tax rate changes, without attempting to model each form of response. A popular constant-elasticity reduced-form specification is the following:<sup>2</sup>

$$z = z_0 (1 - \tau)^\eta \quad (2)$$

where  $z_0$  denotes the individual's income in the absence of taxation (that is, when  $\tau = 0$ ). Importantly, this specification assumes that income effects of tax changes are assumed to be zero. The remainder of this section describes the alternative estimation methods used in this paper.

Let  $z_{it}$  and  $z_{0it}$  denote declared income of person  $i$  at time  $t$  and the income which would be declared in the absence of taxation. Furthermore,  $\tau_{it}$  is the marginal tax rate facing individual  $i$  at time  $t$ , where  $T(z)$  is the tax function. Using the constant elasticity form given above:

$$z_{it} = z_{0it} (1 - \tau_{it})^\eta \quad (3)$$

where by assumption the elasticity  $\eta$  is the same for all individuals in the relevant population group considered.<sup>3</sup> One approach is to consider actual policy changes in the tax structure for which only a relatively small group of individuals are affected, using information about the distribution of taxable income before and after the policy change. For example, suppose there is a change in only the top marginal income tax rate, which has no effect on those subject to lower rates. Let  $P_t$  denote the share of income of the affected group at time  $t$ , and their average marginal tax rate is  $\tau_{Pt}$ . Let  $t = 0$  and  $t = 1$  denote pre- and post-change periods. If the share of income in the relevant group would have remained constant in the absence of the policy change, an estimate can be obtained using:

$$\hat{\eta} = \frac{\log P_1 - \log P_0}{\log(1 - \tau_{P1}) - \log(1 - \tau_{P0})} \quad (4)$$

This method requires only summary data relating to the (cross-sectional) taxable income distribution in two periods.

<sup>2</sup> It can be shown that this follows from an assumption that utility is quasi-linear.

<sup>3</sup> Given information about incomes and the marginal rate for a group of individuals, a simple double-log regression, omitting the unobservable income in the zero-rate case, cannot be expected to provide a useful estimate of the elasticity,  $\eta$ , since the omitted variable is correlated with the marginal rate.

An alternative approach to a policy change involves using a difference-in-difference framework with panel data. Suppose that the treatment group,  $T$ , comprises the top  $P1$  percentile of the income distribution and the control group,  $C$ , is made up of individuals in the next  $P2$  percentile. Again, suppose tax policy changes from period 0 to period 1, and let  $E(\cdot)$  denote the respective sample average. The difference between groups in the differences between average log-taxable income from one period to the next, denoted  $\Delta \log z$ , is given by:

$$\Delta \log z = \{E(\log z_{i1}|T) - E(\log z_{i0}|T)\} - \{E(\log z_{i1}|C) - E(\log z_{i0}|C)\} \quad (5)$$

The difference between groups in the differences between the logarithm of average net-of-tax rates from one period to the next, denoted  $\Delta \log(1 - \tau)$ , is given by:

$$\begin{aligned} \Delta \log(1 - \tau) = & \{E(\log(1 - \tau_{i1})|T) - E(\log(1 - \tau_{i0})|T)\} \\ & - \{E(\log(1 - \tau_{i1})|C) - E(\log(1 - \tau_{i0})|C)\} \end{aligned} \quad (6)$$

The estimate of the elasticity of taxable income can be obtained using:

$$\hat{\eta} = \frac{\Delta \log z}{\Delta \log(1 - \tau)} \quad (7)$$

Again, this approach involves an assumption that without the policy change the incomes of the two groups would have grown at the same rate.<sup>4</sup> In addition, the elasticity of taxable income is assumed to be the same for both groups.

The difference-in-difference approach can also be applied in situations where there is no explicit policy change affecting the marginal tax rate faced by some individuals. In particular, fiscal drag gives rise to a general increase in average tax rates but it can also shift some individuals into the next bracket and thus subject them to a higher marginal rate. Such individuals are regarded as being in the ‘treatment’ group. Those in the lower section of an income range do not face a higher marginal rate, as they do not cross a threshold, and are regarded as being in the ‘control’ group. The expression for the elasticity can thus be used in this context. This method can be applied for each tax bracket, thereby allowing for variations in  $\eta$  with income (between brackets).<sup>5</sup>

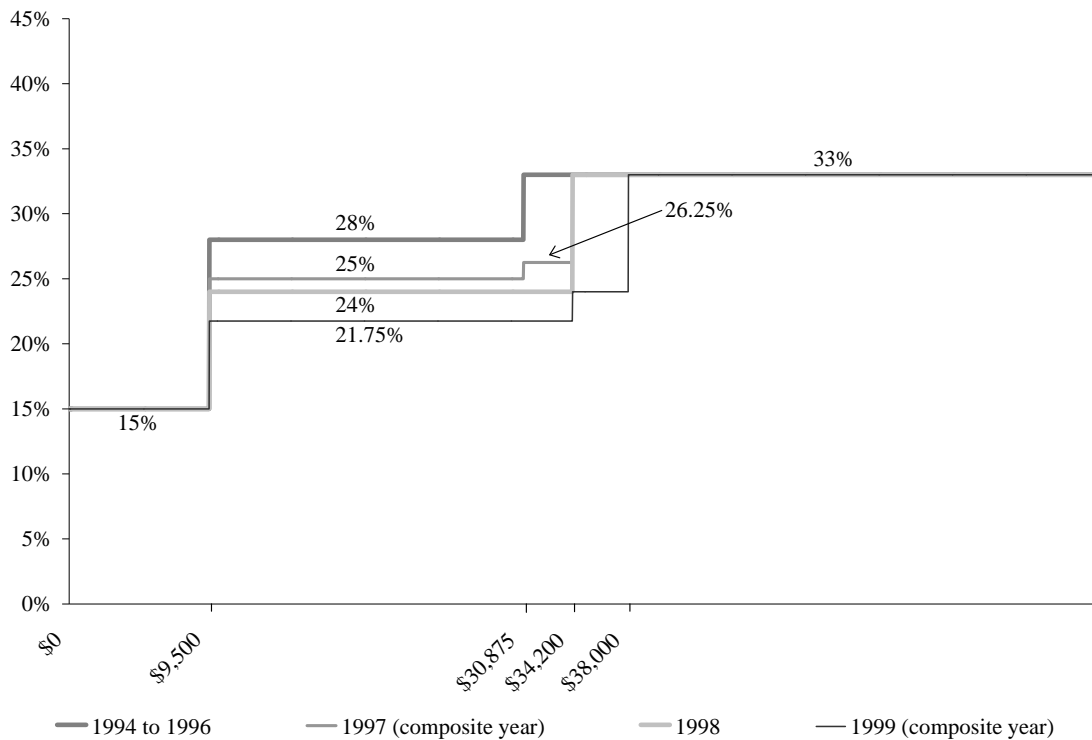
<sup>4</sup> If systematic income changes occur for non-tax reasons, for example if there is some ‘regression towards the mean’ over time, the estimator may be biased. A method of allowing for such changes is examined by Creedy (2010).

<sup>5</sup> In addition to income tax thresholds, the real value of other tax parameters (such as allowance and deduction limits) can fall during inflation, as examined by Onrubia and Sanz (2009). However, this is unlikely to be an issue in New Zealand given the limited allowances and deductions over the period of estimation.

### 3 New Zealand's Income Tax System

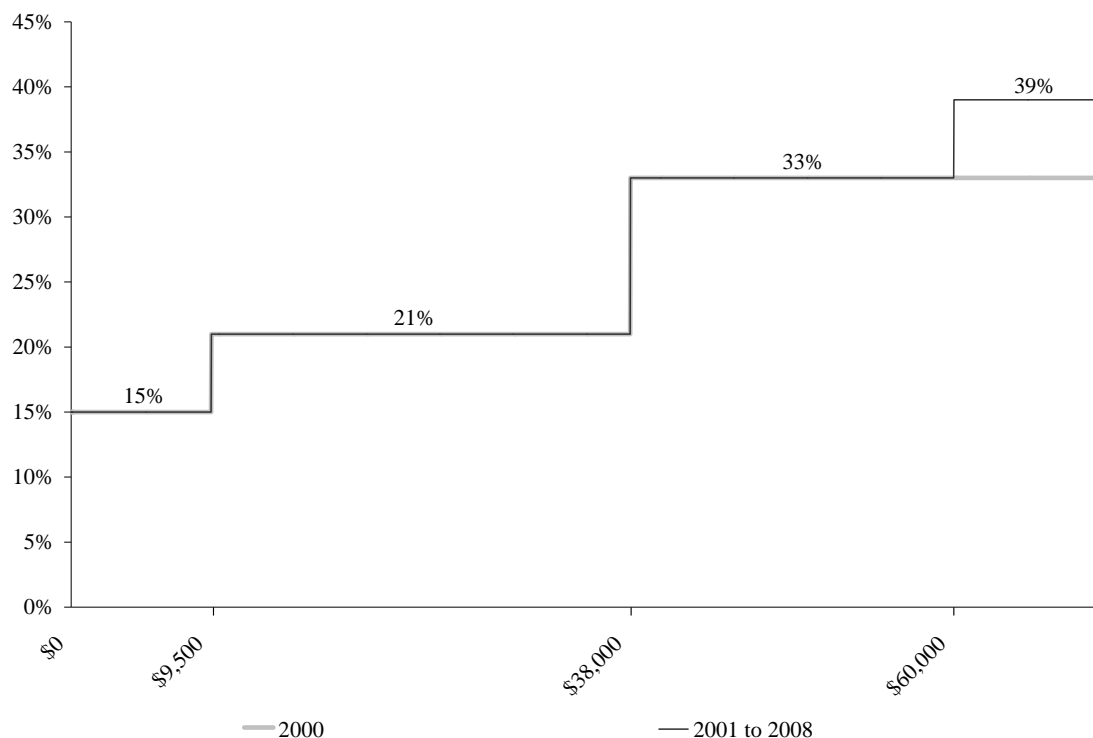
The relative stability of the personal income tax system, in terms of marginal rates, thresholds and the tax base, provides helpful conditions for attempting to estimate the elasticity of taxable income. New Zealand's income tax system was transformed with economic reforms that began in 1984. These reforms were designed to improve efficiency while raising revenue by broadening the tax base and lowering marginal income tax rates; see, for example, Evans et al. (1996). The tax base was broadened by introducing a comprehensive goods and services tax (GST) and a fringe benefit tax, and by eliminating many tax concessions, exemptions, and investment and export incentives. The top personal marginal income tax rate was cut from 66 per cent to 33 per cent and the number of tax brackets was reduced from eleven to three.<sup>6</sup> Aggregate tax revenue actually increased despite the reductions in the tax rates. The tax scales for 1994 to 1999 and 2000 to 2008 are plotted in Figures 1 and 2. The 'composite' years, 1997 and 1999, are years when a tax rate or income threshold change came into effect during the income tax year, which starts on 1 April and ends on 31 March.

**Figure 1 – Effective Tax Rates 1994 to 1999**



<sup>6</sup> The company tax rate was lowered from 48 per cent to 33 per cent.

**Figure 2 – Effective Tax Rates 2000 to 2008**



New Zealand’s personal income tax system introduced during the reforms remained virtually unchanged until 2001, although during 1994 to 2001 the middle income tax bracket was subject to some threshold and rate adjustments. However, in 2001 a new top personal marginal tax rate of 39 per cent for income above \$60,000 was introduced, with the company and trust rates remaining at 33 per cent.<sup>7</sup> This policy change provides a useful natural experiment for studying the responsiveness of taxpayers to changes in marginal tax rates. Furthermore, over the period 2001 to 2008 no threshold or rate changes were made to the other tax brackets.<sup>8</sup> As a result of income growth a large number of taxpayers experienced an increase in their marginal rate because they moved into a higher tax bracket. These fiscal drag effects enable the difference-in-differences estimator discussed in the previous section to be used.<sup>9</sup>

<sup>7</sup> The average monthly exchange rate for 1994 to 2008 was US\$0.60 per NZ\$1.

<sup>8</sup> Changes to the Working for Families (WfF) package began in October 2004 and were implemented in stages through 1 April 2007. They included changes to in-work incentives and family entitlement and support to meet childcare and accommodation costs. Low- to middle-income families were the key target group for these changes.

<sup>9</sup> The rates used here do not reflect the effects of benefit abatement rates in view of the concentration on the top end of the income distribution.

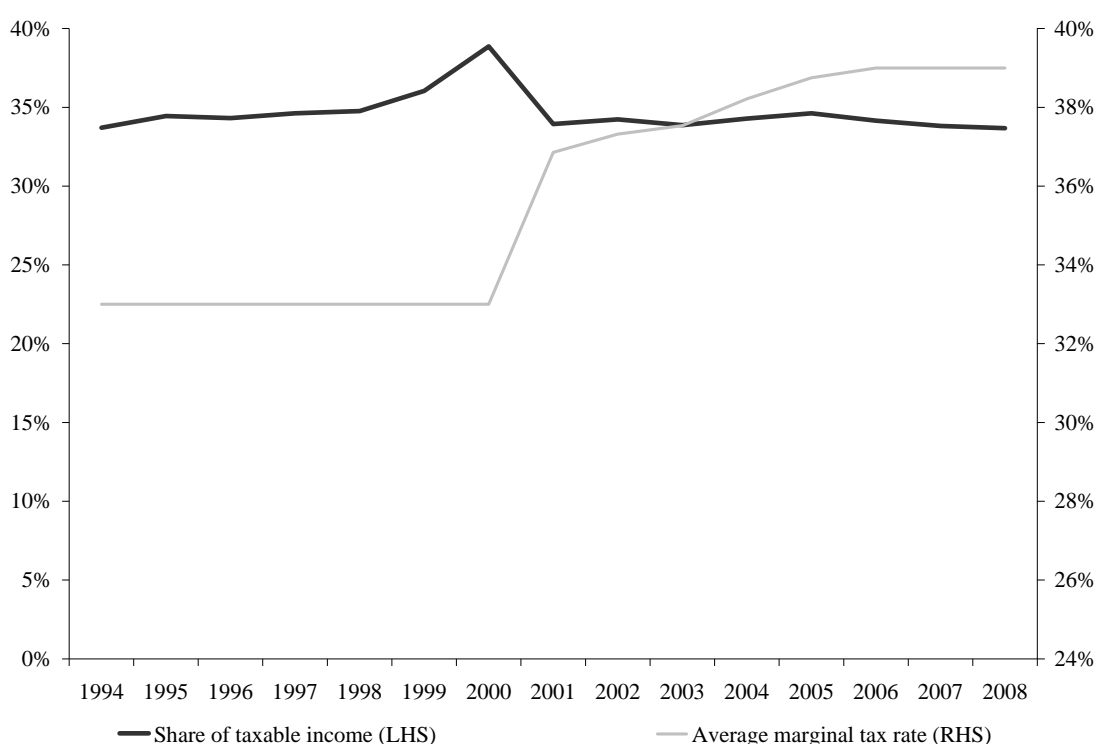
## 4 Empirical Results: Introduction of 39 Per cent Rate

This section presents estimates of taxpayers' responses to changes in marginal tax rates, following the introduction of the 39 per cent top personal marginal rate. Elasticities of taxable income are reported for all taxpayers and for females and males separately. The first set of estimates are obtained using equation (4), calculated for different taxpayer groups. The second set of estimates of the elasticity are based on the difference-in-difference estimate, given by equation (7).

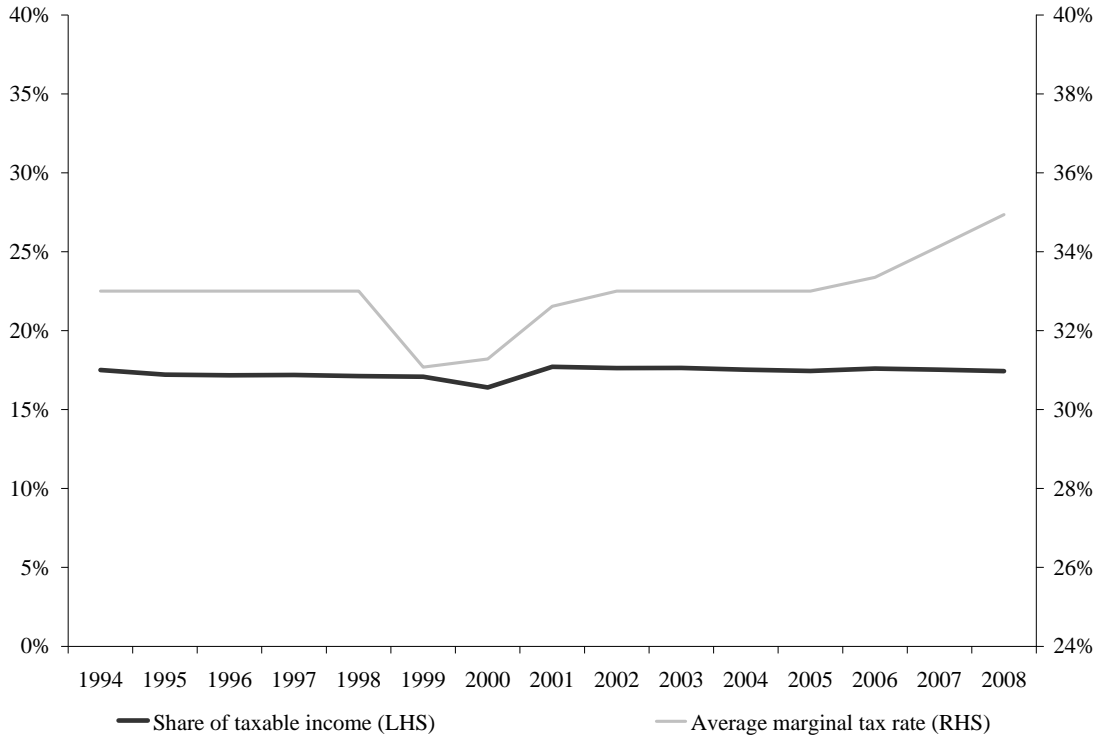
### 4.1 Income Shares and Average Marginal Rates

First, information about the average rates faced by different groups is summarised in Figures 3 to 5. These diagrams plot the average marginal tax rates faced by the top decile, the ninth decile and the combined eighth and seventh deciles (the fourth quintile) of income earners, along with their shares of taxable income from 1994 to 2008. Figure 3 shows that between 1994 and 2000 all top decile income earners faced a marginal tax rate of 33 per cent. Over this period their share of taxable income increased from 33.7 per cent in 1994 to 36 per cent in 1999. Following the announcement of the 39 per cent top personal rate for income above \$60,000 the top decile's share of taxable income rose sharply to 38.9 per cent in 2000. However, following the introduction of the 39 per cent rate it fell to 33.9 per cent in 2001. Between 2001 and 2008 the share of taxable income obtained by the top decile fluctuated between 33.7 per cent in 2008 and 34.6 per cent in 2005. The introduction of the 39 per cent rate led to an increase in the average marginal tax rate of the top decile. By 2006 all top decile earners faced the new top marginal rate of 39 per cent.

**Figure 3 – Top Decile Income Share and Average Marginal Tax Rate**



**Figure 4 – Ninth Decile Income Share and Average Marginal Tax Rate**



**Figure 5 – Combined Seventh and Eighth Decile Income Share and Average Marginal Tax Rate**

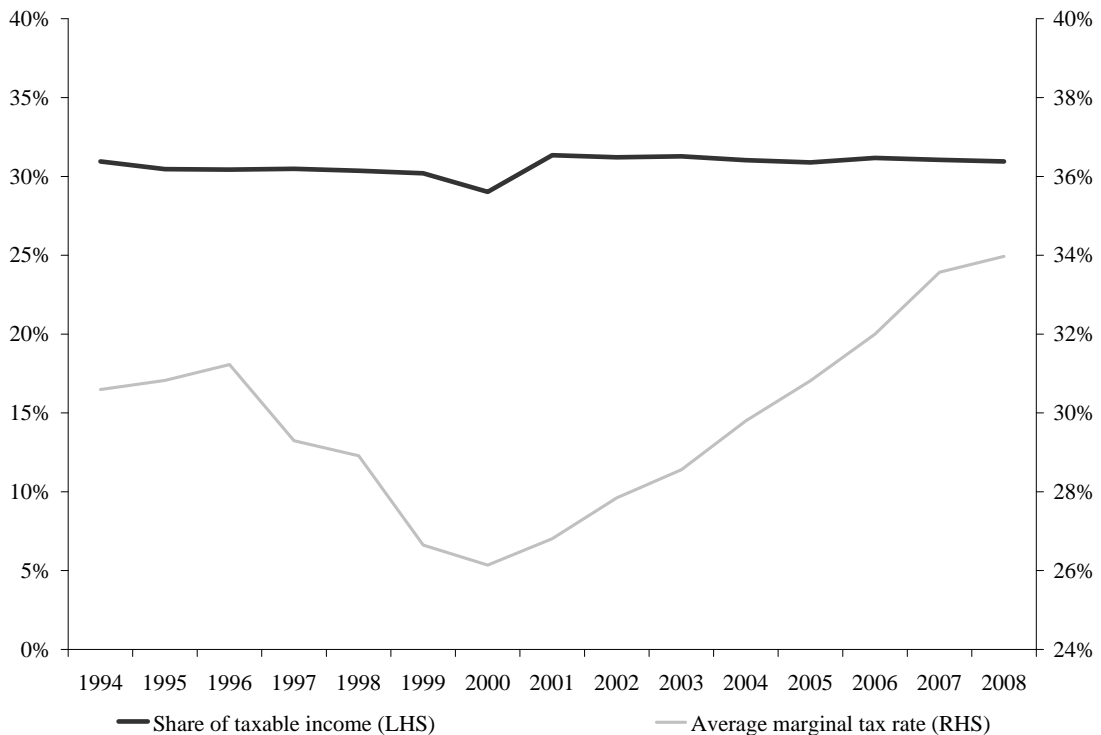


Figure 4 shows that over the period 1994 to 2008 those in the ninth decile of taxable income contributed, on average, 17.3 per cent to the personal income tax base. Their marginal tax rate averaged 33 per cent from 1994 to 1998 and 2002 to 2006. Between 1999 and 2001 it fell below 33 per cent for three years following a threshold and a tax rate adjustment of the middle rate. The average marginal tax rate reached 34.1 per cent in

2007 and 34.9 per cent in 2008 as the number of taxpayers who moved into the top tax bracket increased.

Figure 5 shows that between 1994 and 1996 the average marginal tax rate of the seventh and eighth deciles of taxable income was around 31 per cent. However, it fell sharply to reach a low of 26.1 per cent in 2000 due to various threshold and tax rate adjustments. Since 2001 it has been rising steadily to reach 34 per cent in 2008. Over the period 2000 to 2008 these income earners experienced a slightly larger increase in their average marginal tax rate than the top decile of income earners (7.8 percentage points compared with 6 percentage points). But, in contrast to the top decile earners whose share of taxable income fell, their contribution to the personal income tax base rose slightly. It averaged 30.3 per cent between 1994 and 2000 and 31.1 per cent between 2001 and 2008.

## 4.2 Elasticity Estimates

The elasticities of taxable income, which compare the share of taxable income before and after the introduction of the 39 per cent rate, are reported in Table 1 for the top decile of taxable income earners. Two years are considered before the rate change. They are 1999, which pre-dates the announcement of the 39 per cent top rate and 2000, which is the year before its introduction. The elasticities are calculated for two base years because of the sharp increase in the top decile's taxable income that occurred in 2000. Elasticities for the top decile are between 0.4 and 1 using 1999 values as the income share before the rate change. The elasticities are substantially higher when 2000 is used as the base year, suggesting that a 1 per cent increase in the net-of-tax rate raises taxable income by 1.3 to 2.3 per cent. These values are unrealistically high, and clearly arise from the anticipation of the marginal rate increase. Hence the knowledge that a new top tax bracket is due to be introduced leads to a change in the timing of income flows, particularly for high income earners. This timing change is clearly reflected in Figure 3.

**Table 1 – Elasticity of Taxable Income in Top Decile: Introduction of 39 per cent Marginal Rate**

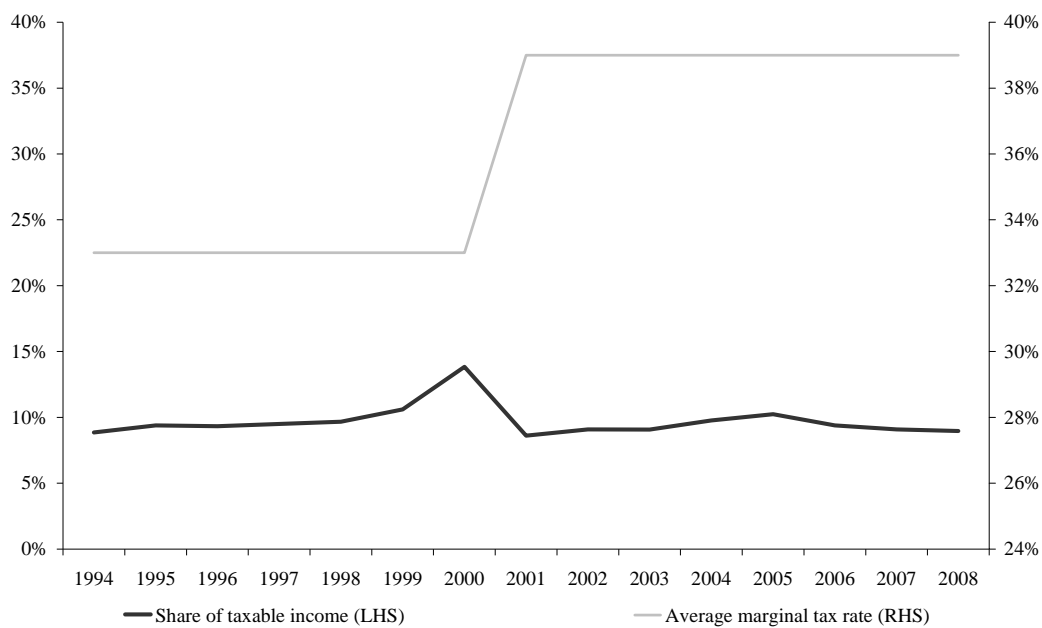
	Compared with:	
	1999 (Pre-announcement)	2000 (Pre-introduction)
2001	1.0 (0.8, 1.2)	2.3 (2.0, 2.5)
2002	0.8 (0.6, 1.0)	1.9 (1.6, 2.2)
2003	0.9 (0.7, 1.1)	2.0 (1.7, 2.3)
2004	0.6 (0.3, 0.9)	1.5 (1.3, 1.7)
2005	0.4 (0.1, 0.8)	1.3 (1.0, 1.6)
2006	0.6 (0.4, 0.8)	1.4 (1.1, 1.6)
2007	0.7 (0.5, 0.8)	1.5 (1.3, 1.7)
2008	0.7 (0.6, 0.9)	1.5 (1.4, 1.7)

Note: 95% confidence intervals are reported in parentheses. They were generated from 1,000 simulations using bootstrapped resampling.



Much lower values were obtained for the ninth and lower deciles, suggesting that higher income earners are clearly more responsive to tax rate changes than lower income earners.<sup>10</sup> In fact, the response of the top decile income earners is largely due to the highest earners in this group. This is illustrated by Figures 6 and 7, which plot the average marginal tax rate faced by the top percentile and the 90-99th percentiles of taxable income earners, along with their shares of taxable income from 1994 to 2008. Both taxpayer groups experienced an increase in their marginal tax rate. The share of taxable income remained virtually unchanged for the 90-99th percentiles. However, for the top percentile, it rose sharply in 2000, the year before the introduction of the 39 per cent rate, and then fell. Between 1994 and 2000 the top percentile of income earners contributed on average 10.2 per cent of personal income tax revenue compared with 9.3 per cent between 2001 and 2008.

**Figure 6 – Top Percentile Income Share and Average Marginal Tax Rate**



<sup>10</sup> Values for the ninth decile and combined seventh and eighth deciles are not reported, as they were all found to be zero when using 1999 as the base year, and 0.1 when using 2000 as base year.

**Figure 7 – 90-99th Percentile Income Share and Average Marginal Tax Rate**

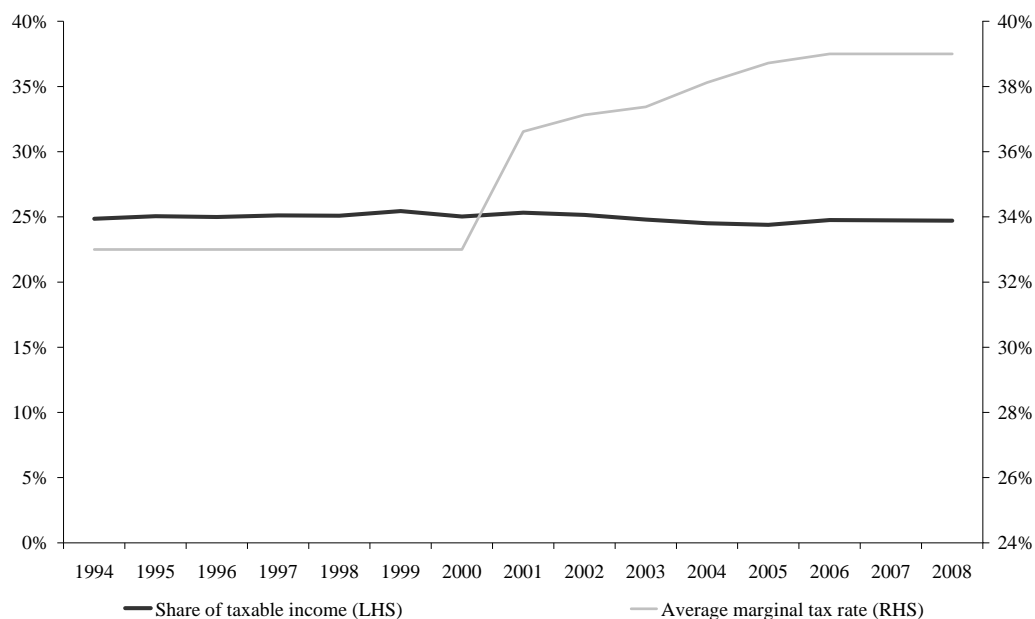


Figure 8 shows that the sharp increase in taxable income of the top percentile of income earners in 2000 was due to a rise in dividend income during that year. Under New Zealand’s imputation system, credits are attached to dividends for income tax that has been paid at the company level. The introduction of the 39 per cent top personal marginal rate and nonalignment with the company tax rate meant an additional 6 per cent tax liability for earners with income above \$60,000. As a result, companies paid out large profits before the 39 per cent top personal rate came into effect. Figure 8 also shows a decline in shareholder employee salaries following the introduction of the 39 per cent top marginal rate.

**Figure 8 – Top Percentile Income Share and Composition and Average Marginal Tax Rate**

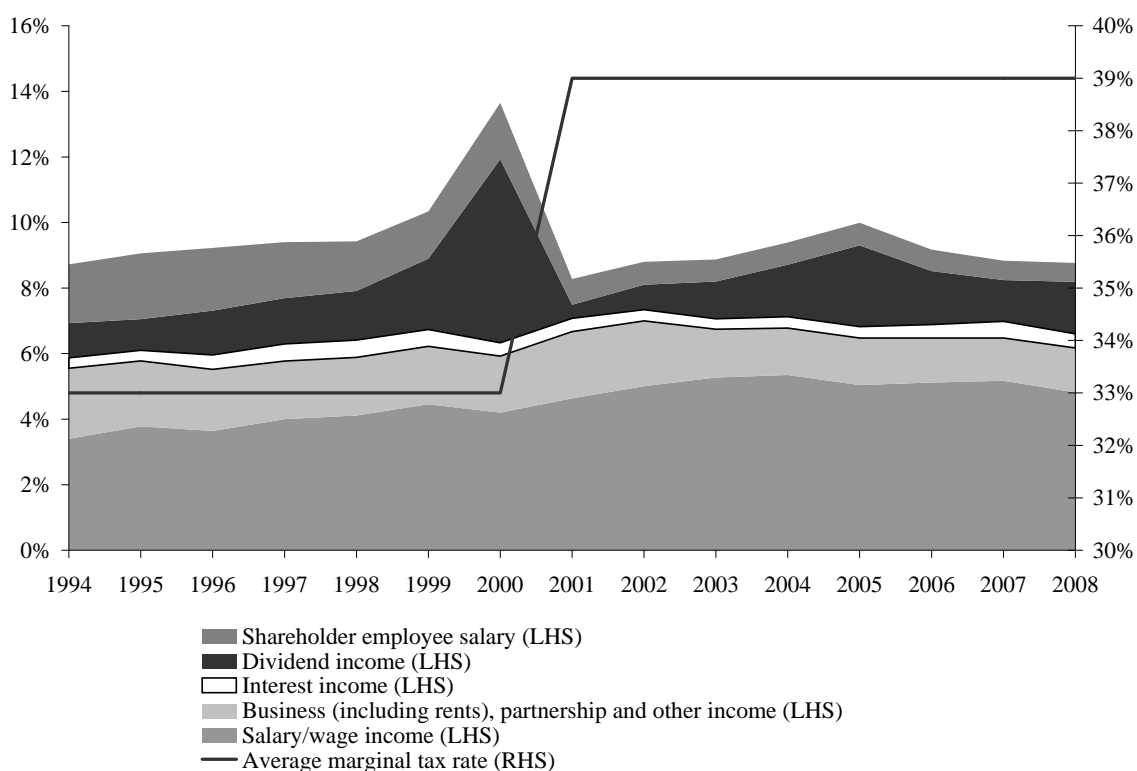


Table 2 reports the elasticities of taxable income for the top percentile of taxable income earners compared with 1999 and 2000. The elasticities of the top percentile of income earners are higher than those of the top decile earners. Values for the 90-99th percentile were found to be negligible, suggesting that most of the response of the top decile income earners is due to the top percentile earners. Again the values using 2000 as the base year are unrealistically high as a result of the bringing forward of taxable income between the announcement of the policy change and its implementation.

**Table 2 – Elasticity of Taxable Income: Top Percentile of Incomes**

	Compared with:	
	1999 (Pre-announcement)	2000 (Pre-introduction)
2001	2.2 (1.7, 2.7)	5.0 (4.3, 5.6)
2002	1.6 (1.1, 2.3)	4.5 (3.7, 5.2)
2003	1.7 (1.0, 2.4)	4.5 (3.7, 5.4)
2004	0.9 (-0.1, 2.0)	3.7 (2.5, 5.0)
2005	0.4 (-0.9, 2.1)	3.2 (1.8, 4.8)
2006	1.3 (0.5, 2.3)	4.1 (3.2, 5.1)
2007	1.6 (1.3, 2.0)	4.5 (3.8, 5.1)
2008	1.8 (1.4, 2.6)	4.6 (4.1, 5.4)

Note: 95% confidence intervals are reported in parentheses. They were generated from 1,000 simulations using bootstrapped resampling.

The difference-in-difference estimator of the elasticity of taxable income is reported in Table 3. It is the elasticity of taxable income for the top decile of income earners compared with the next decile.<sup>11</sup> The difference-in-difference estimator produces similar orders of magnitude compared with the taxable income share elasticity for the top decile of taxable income earners.

**Table 3 – Difference-in-Difference Elasticity of Taxable Income: Top Decile versus Ninth Decile of Incomes**

	Compared with:	
	1999 (Pre-announcement)	2000 (Pre-introduction)
	Top Decile Incomes	
2001	1.2 (0.9, 1.4)	2.0 (1.7, 2.2)
2002	1.1 (0.9, 1.4)	1.9 (1.6, 2.1)
2003	1.4 (1.2, 1.6)	2.0 (1.8, 2.3)
2004	1.2 (1.0, 1.4)	1.7 (1.6, 1.9)
2005	1.0 (0.9, 1.2)	1.5 (1.4, 1.7)
2006	1.0 (0.8, 1.1)	1.5 (1.3, 1.6)
2007	1.2 (1.0, 1.3)	1.8 (1.6, 2.0)
2008	1.5 (1.3, 1.8)	2.3 (2.0, 2.6)

Note: 95% confidence intervals are reported in parentheses. They were generated from 1,000 simulations using bootstrapped resampling.

It is also of interest to investigate whether females and males respond differently to marginal tax rate changes. Tables 4 and 5 report elasticities of taxable income for the top decile and for the top percentile of income earners.<sup>12</sup> Values for lower deciles are negligible, as are the values for the 90-99th percentiles, and are thus not reported. The results confirm the previous finding that higher income earners are more responsive to marginal tax rate changes than lower income earners for both females and males. The elasticity estimates for the top percentile income earners exceeds that of the top decile.

<sup>11</sup> Due to the flat income tax scales in New Zealand the top percentile versus the 90-99 percentile of earners could not be calculated. This is because the 90-99 percentile of earners is not a meaningful control group for the top percentile of earners. Most of them, and at the end of the sample all of them, faced the same marginal tax rate as the top percentile of earners.

<sup>12</sup> Elasticities of the top decile compared with the ninth decile are not reported here, because the relatively higher increase in incomes of females in the ninth decile impart a large downward bias. Values for males steadily increase from 0.8 in 2001 to 1.8 in 2007, when 1999 is the base year.

**Table 4 – Elasticity of Taxable Income: Top Decile of Incomes**

	Compared with:			
	1999 (Pre-announcement)		2000 (Pre-introduction)	
	Female	Male	Female	Male
	Top Decile Incomes			
2001	0.6 (0.1, 1.0)	0.9 (0.7, 1.1)	2.7 (2.0, 3.3)	1.9 (1.6, 2.0)
2002	0.2 (-0.2, 0.6)	0.7 (0.6, 0.9)	2.0 (1.4, 2.6)	1.7 (1.4, 1.9)
2003	0.5 (0.0, 0.9)	0.8 (0.6, 1.1)	2.2 (1.6, 2.7)	1.8 (1.5, 2.1)
2004	0.3 (-0.1, 0.7)	0.6 (0.2, 1.0)	1.7 (1.2, 2.1)	1.5 (1.1, 2.0)
2005	0.2 (-0.2, 0.5)	0.5 (0.0, 1.0)	1.4 (1.0, 1.8)	1.4 (0.9, 2.0)
2006	-0.2 (-0.9, 0.4)	0.8 (0.6, 1.0)	0.8 (0.2, 1.5)	1.8 (1.5, 2.0)
2007	0.1 (-0.1, 0.4)	0.9 (0.7, 1.1)	1.0 (0.7, 1.3)	1.8 (1.5, 2.0)
2008	0.3 (0.1, 0.4)	0.9 (0.7, 1.1)	1.1 (0.8, 1.3)	1.8 (1.5, 2.1)

Note: 95% confidence intervals are reported in parentheses. They were generated from 1,000 simulations using bootstrapped resampling.

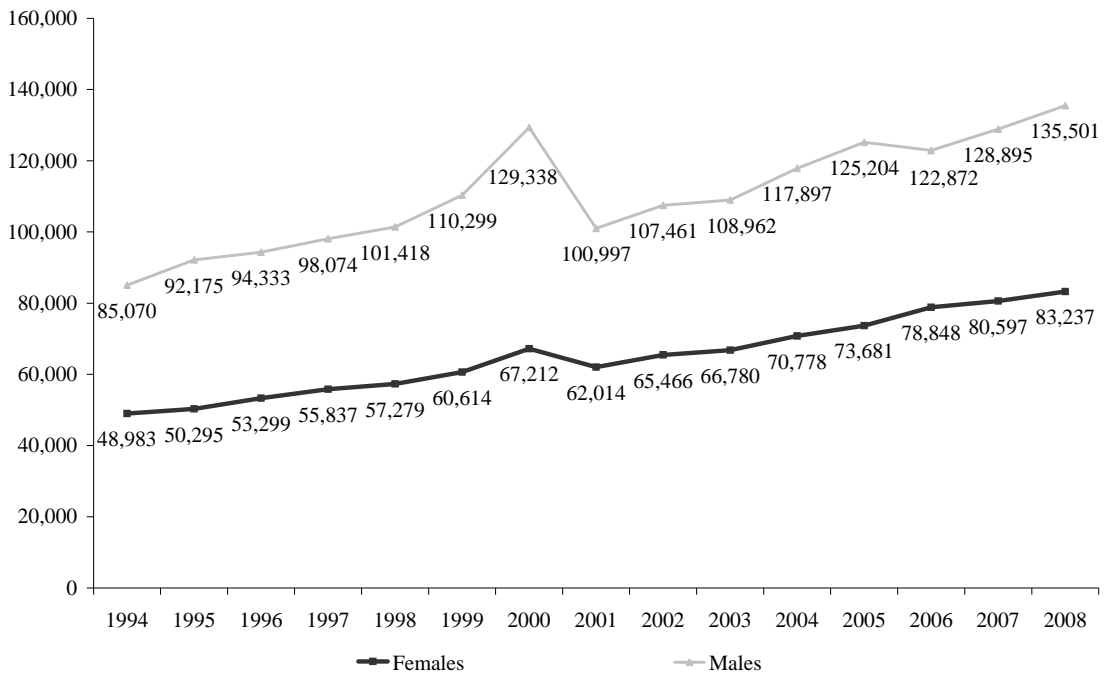
**Table 5 – Elasticity of Taxable Income: Top Percentile of Incomes**

	Compared with:			
	1999 (Pre-announcement)		2000 (Pre-introduction)	
	Female	Male	Female	Male
	Top Percentile Incomes			
2001	1.5 (0.8, 2.1)	2.5 (1.8, 3.2)	4.0 (3.1, 4.8)	5.6 (4.6, 6.4)
2002	1.2 (0.5, 1.9)	1.8 (1.0, 2.7)	3.7 (2.9, 4.6)	4.8 (3.8, 5.9)
2003	1.0 (0.4, 1.9)	1.8 (1.1, 2.9)	3.6 (2.6, 4.6)	4.9 (3.8, 6.0)
2004	1.0 (0.4, 1.7)	0.6 (-0.6, 2.1)	3.5 (2.5, 4.5)	3.7 (2.0, 5.4)
2005	0.7 (-0.3, 1.7)	0.0 (-1.7, 2.4)	3.2 (2.1, 4.3)	3.0 (1.2, 5.5)
2006	-0.4 (-2.1, 1.6)	2.0 (1.2, 2.7)	2.1 (0.3, 4.1)	5.0 (4.0, 5.9)
2007	0.6 (-0.3, 1.6)	2.0 (1.3, 2.7)	3.1 (2.0, 4.2)	5.1 (4.1, 5.8)
2008	1.2 (0.6, 1.8)	1.8 (1.2, 2.9)	3.7 (2.8, 4.5)	4.9 (4.1, 6.1)

Note: 95% confidence intervals are reported in parentheses. They were generated from 1,000 simulations using bootstrapped resampling.

Moreover, the results suggest that men may be more responsive than women to tax rate changes, when 1999 is used as the base year, thereby avoiding the income shifting between periods, discussed above. Women are likely to be less responsive to tax rate changes than men because they have lower incomes. This can be seen in Figure 9, which plots the average income of the top decile female and male earners for 1994 to 2008. The average income of the top decile female earners rose steadily from \$48,983 in 1994 to \$83,237 in 2008. By comparison, the top decile of male incomes increased from \$85,070 to \$135,501. Also notable is the increase in the average taxable income of male earners from \$110,299 in 1999 to \$129,338 in 2000 and the drop in 2001 to \$100,997.

**Figure 9 Average Incomes of Top Decile of Female and Male Earners**



## 5 Empirical Results: Fiscal Drag

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This section, reports estimates of taxpayers' responsiveness to changes in marginal tax rates by examining the behaviour of earners whose marginal tax rate increased because they moved into a higher tax bracket as a result of fiscal drag. The period 2001 to 2008 is considered, as during this time no threshold or marginal rate changes were made to the lower income tax brackets. Elasticities of taxable income are derived for all taxpayers and for females and males separately. The assumption is made that people are fully aware of the effects on their marginal tax rate of bracket creep.

The effects of fiscal drag can be examined by using the difference-in-difference estimator in (7). In previous studies this has been used by taking as the control group those individuals within a tax bracket who remain in the same bracket from one period to the next, despite a general upward movement in incomes. The treatment group consists of those who were in the same tax bracket but moved into a higher bracket and thus experience an increase in their marginal tax rate. However, in the present context, it was found that there are significant variations in income movements. For example, there are many individuals who move from the second highest tax bracket, often into a lower tax bracket, while others move into the highest income range. This type of income dynamics produces a substantial bias if (7) is directly applied. Hence the following approach was used instead.

The calculations are based on people who were in the same tax bracket in period  $t$ , where some of those taxpayers moved into a higher income tax bracket in period  $t+1$ . The difference-in-difference elasticity compares the change in taxable income of these income recipients between periods  $t+1$  and  $t+2$ . Taxable income may have changed because taxpayers adjusted how much they work or save, because of tax planning or because they exited paid market employment or emigrated from New Zealand and hence dropped out of the sample.

The elasticities of earners who moved into the top bracket and of taxpayers who moved into the second highest tax bracket are reported in Table 6. The results confirm earlier findings that higher income earners are more responsive than lower income taxpayers. The elasticities of people who moved into the top bracket are higher than those of taxpayers who moved into the second highest tax bracket. But the elasticities of earners who moved into the top bracket are lower than those of the top decile of earners reported in Table 3.

**Table 6 – Elasticity of Taxable Income: Earners Moving into the Top and the Second Highest Bracket**

	Earners Moving into the:	
	Highest Bracket	Second Highest Bracket
2002	0.5 (-0.1, 1.2)	0.2 (0.0, 0.3)
2003	1.7 (1.0, 2.5)	0.0 (-0.1, 0.2)
2004	1.3 (0.7, 2.0)	0.3 (0.1, 0.4)
2005	1.1 (0.6, 1.6)	0.2 (0.0, 0.4)
2006	0.8 (0.4, 1.3)	0.1 (-0.1, 0.2)
2007	0.9 (0.5, 1.4)	0.1 (0.0, 0.3)
2008	0.7 (0.3, 1.2)	0.2 (0.0, 0.4)

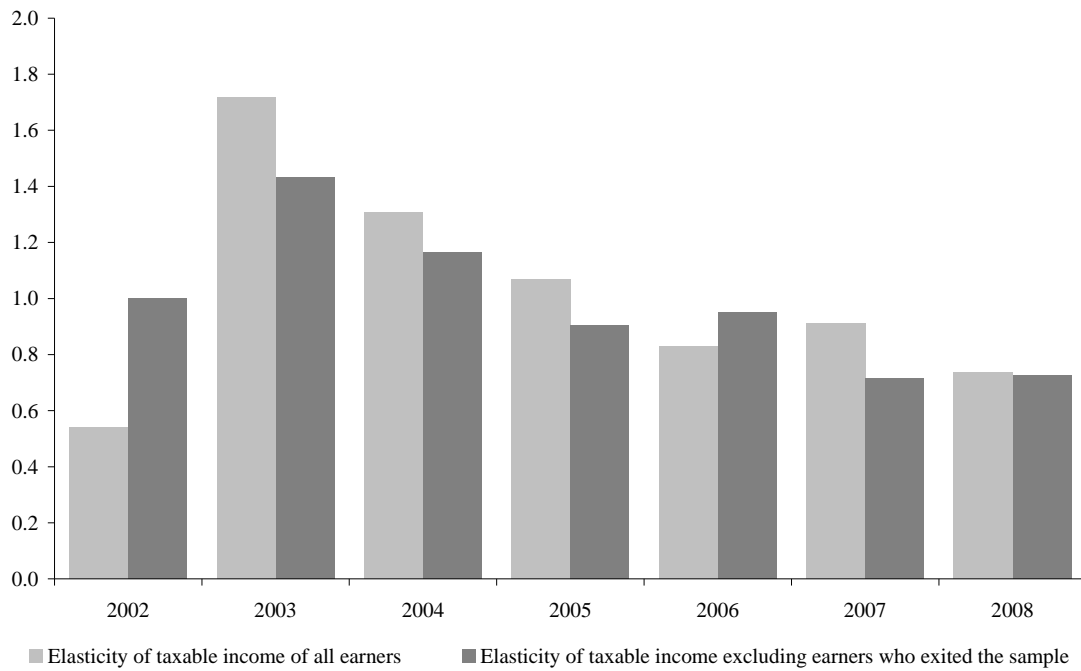
Note: 95% confidence intervals are reported in parentheses. They were generated from 1,000 simulations using bootstrapped resampling.

Consider next the question of whether higher and lower income earners respond differently at the intensive and extensive margin to changes in their marginal tax rates. International evidence suggests that higher income earners tend to respond at the intensive margin; that is they adjust their taxable income by changing work effort, hours worked, the amount they save, and so on. However, lower income earners and secondary earners tend to respond at the extensive margin; that is, they often leave or enter the labour market in response to an increase or decrease in their marginal tax rate.



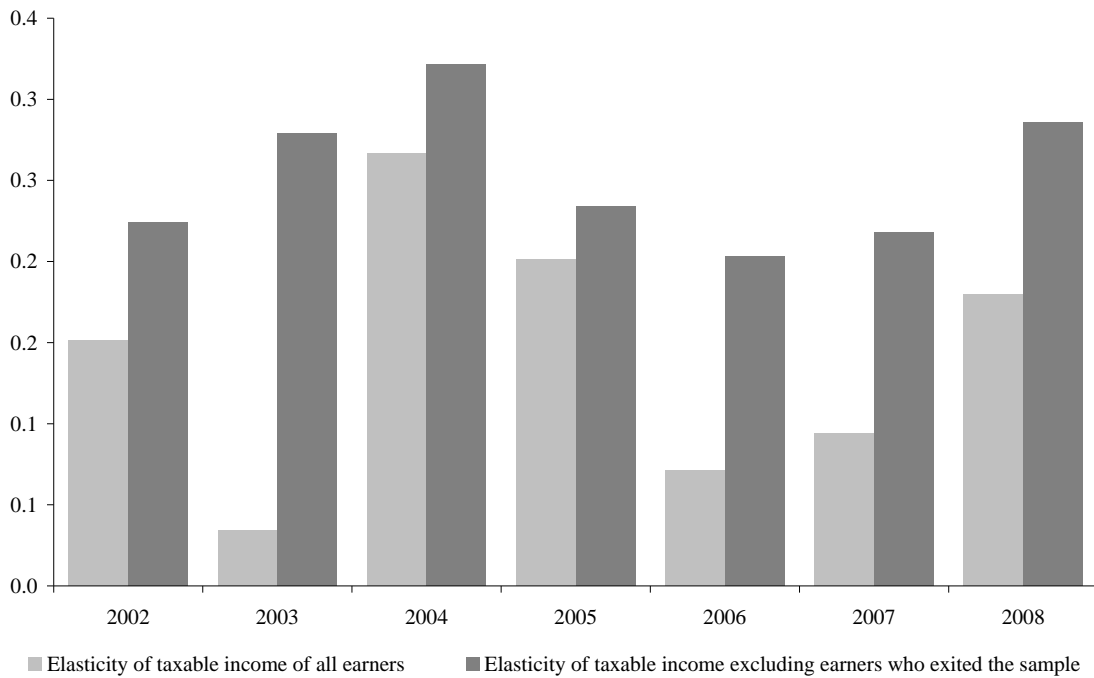
Figure 10 plots the elasticities of taxable income of all earners who moved into the top tax bracket and the elasticities of earners who moved into the top bracket but excluding taxpayers who exited the sample. The figure shows that overall the elasticities are similar; that is, people do not seem to exit paid market employment when they move into the top tax bracket.

**Figure 10 – Revenue Elasticity of Earners Moving into the Top Bracket – All Earners and Excluding Those Who Exited the Sample**



However, a different picture emerges for lower income taxpayers. Figure 11 plots the elasticities of taxable income of all earners who moved into the second highest bracket and the corresponding elasticities, excluding taxpayers who exited the sample. It shows that the values obtained by excluding taxpayers who exited the sample are consistently higher than those for all income recipients. This finding suggests, in line with international evidence, that lower income taxpayers who experience an increase in their marginal tax rate are more likely to exit paid market employment than higher income earners whose marginal tax rate increases.

**Figure – 11 Revenue Elasticity of Earners Moving into the Second Highest – All Earners and Excluding Those Who Exited the Sample**



The elasticities of female and male earners, whose marginal tax rate increased because they moved into the top tax bracket, are summarised in Table 7 for all taxpayers and excluding those who exited the sample. Once again, male earners tend to have higher elasticities than female earners. But neither men nor women appear to be more likely to exit paid market employment or emigrate from New Zealand when moving into the top bracket.

At lower incomes, women appear to be more responsive to changes in their marginal tax rates than men both at the intensive and extensive margin. This is shown in Table 8, which reports the elasticities of taxable income of female and male earners who moved into the second highest tax bracket for all earners and excluding taxpayers who left the sample. Both elasticities are higher for women than men in all years except for 2008 when the elasticity excluding people who left the sample was higher for male earners compared with female earners. The downward bias resulting from not excluding those who left the sample is clear, especially for men in this bracket.

**Table 7 – Elasticity of Taxable Income: Earners Moving into the Top Bracket**

	Including all earners		Excluding those who left the Sample	
	Female	Male	Female	Male
2002	-0.5 (-1.2, 0.2)	1.1 (0.4, 2.1)	0.8 (0.4, 1.3)	1.1 (0.7, 1.6)
2003	2.2 (0.9, 3.8)	1.5 (0.7, 2.4)	1.6 (1.1, 2.3)	1.4 (1.0, 1.8)
2004	1.0 (0.2, 1.9)	1.5 (0.8, 2.4)	1.2 (0.6, 2.0)	1.2 (0.7, 1.8)
2005	0.7 (0.1, 1.4)	1.3 (0.6, 2.1)	0.8 (0.4, 1.2)	1.0 (0.6, 1.4)
2006	1.4 (0.5, 2.5)	0.6 (0.1, 1.2)	1.2 (0.7, 1.9)	0.8 (0.5, 1.3)
2007	0.5 (-0.1, 1.2)	1.2 (0.5, 1.8)	0.5 (0.2, 0.8)	0.9 (0.5, 1.3)
2008	0.7 (0.1, 1.4)	0.8 (0.2, 1.4)	0.6 (0.3, 1.0)	0.8 (0.5, 1.1)

Note: 95% confidence intervals are reported in parentheses. They were generated from 1,000 simulations using bootstrapped resampling.

**Table 8 – Elasticity of Taxable Income: Earners Moving into the Second Highest Bracket**

	Including all earners		Excluding those who left the sample	
	Female	Male	Female	Male
2002	0.3 (0.0, 0.6)	0.0 (-0.2, 0.2)	0.4 (0.2, 0.5)	0.1 (0.0, 0.2)
2003	0.2 (-0.1, 0.5)	-0.1 (-0.3, 0.1)	0.3 (0.2, 0.4)	0.3 (0.2, 0.4)
2004	0.4 (0.1, 0.7)	0.1 (-0.1, 0.3)	0.4 (0.3, 0.6)	0.2 (0.1, 0.4)
2005	0.2 (0.0, 0.5)	0.1 (-0.1, 0.3)	0.2 (0.1, 0.4)	0.2 (0.1, 0.4)
2006	0.2 (0.0, 0.5)	-0.1 (-0.3, 0.1)	0.3 (0.2, 0.5)	0.1 (0.0, 0.2)
2007	0.2 (0.0, 0.5)	-0.1 (-0.3, 0.1)	0.2 (0.1, 0.4)	0.2 (0.1, 0.3)
2008	0.3 (0.0, 0.5)	0.0 (-0.2, 0.3)	0.2 (0.1, 0.4)	0.3 (0.2, 0.5)

Note: 95% confidence intervals are reported in parentheses. They were generated from 1,000 simulations using bootstrapped resampling.

## 6 Some Comparisons

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Many empirical estimates of the elasticity of taxable income have been produced for a large range of countries, as discussed by, for example, Saez et al. (2009). The values vary considerably, depending on the method of estimation used, the particular reform examined, and the country. After mentioning that a number of authors suggest a 'consensus value of about 0.4', Giertz (2004, pp. 14, 37) warns that this 'masks considerable variation in the estimates'. Indeed, there is no reason to expect the elasticity to remain unchanged over time, or to be similar across countries having different tax structures and regulations. Furthermore, the above results have demonstrated some heterogeneity among types of taxpayer, so that there seems little value in attempting to find a consensus value.

Another feature of many estimates is that much uncertainty is attached to them. After reviewing elasticities, Meghir and Richards (2007, p. 19) comment that 'the estimates of the effect of taxes on taxable income, whose purpose is to identify the impact of taxation on other dimensions of effort, should be regarded with caution'. Furthermore, Saez et al. (2009, p. 59) suggest that, 'there are no convincing estimates of the long-run elasticity'. The suggestion, by Saez et al. (2009) that some 'short-run' elasticity estimates obtained from tax reforms may perhaps capture changes in the timing of declarations, has been confirmed by the above analysis of the introduction of the 39 per cent tax rate in New Zealand.

The use of a 'reduced form' specification inevitably carries with it the difficulty that, when a parameter estimate is found to change from one dataset to another, there is no way of knowing precisely what has caused the change. It has been demonstrated above that examination of the various income components is important, particularly among the higher income taxpayers. Giertz (2004, p. 39) suggested that, 'much work is still needed in order to better understand the process by which incomes respond to changes'. This judgement was repeated by Saez et al. (2009) who stressed the need to look at the various margins involved in responses to taxation. The value of examining the different margins was indeed demonstrated in the previous section.

Where it has been possible to estimate elasticities for different income ranges, a common result is that they vary with income, being higher for higher incomes. This result has been confirmed by the present analysis, and it is perhaps not surprising in view of the fact that higher income groups may be expected to have more opportunities to shift income between sources.

Faced with the difficulty of obtaining data in New Zealand, there is only one previous study containing estimates of the elasticity of taxable income for New Zealand. Using a variety of methods, covering a number of tax structure changes, Thomas (2007, p. 22) obtained estimates which 'ranged from 0.35 to 1.10, with a preferred estimate of 0.52'; see also Thomas (2007, p. 18). The present results are thus broadly in line with those reported by Thomas. He found that the tax rate reductions in the mid-1980s

produced substantial reductions in the excess burden from income taxation. Similarly, the increase in the top marginal rate in 2001 again raised excess burdens, though to levels below those of the 1980s. He reported marginal welfare costs of as high as \$8 per extra dollar of revenue raised.<sup>13</sup>

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<sup>13</sup> Atkinson and Leigh (2008) describe changing shares of top incomes in New Zealand. They refer to possible impacts of changes in top marginal rates, along with a factor associated with the threat of emigration, and macroeconomic factors (whether high incomes are 'insulated' from fluctuations). The argument relating to the threat of emigration is that top incomes in New Zealand have had to respond to increases in top incomes in the United Kingdom and Australia, which are popular destinations for migrants. They used a time series regression in which the share of the top percentile was regressed on 1 minus the top marginal rate, top income shares in Australia and the United Kingdom, and gross domestic product (GDP) growth. However, their results do not provide elasticity estimates, and they acknowledged that shares in all three countries may have been influenced by other common factors.

## 7 Marginal Welfare Costs

This section considers the efficiency costs of personal income taxation. Subsection 7.1 shows how marginal welfare costs can be obtained using the elasticity of taxable income concept. Subsection 7.2 reports empirical results. The welfare effects reported here do not allow for the possibility that some income may be shifted to other income sources which attract a lower tax marginal rate.

### 7.1 Revenue and Welfare Effects of the Top Marginal Rate

This subsection considers the efficiency effects of changes in the top marginal income tax rate in a multi-rate system. This has received most attention in the literature and is the policy change considered in Section 4. Suppose income above the threshold,  $z_T$ , is taxed at the fixed rate,  $\tau$ . If this is the top marginal rate, so that there are no higher income thresholds, the tax paid at that rate by an individual in the top bracket is given by  $\tau(z_i - z_T)$  and total revenue collected by the top marginal rate,  $R_T$ , is thus:

$$R_T = \tau \sum_{z_i > z_T} (z_i - z_T) = N_T \tau (\bar{z}_T - z_T) \quad (8)$$

where  $\bar{z}_T$  is the arithmetic mean of those above the threshold, and  $N_T$  is the number of people whose taxable income is above the threshold. It is important to recognise that  $\tau(z_i - z_T)$  is not the total tax paid by person  $i$ , since the latter has to include tax paid at lower rates. However, changes in the top rate are of course expected to have no effect on revenue from the lower rates.

The effect on  $R_T$ , and thus on total revenue, of a change in the top rate is:

$$\frac{dR_T}{d\tau} = \frac{\partial R_T}{\partial \tau} + \frac{\partial R_T}{\partial \bar{z}_T} \frac{\partial \bar{z}_T}{\partial \tau} \quad (9)$$

The first term is a pure 'tax rate' effect while the second term is a 'tax base' effect of the tax rate change. Using  $\frac{\partial R_T}{\partial \tau} = N_T (\bar{z}_T - z_T)$ ,  $\frac{\partial R_T}{\partial \bar{z}_T} = N_T \tau$ , and from the definition of  $\eta$ ,  $\frac{\partial \bar{z}_T}{\partial \tau} = -\frac{\eta \bar{z}_T}{1-\tau}$ , the revenue change becomes:<sup>14</sup>

$$\frac{dR_T}{d\tau} = N_T (\bar{z}_T - z_T) \left\{ 1 - \eta \left( \frac{\bar{z}_T}{\bar{z}_T - z_T} \right) \left( \frac{\tau}{1-\tau} \right) \right\} \quad (10)$$

<sup>14</sup> This is equivalent to the result stated by Saez et al. (2009, p. 5, equation 5).

Let  $f(z)$ ,  $F(z)$  and  $F_1(z) = \frac{\int_0^z u dF(u)}{\int_0^\infty u dF(u)}$  denote the density function, the distribution function and the first moment distribution function of  $z$ . The Lorenz curve is, for example, the relationship between the proportion of people associated with a proportion of total income (cumulating from lowest to highest). In general it can be shown that:

$$\frac{\bar{z}_T}{\bar{z}_T - z_T} = \left[ 1 - \left( \frac{z_T}{\bar{z}} \right) \frac{1 - F(z_T)}{1 - F_1(z_T)} \right]^{-1} \quad (11)$$

where  $\bar{z}$  is the arithmetic mean of the complete distribution of  $z$ . Define:

$$\alpha_T = \frac{\bar{z}_T}{\bar{z}_T - z_T} \quad (12)$$

so that (10) is more succinctly written as:

$$\frac{dR_T}{d\tau} = N_T (\bar{z}_T - z_T) \left\{ 1 - \eta \alpha_T \left( \frac{\tau}{1 - \tau} \right) \right\} \quad (13)$$

The tax rate,  $z^*$ , which maximises revenue from the top marginal rate is thus a simple function of  $\alpha_T$  and the elasticity,  $\eta$ , whereby:

$$\tau^* = (1 + \alpha_T \eta)^{-1} \quad (14)$$

The various components of (11) can be obtained from information about the distribution of declared incomes.

With the crucial assumption of zero income effects, the marginal welfare cost, MWC, defined as the marginal excess burden divided by the change in tax revenue, can be shown to be:<sup>15</sup>

$$MWC = \frac{\eta \tau \alpha_T}{1 - \tau - \eta \tau \alpha_T} \quad (15)$$

This expression is relevant only when the marginal tax rate is below the revenue-maximising rate in (14). The extension to cover all tax brackets is as follows. Suppose that in the  $k$ th tax bracket the marginal tax rate is  $\tau_k$  above the income threshold  $a_k$ , for. For income in the  $k$ th bracket the tax paid at the rate  $\tau_k$  is simply  $\tau_k (z - a_k)$ , and for  $z > a_{k+1}$  the tax paid at that rate is  $\tau_k (a_{k+1} - a_k)$ . Hence total tax paid at the  $k$ th rate is given by:

$$R_k = \tau_k \int_{a_k}^{a_{k+1}} (z - a_k) dF(z) + \tau_k (a_{k+1} - a_k) \int_{a_{k+1}}^{\infty} dF(z) \quad (16)$$

Creedy (2010) shows that the marginal welfare cost in the  $k$ th bracket becomes:

<sup>15</sup> Saez et al. (2009, p. 6) call the MWC the 'marginal efficiency cost of funds (MECF)'. However, the 'marginal cost of funds', or MCF, is usually defined as  $1 + \text{MWC}$ . On these concepts, see Creedy (1998, pp. 54-59).

$$MWC_k = \frac{\eta_k \alpha_k \tau_k}{1 - \tau_k - \eta_k \alpha_k \tau_k + D_k} \quad (17)$$

where:

$$D_k = \frac{(1 - \tau_k) (a_{k+1} - a_k) \{1 - F(a_{k+1})\}}{\bar{z} \{F_1(a_{k+1}) - F_1(a_k)\} - a_k \{F(a_{k+1}) - F(a_k)\}} \quad (18)$$

The result for the top marginal rate is thus simply the special case where  $D_K = 0$ . If, as for example in New Zealand, there is no tax-free threshold in the income tax structure, so that

$$a_1 = 0 \text{ it can be seen that } D_1 = \frac{[(1 - \tau_1) a_2 \{1 - F(a_2)\}]}{\{\bar{z} F_1(a_2)\}}.$$

## 7.2 Empirical Results

The results of the previous section, along with Appendix B, enable the marginal welfare cost to be evaluated for any tax bracket, given cross-sectional information about the distribution of taxable income and the relevant value of the elasticity of taxable income. Earlier results have produced a range of values for the elasticity, with lower values in lower income groups and for women compared with men (with the exception of the fiscal drag results for movement into the second highest tax bracket). For this reason computations were carried out for a range of values of  $\eta$  in each tax bracket, thereby also enabling the sensitivity of welfare changes to  $\eta$  to be examined.



**Table 9 – Marginal Welfare Costs**

Threshold	$\tau$	$\eta = 0.5$	$\eta = 0.7$	$\eta = 0.9$	$\eta = 1.1$
1994					
0	0.15	0.04	0.06	0.07	0.09
9,501	0.28	0.17	0.26	0.35	0.47
30,875	0.33	1.51	5.3	-	-
1995					
0	0.15	0.04	0.06	0.07	0.09
9,501	0.28	0.18	0.27	0.37	0.49
30,875	0.33	1.37	4.27	-	-
1996					
0	0.15	0.04	0.06	0.07	0.09
9,501	0.28	0.18	0.27	0.38	0.5
30,875	0.33	1.36	4.18	-	-
1997					
0	0.15	0.04	0.05	0.07	0.09
9,501	0.25	0.16	0.24	0.33	0.44
30,876	0.2625	-	-	-	-
34,200	0.33	1.4	4.47	-	-
1998					
0	0.15	0.04	0.05	0.07	0.09
9,501	0.24	0.14	0.21	0.29	0.38
34,200	0.33	1.36	4.18	-	-
1999					
0	0.15	0.04	0.05	0.07	0.09
9,501	0.2175	0.12	0.18	0.25	0.32
34,201	0.24	0	0	0	0
38,000	0.33	1.27	3.6	0	0
2000					
0	0.15	0.04	0.06	0.07	0.09
9,501	0.21	0.11	0.17	0.22	0.29
38,000	0.33	1.03	2.45	10.52	-
2001					
0	0.15	0.04	0.05	0.07	0.09
9,501	0.21	0.11	0.16	0.21	0.27
38,001	0.33	-	-	-	-
60,000	0.39	4.32	-	-	-

**Table 10 – Marginal Welfare Costs**

Threshold	$\tau$	$\eta = 0.5$	$\eta = 0.7$	$\eta = 0.9$	$\eta = 1.1$
2002					
0	0.15	0.04	0.05	0.07	0.09
9,501	0.21	0.11	0.16	0.21	0.28
38,001	0.33	-	-	-	-
60,000	0.39	3.83	-	-	-
2003					
0	0.15	0.04	0.05	0.07	0.08
9,501	0.21	0.11	0.16	0.22	0.28
38,001	0.33	-	-	-	-
60,000	0.39	3.98	-	-	-
2004					
0	0.15	0.04	0.05	0.07	0.08
9,501	0.21	0.11	0.16	0.22	0.28
38,001	0.33	-	-	-	-
60,000	0.39	3.55	-	-	-
2005					
0	0.15	0.04	0.05	0.07	0.09
9,501	0.21	0.11	0.16	0.22	0.28
38,001	0.33	-	-	-	-
60,000	0.39	3.3	-	-	-
2006					
0	0.15	0.04	0.05	0.07	0.09
9,501	0.21	0.11	0.16	0.21	0.27
38,001	0.33	-	-	-	-
60,000	0.39	3.9	-	-	-
2007					
0	0.15	0.04	0.05	0.07	0.09
9,501	0.21	0.11	0.16	0.21	0.27
38,001	0.33	-	-	-	-
60,000	0.39	4.14	-	-	-
2008					
0	0.15	0.04	0.05	0.07	0.09
9,501	0.21	0.11	0.16	0.21	0.27
38,001	0.33	-	-	-	-
60,000	0.39	4.14	-	-	-

Tables 9 and 10 report the marginal welfare costs for each year and tax bracket, for four alternative values of  $\eta$ . A dash in any cell of the table indicates that the tax rate exceeds the revenue-maximising rate for that tax bracket. This occurs in a substantial number of cases, particularly for the top marginal rate groups and the higher elasticity values. The estimates reported above are indeed in those higher ranges. As expected the marginal welfare costs for the lower elasticity values and the lower tax brackets are relatively small, while for the top tax bracket they are large – mostly in excess of unity.<sup>16</sup>

<sup>16</sup> Higher welfare costs for individuals in Australia were found by Creedy et al. (2008), using a structural labour supply model, even though labour supply changes were small. The assumption of zero income effects which is imposed in the present analysis may thus affect results.

Thus for those top brackets, when the tax rate is below the revenue-maximising value, the welfare cost of raising an extra dollar of revenue is well in excess of a dollar. Furthermore, it can be seen that the welfare costs for the top marginal rate bracket increase substantially after the introduction of the 39 per cent top tax rate. To the extent that a proportion of taxable income is being diverted into other sources which attract lower tax rates, the above estimates overstate the marginal welfare costs.

It is known that the marginal welfare costs can be highly sensitive with respect to the elasticity of taxable income. However, the values reported in these two tables are relatively stable in the lower and middle tax brackets, becoming more sensitive for the higher marginal rates. For the lower tax brackets, where the rates and thresholds remain stable, the welfare costs change very little over time, reflecting the relative stability in the distribution of taxable incomes.

The above calculations all assume that as a result of an increase in any marginal tax rate, taxable income falls as a result of incentive effects or is shifted into an untaxed source. However, one possible response to the introduction in 2001 of an extra income threshold, with a top marginal tax rate of 39 per cent, is to ‘convert’ some income into trust or corporate income, which continued to be taxed at a rate of 33 per cent. It can be shown that if  $s$  denotes the proportion of the reduction in taxable income that attracts a tax rate of  $t < \tau$ , equation (17) is modified so that the marginal welfare cost becomes:

$$MWC_k = \frac{\eta_k \alpha_k (\tau_k - st)}{1 - \tau_k - \eta_k \alpha_k (\tau_k - st) + D_k} \quad (19)$$

Table 11 shows the marginal welfare costs for the year 2001 for those in the top income tax bracket, under alternative assumptions about the value of  $s$ , with  $t = 0.33$ . In view of the relative stability of the income distribution, these are similar for later years. As  $s$  increases, the range of values of  $\eta$ , for which the tax rate of  $\tau = 0.39$  is above the revenue-maximising rate, becomes smaller. These results demonstrate yet again the sensitivity of welfare costs to variations in the elasticity of taxable income, as well as the sensitivity to the value of  $s$ . For the lower income tax brackets, a less clear assumption can be made about such shifting.<sup>17</sup>

**Table 11 – Marginal Welfare Costs 2001: Top Tax Rate with Income Shifting to Lower Tax Rate**

$s$	$\eta = 0.5$	$\eta = 0.7$	$\eta = 0.9$	$\eta = 1.1$
0.2	2.07	16.98	–	–
0.4	1.16	3.03	29.18	–
0.6	0.67	1.27	2.57	7.29
0.8	0.36	0.58	0.89	1.36

<sup>17</sup> However, suppose those in the bracket with a 33 per cent marginal rate are able to shift some income such that it attracts the next-lower rate of 21 per cent. It is found that, even if all the reduction in taxable income is taxed at the lower rate, the rate of 33 per cent is above the revenue-maximising rate for those in that tax bracket, for all values of  $\eta$  above 0.12.

## 8 Conclusions

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This paper has provided estimates for New Zealand of the concept of the elasticity of taxable income, with respect to changes in the net-of-tax marginal tax rate. This concept has the advantage of measuring, in a reduced-form context, all possible responses to tax rate changes and of enabling the efficiency effects to be measured. Results were obtained using a special dataset constructed from a random sample of New Zealand taxpayers.

Two approaches were used to estimate elasticity values for different groups of taxpayers. First, the introduction of an additional top marginal tax rate bracket provided a useful policy change as a natural experiment. Secondly, the stability of the tax structure over recent years enables the effect of fiscal drag, in shifting some individuals into a higher marginal tax rate bracket, to be considered. In using the first approach, it was particularly important to consider the possibility that some observed responses to tax changes may involve the timing, rather than the total amount, of taxable income declared, particularly in anticipation of announced changes taking effect. Furthermore, in estimating the elasticity, care needs to be taken to avoid attributing some of the changes in declared income to marginal tax changes, when they may have arisen from other dynamic factors. Non-tax-related income movements were observed, particularly when attempting to base estimates on tax rate changes arising from fiscal drag and the movement into higher tax brackets.

In view of these complications, the results should be treated with caution. Nevertheless, it was found that the elasticity of taxable income is substantially higher for the highest income groups. Indeed for lower deciles of the income distribution, the elasticity was found to be negligible. Generally the elasticity was higher for men than for women. This may be largely because the taxable incomes of men are systematically above those of women. Changes in the timing of income flows for the higher income recipients was found to be an important response to the announcement of a new higher-rate bracket. The marginal welfare costs of personal income taxation were consistent across years, being relatively small for all but the higher tax brackets. For the top marginal rate bracket of 39 per cent, the welfare cost of raising an extra dollar of tax revenue was found to be well in excess of a dollar. Furthermore, for the top bracket the marginal tax rate was often found to exceed the revenue-maximising tax rate, for appropriate values of the elasticity of taxable income.

## Appendix A: The Data

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This appendix describes the data used in the analysis. The database was constructed by randomly sampling Inland Revenue's individual taxpayer population. It covers the period from 1994 to 2008. The number of taxpayers in the random sample rises from 128,440 in 1994 to 162,651 in 2008. The random sample is weighted to match the individual taxpayer population, which increased from 2,761,000 taxpayers in 1994 to 3,423,421 in 2008. The database includes people with wage/salary income (including taxable welfare benefits) and people who filed an IR5 or IR3 tax return or received a personal tax summary (PTS). It excludes people with no personal taxable income unless they filed.

The requirement for wage and salary earners to file an IR5 tax return was in part based on earnings over a threshold. This threshold was eased during the 1990s from \$20,000 in the early 1990s, to \$38,000 by 1999. However a significant administrative change in 2000 removed the IR5 tax return entirely and replaced it with the PTS, a pre-populated taxpayer square-up based on data collected from employers during the year. The income threshold was removed, with a consequential reduction in the number of taxpayers required to square-up. This has caused a structural break in the income tax data collected, especially on dividend and interest income. Taxpayers who previously filed an IR5 were not required to square up via a PTS if their only income was from salary and wages or from investments with the correct amount of tax deducted at source, or where the investment income was below a certain threshold.

Individual taxpayer information is gathered from the following sources/returns:

1. Client registration
2. Individual tax return IR3
3. Personal tax summary (PTS) from 2000 onwards
4. Salary/wage earner income tax return IR5 (pre-PTS) from 1994 to 1999
5. Employer monthly schedule (EMS) from 2000 onwards
6. Annual tax deduction certificate (TDC) from 1994 to 1999

Taxpayers are broadly categorised into two groups based on a taxpayer's 'entity class'; a client registration feature: (a) salary/wage earner with a salary/wage (SW) entity class; and (b) other taxpayers with a non-SW entity class (for example, self-employed or salary/wage earners with other income from rental properties or overseas investments). The selection method is as follows:

1. A random two per cent of total salary/wage earners – with the random sample selected from the last two digits of their IRD number;
2. A random ten per cent of total other individual taxpayers – also based on the last two digits of the IRD number with the chosen range including the two per cent sample above.

A taxpayer generally has one IRD number and the same entity class. However, a minority of taxpayers could have a second IRD number due to bankruptcy or they might retain the same IRD number but change entity class over time. This means that the above selection method will have some 'missing' taxpayers if a taxpayer has an entity class change from non-SW to SW, or a taxpayer is issued a new IRD number because of bankruptcy.

The dataset contains the following main variables:

1. General variables – unique IRD number, date of birth, gender
2. Income variables – salary/wage income, business income, estate or trust beneficiary income, interest income, dividend income, overseas income, rental income, shareholder-employee salary, partnership income, other income, taxable income
3. Other variables – expenses, losses claimed, loss attributing qualifying company (LAQC) losses claimed

The gender variable is determined based on the ‘title’ of a taxpayer (e.g. Mr, Miss) so some imputation is required. When no title is present, or the title is ambiguous, gender is randomly assigned.

Some of the variables are unique to IR3 filers and not available for non-filers. Differences in the return financial variables are summarised in Table A1.

**Table A1 – Income Variables**

IR3	PTS/IR5	Non filer TDC/EMS
Salary/wage income	Salary/wage income	Salary/wage earning
Interest income	Interest income	
Dividend income	Dividend income	
Business income		
Estate or trust beneficiary income		
Overseas income		
Shareholder-employee salary		
Net rents		
Partnership income		
Other income		
LAQC losses claimed		
Expenses		
Losses claimed		
Taxable income		

Taxable income is the sum of all incomes less LAQC losses claimed, less expenses and less losses claimed (in that order). Taxable income is zero if a taxpayer has negative taxable income (i.e. a loss). As the focus is on income, rebates (such as child care, housekeeping and donations) are ignored.

The expenses variable is different from the business expenses that can be claimed in the general set of financial accounts. The expenses variable can be defined as ‘fees’ paid for professional services:

- A fee to someone for completing a tax return.
- Commission on interest or dividend income.
- Expenses incurred in earning income that has had withholding tax deducted.
- Additional expenses incurred in earning partnership income, for example, interest on capital borrowed to purchase a share in the partnership.
- Interest on money borrowed to buy shares or to invest.
- Premiums on loss of earnings insurance (income protection), provided the benefit from the insurance policy is taxable.

## Appendix B: Data for Calculation of Welfare Costs for all Income Tax Brackets

Tables B1 and B2 report the various components – other than the elasticity of taxable income – needed to compute the welfare measures. The tax rates in these tables include a low income rebate.

**Table B1 – Components of Marginal Welfare Costs: 1994–2000**

Thresholds	$\tau_k$	$\alpha_k$	$D_k$	$\bar{z}_k$
		1994		
0-9,500	0.15	1.00	1.12	4,868
9,501-30,875	0.28	2.16	1.36	17,690
Over 30,875	0.33	2.44	0.00	52,293
		1995		
0-9,500	0.15	1.00	1.13	4,777
9,501-30,875	0.28	2.15	1.28	17,766
Over 30,875	0.33	2.35	0.00	53,819
		1996		
0-9,500	0.15	1.00	1.14	4,656
9,501-30,875	0.28	2.13	1.24	17,894
Over 30,875	0.33	2.34	0.00	54,002
		1997 (composite year)		
0-9,500	0.15	1.00	1.23	4,331
9,501-30,875	0.25	2.19	1.22	17,457
30,876-34,200	0.2625	19.84	-1.45	32,515
Over 34,200	0.33	2.37	0.00	59,187
		1998		
0-9,500	0.15	1.00	1.25	4,206
9,501-34,200	0.24	2.03	1.19	18,682
Over 34,200	0.33	2.34	0.00	59,768
		1999 (composite year)		
0-9,500	0.15	1.00	1.18	4,432
9,501-34,200	0.2175	2.05	1.24	18,550
34,201-38,000	0.24	19.08	-1.29	36,092
Over 38,000	0.33	2.27	0.00	67,866
		2000		
0-9,500	0.15	1.00	1.12	4,409
9,501-38,000	0.21	1.91	1.18	19,905
Over 38,000	0.33	2.06	0.00	73,945

**Table B2 – Marginal Welfare Cost Components: 2001–2008**

Thresholds	$\tau_k$	$\alpha_k$	$D_k$				$\bar{z}_k$			
			2001		2002		2003		2004	
0-9,500	0.15	1.00	1.20	4,260	1.00	1.22	3,980			
9,501-38,000	0.21	1.90	1.26	20,108	1.89	1.23	20,214			
38,001-60,000	0.33	5.24	-0.60	46,970	5.19	-0.67	47,080			
Over 60,000	0.39	2.54	0.00	98,871	2.48	0.00	100,475			
			2005				2006			
0-9,500	0.15	1.00	1.28	3,708	1.00	1.26	3,620			
9,501-38,000	0.21	1.89	1.19	20,209	1.87	1.18	20,405			
38,001-60,000	0.33	5.13	-0.68	47,200	5.11	-0.80	47,248			
Over 60,000	0.39	2.50	0.00	100,014	2.44	0.00	101,562			
			2007				2008			
0-9,500	0.15	1.00	1.20	3,550	1.00	1.19	3,479			
9,501-38,000	0.21	1.83	1.19	20,966	1.81	1.18	21,239			
38,001-60,000	0.33	5.00	-1.18	47,499	4.93	-1.42	47,676			
Over 60,000	0.39	2.52	0.00	99,381	2.52	0.00	99,466			



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