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Estimating Elasticities of Taxable Income and Adjustment Costs from Tax Kink Bunching: Evidence from Register Data for New Zealand*

Nazila Alinaghi, John Creedy and Norman Gemmell†

Abstract

Using the well-established connection between the elasticity of taxable income and the excess bunching of individuals at income tax thresholds, or kink points, this paper obtains ETI estimates from administrative taxable income data for the New Zealand taxpayer population over the period, 2000 to 2017. Results are based on observed bunching at two kink points in the income tax schedule and for various taxpayer decompositions. This includes investigation of differences in ETIs obtained from persistent bunching at kink points when the tax regime is unchanged, from transitory effects associated with specific tax reforms. Results suggest relatively large responses by the self-employed, and adjustment costs and/or inattention biases associated with a shift in a tax threshold equivalent initially to around 18 per cent (declining to 6 per cent) of the observed excess mass at the post-reform kink. In addition, using census data to match individual taxpayers who are partnered provides strong support for the hypothesis that ETIs are larger for individuals in couples than for singles.

JEL Classification: H26; D31; D04

Keywords: Elasticity of taxable income; bunching estimates; adjustment costs

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Disclaimer

The results presented in this study are the work of the authors, not Statistics NZ; they are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI), managed by Statistics New Zealand. The opinions, findings, recommendations, and conclusions expressed in this paper are those of the authors, not Statistics NZ, or Inland Revenue. Access to the anonymised data used in this study was provided by Statistics NZ under the security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular person, household, business, or organisation, and the results in this paper have been confidentialised to protect these groups from identification and to keep their data safe. Careful consideration has been given to the privacy, security, and confidentiality issues associated with using administrative and survey data in the IDI. Further details can be found in the Privacy impact assessment for the Integrated Data Infrastructure available from www.stats.govt.nz. The matching of different data sources on the IDI spine is done by Statistics NZ. These datasets are anonymised thereafter and made available to researchers. The results are based in part on tax data supplied by Inland Revenue to Statistics NZ under the Tax Administration Act 1994. The tax data must be used only for statistical purposes, and no individual information may be published or disclosed in any other form, or provided to Inland Revenue for administrative or regulatory purposes.

1 Introduction

The elasticity of taxable income (ETI) – the responsiveness of taxable income to changes in the marginal net-of-tax rate – provides a convenient summary of all responses to income tax changes including labour supply, income shifting (over time and between income sources) and evasion. The concept has become popular in tax debates in part because, under strong assumptions, it can be linked to the determination of 'optimal' tax rates.[1] Its widespread attraction is despite the fact that it cannot be expected to be fixed, since it depends on many characteristics of the tax structure, such as the ease of incorporation and the nature and extent of tax enforcement. In addition, since ETIs are likely to vary across different types of individual taxpayer, and responses are not necessarily symmetric between increases and decreases in the marginal tax rate, estimation gives rise to substantial challenges.

Particular challenges for most estimation methods (and all previous New Zealand studies) is a reliance on longitudinal information on income changes of individuals over time, separating 'treated' from 'non-treated' groups, and finding suitable 'instruments' to deal with endogeneity. These issues can largely be circumvented using the 'bunching method' initially devised by Saez (2010) and modified by Chetty *et al.* (2011), which exploits the fact that taxpayers are often observed to bunch at income thresholds above which the marginal tax rate increases.[2] The present paper applies this method to obtain new estimates of the elasticity of taxable income for New Zealand (NZ) and explore its decomposition, using a large unit-record dataset on individual taxpayers.[3]

Within the labour economics literature it has long been recognised that the labour supply of an individual (in terms of hours worked) remains fixed over a range of wage rates associated with kinks in post-tax budget sets, effectively a 'corner solution', with discontinuous 'jumps' over hours ranges where marginal tax rates fall. However, the relevant structural parameters cannot be inferred, or 'recovered', from such bunching behaviour. By contrast, an advantage of the ETI, being based on a simple reduced-form model of behaviour, is that a direct relationship exits between the value of the elasticity and the extent of observed bunching;

[1] For a survey of earlier literature, see Saez *et al.* (2012). On the elastity and optimal tax rates, see Saez (2001) and Creedy (2015).

[2] However, bunching need not necessarily be observed when tax rates increase even when significant incentive effects are present; see, for example, Creedy and Scutella (2001). Further, Blomquist and Newey (2017) have recently argued that identification of the taxable income elasticity using bunching methods depends crucially on the particular specification of preference heterogeneity and variations in budgets sets.

[3] Subsequent applications of bunching methods to ETI estimation include le Maire and Schjerning (2013), Bastani and Selin (2014), Paetzold (2019), Bertanha *et al.* (2019), Bosch *et al.* (2019) and Gelber *et al.* (2019). Previous NZ estimates obtained using alternative estimation methods include Claus *et al.* (2012), Thomas (2012), and Carey *et al.* (2015) and Creedy *et al.* (2018). Neisser (2017) uses meta-analysis to evaluate numerous ETI studies.

see Kleven (2016) for a review.[4] Indeed, the ETI is directly proportional to the extent of bunching. This has the further advantage that cross-sectional income distribution data can be used, and the ETI can be estimated for a variety of tax kinks and years.

In the present paper, ETI estimates are obtained from administrative taxable income data for the NZ taxpayer population over eighteen years, 2000 to 2017, based on observed responses at two kink points in the tax schedule and for various taxpayer decompositions. A particular advantage of the NZ data and tax reform context is that it facilitates investigation of differences in ETI estimates obtained from relatively persistent bunching at kink points when the tax regime is unchanged, from more transitory effects on bunching associated with tax reforms which occurred during the period.

For example, evidence of 'transitory bunching' reported here suggests that adjustment costs and/or inattention biases associated with a shift in a tax threshold are equivalent to around 18 per cent of the observed excess mass at the new tax threshold. As expected, these costs decline over time but remain around 6 per cent up to eight years later. In addition, using recent New Zealand census data that matches individual taxpayers who are partnered enables testing of the hypothesis that ETIs are larger for couples than for singles. Though limited to a single census year, the evidence strongly supports this hypothesis.

The remainder of the paper is organised as follows. Section 2 summarises the bunching approach to ETI estimation. Section 3 provides details of the NZ income tax structure. Section 4 describes the dataset used and presents an initial indication of bunching observed in the taxable income distribution. Section 5 then presents the main empirical results for the top two income tax thresholds, and separate groups of wage earners and the self-employed. Further results, including extensive robustness testing, the effects of 'frictions', and differences between single individuals and those in couples are reported in Section 6. Brief conclusions are in Section 7.

2 The Bunching Method

This section first summarises the essence of the bunching approach to taxable income elasticity estimation. Following Saez (2010) as modified by Chetty *et al.* (2011), the approach is based on the argument, loosely stated, as follows.[5] Suppose the marginal rate over a given

[4] Blomquist and Selin (2010) provide an interesting application of ETI estimation methods to hourly wage rate responses to taxation, providing a link with the established literature estimating labour supply elasticities.

[5] Rigorous derivations can be found in Saez (2010), Chetty *et al.* (2011) and Kleven (2016). The linear approximation described below is based on 'small' changes in taxable income, Δz; Saez (2010) and Chetty *et al.* (2011) derive equivalent results involving intergation across relevant segments of the taxable income distribution, $h_0(z)$.

taxable income range is τ, and a new higher rate of τ_1 is introduced at the taxable income threshold of z_0, which is initially associated with a density of h_0. This creates a kink in individuals' budget constraints. Those below z_0 are not affected by the policy change, but suppose that those in the small interval between z_0 and $z_0 + \Delta z$ move to the kink. The proportion of people moving to z_0, denoted by B, is represented by the area of the narrow rectangle with height, h_0, and width Δz, so that $B = h_0 \Delta z$. The ETI, η, is defined as:

$$\eta = \frac{\Delta z}{z_0} \frac{1-\tau}{\Delta (1-\tau)} \tag{1}$$

Substituting for $\Delta z = B/h_0$ into (1), and using the approximation, $\frac{\Delta(1-\tau)}{1-\tau} = \Delta \log (1-\tau) = \log \left(\frac{1-\tau_1}{1-\tau} \right)$, gives:

$$\eta = \frac{B}{z_0 h_0} \frac{1}{\log \left(\frac{1-\tau_1}{1-\tau} \right)} \tag{2}$$

Hence the ETI is proportional to the (additional or excess) proportion of taxpayers who are placed at the kink, B/h_0, and inversely proportional to the log change in the net-of-tax rate, $\log \left(\frac{1-\tau_1}{1-\tau} \right)$. On the assumption that the elasticity is constant over the relevant range, the above can be adapted to the case of a discrete change in the marginal tax rate at a given threshold.

In practice, individuals for whom it is optimal to move to the 'new' threshold cannot all be expected to be observed at the kink, given various frictions and optimisation errors. As identified in a number of previous studies, and shown below for NZ, observed spikes in the distribution of taxable income are often spread over a range of taxable incomes around each tax threshold or kink. The range used to determine the values of B and h_0, and hence the elasticity, is typically selected visually. This may be symmetric or asymmetric around the kink point. The remaining challenge is to determine the counterfactual densities over this range, since only the *ex post* distribution is observed.

The estimates reported below follow the approach used by Chetty *et al.* (2011).[6] First, over a range of incomes either side of the relevant income threshold, which is sufficiently wide to contain enough information to estimate the counterfactual distribution, individuals are grouped into income classes of equal size, and the relative frequency in each class, along with the associated arithmetic mean taxable incomes, are calculated. For convenience, these income values are transformed, by subtracting the threshold income and dividing by the income group width. Then, based on the resulting histogram, the range or 'window' defining the base of the spike is chosen.

[6] Results are obtained using adaptations of the Stata code provided by Chetty *et al.* (2011) at http://www.rajchetty.com/papers-categorized/.

The counterfactual density function is obtained by first fitting an n^{th} order polynomial to the observations, using a dummy variable to distinguish the base of the spike. The *ex ante* densities are obtained from the polynomial, by omitting the dummies, with an additional step to allow for the fact that the 'excess density' in the spike has to have come from the range of incomes to the right of the income threshold. To achieve this last requirement, the 'predicted' densities are adjusted such that the area contained by the counterfactual distribution is the same as that of the observed distribution. Finally, the excess density, B, is obtained simply as the difference between the counterfactual distribution and the actual distribution, over the chosen range of the spike.[7]

3 The NZ Income Tax Structure

The New Zealand income tax system is relatively simple, with few deductions or allowances and no tax-free threshold. Individuals in couples are taxed separately, although social assistance is based on household income. Taxable income includes wage and salary earnings, self-employment income (shareholder salary, partnership), dividends, interests, and rental income. Furthermore, pensions (including New Zealand superannuation payments) and other transfer payments are taxable. The income tax, like the Goods and Services Tax (GST), is characterised as having a broad base and low rates.

Over the period of this study, 2000 to 2017, two significant reforms took effect, in 2001 and 2011. The 2001 tax reform represented a substantial policy change after a few years of minor tax changes, and mainly involved the introduction of a new top marginal rate of 39 per cent applied to income above \$60,000. The reform was announced on the 22nd December 1999, and the tax rate changes took effect in the 2001 tax year (1st April 2000 to 31st March 2001). As a result, taxpayers had some time between the announcement and implementation of the reform to adjust their incomes to some extent; see Claus *et al.* (2012) for discussion.

A further feature of the NZ tax system is the relative ease with which income taxpayers can legally shift income between the personal tax code, trusts, and the corporate income tax code. Since tax rates applicable to income earned in trusts or companies did not change with the 2001 reform (the relevant top rates remained at 33 per cent), this reform generated a particular incentive for higher personal income earners to shift income out of the personal income tax code.

Table 1 shows the pre- and post-reform tax rates and income thresholds.[8] In 2001, the

[7] When considering spikes at more than one kink, the elasticity at each threshold needs to be interpreted as conditional on the existence of the other thresholds which may influence the distribution over a range of incomes.

[8] The marginal rates in the low-income groups allow for low-income rebates.

two middle tax brackets, with marginal rates of 21.75 and 24 per cent in 2000, were combined to form a single bracket with a rate of 21 per cent. In addition, the top tax rate, previously applied to individuals with taxable income above $38,000, was divided into two brackets with the 33 per cent rate applied to income between $38,001 and $60,000, and a new top rate of 39 percent for income above $60,000.

Table 1: Marginal Tax Rates and Income Thresholds

1999 Tax Structure		2002 Tax Structure	
Income range	Marginal tax rate (%)	Income range	Marginal tax rate (%)
1–9,500	15	1–9,500	15
9,501–34,200	21.75	9,501–34,200	21
34,201–38,000	24	34,201–38,000	21
>38,000	33	38,001–60,000	33
		>60,000	39
2010 Tax Structure		2012 Tax Structure	
1–14,000	12.5	1–14,000	10.5
14,001–48,000	21	14,001–48,000	17.5
48,001–70,000	33	48,001–70,000	30
>70,000	38	>70,000	33

These 2001 income thresholds and tax rates remain unchanged until the 2008 tax year (1st April 2007 to 31st March 2008). A minor reform in 2009 raised the top rate threshold to $70,000, while reducing the marginal rate to 38 per cent for the 2010 tax year. The major tax reform in 2011, effective from 1st October 2010 (mid-way through the 2011 tax year), reduced all income tax rates and the company tax rate, raised the GST rate, and made numerous other small changes. The income tax rates imposed in 2011 were therefore 'composite rates' reflecting an average of the two income tax regimes used during that year. The reformed tax structure has remained unchanged thereafter. A feature of the 2011 reform was that the trust, and top personal, income tax rates became aligned again at 33 per cent, but the company income tax rate was cut to 28 per cent. Hence, there remained tax advantages for income earned through companies.

4 The Administrative Data

The data used here include the full New Zealand population of taxpayers from 2000, and were extracted from Statistics New Zealand's large confidential research database, the Integrated Data Infrastructure (IDI). A number of administrative datasets within the IDI, including the Income Tax Register, have been merged to form the final dataset employed in this study. The primary database covers the Inland Revenue individual taxpayer population, containing detailed tax return information such as wage and salary earnings, self-employment income, pensions and capital income. Socioeconomic variables such as gender, age and ethnicity were then added to the primary dataset; see Appendix A for further details.

The analyses reported here are restricted to individuals aged from 15 to 70. Also, income earners are divided into two subgroups: wage earners and self-employed. The self-employed are defined as those with some positive or negative earnings ('business income') derived from self-employment.[9] These include self-employment sub-groups of sole traders, director/shareholders of a company and individuals in partnerships. Wage earners here are taxpayers with no business income, though they may have other non-wage income such as rental, interest or dividend income. Table 2 presents summary statistics for the population of 15 to 70 year-olds as a whole, all wage earners and self-employed individuals, over the period 2001 to 2017 (excluding 'composite' reform years).

Table 2: Summary Statistics for the New Zealand Taxpayers Population

		2001–2008	
	All individuals	Wage earners	Self-employed
Average annual taxable income	\$31,364	\$28,660	\$41,663
Average age	39.9	38.5	46.7
Percentage Female	49.2	50.8	41.4
Percentage Maori (%)	14.9	16.8	5.4
Total observations$^{\xi}$	21,532,800	17,857,395	3,675,408
		2012–2017	
Average annual taxable income	\$43,956	\$41,366	\$59,331
Average age	41.3	40.1	48.9
Percentage Female	49.1	50.1	42.8
Percentage Maori (%)	15.0	16.4	5.9
Total observations	18,028,122	15,512,757	2,515,365

ξ: The totals do not add precisely because of the Statistics NZ confidentiality rule requiring random rounding to base 3.

4.1 Taxable Income Distributions

Figure 1 reports the histogram for (pooled) taxable incomes over the period 2001 to 2008. The graph also depicts the corresponding marginal tax rate (dashed line) on the right-hand vertical axis, as well as the location of the kinks using vertical lines at the income thresholds. There is a clear clustering of taxpayers around the top two kink points. The large bunching

[9] A small fraction of self-employed businesses report taxable income losses (negative earnings) in any given year.

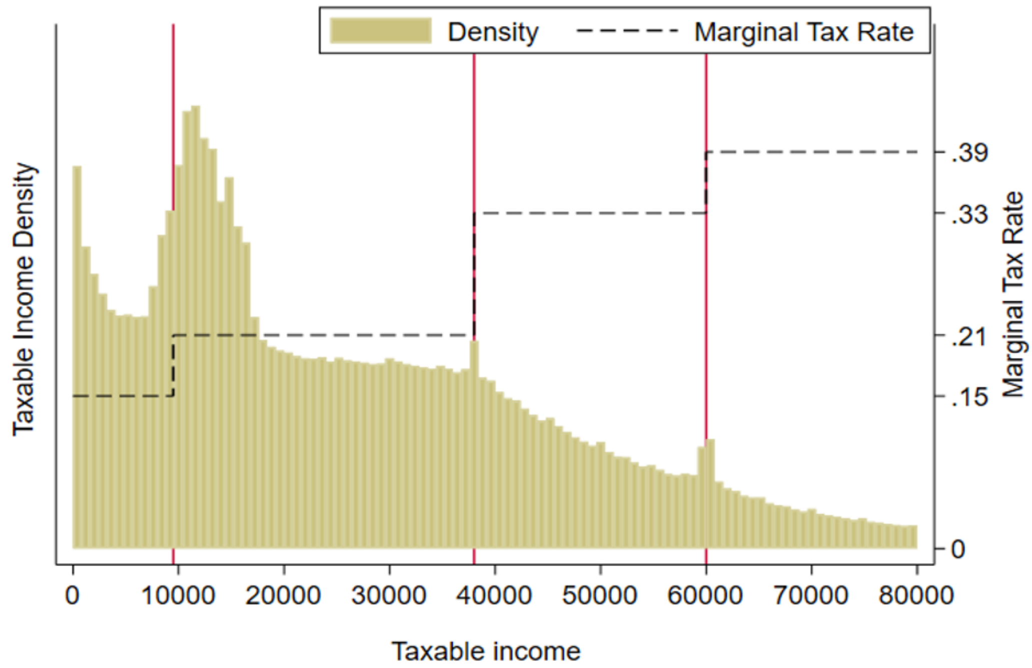

Figure 1: Taxable Income Density Distribution and Marginal Tax Rate (2001–2008)

above the lowest threshold especially reflects the receipt of the basic state pension (NZ superannuation) and other transfers by individuals in this part of the distribution.

In Figure 2, the taxpayer population is divided into the self-employed and wage earners (as defined above). Self-employed individuals are of particular interest since, with limited or no third-party reporting, they have more discretion over their declared taxable income levels than wage earners.[10] The difference between the two groups is noticeable, with the self-employed density displaying a large spike at the top two kink points while there is almost no bunching in the population of wage earners.

Figure 3 focuses on self-employed individuals and compares two periods: 2000, before the introduction of the new top marginal rate at incomes above $60,000 (dashed line density) and 2001–2008 (solid line density). The 2001–2008 densities display huge spikes at the second and third kink points ($38,000 and $60,000). The spike observed at the third kink point is more pronounced in 2001–2008 compared to the second kink point. The major bunching observed at $60,000 over 2001-08 began in 2001 in association with the introduction of the new top marginal tax rate above this income level. There is, however, a small 'hump' at $60,000 before the higher kink is introduced.[11]

[10] To facilitate comparison of the densities of these two groups, kernel density estimates are shown.

[11] With the top tax rate change announced in December 1999, self-employed individuals had a few months to adjust their 2000 tax year incomes, or they could file for year 2000 one year later; that is, after the new

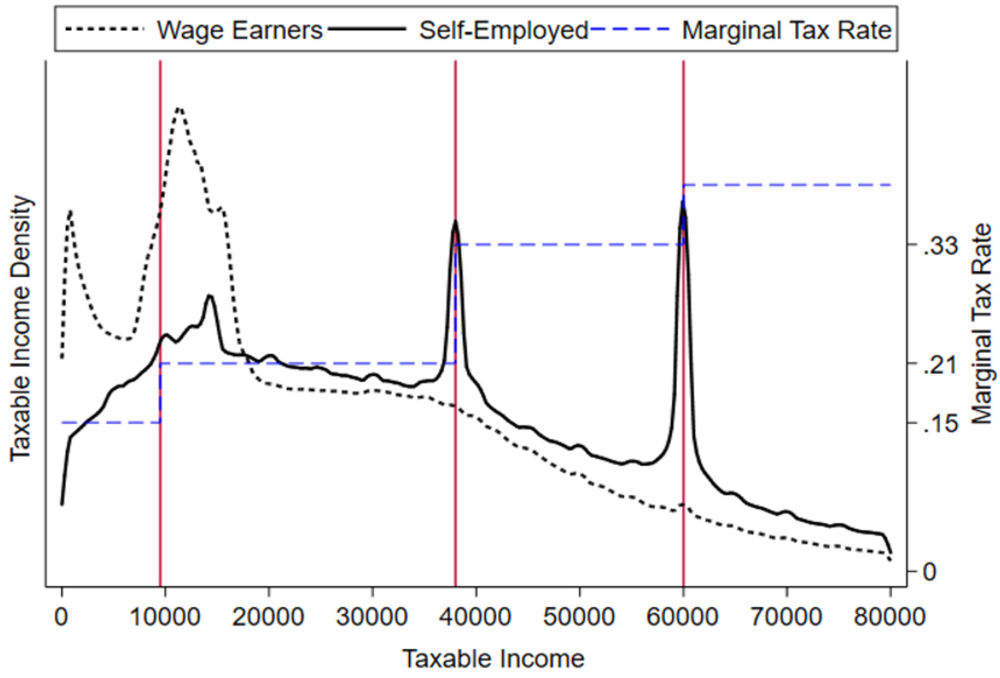

Figure 2: Taxable Income Distribution: Wage Earners and Self-employed (2001–2008)

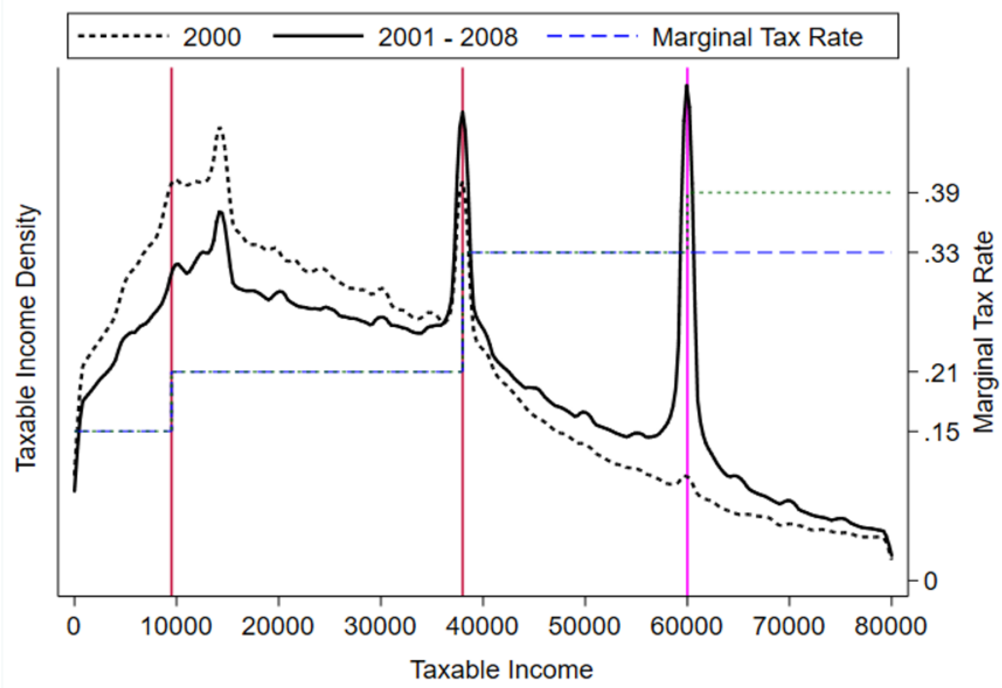

Figure 3: Taxable Income Distribution: Self-Employed (2000 and 2001–2008)

5 Elasticity estimates

Having established *prima facie* evidence of some bunching at key tax kink points, this section reports estimates of elasticities. Subsection 5.1 reports estimates relating to the top rate threshold. Subsection 5.2 then considers differences in top kink bunching between wage earners and the self-employed, while subsection 5.3 examines whether gender differences in bunching and ETIs, are important. Subsection 5.4 examines whether evidence of bunching at the penultimate kink in the tax schedule yields similar ETI estimates.

5.1 The Top Threshold

The bunching analysis begins by considering the top tax threshold where, following the 2001 tax reform, the marginal net-of-tax rate fell by approximately 9.4 per cent at $60,000: $1-\tau$ becomes 61 per cent during 2001–2008 instead of the previous 67 per cent.[12] Subsequent reforms increase this threshold to $70,000 (in 2009) and reduce the top tax rate back to 33 per cent (in 2011). As a result, during 2012 to 2017, $1-\tau$ fell 4.4 per cent at the $70,000 kink during those years.

Using equation (2), estimates of excess mass, B, around the top kink (with associated bootstrapped standard errors), and the implied taxable income elasticity, η, were obtained. This exercise was conducted both on annual data and on two pooled multi-year samples: 2001 to 2008 and 2012 to 2017. Within each of those pooled periods, the tax parameters were unchanged and follow the two major tax reform episodes described above. It can be expected that observed bunching at kink points in years soon after these reforms partly reflect short-term adjustment to the reforms in addition to the more persistent bunching expected in non-reform years. This aspect is discussed further below.

In each case the empirical distribution of taxable income for relevant taxpayers is constructed as described in Section 2. First, the difference between each individual's taxable income and taxable income at the top kink point was calculated, and individuals were grouped into $500 income groups (such as -$250 to $250, $250 to $750, and so on) using this 'recentred' taxable income. The number of individuals falling into each group was then counted.

An example is illustrated in Figure 4, which uses the pooled 2001–2008 dataset. The vertical line at zero denotes the top kink point at the $60,000 income threshold. The solid line represents the polynomial fitted to the taxable income distribution when a window around the kink is excluded. In this case, the excluded region around the kink is [-$3,000,

threshold/rate had been introduced for 2001.

[12] These percentages are log-changes, used in the elasticity estimation.

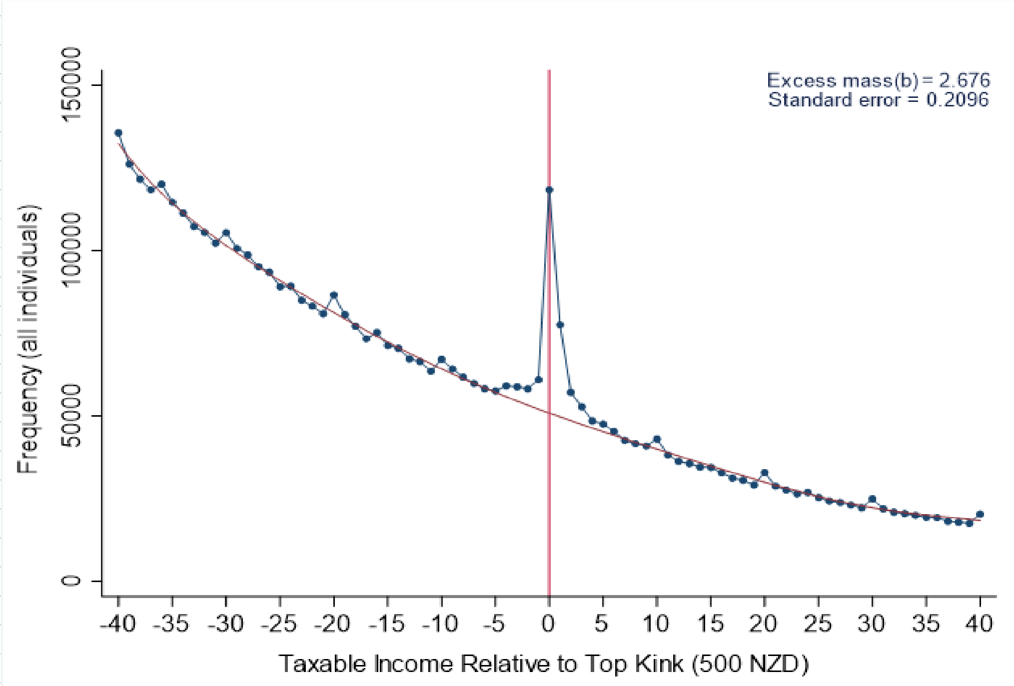

Figure 4: Bunching at the Top Tax Kink: All Taxpayers (2001–2008)

$3,000] and a 7^{th} order of polynomial was fitted. Figure 4 reveals a clear spike at the top kink in an otherwise regularly declining segment of the income distribution. The estimated excess mass is $B = 2.676$ (with standard error, $s.e. = 0.210$); that is, the excess mass around the kink is 267.6 per cent of the average mass of the counterfactual distribution within $\pm$\$3,000 of the kink. This yields an implied elasticity of $\eta = 0.238$ for all individuals in this pooled example. Equivalent annual graphs for 2001 to 2017 are reported in Appendix B.

5.2 Estimates for Wage Earners and Self-employed

As Saez (2010) and Chetty *et al.* (2011) report, distinguishing between wage earners and self-employed taxpayers is particularly important in estimating the elasticity of taxable income, in part because the self-employed are less constrained by third-party income reporting. In addition, income shifting between periods and/or income sources is easier for the self-employed.[13] The equivalent taxable income distributions for wage earners and the self-employed over 2001 to 2008 are shown in Figures 5 and 6 respectively. It can be seen that the excess mass for wage earners is relatively small ($B = 0.676$; $s.e. = 0.204$) and narrowly focused at the kink, with a small implied elasticity of 0.060. By contrast, the estimate for the self-employed group

[13]Shifting between personal and corporate status, and between individual and trust status, are relatively easy in New Zealand; see Claus *et al.* (2012) and Carey *at al.* (2015) for discussion.

is much larger ($B = 9.354$; $s.e. = 0.258$) and more widely spread around the kink, with an implied elasticity of 0.831, significantly different from zero. There is also some evidence in Figure 5 of 'round number bunching' (at ± 10 intervals around the top tax kink), such that some of the observed excess mass at the \$60,000 tax kink is likely attributed to this non-tax aspect. Kleven and Waseem (2013) find evidence of round number bunching in their study of tax notch effects, but mainly for the self-employed (and which they attribute to poor recall of their incomes). By contrast, the evidence here suggests greater rounding by wage earners; for the self-employed, any round number bunching appears small in Figure 6.

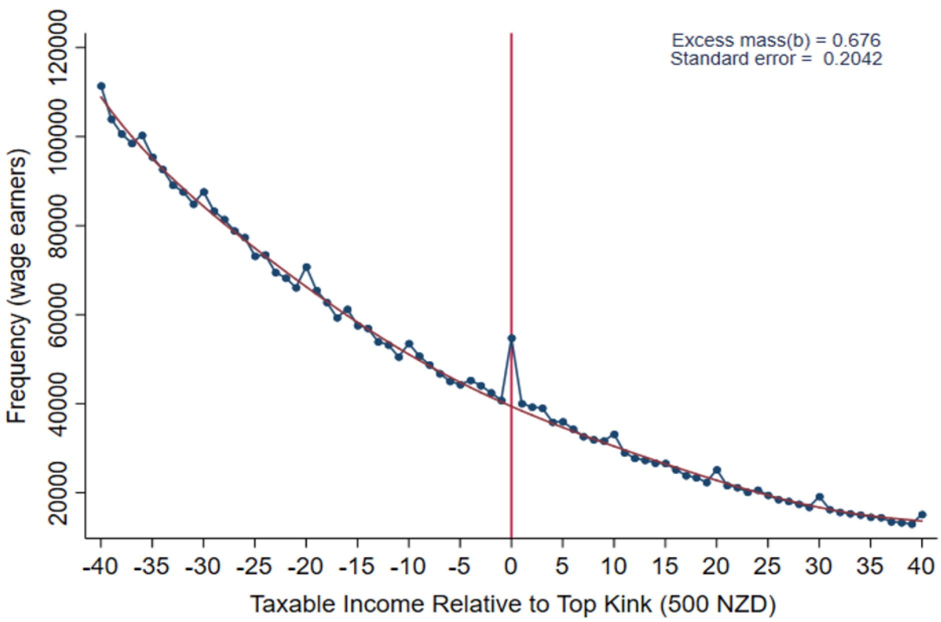

Figure 5: Bunching at the Top Tax Kink: Wage Earners (2001–2008)

Results for excess mass calculations and elasticities by year are reported in Table 3 for all individuals, and separately for the self-employed and wage earners. Elasticity estimates for all individuals during the years 2001 to 2008 generally lie in the range 0.21 to 0.35 (the 2008 estimate is somewhat lower at 0.144, mainly associated with a lower estimate for wage earners). As observed by Saez (2009) for the US, and Chetty *et al.* (2011) for Denmark, these elasticities are a composite of much higher elasticities for the self-employed (ranging from around 0.70 to 1.0) and low or zero elasticities for wage earners (those with no self-employment income). However, unlike the US and Danish studies, there is more substantive and robust evidence of positive elasticities for wage earners, at least after 2003; the largest estimate is $\eta = 0.159$ in 2004. A possible reason for some larger elasticities for wage earners here is that the definition of self-employment (non-zero net business income) may allocate some self-employed with zero net profit in a given year, to the wage earner category, especially

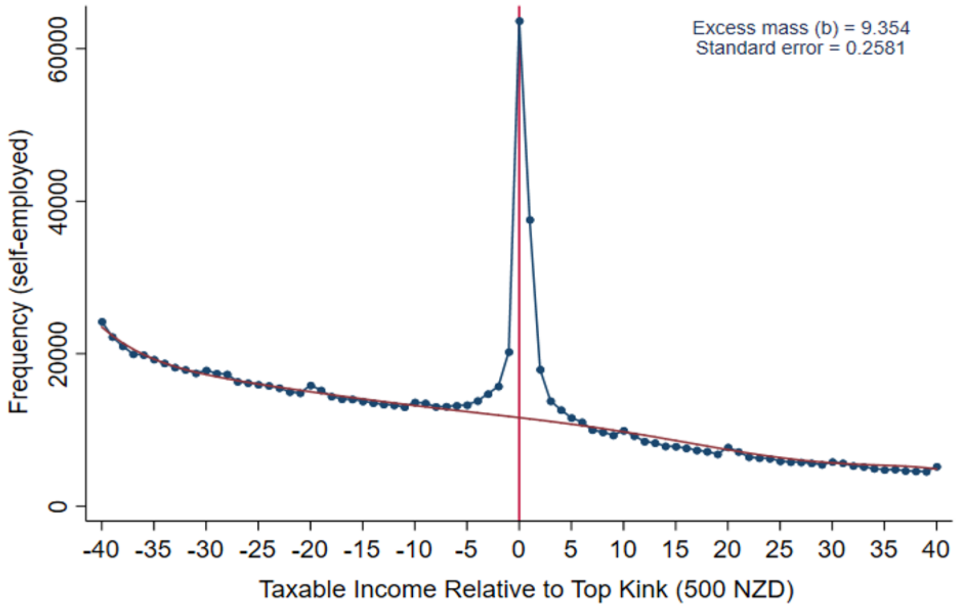

Figure 6: Bunching at the Top Tax Kink: Self-employed (2001–2008)

Table 3: Excess Mass and ETI Estimates (2000–2017)

Year	All individuals		Wage earners		Self-employed	
	B (*s.e.*)	η	B (*s.e.*)	η	B (*s.e.*)	η
2001	2.458 (0.374)	0.218	-0.412 (0.438)	–	9.238 (0.258)	0.821
2002	3.055 (0.329)	0.271	-0.194 (0.361)	–	11.23 (0.289)	0.997
2003	2.909 (0.302)	0.258	0.133 (0.322)	–	10.94 (0.334)	0.972
2004	3.886 (0.278)	0.345	1.791 (0.274)	0.159	10.03 (0.364)	0.891
2005	3.150 (0.252)	0.280	1.302 (0.243)	0.116	9.156 (0.359)	0.813
2006	2.554 (0.234)	0.227	1.035 (0.237)	0.092	8.229 (0.346)	0.731
2007	2.404 (0.225)	0.214	0.925 (0.221)	0.082	8.486 (0.385)	0.754
2008	1.620 (0.199)	0.144	0.240 (0.190)	0.021	7.920 (0.364)	0.703
2001-08	2.676 (0.210)	0.238	0.676 (0.204)	0.060	9.354 (0.258)	0.831
2010	1.291 (0.379)	0.119	0.500 (0.365)	0.046	5.473 (0.548)	0.504
2012	1.652 (0.322)	0.269	0.672 (0.306)	0.110	6.656 (0.536)	1.085
2013	1.482 (0.308)	0.242	0.606 (0.294)	0.099	6.164 (0.493)	1.005
2014	1.447 (0.280)	0.236	0.483 (0.253)	0.079	6.567 (0.545)	1.071
2015	1.212 (0.244)	0.198	0.307 (0.213)	0.050	6.311 (0.537)	1.029
2016	1.046 (0.237)	0.171	0.183 (0.221)	0.030	6.129 (0.517)	0.999
2017	1.002 (0.233)	0.163	0.091 (0.208)	0.015	6.432 (0.566)	1.049
2012-17	1.284 (0.245)	0.209	0.368 (0.215)	0.060	6.376 (0.495)	1.040

since some directors of self-employed business also receive a wage from their own business; see Cabral and Gemmell (2018) for some evidence on 'self-employed wage earners' in New Zealand.

Excess mass and elasticity estimates are not calculated for the two years, 2009 and 2011. As well as expecting that some time would be required for taxpayers to adjust to announced or implemented tax structure changes, those years involved the new tax structure being introduced during the middle of the tax year. As a result the rates applicable throughout these 'transitional' years were an average of the two structures.

Elasticity estimates for 2010, following the minor change in the top tax rate from 39 per cent to 38 per cent, are similar to prior years. However the estimate of excess mass in 2010 is lower than the previous years which may reflect the fact that this estimate is the first to be obtained at the new top threshold of \$70,000. Given adjustment costs, and inattention biases, it is perhaps to be expected that only some of the previous excess mass at \$60,000 would have shifted to \$70,000 by 2010, generating lower values of excess mass and elasticities at the \$70,000 kink. This aspect is investigated further in subsection 6.2.

Following the more substantial 2011 tax-year reforms, estimates of ETIs in 2012 and later years are generally larger than during 2001–2008, although there is clear evidence that ETI values tend to decline from their peak in 2012. These two phenomena – the higher ETI values in 2012, and the subsequent decline – may reflect the strong initial incentive to shift the excess mass, previously at \$60,000, to the new threshold of \$70,000, with a declining incentive to bunch after the 2011 reform, as the difference in marginal tax rates at the kink became a mere three percentage points (the tax rate at teh kink jumps from 30 to 33 per cent, instead of 39 per cent). That is, taxpayers who had already incurred fixed costs setting up mechanisms (such as use of corporate and trust vehicles, family income sharing) to facilitate bunching at the top income tax kink could be expected to continue to bunch immediately after the 2011 tax reform. However, new taxpayers who shift into the potential bunching region in subsequent years (for example, due to income growth over time), had less incentive to incur the required adjustment costs.

Table 3 shows that this aspect affects ETI estimate for all individuals combined and for wage earners. However, it does not in general apply to ETI estimates for the self-employed. In their case, ETI estimates are higher than during the 2001–2008 period, with values of around 1.0 over the period 2012–2017. Nevertheless, estimates of excess mass for the self-employed, of around 6.1 to 6.6, are generally lower than their 2001–2008 equivalents. The higher elasticities therefore largely reflect the importance of the lower value after 2011 of the denominator in equation (2), $\log\left(\frac{1-\tau_1}{1-\tau}\right)$, due to the new lower top tax rate of 33 per cent.

5.3 Estimates for Males and Females

It is well-known that the labour supply literature has regularly found larger response elasticities for females than males, especially where the former are secondary earners within households; see, for example, LaLumia (2008), Blomquist and Selin (2010), Blundell *et al.* (2016), Creedy and Mok (2019). However, by contrast, the literature on tax evasion and avoidance has sometimes found the reverse, with females less responsive than males; see, for example, Kleven *et al.* (2011) for Denmark, and Cabral and Gemmell (2018) for New Zealand. Other studies have failed to find gender-based differences, such as Schuetze (2002) and Baldini *et al.* (2009).

It is therefore unclear whether the tendency towards bunching at tax kink points are likely to be greater for males or females, but may well depend on what underlies those responses – labour supply or tax compliance decisions. Indeed, it is known that in New Zealand, despite individual-based personal income taxation, there are various means by which individuals in couples can share some income to minimise their joint tax liability.

Table 4: Excess Mass and ETI Estimates: Males and Females

Year	Males		Females	
	B $(s.e.)$	η	B $(s.e.)$	η
2001	2.439 (0.347)	0.217	2.478 (0.601)	0.220
2002	3.139 (0.281)	0.279	2.857 (0.545)	0.254
2003	3.010 (0.263)	0.267	2.685 (0.444)	0.238
2004	3.186 (0.239)	0.283	5.306 (0.514)	0.471
2005	2.521 (0.252)	0.224	4.392 (0.332)	0.390
2006	2.188 (0.210)	0.194	3.220 (0.351)	0.286
2007	2.111 (0.231)	0.188	2.908 (0.269)	0.258
2008	1.625 (0.200)	0.144	1.601 (0.259)	0.142
2001-08	2.448 (0.208)	0.217	3.092 (0.230)	0.275
2010	1.259 (0.413)	0.116	1.335 (0.364)	0.123
2012	1.578 (0.343)	0.257	1.761 (0.322)	0.287
2013	1.326 (0.326)	0.216	1.714 (0.311)	0.280
2014	1.297 (0.286)	0.212	1.672 (0.297)	0.273
2015	1.177 (0.266)	0.192	1.261 (0.252)	0.206
2016	1.093 (0.242)	0.178	0.971 (0.270)	0.158
2017	1.058 (0.252)	0.173	0.914 (0.244)	0.149
2012-17	1.239 (0.266)	0.202	1.350 (0.223)	0.220

Table 4 shows separate excess mass and ETI estimates for male and female taxpayers over 2001–2017 following the same approach as above. This reveals that, in general, male and female ETIs are very similar in magnitude and not typically significantly different statistically. To the extent that there are differences, such as the estimates for 2004 to 2007, ETIs for females tend to be larger than male equivalents.

As shown in Table 3, this phenomenon is mirrored in the ETIs for wage earners but not for the self-employed, suggesting that these higher ETIs in 2004 to 2007 are likely to be associated with female employees. This, in turn, raises the possibility of couples being able to share income as a tax minimisation exercise whereby female employees partnered with male self-employed are able to adjust their taxable incomes more readily, soon after the top marginal tax rate was raised substantially in the 2000 reform. Especially where female wage earners are employed in a partner's business, there is considerable discretion over declared taxable income levels which are also subject to more limited third-party reporting. This is explored further in subsection 6.3.

5.4 Estimates from the Penultimate Kink

The bunching method can also be used to estimate ETIs lower down the income scale by testing for taxpayer bunching at the next-to-top, or penultimate, income threshold of $38,000 during 2001–2008, and $48,000 thereafter.[14]

Table 5: Excess Mass and ETI Estimates at Penultimate Kink

Year	All individuals		Wage earners		Self-employed	
	B (*s.e.*)	η	B (*s.e.*)	η	B (*s.e.*)	η
2001	0.495 (0.100)	0.040	-0.032 (0.114)	–	2.757 (0.104)	0.220
2002	0.719 (0.092)	0.057	0.167 (0.098)	0.013	3.265 (0.138)	0.261
2003	0.715 (0.105)	0.057	0.140 (0.107)	0.011	3.474 (0.185)	0.277
2004	0.935 (0.085)	0.075	0.421 (0.088)	0.034	3.488 (0.141)	0.279
2005	0.964 (0.079)	0.077	0.467 (0.081)	0.037	3.534 (0.160)	0.282
2006	0.805 (0.090)	0.064	0.330 (0.099)	0.026	3.407 (0.165)	0.272
2007	0.865 (0.138)	0.069	0.381 (0.153)	0.030	3.633 (0.176)	0.290
2008	0.709 (0.139)	0.057	0.260 (0.152)	0.021	3.424 (0.174)	0.273
2001-08	0.781 (0.069)	0.062	0.276 (0.069)	0.022	3.370 (0.101)	0.269
2010	0.693 (0.174)	0.044	0.229 (0.164)	0.014	3.559 (0.359)	0.225
2012	0.574 (0.148)	0.036	0.126 (0.139)	0.008	3.376 (0.334)	0.214
2013	0.508 (0.148)	0.032	0.112 (0.140)	0.007	3.061 (0.317)	0.194
2014	0.624 (0.136)	0.040	0.232 (0.125)	0.015	3.128 (0.337)	0.198
2015	0.574 (0.121)	0.036	0.196 (0.107)	0.012	3.047 (0.343)	0.193
2016	0.575 (0.102)	0.036	0.223 (0.088)	0.014	2.926 (0.309)	0.186
2017	0.667 (0.122)	0.042	0.273 (0.106)	0.017	3.335 (0.342)	0.211
2012-17	0.589 (0.119)	0.037	0.196 (0.105)	0.012	3.145 (0.305)	0.199

Based on the same approach as for the top kink, Table 5 shows pooled and annual ETI

[14] Across all taxpayers in the dataset, mean taxable income was $31,364 averaged over 2001-08, and $43,956 over 2012-17; see Table 2.

estimates over the period, 2001–2017. It can be seen from the top panel that all ETI estimates at this kink are lower compared to the top kink, with wage earner ETI estimates around 0.03 (with excess mass that is often not statistically significant) and self-employed ETIs around 0.27 (which are highly statistically significant). For the self-employed taxpayers, annual ETIs estimates are in a narrow range of 0.186 to 0.290. For both groups, excess mass and ETI estimates for years after the 2011 reform tend to be somewhat lower than those for earlier years. Also, as observed for the top kink, over the period 2001–2008 annual ETI estimates tend to peak around 2004 or 2005 before declining prior to the 2009 and 2011 reform.

These results are consistent with other studies that have found taxpayer responsiveness, at least in terms of income shifting and avoidance, to be lower for taxpayers on lower incomes and that wage-earning taxpayers responses are low or negligible. One reason why some significant responses by wage earners are observed here may be due in part to the definition of wage earner in the dataset as discussed above. Secondly, data for some, but not all, wage earners includes other (non-wage, non-business) income such as interest, dividends and rental income. These income sources are generally not third-party reported, or not taxed at source, and are more liable to income shifting and avoidance opportunities.[15]

6 Further Results

This section presents a number of further empirical results. Subsection 6.1 considers how far the results are sensitive to the choice of 'bunching window'. Subsection 6.2 examines the contribution of possible adjustment costs which limit bunching at new kink points. Subsection 6.3 examines how far ETIs for partnered, versus single, taxpayers differ. Finally, Subsection 6.4 compares the present results with earlier ETI estimates based on alternative methods.

6.1 Sensitivity to Bunching Specifications

This subsection examines the sensitivity of previous results to three aspects of the excess mass calculation: the size of income groups chosen, the size of the bunching window adopted around the tax kink, and the degree of the polynomial selected to specify the counterfactual income distribution. Focussing on the top kink for self-employed taxpayers, Table 6 first considers the effects of reducing the width of the income groups from $500 to $250, thereby doubling the number of discrete observations of the actual and counterfactual income dis-

[15] As described in Appendix A, taxable income data are obtained from a number of Inland Revenue sources some of which, but not all, record a taxpayer's 'other income' (mainly dividends, interest and property income).

tributions. To save space only estimates for the pooled datasets, 2001–2008 and 2012–2017 are reported; results for annual estimates are similar.[16]

Firstly, the change in the income group size, which doubles the number of income groups, is shown to have a negligible impact on excess mass or ETI estimates. Secondly, Table 6 reports the effect of increasing and reducing the bunching window to [±7; ±5] or [±$3,500; ±$2,500], and an asymmetric window [−7; +5], since for some years there is some suggestion of greater excess mass below the kink; see Appendix B. Again, excess mass and ETIs appear to be robust to those changes in parameter size. Unsurprisingly, point estimates are slightly lower when a narrower bunching window is used, and slightly higher for a larger window; for example, ETI = 1.057 for 2012–2017 using the [±7] window, compared with ETI = 1.040 using the [±6] window.

Thirdly, using a potentially less flexible 6^{th}-order polynomial instead of seven has almost no effect on excess mass or ETI estimates. The table also confirms that reducing the order further to five leads to slightly lower estimates, but these remain statistically indistinguishable from results obtained using higher orders.

Table 6: Excess Mass and ETIs for Self-Employed Individuals: Robustness Testing

	2001–2008		2012–2017	
	B (*s.e.*)	η	B (*s.e.*)	η
Baseline[§]	9.354 (0.258)	**0.831**	6.376 (0.495)	**1.040**
Income class width: $250	18.860 (0.531)	0.838	13.010 (1.063)	1.061
Bunching window:				
[-7, +7]	9.533 (0.302)	0.847	6.480 (0.592)	1.057
[-5, +5]	8.950 (0.227)	0.795	6.103 (0.412)	0.995
[-7, +5]	9.068 (0.264)	0.805	6.192 (0.488)	1.010
Order of polynomial:				
5	9.131 (0.219)	0.811	5.568 (0.399)	0.908
6	9.339 (0.278)	0.830	6.359 (0.515)	1.037

[§]Baseline: income class width = $500; bunching window = [-6; +6]; polynomial degree = 7.

6.2 Effects of Adjustment Costs

Following Chetty *et al.* (2011) and Chetty (2012), it has been recognised that empirical estimates of labour supply, and to a lesser extent taxable income, responses may be attenuated due to the presence of adjustment costs or 'optimising frictions'. These lead some optimising taxpayers to be in a sub-optimal position following a tax change, when that optimum, in the

[16]Annual results are available from the authors on request.

absence of adjustment costs, shifts. Alternatively taxpayers may suffer from 'inattention' such that they are unaware, perhaps temporarily, of their new optimal position.

One of the recent New Zealand tax reforms provides a convenient opportunity to examine the importance of such adjustment frictions and inattention biases. For the purpose of measuring these effects, the 2009 reform involved few changes. That is, apart from raising the two top thresholds, from \$38,000 and \$60,000 to \$48,000 and \$70,000 respectively, the only other change was a slight cut in the top MTR, from 39 per cent to 38 per cent. All other income tax parameters, and the broader tax system, remained unchanged. These threshold changes were also relatively salient to income taxpayers since they were publicly announced in the 2008 Budget and were directly observable, unlike the effective marginal tax rate effect of, say, a change in a benefit abatement rate or effective threshold.

This change in the two tax thresholds for tax years after 2009, combined with the bunching ETI estimation approach, provides an opportunity to examine how long it took for the pre-2009 tax kink-induced bunching to disappear once the kink moved. In addition, by measuring the remaining excess mass at the old kink, relative to excess mass at the new kink, it is possible to quantify the impact on ETI estimates based on bunching at the new kink, of any adjustment costs or inattention.

A similar exercise and approach was adopted by Gelber *et al.* (2019) when examining the impact on bunching at kinks in the effective tax schedule in the US when an income test (the Social Security Annual Earning Test) was removed. Zaresani (2019) also uses a bunching approach to estimate adjustment costs associated with a Canadian policy change that altered work incentives. She found that, when allowing for adjustment costs, estimated ETI values can be as much as double those obtained when assuming zero adjustment costs.

For the New Zealand case, kernel densities in Figure 7 show the substantial shift in bunching by the self-employed at the two higher kinks just one year after these were increased by \$10,000 in 2009. However, especially for the top kink, a noticeable excess mass remains at the previous threshold of \$60,000 in 2010. Further, as the excess mass values in Table 3 show, the large excess mass (of 7.920) observed at \$60,000 in 2008 is substantially larger than the excess mass (of 5.473) observed at \$70,000 in 2010. By 2012 this excess mass at \$70,000 had risen somewhat to 6.656. That is, excess mass at the top kink (now \$70,000) in 2010 was only around 69 per cent of its 2008 value, but rose to 84 per cent in 2012. Clearly, some taxable income responded to the changed tax incentives more quickly than others. As Table 3 shows, from 2014 onwards, excess mass values at the top kink become relatively stable at around 6.3 to 6.5, with associated ETIs of around 1.0.

The impact of the implicit adjustment costs giving rise to this shift in bunching can be measured by the size of any excess mass remaining at \$60,000 after 2008, and the time taken

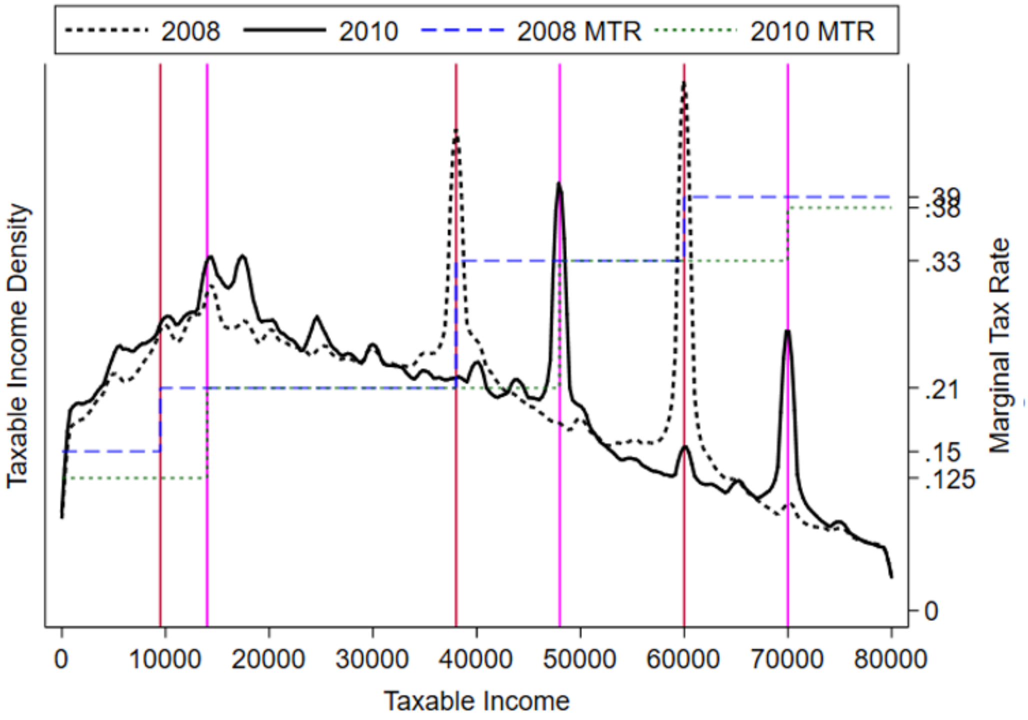

Figure 7: Self-Employed Income Bunching after Top Kink Change

for this mass to disappear. Using the same bunching methods as above but applied to the \$60,000 'former' tax kink during 2010 to 2017, Table 7 reports values for the excess mass in each year, together with the excess mass observed at the new \$70,000 tax kink.[17] This analysis is conducted for the self-employed sample, given the clearer evidence of bunching in general by this group.

Two alternative methods were used. Firstly, a counterfactual distribution was fitted around \$60,000 using a relatively narrow window that excludes \$70,000 to obtain the counterfactual distribution polynomial, and based on taxable income groups of either \$250 or \$500. Secondly, the previously-estimated counterfactual income distribution yielded counterfactual taxable income densities for incomes around the \$70,000 tax kink. These can be substituted for the actual observations (where excess mass was previously observed) around the \$70,000 tax kink and a new polynomial function fitted to identify the size of the excess mass at \$60,000.[18] Each approach was found to yield similar outcomes; Table 7 reports results from the first method, using \$500 income groups.

Columns (*ii*) and (*iii*) of Table 7 report estimates of self-employment excess mass around

[17] ETIs are not reported here after the tax kink moves to \$70,000, since a bunching-based ETI at \$60,000 is undefined when $\Delta(1-\tau)=0$.

[18] This approach is required when including observations around or above the \$70,000 kink since the bunching computer program searches for only one kink at a time.

Table 7: Excess Mass and Adjustment Costs: Self-Employed

(*i*) Year	(*ii*) B (*s.e.*) at \$60k	(*iii*) B (*s.e.*) at \$70k	(*iv*) B Total	(*v*) B at \$60k as ratio of (*iii*)	(*vi*) B at \$60k as ratio of (*iv*)	(*vii*) ETI based on total B
2010	0.986 (0.197)	5.473 (0.548)	6.459	0.180	0.153	0.595
2012	0.756 (0.194)	6.656 (0.536)	7.412	0.114	0.102	1.209
2013	0.863 (0.152)	6.164 (0.493)	7.027	0.140	0.123	1.146
2014	0.629 (0.200)	6.567 (0.545)	7.196	0.096	0.087	1.173
2015	0.637 (0.185)	6.311 (0.537)	6.948	0.101	0.092	1.133
2016	0.508 (0.150)	6.129 (0.517)	6.637	0.083	0.077	1.082
2017	0.433 (0.204)	6.432 (0.566)	6.865	0.067	0.063	1.119

$60,000 and $70,000 taxable income levels respectively, after the tax kink moved from the former to the latter threshold in 2009. Column (*iv*) sums the two excess mass values while columns (*v*) and (*vi*) show the column (*ii*) excess mass as a fraction of the $70,000 excess mass, and total excess mass, respectively. It is immediately clear that a large fraction of excess mass remains at $60,000 in 2010, one year after the shift of the kink. This remaining excess mass is around 18 per cent of the mass at the new income threshold or, as shown in column (*vi*), 15 per cent of the total mass (shown in column (*iv*)).

Following the major 2011 tax reforms, the excess mass at $70,000 is less from 2012 onwards than it had been during 2001–2008; see Table 3. Table 7 shows that this excess mass is generally decreasing from 2012, while the remaining excess mass at $60,000 is also decreasing and at a faster rate. As a result, remaining excess mass at $60,000 as a fraction of the total excess mass falls from 15.3 per cent in 2010 to 6.3 per cent by 2017. Also, by 2017 the excess mass at $60,000 reaches its lowest value (at 0.433) and, unlike earlier years, has a relatively high standard error (0.204).

More recent data are not available, so it cannot be established whether this excess mass in 2017 would eventually disappear (or at least disappear apart from any small contribution from bunching at round numbers), or whether there is some persistent or permanent inattention leading to bunching at the former tax kink.[19] Nevertheless, these results point to moderately high initial adjustment costs or inattention biases in bunching estimates of around 15 per cent associated with the top tax kink shifting. While these costs seem to diminish over time, up to eight years later they remain around 6 per cent of the bunching estimated at the new (higher) kink point.

Finally, the right-hand column (*vii*) in Table 7 shows ETI values based on the combined

[19] However, as shown in Figure 6, there is little evidence of round number bunching by the self-employed. The vast majority of the excess mass oberved to remain at, or shift from, $60,000 is therefore likely to be associated with adjustment costs and/or inattention biases.

excess mass in column (*iv*). These may be compared with the equivalent estimates for the self-employed, based only on the excess mass at the $70,000 kink, in Table 3. This shows, for example, that the ETI estimate, when taking account of the 'unshifted' mass from $60,000, becomes 1.209 in 2012 instead of 1.085, and 1.119 in 2017 instead of 1.040. Ignoring these adjustment cost or inattention related factors therefore leads to a non-trivial downward bias in ETI estimates even when these adjustment costs are relatively small, at 6 per cent in 2017.

6.3 Estimates for Individuals in Couple Families

In subsection 5.3 it was suggested that, despite the New Zealand personal income tax being based on individual, as opposed to joint, taxation, there are likely to be opportunities for partnered taxpayers to share some income for tax purposes, or otherwise arrange their labour supply behaviour in response to joint tax liabilities. Recent conceptual ETI modelling by Creedy and Gemmell (2019) suggests that ignoring couple aspects when estimating ETIs may lead to a downward bias in these estimates, while Gelber (2014) showed that empirical ETI estimates for married couples in Sweden were biased downwards when ETI regression specifications ignored joint responses to tax changes.

Unfortunately, the individual taxpayer basis for income taxation in New Zealand means that administrative income tax returns provide no information on partner incomes, nor indeed who is partnered with whom. As a result, it is not feasible to obtain ETI estimates for household or family decompositions that are comparable to those reported above. This would also need information on changes in household composition over time (as a result of marriages, divorces and deaths).

However, data from the 2013 New Zealand population census provides information on household composition in that year. Using Statistics New Zealand's IDI enables matching of income tax return data with demographic data generated by the 2013 census. Following a careful matching exercise that identifies whether individual taxpayers are 'single' or 'partnered' (married or in a *de facto* relationship, as indicated by 2013 census responses), the bunching approach was re-run on these two sub-samples of the taxpayer population in 2014.

Results from this exercise confirm much greater excess mass and larger elasticities for partnered, compared with single, individuals. The excess mass at the top kink is 1.770 and 0.853 for partnered and single individuals respectively, resulting in ETI estimates of 0.289 and 0.139. These compare with estimates of excess bunching for the combined sample of 1.447, and an associated elasticity of 0.236; see Table 3. At the lower or penultimate kink, equivalent excess bunching values are 0.809 and 0.408, for partnered and single individuals respectively, resulting in ETI estimates of 0.051 and 0.026. For the combined sample, excess bunching and elasticity values are 0.624 and 0.040 respectively. All excess mass values are statistically significant at the 5 per cent level, and partnered and single taxpayer group values are significantly different from each other.[20] Thus, ETIs of partnered individuals at both tax thresholds are approximately double those of single individuals. While this evidence cannot distinguish between real and tax compliance responses to taxation, it is suggestive of the latter being more important, since income shifting within families is relatively easy compared with adjusting joint labour supply decisions, at least in the shorter-term.

6.4 Comparisons with Alternative Estimates

It is useful to compare the bunching ETI estimates with those reported using alternative methods by previous New Zealand ETI studies. As mentioned in Section 1, Claus *et al.* (2012), Thomas (2012), Carey *et al.* (2015) and Creedy *et al.* (2018) produced ETI estimates for New Zealand based on a variety of approaches and data sources. Thomas (2012), Carey *et al.* (2015) and Creedy *et al.* (2018) each used ETI regressions methods of the form initiated by Gruber and Saez (2002), but with a variety of instruments to deal with endogeneity aspects.

Table 8: Comparisons with Previous Results

Panel A							
	Top tax bracket			Lower tax bracket			Sample
	2002	2003	2004	2002	2003	2004	
Present paper	0.997	0.972	0.891	0.261	0.277	0.279	Self-employed
	0	0	0.159	0.013	0.011	0.011	Wage earners
	0.271	0.258	0.345	0.057	0.057	0.057	All taxpayers
Claus *et al.*	0.5	1.7	0.2	0.2	0.0	0.3	
(2012)	1.0	0.8	0.6	-	-	-	Top 10 per cent
	2.2	1.6	1.3	-	-	-	Top 1 per cent

Panel B					
	Carey *et al.* (2015)			Creedy *et al.* (2018)	
				Income effects?	
	All taxpayers	With other income	No other income	Yes	No
	0.676	0.909	0.190	0.520	0.375

Results from Thomas (2012) were obtained from a 1986 tax reform which substantially reduced all MTRs. For taxpayers across all income levels he found an ETI of 0.34. Results

[20]Summary statistics for the two sub-samples show that partnered individuals tend to have higher taxable income on average, and are around ten years older on average. These differences in charactersitics (which are not controlled for in the bunching approach) may also affect the propensity of each group to respond differently in terms of tax kink bunching.

by Carey *et al.* (2015) and Creedy *et al.* (2018) were obtained from the 2001 tax reform which mainly affected the top MTR. Claus *et al.* (2012) also examined the 2001 reform by constructing ETIs for the top decile and one percentile of the income distribution (all of whom faced the new top MTR change) and comparing taxable income changes between the pre-reform year and a series of post-reform years, 2001 to 2008.[21]

Carey *et al.* (2015) and Creedy *et al.* (2018) also examined the 2001 tax reform, comparing the 1999 and 2002 (pre- and post-reform) years and reporting results for various taxpayer and income decompositions. Thus, unlike in Thomas (2012), their ETI results are likely to be dominated by responses of higher income taxpayers to the increase in the top MTR.

Table 8 compares results obtained from the 2001 reform with those obtained here, based on ETIs estimated for 2002 to 2004. While there are differences in samples and sample decompositions, ETI estimates for higher-income (especially those with non-wage income) and/or self-employed taxpayers are estimated in a reasonably narrow range of 0.9 to 1.0. Similarly, results for lower-income taxpayers, those in the lower ($38,000 to $60,000) tax bracket or around the $38,000 kink, range from 0.0 to 0.3 in both studies that examine this part of the income distribution directly. For those taxpayers with limited or no non-wage income, ETI estimates are consistently around 0.01 to 0.2.

7 Conclusions

This paper has used the bunching approach of Saez (2010) and Chetty *et al.* (2011) to estimate elasticities of taxable income from administrative personal income data for the New Zealand taxpayer population over eighteen years, 2000 to 2017. Results were obtained based on observed responses at two income thresholds, or kink points, in the income tax schedule and for various taxpayer decompositions, including the self-employed, wage earners, males and females. In addition, the use of census data to match individual taxpayers who are partnered made it possible to test the hypothesis that individuals in couple families have higher elasticities than single taxpayers, despite taxation being based only on individuals.

Investigating bunching-related excess mass at the top tax kink, initially at $60,000, then $70,000, provided evidence on the responsiveness of relatively high income taxpayers (approximately the top 20 per cent of income taxpayers in 2017). In addition, investigation of the next-to-top kink provided evidence for taxpayers who are located around the arithmetic mean of the taxable income distribution. Annual and multi-year pooled results were obtained for two periods, 2001–2008 and 2012–2017, when the income tax regime remained unchanged.

[21] Alternative estimates were also obtained based on changes in MTRs for taxpayers where fiscal drag over 2002 to 2008 led to a change in their MTR bracket.

These results suggested substantial bunching around both the tax kinks. At the top kink this yielded ETIs of around 0.2 to 0.3 averaged across all taxpayers, with ETIs slightly lower in the later period. However these overall averages conceal much larger ETIs for the self-employed, with estimates around 0.8 to 1.0 across the whole 2001–2017 period. There was no statistically significant support for the hypothesis that males and females have different elasticities.

Reform of the top income tax threshold in 2009, when it increased by $10,000, allowed investigation of differences in ETIs associated with persistent bunching at kink points when the tax regime is unchanged, from possible transitory effects associated with the tax reform. In particular, following the threshold increase, measuring the size of excess mass at the 'old' and 'new' kink points in subsequent years suggested substantial impacts arising from adjustment costs and/or inattention, equivalent to around 18 per cent of the observed excess mass at the post-reform tax kink. This declined to 6 per cent at the end of the data coverage in 2017, eight years after the 'old' tax threshold had been removed. These adjustment costs are clearly non-trivial and were shown to generate substantive downward biases in ETI estimates, including several years after the tax kink changed.

Using the 2013 New Zealand population census, data for individual taxpayers in the same family were matched. This enabled bunching at two tax threshold in 2014 by individuals who are partnered to be distinguished from bunching by single taxpayers. Results strongly supported the hypothesis that ETIs are larger for partnered taxpayers than for single individuals; indeed, they were found to be approximately twice as large at both kinks. Notwithstanding some differences in personal characteristics between the two groups such as average taxable income levels, this seems likely to be mainly due to the ability of couple earners to shift income within the family, rather than engaging in greater real responses (for example, to labour supply), though the empirical analysis could not address this question directly. The separate consideration of couples would seem to offer a fruitful avenue for future research, where data challenges can be overcome.

The estimation of taxable income elasticities presents substantial and widely-recognised problems, and the bunching method is not without its own difficulties. For example, 'excess bunching' may not be observed when significant incentive effects are known to exist, depending on the joint distribution of wage rates and preferences. Nevertheless, there are substantial advantages from using a method that does not rely on the use of longitudinal data and simple tax reforms to marginal rates (which hold other aspects of the tax structure, including indirect taxes, unchanged), and does not have to deal with complex endogenous and exogenous income dynamics.

Furthermore, by considering a number of income thresholds, the bunching approach allows a greater degree of population heterogeneity to be examined. This has allowed the present analysis to consider a range of different time periods and demographic groups, for the top two kink points of the NZ income tax structure. The estimates were found to be relatively stable over time and robust with respect to a range of assumptions used in the calculations.

Neverthless, evidence on adjustment costs associated with changes in the NZ tax structure in 2009, suggested these can be moderately large and impact substantively on post-reform ETI estimates. This is consistent with the adjustment cost evidence of Gelber *et al.* (2019), obtained from a quite different (US) policy context, who found that 'the short-run impact of changes in the effective marginal tax rate can be substantially attenuated, even with large policy changes' (Gelber *et al.*, 2019, p.25).

The analysis here has had the further advantage of being able to make use of more reliable administrative data on declared taxable incomes covering the complete population rather than relying on sample data. Where possible, comparisons with estimates using different estimation techniques and data have found broad agreement. This is encouraging, in view of the central role of the elasticity of taxable income in a wide range of tax policy analyses.

Appendix A: The New Zealand Taxpayer Dataset

The database used for this study is the Integrated Data Infrastructure (IDI), maintained by Statistics New Zealand (SNZ). This dataset is constructed by linking administrative and survey data sources at the individual level through a central 'spine'; see Statistics New Zealand (2014). It provides a large, anonymised, longitudinal dataset covering a wide range of data sources, including the Income Tax Register, since 1999.

The most extensive source of income information in the IDI is from Inland Revenue (IR), the New Zealand government's tax revenue collection agency. This information is derived from four main IR income tax forms namely, EMS, IR3, IR4S and IR20. Each of these is explained below.

In New Zealand, all businesses with paid employees are obliged to deduct and withhold income tax at source under the Pay-As-You-Earn (PAYE) system. This information is then transferred to the Inland Revenue by filing the Employer Monthly Schedule (EMS), a mandatory monthly reporting requirement. Individuals who earn income other than salary and wages, interests, dividends and/or taxable Māori authority contributions are required to declare such incomes by filing an IR3 (an individual income tax return).

Company shareholder details are filed through the IR4S. This includes details of all shareholders, directors and relatives of shareholders who receive remuneration (with no PAYE deducted). The filing is required for all active and New Zealand resident companies. Partnership and Look-Through Companies (LTCs) are required to file an IR7 (labelled IR20 in the IDI dataset). An LTC is a form of company structure with limited liability, and which is allowed to transfer income and expenditure to shareholders directly. The IR3 tax return is the most comprehensive form, including income information otherwise reported in the IR4S and IR20.

In addition, an IR-produced Personal Tax Summary (PTS) records income and tax deductions such as interest, dividends and tax credits for salary and wage earners. Under certain circumstances, this summary is sent automatically to taxpayers by IR or individuals can request a PTS to confirm whether that are paying the right amount of tax.

Income information for a given individual is sometimes available from more than one source; for example, IR3 and EMS. Thus, to construct a dataset covering the taxpayer population over the period of study (2000 to 2017), the following steps were taken. Firstly, data sources were prioritized according to their comprehensiveness and checked in sequence. The most comprehensive source is IR3, followed by the PTS and then EMS. Therefore, if income information for a given individual is available from the IR3, it is recorded as final. Otherwise, availability in the PTS, then EMS, is checked. This procedure continues until all available taxpayers' income information is collected.

Secondly, several socioeconomic variables such as gender, age, and ethnicity are added. Since individuals are taxed separately in New Zealand their legal or 'social' (*de facto*) marital status is not recorded for tax purposes. In principle, population censuses provide a source of family relationship information, but only the 2013 census is currently linked to the IDI. This source has been used to match individuals in families for 2014 in order to separate out 'partnered' from 'single' taxpayers, where the former includes married, civil union and *de facto* partner relationships.[22]

[22] Some 'life events' information, including marriages and civil unions registered in New Zealand, is available in the IDI (from the Department of Internal Affairs). Also, where household-based social assistance is received, partnership information is generally available from Ministry of Social Development sources. However, limited taxpayer coverage renders these unsuitable here as sources of taxpayers' relationship status.

Appendix B: Bunching in Annual Data (2000 to 2017)

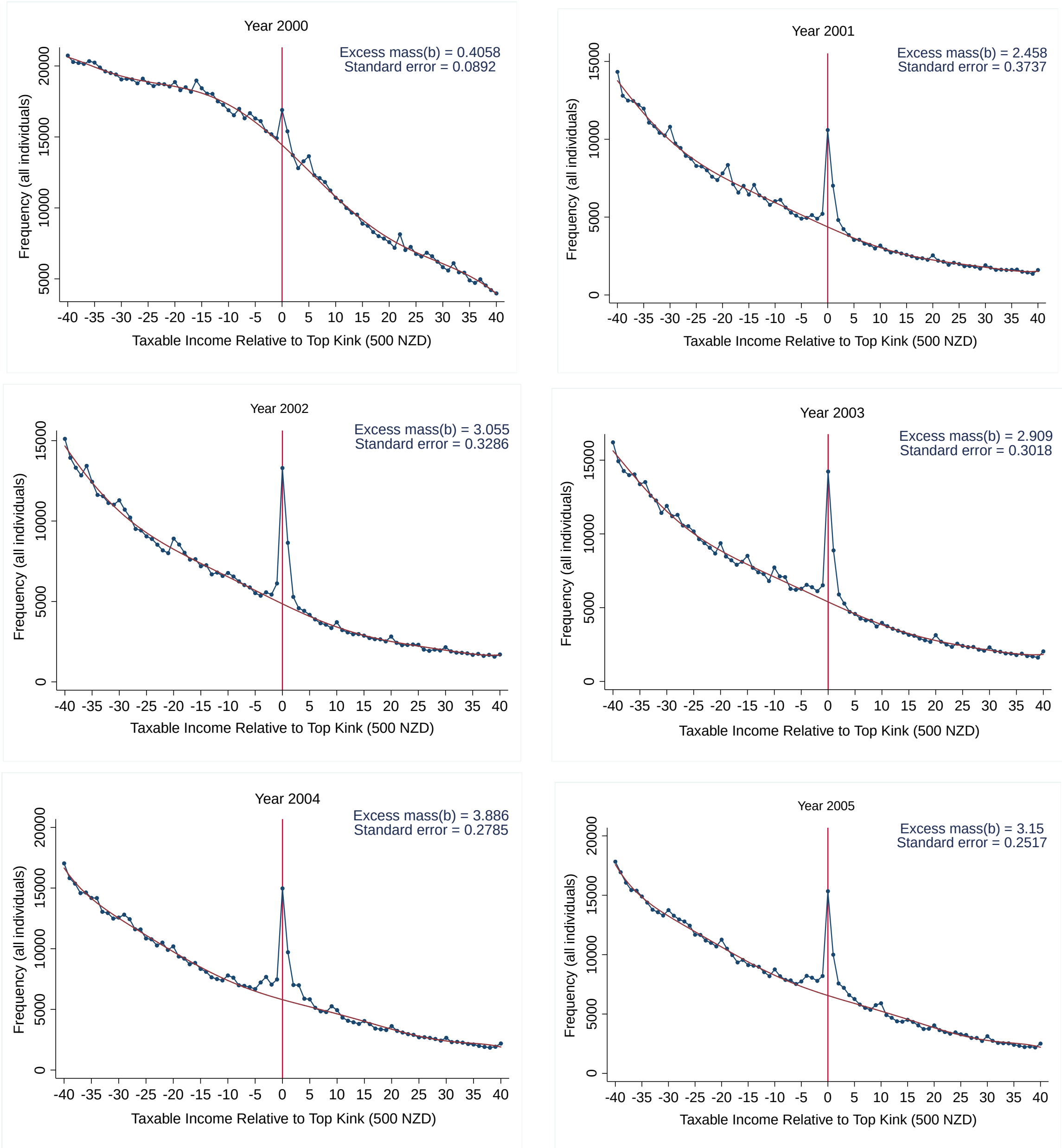

Figure B.1: Income Distributions Around the Top Tax Threshold: 2000–2005

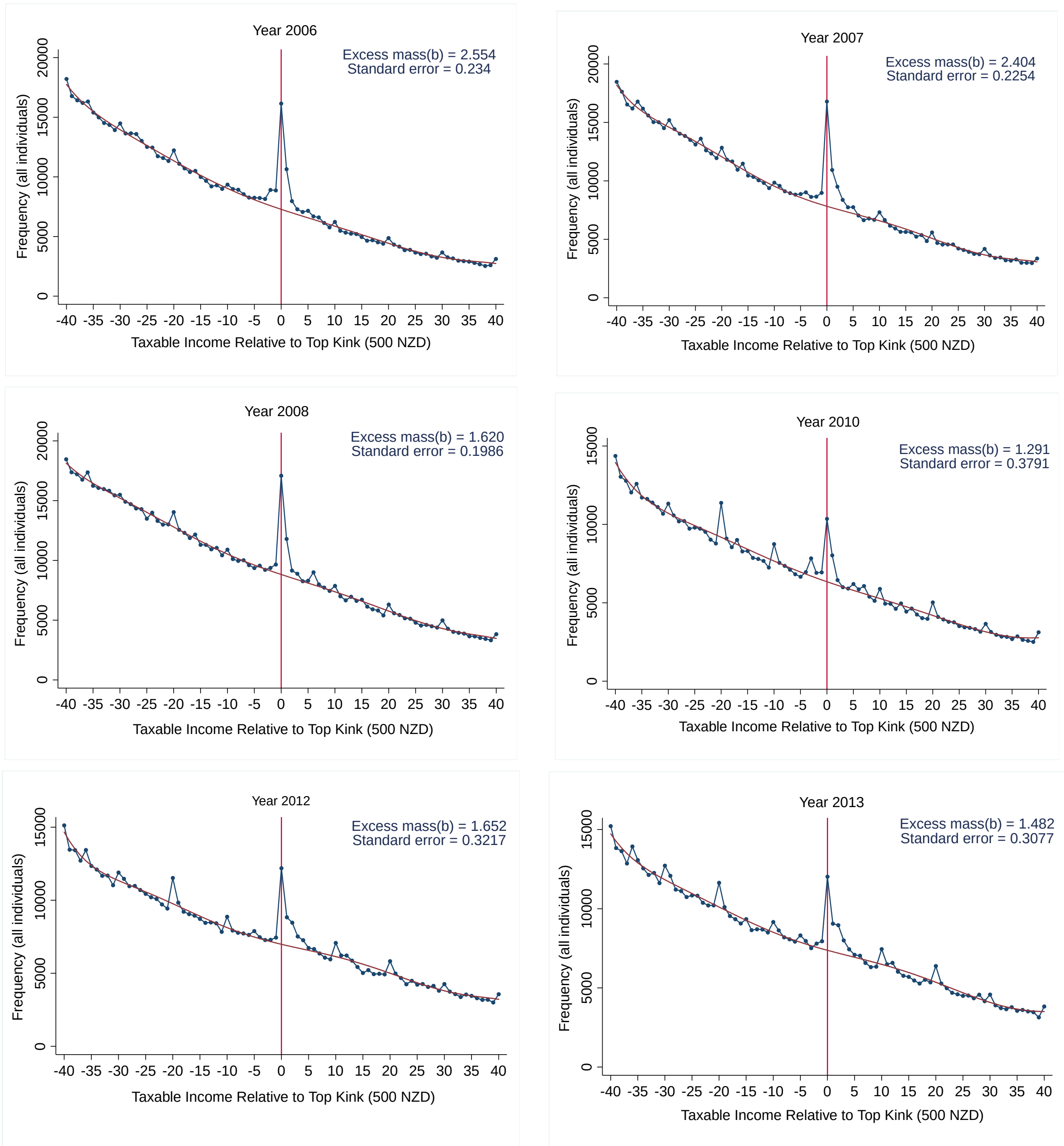

Figure B.2: Income Distributions around the Top Tax Threshold, 2006 - 2013

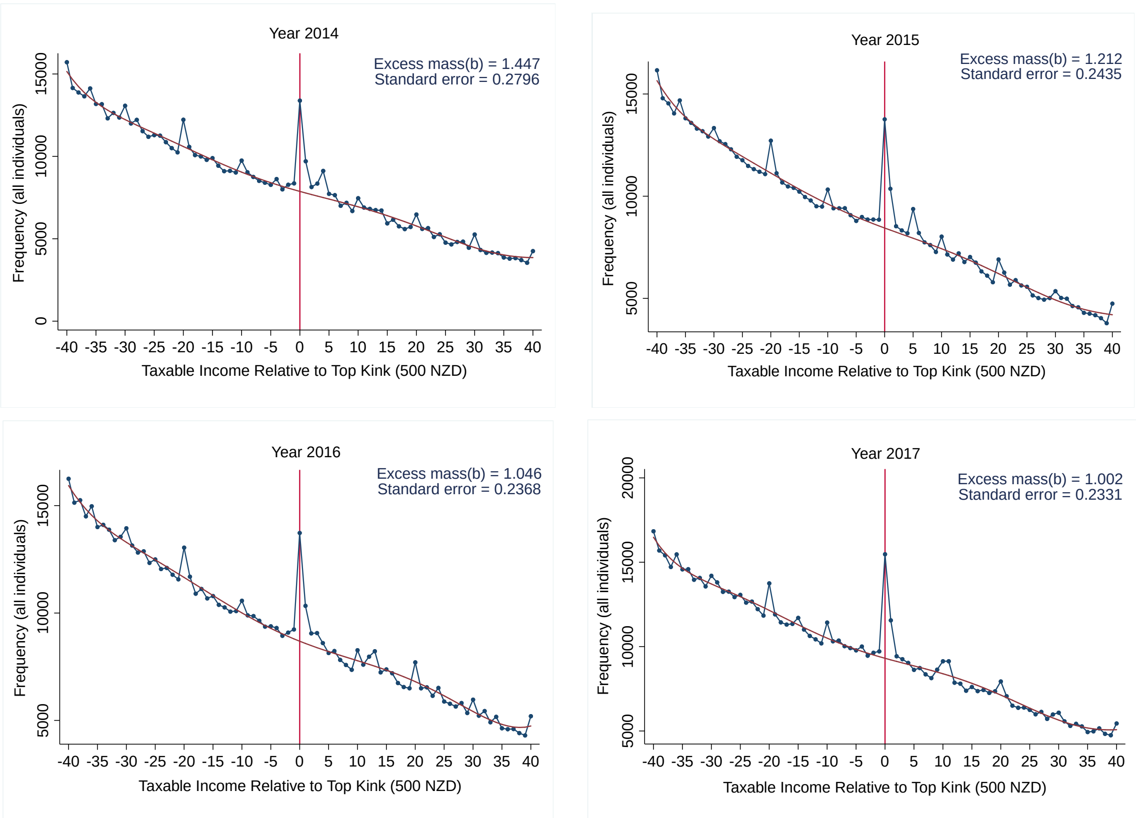

Figure B.3: Income Distributions around the Top Tax Threshold, 2014 - 2017

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