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Firms' strategic responses to tax policies

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Abstract

This article applies an explicit statistical test to a data set of US firms for the period 1988 to 2010 to test for the presence of bunching behaviour around kinks in the tax code implied by strategic cost-shifting. Using the McCrary's (2008) density test, the study finds evidence of clustering behaviour at bracket thresholds associated with increases in marginal tax rates (convex kinks) and gaps or holes at bracket cut-points where the marginal tax rates drop. This evidence implies that kinked tax codes create incentives for taxpayers to engage in manipulation of taxable income.

Key words: bunching, manipulation, discontinuity, kinks, strategic responses, incentives

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1. INTRODUCTION

Tax policies have been known to create discontinuities in budget sets of economic agents. Such discontinuities usually manifest themselves as jumps in marginal tax rates (kinks) of tax schedules. There is evidence that taxpayers respond to the kinks in the graduated tax codes by bunching around the kink points or avoiding the region around the kink point. This manipulative behaviour usually aimed at influencing the tax liability has been termed strategic responses in the public finance literature (Saez, 2010; Chetty et al., 2011). This article seeks to establish whether firms in the United States have engaged in the manipulation of their incomes in response to the incentives generated by the graduated federal income tax schedule.

This article studies the tax schedules for the period 1988-2010. The study omits the period before 1988 because of the data limitations. Specifically, some of the key variables needed to compute taxable income are not available from 1982 to 1984. Two major reforms, namely the Tax Reform Act of 1986 (TRA 1986: 1988-1992) and the Omnibus Reconciliation Act (OBRA: 1993) were in effect during the study period. The reforms that were undertaken during the study period mainly involved changing the number of brackets and adjusting tax rates. The study follows prior literature (Altig & Carlstrom, 1992) and argues that tax policies that involve simplifying the tax codes generate substantial jumps in marginal tax rates, which may stimulate incentives for tax avoidance behaviour. Any evidence of clustering or bunching around tax bracket thresholds indicates strategic responses to tax codes.

Two types of kinks are considered in the literature. The first one is the convex (or upward) kink which refers to discrete jumps in marginal tax codes. This is the most common type of kink, and it has been a significant focus of research. The US federal corporate tax code features these convex kinks for greater portions of the tax schedule. The second type of kink is the non-convex (downward) kink, which occurs when there is a discrete drop in the marginal tax rate. Although this type of kink is not common, this article examines it briefly since the US federal corporate tax code includes this type of kink. For the US corporate tax code, the non-convex kink appears at the end of the tax schedule.

Understanding and quantifying how taxpayers respond to tax policy changes is vital for estimating the incidence and efficiency of tax policy. As Saez (2010) puts it, the magnitude of the bunching is proportional to the elasticity of taxable income which is of interest to economists. Additionally, the nature of strategic responses induced by a tax code is critical for estimating expected revenue, which is an essential aspect of public finance. Furthermore, by studying how firms respond to incentives generated by tax reforms, this study hopes to provide useful information about the effectiveness and efficiency of the tax reforms.

Although the proportion of corporate income tax in total revenue is not as significant as that of personal income tax, the strategic role that firms play in economic organisations necessitates investigation of the nature of their strategic responses to tax codes. Firms may respond to changes in tax policy through income shifting, exploring tax incentives, strategic reporting of input costs and output, and adjustment of wages or employment, among other responses. Such responses could result in misallocation of resources in the sense that factors of production get directed to less productive activities. Additionally, given the increased role of taxation in government stimulus plans, the importance of

understanding the responses of economic agents (firms, individuals) to tax policy changes cannot be overemphasised.

The strategic responses can be divided into real responses, in which the firms adjust their productivity (real activity) in response to taxation; and avoidance responses, in which firms engage in various income shifting and timing activities aimed at minimising their tax liability (Slemrod, 1995). Firms would opt to engage in this behaviour to minimise tax-related costs and uncertainties.

In order to investigate the strategic responses of firms, the article builds on the literature that uses bunching methods (Saez, 2010; Chetty et al., 2011) to study strategic responses of economic agents to changes in tax policy. A recent comprehensive review of this literature is provided by Kleven (2016), and it reveals mixed findings with regards to evidence of bunching. For instance, Saez (2010) finds no bunching for wage earners at the large kink points created by the US income tax schedule and Earned Income Tax Credit (EITC). Likewise, Bastani and Selin (2014) find that Swedish wage earners do not bunch at a larger kink. However, evidence of bunching has been established among wage earners in Denmark (Chetty et al., 2011) and Pakistan (Kleven & Waseem, 2013). Researchers have also reported lower taxable income elasticities for wage earners than for self-employed individuals (Saez, 2010; Chetty et al., 2011; Kleven & Waseem, 2013; Bastani & Selin, 2014).

Although most studies on the strategic responses to taxation have primarily focused on estimating the elasticity of taxable income for individual taxpayers (Feldstein, 1995; Saez, 2010; Chetty et al., 2011), there is also extant literature on firms' strategic responses to tax policies. One such study is by Gruber and Rauh (2007) who use the Compustat data set covering 1960 to 2003 and an instrumental variable technique to estimate the elasticity of taxable income with respect to the effective marginal tax rate. Their study finds an elasticity of 0.2, which indicates that the corporate tax base is moderately responsive to tax rates. A more recent study by Coles et al. (2019) uses bunching and control group methods to investigate the responsiveness of US private firms to tax rates. Using an administrative data set of US private firms, their study estimates an elasticity of taxable income of 0.88, suggesting that US corporations are highly sensitive to tax rates.

This article mainly draws on the literature that applies regression discontinuity design (RDD) approaches to study the impact of taxation (Bruhn & Loeprick, 2014; Kneller & McGowan, 2013; Sánchez, 2014). Rather than applying RDD directly to study the impact of taxation, this study exploits McCrary's (2008) density test – a validity test employed in RDD to provide evidence showing how the graduated tax code creates incentives for taxpayers to manipulate taxable income.

This article also makes a departure from the focus of prior literature by investigating the strategic responses to the kinks in the corporate income tax schedule and employing an alternative estimation technique with minimal data requirements. Specifically, unlike other studies that typically focus on one kink, this article expands the analysis to all kink points in the corporate tax schedule.

Due to the challenges of obtaining actual tax return data, the study uses Compustat to compute a measure of taxable income. The Compustat database includes financial statements for publicly traded C corporations. The article focuses on the period 1988-2010 since it has complete data for all the variables needed to construct a measure of

taxable income. Prior studies (Gruber & Rauh, 2007; Hanlon, 2003; Hanlon et al., 2005; Kinney & Swanson, 1993; Mills, Newberry & Novack, 2003) have acknowledged and highlighted the limitations of using Compustat data to estimate taxable income. The limitations mainly arise from the fact that financial statements and tax reporting differ along many dimensions. Additionally, because Compustat only includes publicly traded companies, the sample this article uses is not representative of the entire US corporate sector. Although there is some evidence that taxable income estimated from financial statements is a good proxy for a firm's actual taxable income (Ayers, Jiang & Laplante, 2009; Plesko, 1999, 2007), the limitations of Compustat data should be kept in mind when interpreting the findings of this article.

The article then uses a combination of graphical techniques (histogram analysis) and explicit statistical procedures (RDD validity test) to test for the presence of bunching behaviour around kinks in the tax code implied by strategic cost-shifting behaviour. The advantage of using these estimation techniques is that they only require one variable (taxable income) to analyse the responses to changes in tax policy.

The results suggest that firms respond to the kinked tax code by avoiding the higher tax side of the bracket threshold. Specifically, this study establishes that firms respond to an increase in tax rate by bunching around the kink point. The results also reveal that a decline in tax rates is associated with gaps or holes around the kink point. These findings suggest that firms manipulate their taxable income in response to changes in tax policy.

The article proceeds as follows. Section 2 provides a brief overview of the US corporate income tax code. Section 3 discusses the estimation strategy, while section 4 describes the data and reports summary statistics. Section 5 presents the results, and section 6 concludes.

2. OVERVIEW OF THE US CORPORATE INCOME TAX CODE

Table 1 summarises the US corporate income tax schedules from 1988 to 2010. It should be noted that the federal income tax code underwent two major reforms during the period 1988 to 2010. The Tax Reform Act of 1986 (TRA 1986) was in effect from 1987 to 1992, while the Omnibus Reconciliation Act (OBRA) covered the period 1993 to 2010. It is also worth noting that the TRA 1986 remains the most comprehensive change to the US tax code. A common feature of these tax schedules is a progressive tax code for smaller firms while at the same time ensuring that larger firms pay more in taxes. This is partly achieved by 'bubble' tax rates of 39% and 38% that are designed to neutralise the advantages of lower tax bracket rates. Specifically, the formulation of the 'bubble' rates (39% and 38%) helps to ensure that higher-income corporations face higher effective tax rates and pay more taxes (Sherlock & Marples, 2014).

A look at Table 1 also reveals a variation in the number of tax brackets over the period with the OBRA having the highest number of tax brackets. Specifically, the number of tax brackets increased from five during TRA 1986 to eight for the OBRA. Table 1 also shows that the size of the jump or drop in tax rates ranged between 1 and 10 percentage points over the study period.

Additionally, the changes to the US federal income tax system also involved altering the top individual and corporate tax rates. The relationship between these rates is important for understanding income shifting behaviour. For example, when the top individual tax rate is set below the top corporate tax rate, firms could opt to report less

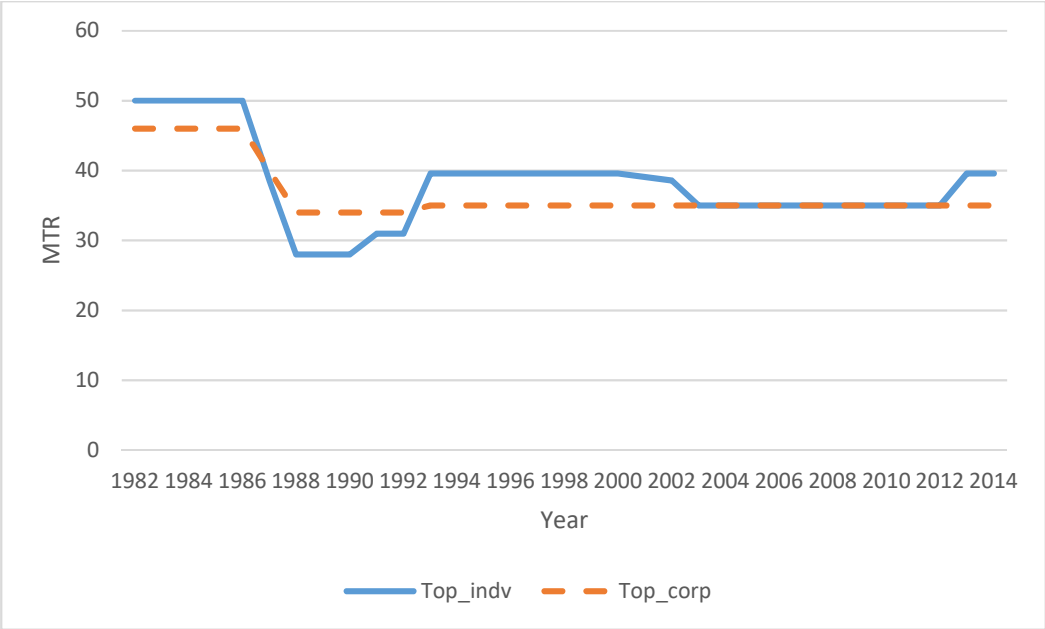
corporate income in order to take advantage of the lower individual tax rate. Figure 1 shows that the top corporate tax rate has remained below the top individual rate for most of the period. However, the top individual rate fell below the top corporate tax rate after TRA 1986 went into effect. The top corporate and individual rates were on par between 2000 and 2010.

Table 1: Corporate Income Tax Schedules (1988-2010) (USD)

Tax Code	TRA 1986: 1988-1992	OBRA: 1993-2010
Tax brackets and rates	15% (0-$50,000)	15% (0-$50,000)
	25% ($50,000-$75,000)	25% ($50,000-$75,000)
	34% ($75,000 $100,000)	34% ($75,000 -$100,000)
	39% ($100,000-$335,000)	39% ($100,000-$335,000)
	34% ($335,000+)	34% ($335,000-10 million)
		35% ($10-15 million)
		38% ($15-18.3 million)
		34% ($18.33 million+)

Source: Internal Revenue Service; Tax Policy Center; Tax Foundation.

Fig. 1: Top Marginal Tax Rates (MTR) for US



Source: Tax Policy Center.

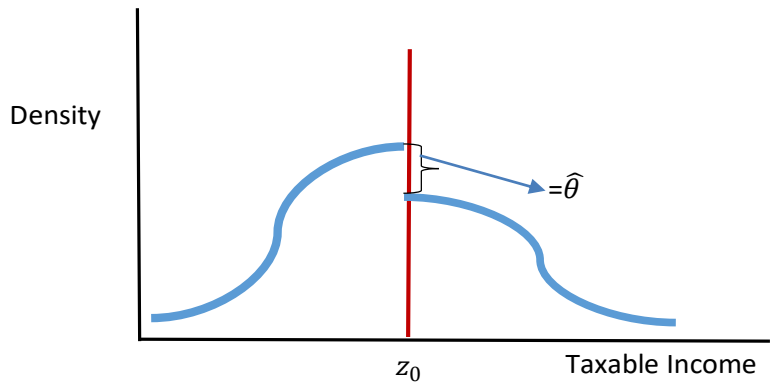
3. ESTIMATION STRATEGY

This study uses graphical techniques (histogram analysis) and explicit statistical procedures (McCrary's density test) to test for the presence of bunching behaviour around kinks in the tax code. Using a combination of these techniques, the study examines the distribution of taxable income around the tax bracket thresholds for the tax schedules over the study period. In the histogram analysis, evidence of bunching will be indicated by the differences in the density of taxable income at the threshold.

The statistical tests employed in this study are based on the validity test that was developed in the Regression Discontinuity Designs (RDD). RDD exploits discontinuities in the likelihood of treatment as a function of some continuous variable also referred to as the assignment or running variable (Lee, 2008). Based on some cut-off point or threshold for the assignment variable, experimental units (individuals or firms) are assigned to treatment or control categories. Successful implementation of RDD relies on the key identifying assumption of continuity in the density of the running variable at the threshold of interest. Unlike other studies that have used RDD to analyse the impact of taxation (Bruhn & Loeprick, 2014; Kneller & McGowan, 2013; Sánchez, 2014), this article exploits the validity test of the design to estimate strategic responses to kinks in the US tax code. McCrary's (2008) density test was developed as a validity test in RDD. One of the advantages of employing the density test is that it is possible to detect manipulation in the variable without information on the outcome variable.

The density test estimates the size of the jump in the density of the running variable and the jump captures the magnitude of manipulative behaviour. The size of the jump which represents an estimate for discontinuity in the running variable is also useful for estimating the responsiveness of taxable income to change in the tax rate (elasticity). Figure 2 depicts the discontinuity in taxable income at the threshold of z_0. The estimate of discontinuity is denoted $\hat{\theta}$ and is shown in Figure 2.

Fig. 2: Density of Taxable Income



The density test depicted in Figure 2 is based on the idea that economic agents that stand to gain from a policy change self-select to manipulate the running variable, which is taxable income in this study. Firms that find it profitable to manipulate taxable income will self-select so that they bunch around the tax bracket thresholds. This study uses the density test to detect and quantify this sorting behaviour among firms. The study expects that manipulation will be seen in reported income at the various thresholds in the tax code.

McCrary's (2008) density test is based on an estimator for the discontinuity at the threshold in the density of the running variable. The discontinuity will be taken as a measure of tax avoidance (Saez, 2010; Chetty et al., 2011). The test is implemented as a Wald test and the null hypothesis is that the coefficient, which captures discontinuity is zero. The test involves two steps. First, finely-gridded histograms are created. The second step involves applying a local linear regression technique to smooth the histograms on each side of the threshold. The local linear regressions involve regressing the normalised counts of the number of observations in each bin against mid-points of the histogram bins (McCrary, 2008). The estimate of the density, $\widehat{\theta}$ is found by taking the log difference in local linear regression estimates at discontinuity on either side of the threshold. Specifically, $\widehat{\theta}$ is estimated as follows:

$$\widehat{\theta} \equiv ln\hat{f}^{+} - ln\hat{f}^{-} \qquad (1)$$

where $\hat{f}^{+}$ is the local linear regression estimate at discontinuity from the right side of the threshold, and $\hat{f}^{-}$ is the local linear regression estimate at discontinuity from the left side (McCrary, 2008).

Despite the extensive application of bunching methods to study strategic responses to policies, a debate has arisen recently questioning the ability of the bunching methods to accurately identify elasticities (Blomquist & Newey, 2017; Bertanha, McCallum & Seegert, 2019; Patel, Seegert & Smith, 2016). While this study acknowledges the concerns raised in these debates and the author intends to explore them in her future work, the author should point out that this article uses a slightly different approach than those employed by other researchers. Unlike prior literature (Gruber and Rauh 2007; Coles et al., 2019) that uses the bunching methods advanced by Saez (2010) and Chetty et al. (2011) to estimate elasticities, this article uses the failure of the RDD identification strategy to detect strategic response to tax policy. In future work, the author intends to explore the suite of estimation methods proposed by prior studies (Bertanha et al., 2019; Blomquist & Newey, 2017; Coles et al., 2019) to investigate taxpayers' responsiveness to tax rates and estimate elasticities of taxable income.

4. DATA AND DESCRIPTIVE STATISTICS

4.1 Data

The study uses US firm-level data from the Compustat database for the period 1988 to 2010. The Compustat data set consists of publicly traded C corporations and only contains items from financial statements. Due to the fact that firm-level tax return data is not publicly available, the study constructs a measure of taxable income from financial statements. The study divides the sample into TRA 1986 (1988-1992) and OBRA (1993-2010) to reflect the differences in tax policy that characterised the study

period. Additionally, the study excludes financial institutions (SIC codes 6000–6999), utilities (SIC codes 4900–4999), and firms that are not incorporated in the US because they are subjected to different tax rules and regulations (Ayers et al., 2009). Further, the study's final sample only includes firms with complete data on all variables needed to construct the measure of taxable income.

Taxable income is the main variable of interest in this study and the study follows Hanlon, Laplante and Shevlin (2005) and constructs it as follows:

$$Taxable\ Income_i = \frac{\text{tax expense}}{\text{tax rate}} - \Delta NOL \quad (2)$$

where tax expense is a sum of foreign and federal income taxes; tax rate is as depicted in Table 2; and ΔNOL is the change in net operating loss (NOL) carryforwards.

These variables are readily available in Compustat for all the firms in the sample. To compute the taxable income, the study uses the information in Table 1 to reconstruct tax brackets for the tax expense variable. This is done to ensure that the measure of taxable income reflects the progressive nature of the tax code by allowing the estimate of tax liability to vary by tax rate. This approach is a slight departure from the accounting literature that uses the top tax rate in the denominator of equation 2. The accounting literature assumes that all firms are large, and are all subjected to the same top tax rate. This assumption justifies their reasoning to divide tax expense by the top rate when computing the taxable income variable. Table 2 presents the tax expense brackets and associated tax rates that this study uses to construct the measure of tax avoidance.

Table 2: Tax Expense Brackets and Tax Rates (TRA 1986)

Tax rate (%)	Taxable income (USD million) bracket	Tax expense (USD million) bracket
0.15	(0 - 0.05)	(0 - 0.008)
0.25	(0.05 - 0.075)	(0.008 - 0.014)
0.34	(0.075 - 0.1)	(0.014 - 0.022)
0.39	(0.1 - 0.335)	(0.022 - 0.114)
0.34	(0.335 - 10)	(0.114 - 3.29)
0.35	(10 - 15)	(3.29 - 5.04)
0.38	(15 - 18.3)	(5.04 - 6.30)
0.35	18.3+	6.30+

Using the information in Table 2, the study is able to determine the appropriate tax rate for each of the tax expense brackets, and then use it to construct the measure of taxable income. In order to obtain a more accurate estimate of taxable income from the financial statements, the study follows the accounting literature and subtracts the change in net operating loss (NOL) carryforwards (Ayers et al., 2009).

There are several limitations associated with using the Compustat database to construct a measure of taxable income. First, Compustat contains financial statements data rather than actual tax return data. Because financial reporting differs from tax reporting, using financial statement data to estimate taxable income is challenging and may result in inaccurate taxable income estimates. For example, stock option deduction and tax cushion are treated differently for financial accounting purposes. Differences in consolidation rules for financial accounting and tax purposes also account for disparities between estimates of taxable income and tax liability from actual tax returns (Hanlon, 2003; Hanlon et al., 2005). Second, Compustat suffers from coding and reporting errors, especially for special items such as NOL carryforwards (Kinney & Swanson, 1993; Mills et al., 2003). Mills et al. (2003) also emphasise the need to be careful when using financial statement data to estimate taxable income for firms with foreign operations or acquisitions. Another issue with using the Compustat data set to obtain estimates of taxable income is that the data set is not representative of the entire US corporate sector. Despite these limitations, there is evidence that shows that taxable income estimated from financial statements is a reasonable estimate for actual taxable income as reflected on a tax return (Ayers et al., 2009; Plesko, 1999, 2007). Nevertheless, the data limitations and caveats highlighted above should be kept in mind when interpreting and generalising the findings of this article.

4.2 Descriptive statistics

Table 3 presents summary statistics for the variables of interest in this study. Since the analysis is done for two different tax policies or schedules, the study reports summary statistics separately for each tax schedule. Table 3a presents summary statistics for the TRA 1986 tax code (1988-1992), while Table 3b reports statistics for the 1993-2010 period. The sample in Table 3a is much smaller than the one in Table 3b because it only includes firms with taxable income between USD 0 and USD 0.5 million. The study restricts the sample this way because the highest tax bracket under TRA 1986 starts at USD 0.335 million, and the methods employed in this study only rely on observations in the neighbourhood of the bracket thresholds. Correspondingly, the study restricts the sample for Table 3b to include firms with taxable income between USD 0 and USD 25 million since the top tax bracket for the 1993-2010 tax code starts at USD 18.33 million.

The statistics in Table 3a show that the average firm in the sample has about USD 109 million in assets, USD 27,000 in tax expenses, a negative change in NOL carryforwards amounting to USD 39,000 and USD 119,000 in taxable income. When put in the context of the applicable tax schedule, the mean taxable income of USD 119,000 implies that an average firm falls in the fourth tax bracket (Table 1, column 2). This tax bracket also corresponds to the bubble tax rate. As explained earlier, the bubble tax rates are designed to ensure that higher-income corporations face a higher effective tax rate. Having the mean income that falls within this high-tax bracket is somewhat unexpected, given the study's hypothesis that firms would opt to avoid the higher tax side of the bracket threshold. This result further suggests that an average firm faces a higher effective tax rate in the post-1986 reform period. Further, the presence of NOLs also indicates that firms have opportunities to influence their tax liabilities.

Table 3: Descriptive Statistics (1988-2010)

Table 3a: Descriptive Statistics for TRA1986 Analysis (1988-1992) (USD million)

VARIABLES	n	mean	Std deviation	min	max	p50	p75
Tax expense	804	0.027	0.085	-1.605	1.111	0	0.042
ΔNOL	804	-0.039	0.161	-1.700	3	0	0
Assets	804	109.2	334.1	0	3,913	10.69	63.21
Taxable Income	804	0.119	0.149	0	0.497	0.042	0.217

Table 3b: Descriptive Statistics for Analysis of (1993-2010) Tax Code (USD million)

VARIABLES	n	mean	Std deviation	min	max	p50	p75
Tax expense	4,508	2.373	3.766	-90	58	1.262	3.854
ΔNOL	4,508	-0.333	7.690	-97	154	0	0
Assets	4,508	431.5	11,236	0	751,216	73.81	196.4
Taxable Income	4,508	7.262	6.902	0	25	4.960	11.81

Note: p50 refers to median; p75 is the 75th percentile.

Table 3b reports statistics for the period 1993-2010 which corresponds to a different tax reform (OBRA). Results show that the mean tax expense is USD 2.4 million, while mean assets stood at USD 431.5 million. The analysis also reveals that the mean taxable income is USD 7.3 million which places most of the firms in the sample in the 5th tax bracket (of USD 335,000 to 10 million, Table 1, column 3). This tax bracket attracts a tax rate of 34% and it comes after the tax bracket associated with the bubble rate of 39%, and just before the bracket with a 35% tax rate. Having the mean taxable income in the lower tax region could be interpreted as evidence that firms seek to avoid the higher tax brackets in favour of brackets with lower tax rates. Additionally, the mean change in NOLs indicates that there is potential for tax planning activities because firms can use the provisions in the tax code to defer their tax obligations.

5. RESULTS

5.1 Histogram analysis

The study constructs histograms of taxable income to test whether taxpayers strategically locate at various tax bracket cut-off points. Figure 3a displays the histogram analysis for the TRA 1986 tax code. Given that the top tax bracket starts at USD 0.335 million, the histogram analysis is restricted to include taxable income in the range (USD 0 to 0.5 million). The vertical lines correspond to the thresholds of interest (0, 0.05, 0.075, 0.1, and 0.335 in USD million). The study includes the taxable income of zero (non-tax paying firms) so as to illustrate and pin-point the existence of the 'zero-tax' phenomena. As one would expect, the histogram shows significant bunching at zero implying that most firms engage in zero-tax paying behaviour. The evident clustering at zero could be attributed to the fact that taxpayers tend to exploit various provisions in the tax code to minimise their tax liabilities. Certain provisions in the tax code make it possible for firms to zero-out their taxable income thereby generating the clustering at zero. Some of the provisions include accelerated depreciation, stock options, tax breaks, subsidies, and the ability to carry forward net operating losses.

Figure 3a also reveals moderate clustering at thresholds of USD 0.05 million (USD 50,000) and USD 0.1 million (USD 100,000) and a gap or hole around USD 0.335 million (USD 335,000). In line with theoretical predictions, clustering is associated with convex kinks (discrete jump in marginal tax rate) while holes occur at thresholds where the marginal tax rate drops (non-convex kink). In this analysis, the non-convex kink occurs at USD 0.335 million while the rest are convex kinks. The clustering is even more pronounced when the analysis only includes observations in the neighbourhood of USD 0.075 million and USD 0.1 million. Appendix Figure A shows more visible clustering at the thresholds of USD 0.075 million and USD 0.1 million where the convex kinks are located.

A look at Figure 3a also reveals a hole around the highest bracket threshold of USD 0.335 million rendering support to theoretical predictions that taxpayers opt to avoid the region around the non-convex kink point. Additionally, the noticeable gap in the range (USD 0.1 million to 0.335 million) could also be attributed to firms' efforts to avoid this tax bracket. It is worth pointing out that this is also the bracket associated with the bubble rate. Additional analysis using kernel density (Appendix Figure B) offers more support to the evidence of bunching and holes around bracket thresholds.

Fig. 3a: Density of Taxable Income for TRA1986 (1988-1992) Tax Code (USD million)

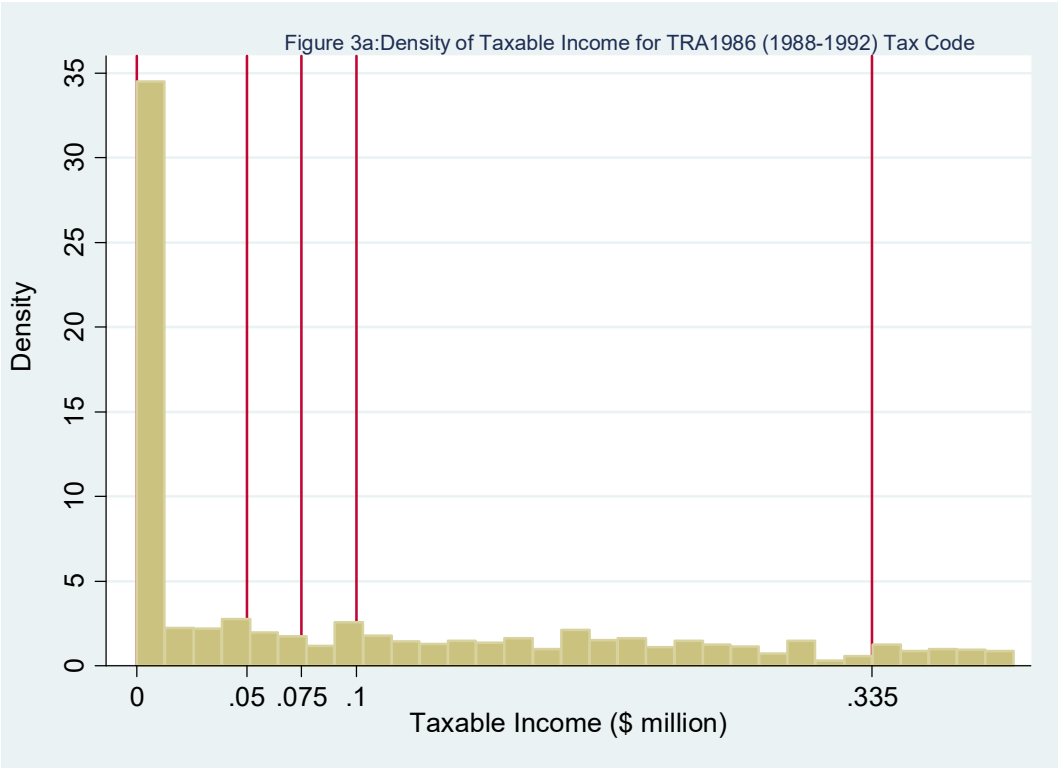
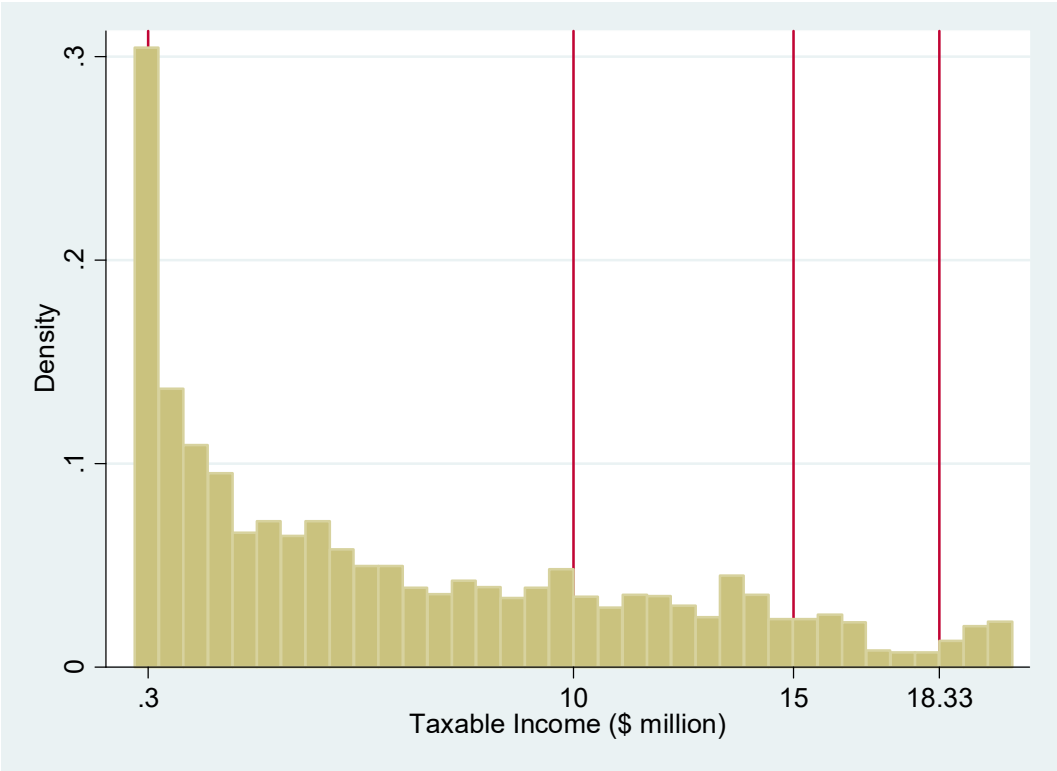


Figure 3b presents the histogram analysis for the 1993-2010 tax code. The vertical lines correspond to the thresholds of interest (0.335, 10, 15 and 18.33 in USD million). The graph reveals sizable bunching at USD 0.335 million and moderate clustering around

USD 10 million. Also notable is the gap around the top bracket cut-point of USD 18.33 million, which is associated with a decline in the tax rate. The distribution for the lower brackets (0.05, 0.075, 0.1, and 0.335 in USD million) reveals a pattern similar to that of the TRA 1986 (Appendix Figure C). The study also presents results for kernel density analysis in Appendix Figure D and the results indicate some evidence of bunching at thresholds of 0.05, 0.1 and 10 (USD million). Overall, these findings suggest that firms opt to locate on lower tax sides of the tax bracket thresholds in order to reduce their tax liabilities.

Fig. 3b: Density of Taxable Income: 1993 – 2010 (USD million)



5.2 Statistical tests: McCrary's (2008) Density Test

Because the histograms may not accurately capture bunching at all tax thresholds and do not allow for point estimation or inference, the study turns to statistical tests for discontinuity in the distribution of taxable income. The study applies the McCrary's (2008) density test to the two tax codes spanning the period 1988-2010. Table 4a presents the results of the McCrary density test for the TRA 1986 tax code (1988-1992). The analysis involves determining whether taxpayers engage in strategic behaviour around tax bracket cut-points (thresholds). The study considers cut-points where the tax rate increased (0, 0.05, 0.075, and 0.1 in USD million) as well the top bracket threshold of USD 0.335 million that is associated with a decline in the tax rate. The results show evidence of firms manipulating taxable income by locating at the lower tax side of the

thresholds. This is evidenced by the negative coefficients of discontinuity at tax bracket cut-points where the tax rate rises, and a positive coefficient for the top tax bracket where the rate declines.

Given that firms have a tendency to report zero taxable income, the study also analyses the reporting behaviour at the threshold of zero. The coefficient 1.433 associated with the threshold of zero indicates that the percentage of firms reporting zero taxable income increased by 143%. Additionally, the positive coefficient at zero could mean that most taxpayers opt to pay the lowest tax rate possible or zero taxes at the most. The coefficient for the top tax bracket threshold is 1.138 suggesting that the proportion of firms reporting income increased by 113.8% in response to the drop in the tax rate.

The results also indicate the estimates of log discontinuity are negative at tax brackets where tax rates increased. For instance, the coefficients at thresholds of USD 0.05 million, USD 0.075 million and USD 0.01 million of -1.307, -1.137, and -0.8, respectively, indicate that the number of firms reporting taxable income decreased at thresholds where the tax rate increased. These magnitudes entail that the percentage of firms locating to the lower tax side of these brackets fell by 130.7%, 113.7% and 80% at the thresholds of USD 0.05 million, USD 0.075 million and USD 0.01 million, respectively. These findings further suggest that a kinked tax code provided incentives for firms to engage in tax avoidance behaviour by sorting around the bracket thresholds and strategically locating on the lower tax portions of the brackets. The results also imply that the responses to changes in tax rates are much larger at lower tax brackets.

Table 4a: Density Test for 1988-1992 Tax Code

Threshold (USD million)	$0	$0.05	$0.075	$0.1	$0.335
coefficient	1.433	-1.307	-1.137	-0.800	1.138
bin size	0.014	0.014	0.014	0.014	0.014
Band width	0.318	0.367	0.451	0.365	0.370
Standard error	0.072	0.076	.072	.081	.176
P value	0.000	0.000	.000	.000	.000

The graphical results of McCrary's density are presented in Figure 4a. The graphs show a drop in the density of taxable income at thresholds of USD 0.075 million and USD 0.1 million where the marginal tax rate increases. The results also show that the density of taxable income registered a jump at 0 where the first tax bracket kicks in, as well as at the top tax bracket of USD 0.335 million where there is a decrease in the tax rate. These results suggest that firms engage in activities that ensure that they minimise their tax liabilities.

Table 4b presents McCrary's density test results for the 1993-2010 tax code. The study considers the thresholds of 0, 0.075, 0.1, 0.335, 10, 15, and 18.3 (in USD million). The estimates of discontinuity are negative at thresholds where the tax rates increase (0.075; 0.1; 10; 15, USD million), suggesting that firms tend to choose the lower tax side of the threshold. Additionally, the positive coefficients are associated with declines in tax rates that occur at USD 0.335 million and USD 18.33 million. This suggests that firms strategically manipulate their income to obtain desirable tax outcomes. This behaviour confirms the argument of this study that firms make decisions to ensure that they locate at the lower tax side of the kink.

Fig. 4a: McCrary's Density Test (1988-1992)

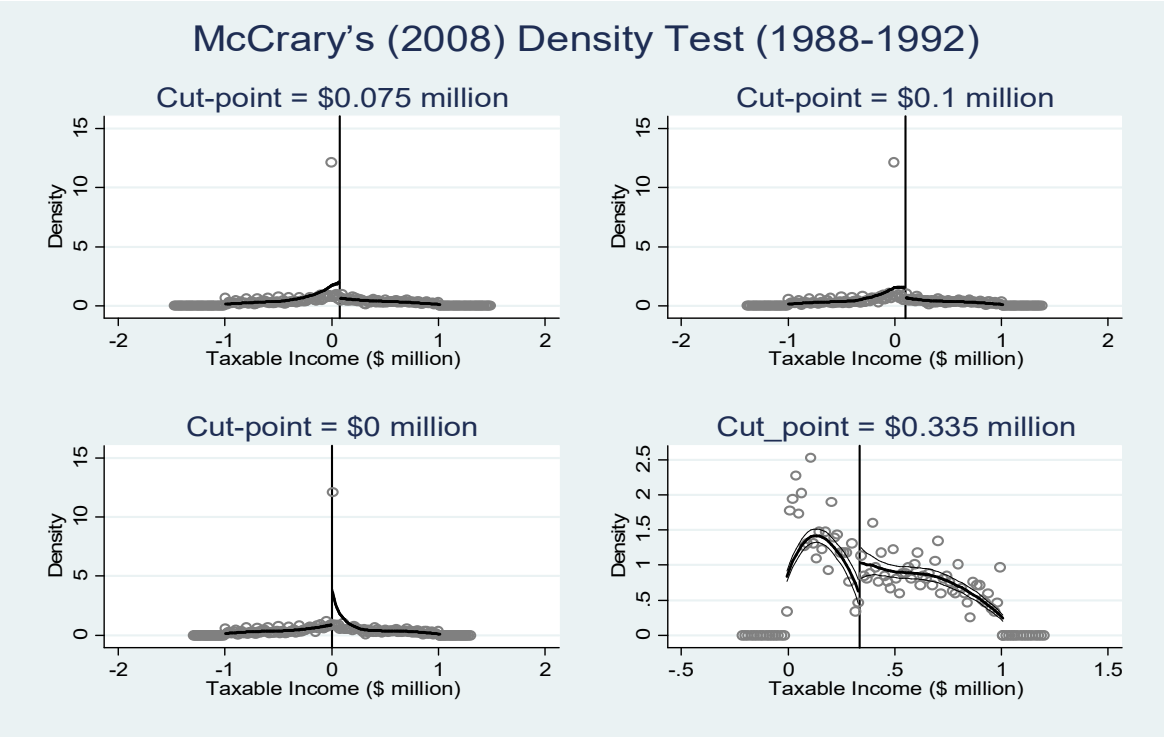


Table 4b: McCrary's (2008) Density Test (1993-2010)

Threshold ($ million)	0	0.05	0.075	0.1	0.335	10	15	18.33
coefficient	1.710	-1.406	-1.300	-0.978	1.320	-0.306	-0.026	1.499
bin size	0.023	0.023	0.023	0.023	0.023	0.236	0.236	0.236
Band width	0.321	0.369	0.427	0.372	0.129	2.557	3.275	3.423
Standard error	0.124	0.127	0.125	0.135	0.594	0.154	0.158	0.349
P value	0.000	0.000	0.000	0.000	.026	0.047	.0800	0.000

The graphical results of the McCrary density test are depicted in Figures 4b and 4c. Figure 4c presents the results of the McCrary test for tax thresholds where the tax rates dropped. The results indicate a discrete jump in the density at the thresholds where tax rates dropped. The rise in the density to the lower-tax side and drop in density on the higher tax side of the thresholds strengthens the argument of the study that firms engage in strategic cost-shifting behaviour. These results also reinforce the findings of the study that taxpayers engage in manipulative behaviour by locating on the lower tax side of the threshold.

Fig. 4b: McCrary's Density Test for a Rise in Marginal Tax Rates

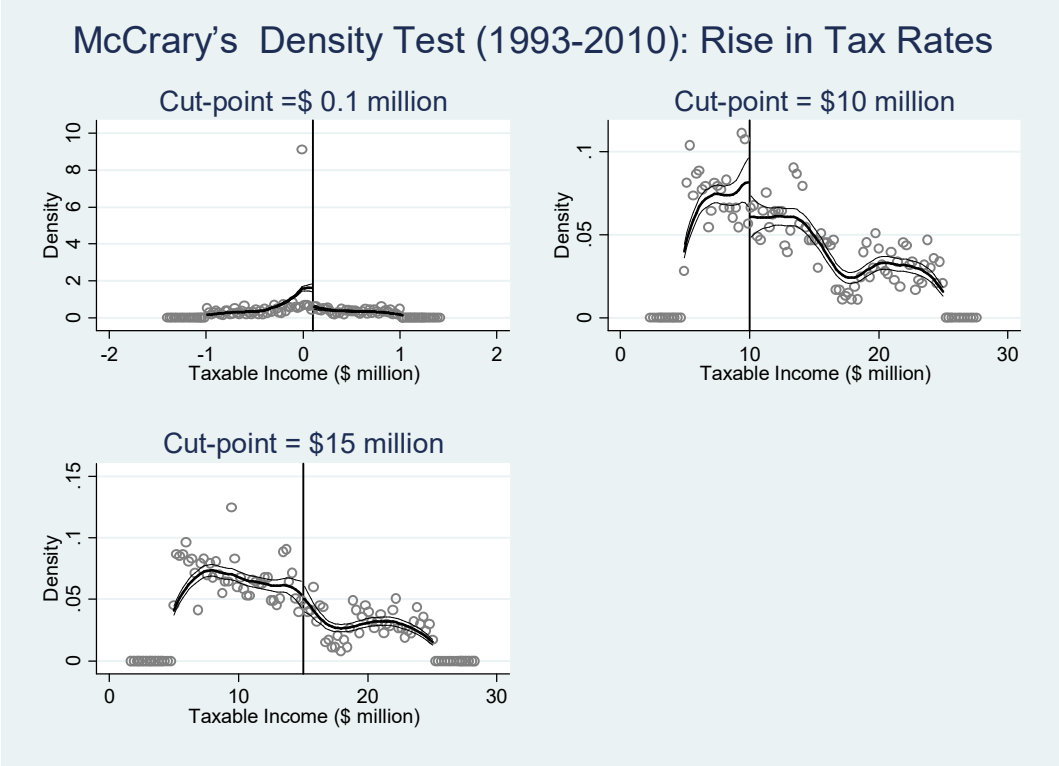
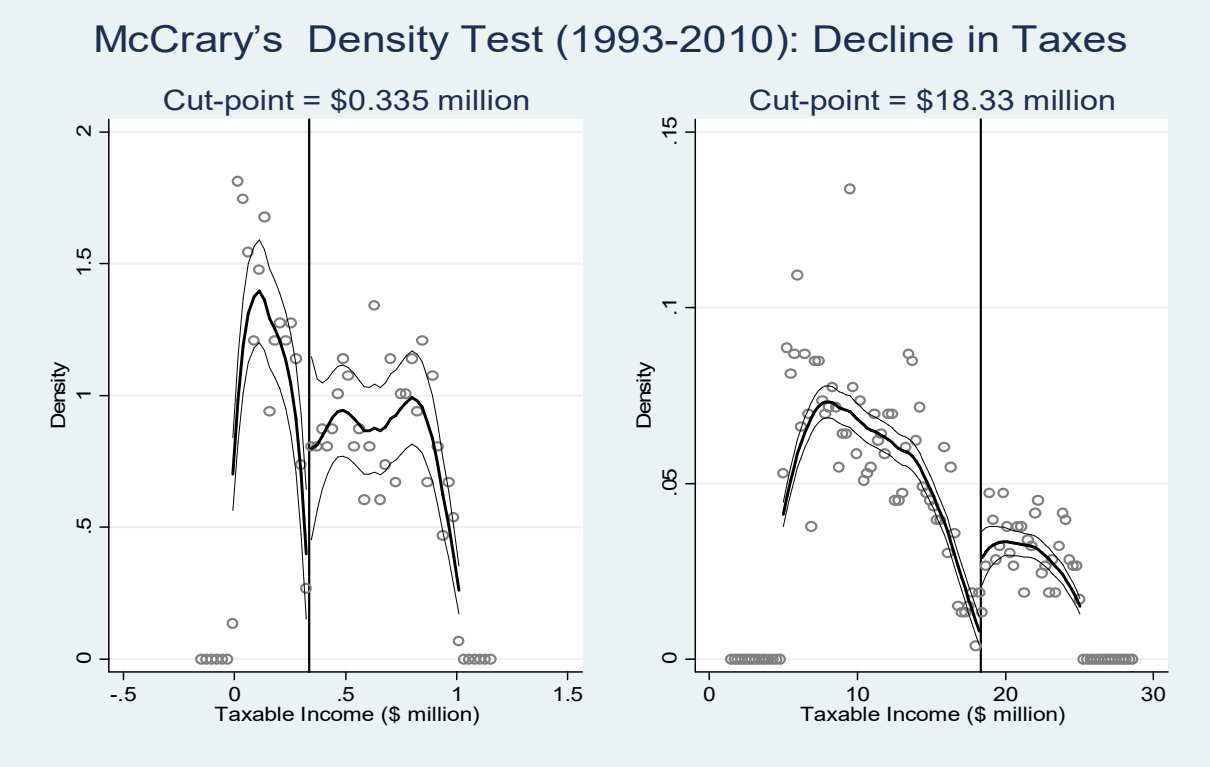


Fig. 4c: Density of Taxable Income for a Decline in Tax Rates



6. CONCLUSION

Graduated tax codes feature tax brackets with different marginal tax rates. Although the idea behind designing such tax codes is to ensure progressivity and efficiency, having such tax structures could also induce incentives for taxpayers to engage in manipulative behaviour. This is because profit-maximising agents will seek to find ways to game the system so as to influence their tax liabilities. The discontinuities (kinks) in choice sets of taxpayers created by graduated tax codes provide evidence of strategic responses to tax codes. This article investigates whether US firms engage in the manipulation of taxable income around tax bracket thresholds for the period 1988 to 2010.

The study finds evidence of clustering behaviour at bracket thresholds associated with increases in marginal tax rates (convex kinks) and gaps or holes at bracket rates where the marginal tax rates drop. These findings suggest that firms manipulate their taxable income to locate on the tax-favoured side of the kink and point to the existence of strategic responses to changes in tax policy. This evidence also implies that kinked tax codes create incentives for taxpayers to engage in manipulation of taxable income around the thresholds. Such manipulation of taxable income will be taken to be an indication of tax avoidance.

The evidence of manipulative behaviour around the thresholds could have implications for the effectiveness and efficiency of the tax reforms. In addition, the knowledge of strategic responses at kink points is important for estimating tax price elasticities as well as the welfare costs of the tax policy.

This study makes a contribution to the literature by constructing a measure of taxable income from financial statements using a slightly different approach than that widely used in the accounting literature. Unlike the accounting literature that constructs taxable income by dividing tax expenses by the top tax rate, this study allows the tax expenses to have varying tax rates. The study does so by constructing tax brackets for tax expenses that it then uses in the formula for computing taxable income. This study also contributes to the literature by focusing on examining strategic responses to corporate tax schedules. To the author's knowledge, strategic responses to personal income tax schedules have received more attention than responses to corporate income tax codes. Additionally, the study contributes to the literature by applying a density test to detect and quantify the strategic responses over a long study period that spans two different tax reforms.

One particular challenge of the many that continue to trouble researchers in the public finance and tax fields has to do with the lack of actual tax return data. As a result, most studies rely on estimates of taxable income and tax avoidance that unfortunately have issues. Some of the issues involve measurement errors that may have an adverse effect on inferences. Despite these data issues, this study helps to extend the literature by using an estimate of taxable income and methods that are more accurate at detecting and quantifying tax avoidance activities. For instance, while prior studies indicate that the 1986 reform was effective in reducing tax avoidance, this study shows evidence of manipulative behaviour. This is an important contribution to the tax avoidance literature and the findings of this article have potential implications for the design of more effective and efficient tax systems.

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APPENDIX

Fig. A: Density of Taxable Income in USD million (1988-1992)

Fig. B: Kernel Density (1988-1992)

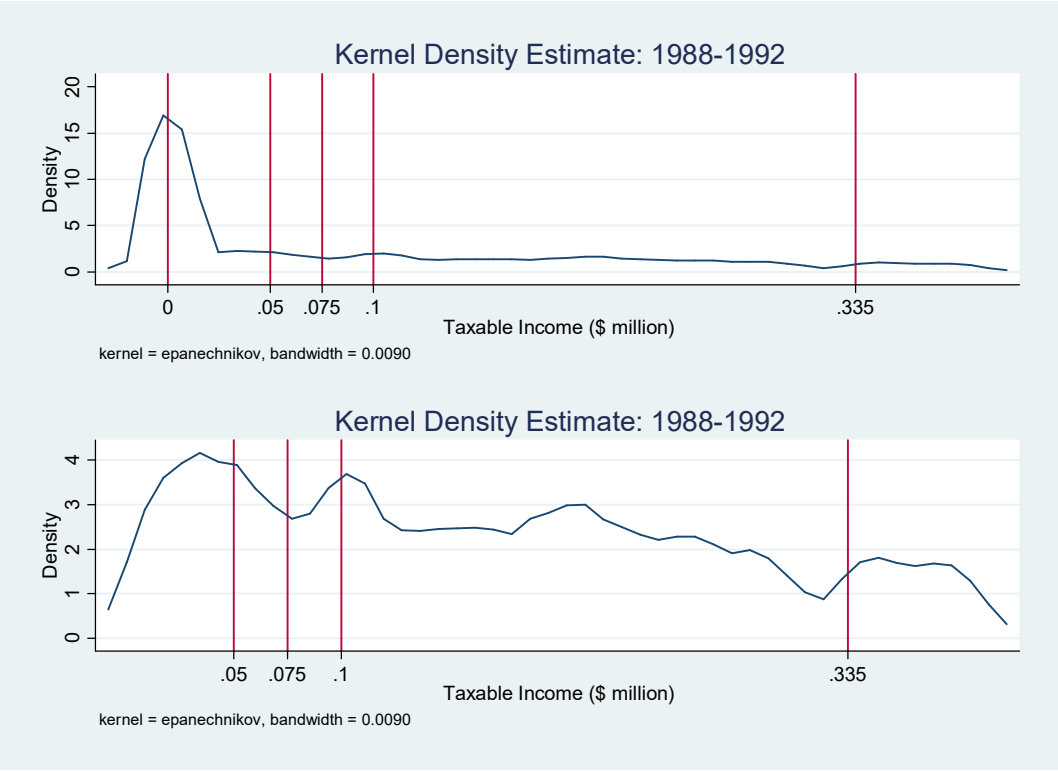
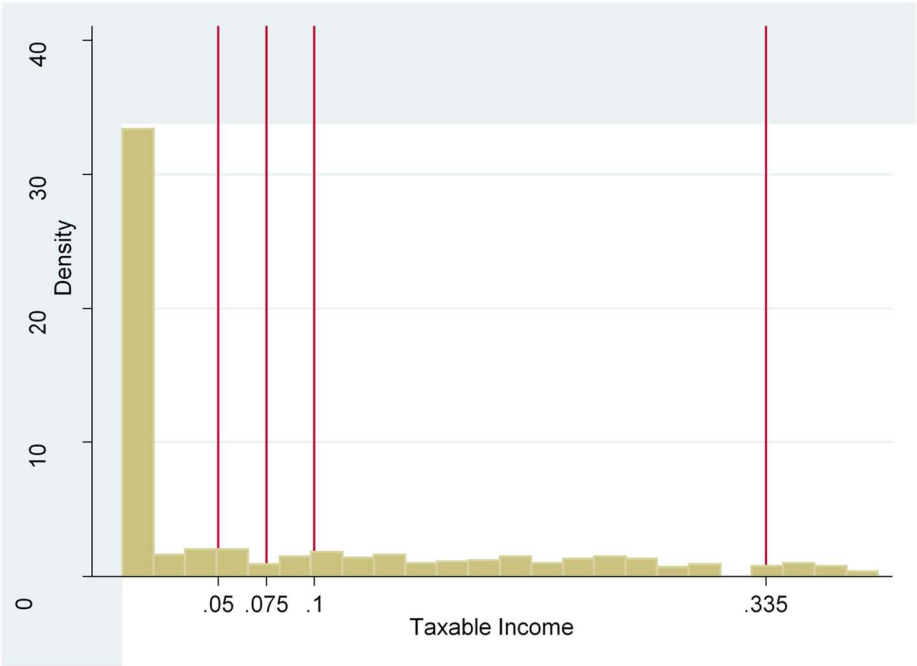


Fig. C: Density of Taxable Income (1993-2010; Lower and Top Brackets)

C1: Lower Income Tax Brackets



C2: Top Tax Bracket

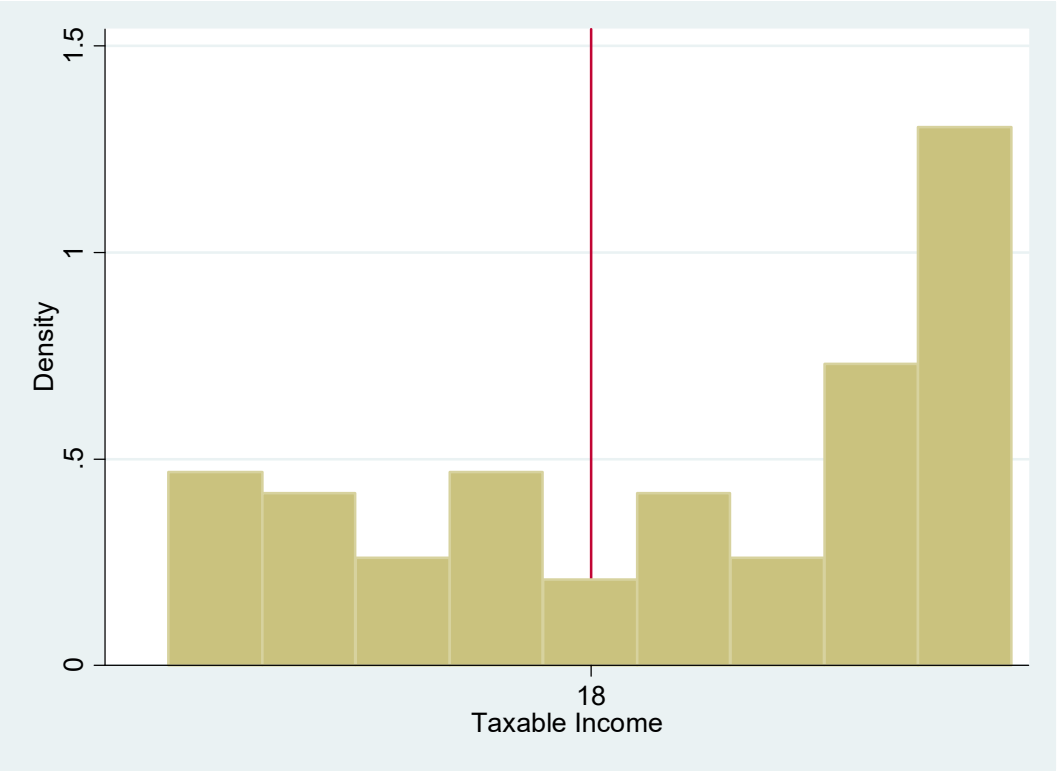


Fig. D: Kernel Density Analysis for 1993-2010 Tax Code

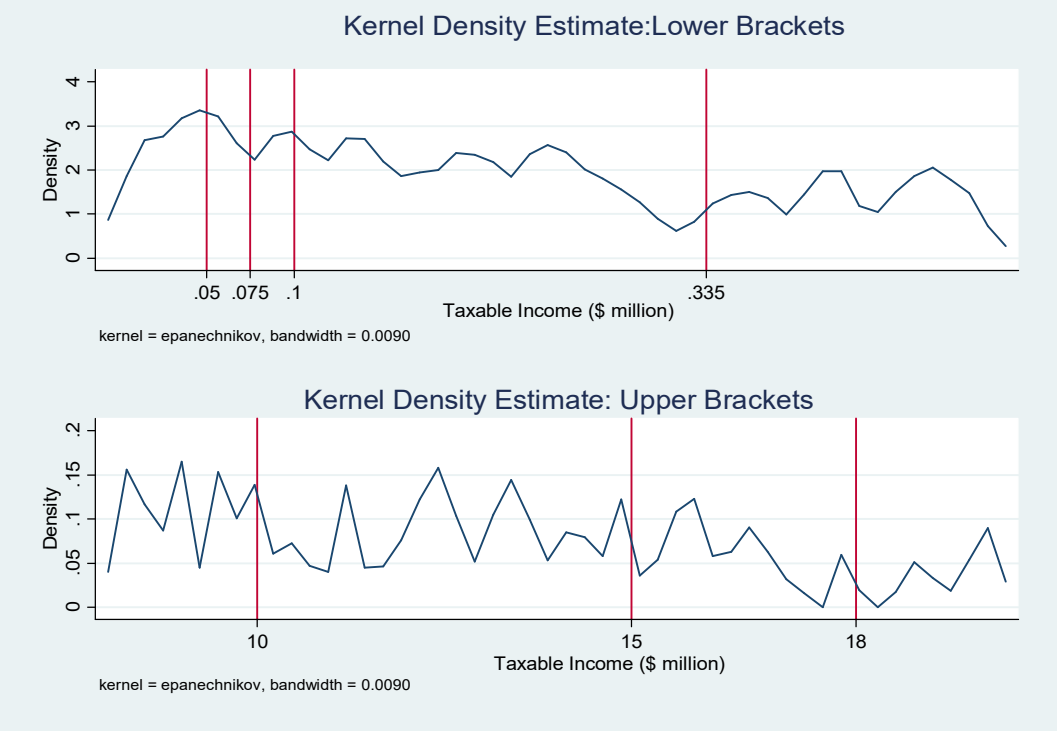


Fig. E: Density for 1988 to 2010