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Strategic Responses to Taxation and Welfare Effects of Tax Policies

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STRATEGIC RESPONSES TO TAXATION AND WELFARE EFFECTS OF TAX POLICIES

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This dissertation focuses on firms' strategic responses to taxation and the welfare implications of changes in tax structure. The dissertation is comprised of three essays. In the first essay, I use the Tax Reform Act of 1986 to investigate how firms adjust their tax strategies in response to the tax incentives induced by the reform. The results in essay one suggest that the 1986 reform created incentives for firms following a sustainable tax strategy to engage in more tax avoidance behavior. In essay two, I test for the presence of strategic cost shifting behavior by examining the distribution of taxable income around kinks in the corporate tax code. Specifically, the McCrary's (2008) density test, which was developed as a validity test in regression discontinuity design (RDD) is applied to a data set of US firms for the period 1988-2010. The results show that reported taxable income has a tendency to bunch at levels just under upward kinks in the marginal tax rate. Conversely, taxable income tends to exhibit gaps in the region below a downward kink in marginal tax rates. Both findings suggest that firms manipulate taxable income in response to kinks in the corporate tax code. In essay three, I provide an explicit model that illustrates the incentives for strategic cost shifting behavior when the tax code exhibits kinks. In the presence of upward kinks in marginal tax rates, profit maximizing firms will choose a path for investment that makes pre-tax profits bunch just below the kink point. I then use the model to quantify the welfare cost of kinks in the marginal tax rates. Additionally, I find that replacing a kinked tax code with one in which marginal tax rates rise smoothly retains the progressivity inherent in the current tax code while largely avoiding the welfare costs associated with large jumps in marginal tax rates.

DEDICATION

To my father Micheal Mulenga Mwamba, and to the memory of my mother, Domitilla Yandwa Chileya. This dissertation is for you.

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Chapter 1

Introduction

We would expect profit maximizing firms to respond to changes in tax policies by engaging in manipulation of income to minimize their tax liabilities. These 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 different income shifting and timing activities aimed at minimizing their tax liabilities. The motivation for firms to engage in these tax liability manipulation activities is to eliminate the unexpected shocks due to tax regime changes that create uncertainty in their earnings portfolio, making them less desirable to potential investors. Given the importance of these fluctuations to the growth of the firm, it is vitally important to understand the firms' reactive policies to tax regime changes. Most scholars who have studied the responses to taxation have largely ignored this aspect and instead focused on estimating the elasticity of taxable income for individual taxpayers(Feldstein, 1995; Saez, 2010; Chetty et al., 2009, 2011). My dissertation focuses on analyzing the strategic responses of US firms to taxation, in order to fill this gap in the literature.

Proponents of the tax reforms that characterized the 1980s argued that broadening the base and reducing the marginal tax rate would make the tax system more efficient. However, with these changes came the reduction in a number of tax brackets which entailed having broad bands of income over which marginal tax rates are constant in conjunction with discontinuous jumps in marginal tax rates –"kinks" (Altig and

Carlstrom, 1994). These changes to the tax codes have the potential to induce tax avoidance incentives which could erode the expected benefits of tax policies. For example, the jumps in marginal tax rates could result in firms bunching around the bracket cut-point as they seek to avoid higher tax rates.

Even though the reforms were aimed at making the tax systems more efficient, there is limited empirical evidence to support such claims (Altig and Carlstrom, 1994). The research into how reforms impact taxpayers, particularly firms is surprisingly limited, given the worldwide calls to reform tax systems. This dissertation addresses this gap in the literature by analyzing the strategic responses of firms to taxation, as well as the welfare implications of changes in tax policy.

Understanding and quantifying the strategic responses to a tax change is essential for estimating the incidence and efficiency of a tax policy. As Saez (2010) puts it, the magnitude of the bunching is proportional to the elasticity of taxable income which is an important component in the analysis of tax incidence and the welfare. Additionally, the nature of strategic responses induced by a tax code is a critical factor in estimating expected revenue, which is an important aspect of public finance. Furthermore, by studying how firms respond to incentives generated by tax reforms, this study hopes to also provide useful information about the effectiveness and efficiency of the tax reforms. The dissertation comprises three essays which I briefly discuss below.

Essay 1: Tax Avoidance and Sustainable Tax Strategies: The Effect of Tax Reform Act of 1986: Most literature on the effect of the 1986 Tax Reform Act (TRA1986) has focused on agents' tax avoidance behavior (low levels of tax avoidance outcomes) despite evidence that firms also emphasize sustainable tax strategies (stable tax avoidance outcomes). I use a US tax reform (TRA1986) to investigate how firms adjust their tax strategies in response to the tax incentive. Using a US panel data set from 1982 to 1992, I analyze how the TRA1986 influenced the value of pursuing a sus-

tainable tax strategy. Due to the bounded nature of the measure of tax avoidance, I estimate a fractional response model (FRM) which overcomes the limitations of other estimation methods (e.g., OLS, Tobit). The findings of this paper indicate that tax sustainability is negatively related to tax avoidance behavior. However, the relationship is stronger in the pre-reform than the post-reform period suggesting that TRA1986 created incentives for firms following a sustainable tax strategy to engage in more tax avoidance behavior.

Essay 2: Firms' Strategic Responses to Tax Policies: In this essay, I apply an explicit statistical test to a data set of US firms for the period 1988-2010 to test for the presence of bunching behavior around kinks in the tax code implied by strategic cost shifting. The McCrary's (2008) density test, which was developed as a validity test in regression discontinuity design (RDD) is employed to empirically show that kinked tax codes create incentives for taxpayers to engage in manipulation of taxable income around the thresholds(McCrary, 2008). Such manipulation of taxable income will be taken to be an indication of tax avoidance. Additionally, the evidence of manipulative behavior around the thresholds could have implications for the effectiveness and efficiency of the tax reforms. The results show evidence of firms manipulating taxable income by positioning themselves on the lower tax side of the tax bracket thresholds. The knowledge of the strategic responses around the kinks is important for estimating the price elasticity and welfare costs of the tax policies (Saez, 2010; Chetty et al. 2011). A high degree of bunching at the kink indicates high elasticity, which is a major component in welfare analysis.

Essay 3: Optimal Taxation in the Face of Strategic Behavior: In this essay, I suggest a model of strategic cost shifting behavior and quantify possible welfare costs associated with kinks in the tax code. Using the model, I analyze whether 'complicated' tax systems that avoid kinks in the marginal tax rates can retain the pro-

gressivity inherent in the current tax code while avoiding the costs associated with large jumps in marginal tax rates. Results show that firms engage in manipulation of profits mainly through strategic investment behavior. Results from welfare analysis indicate that graduated tax codes that avoid kinks are less distortionary than their kinked counterparts.

The dissertation contributes to the literature in many ways. First, I focus on firms' strategic responses to taxation, which has not received much attention in public finance. Most empirical literature has focused on strategic responses of households to changes in tax rate structure (Feldstein, 1995; Saez, 2010; Altig and Carlstrom, 1994; Chetty et al., 2011). Additionally, the longer study period (1982-2010) enables me to examine and compare the strategic responses across different tax schedules. The extensive study period also allows for exploring whether simplifying the tax system may have exacerbated tax avoidance by generating huge jumps in marginal tax rates that in turn, induce strong strategic responses.

Second, I incorporate the "sustainable tax strategy" phenomena into the tax avoidance model and examine the effect of major tax reform on firms' tax avoidance strategies. Additionally, I apply a validity test employed in RDD (McCrary's density test) to study strategic tax behavior among US firms.

Another way in which my dissertation contributes to the literature is applying an estimation technique that is more appropriate for bounded dependent variables, thereby providing robustness to the theoretical econometric methods (e.g. OLS). I do so by following recommendations indicating that ordinary least squares (OLS) is not adequate when the dependent variable is a proportion, and estimate a fractional response model (FRM) (Baum et al., 2008; Papke and Wooldridge, 1996).

In addition to these contributions, this dissertation provides an explicit model that illustrates the incentives for strategic cost shifting behavior when the tax code

exhibits kinks. The model has the potential to provide a framework for identifying real and avoidance responses. For example, if firms are making adjustments by altering their levels and patterns of expenditures, that would constitute a real response. Such knowledge is necessary for accurately estimating revenue and welfare consequences of tax policies. One of the arguments that is usually put forward in support of tax reform is the need to simplify the tax system so as to make it more efficient. My dissertation could shed some light on whether the nature of kinks created by a simplified tax code induces larger strategic responses and generates greater welfare consequences. My approach also allows for comparison of the revenue and efficiency implications of the various tax codes and their associated kinks.

Chapter 2

Essay 1: Tax Avoidance and Sustainable Tax Strategies:The Effect of Tax Reform Act of 1986.

2.1 Introduction

Given the profit maximizing goal of firms, we would expect them to respond to changes in tax policies by to engaging tax liability minimizing behavior. Such manipulation of tax outcomes can manifest in volatile effective tax rates (ETRs). The accounting literature employs ETRs as measures of tax avoidance and tax planning. For example, lower levels of ETR indicate high levels of tax avoidance or tax planning activity. While tax avoidance behavior has been examined extensively, there is also evidence suggesting that a number of firms opt to maintain a stable sequence of ETRs (McGuire et al., 2013; Neuman, 2014). I refer to firms that maintain stable ETRs as pursuing a "sustainable tax strategy." In this paper, I investigate how the Tax Reform Act of 1986 (TRA1986) influenced the value of pursuing a sustainable tax strategy. To my knowledge, tax avoidance literature does not address this question.

There is evidence that shows that a proportion of firms tend to follow sustain-

able tax strategies as opposed to focusing on tax minimization[1]. As McGuire et al. (2013)points out, tax minimization and sustainable differ in that the former is inconsistent in nature while the latter focuses on maintaining stable tax outcomes over time. However, questions remain as to why some firms prefer to pursue a sustainable tax strategy as opposed to employing a tax minimization strategy. Neuman (2014)argues that a firm could opt to pursue a sustainable tax strategy to reduce tax-related uncertainties or to maximize firm value.

Additionally, the fact that investors view tax sustainable firms as a signal for better performance makes sustainability an attractive option for certain types of firms. Moreover, firms that pursue a sustainable tax strategy tend to exhibit distinct characteristics from those that focus more on tax avoidance behavior. For example, some studies have found that firms that pursue sustainable tax strategies tend to be larger; be less leveraged; be less likely to have tax loss carry-forwards; have more extensive foreign operations, and have fewer tax planning opportunities (Neuman, 2014). Given these differences in characteristics, understanding the interaction between a strategy intended to minimize firms' explicit taxes and sustainable tax strategies is important for devising more effective tax policies.

Given that the TRA1986 is the most comprehensive change to the U.S federal income tax law, I expect the reform to affect the value of sustainable tax strategies. This expectation arises from the knowledge about components of the reform that were designed to make tax avoidance behavior less profitable (Weinberg, 1987). These components include the repeal of the investment tax credit, reduction of the top corporate tax rate from 46% to 34%, decrease in the number of tax brackets, and an increase in the alternative minimum tax (AMT) threshold to 21%. Ultimately, the reform was expected to reduce the variability of ETRs and minimize the incentives

[1]Hanlon and Heitzman (2010) defines tax avoidance as the reduction of explicit taxes.

for tax avoidance behavior. However, evidence suggests that firms responded to the reform by engaging in more tax avoidance behavior such as income shifting, and strategic reporting (Slemrod, 1990; Enis and Ke, 2003; Wilkie et al., 1996; Gordon and Slemrod, 1998). This evidence necessitates studying how the reform affected the benefits of firms' tax strategies. Specifically, I posit that the TRA1986 will influence the value of pursuing a sustainable tax strategy. Lowering the value of a sustainable tax strategy would imply that the reform provided more incentives for tax avoidance behavior.

Studying how the TRA1986 affects the benefits of sustainable tax outcomes could provide information as to whether or not firms switch between the tax strategies that minimize explicit taxes or stabilize tax outcomes. This information is important for designing more effective tax reforms, which incorporate the sustainability aspects of tax strategy. Additionally, incorporating sustainable tax strategies into the model of tax avoidance behavior is important because it could provide some insight into the nature of tax avoidance behavior. For example, if a significant proportion of firms are more interested in maintaining sustainable tax strategies, tax avoidance will be less pronounced.

Taking sustainability into consideration is also important given the evidence that a proportion of firms are more concerned about maintaining sustainable tax strategies than minimizing tax liabilities (McGuire et al., 2013; Neuman, 2014). Thus, studies that ignore the existence of firms that pursue sustainable tax strategies run the risk of modeling tax avoidance behavior incorrectly. It is also noteworthy that the two tax strategies could have different implications for tax revenue and efficiency. By studying how a major reform affects the benefits of these two tax strategies, this study hopes to also provide useful information about the effectiveness and efficiency of the tax reform.

In this paper, I use a sample of USA firms from Compustat database over the period 1982-1992. I only include firms with complete data for the entire study period. I then divide the sample into pre-reform (1982-1986) and post-reform (1988-1992) periods. I follow the accounting literature(Mayberry et al., 2015; Neuman, 2014; McGuire et al., 2014) that uses effective tax rates (ETRs) to measure tax avoidance. Specifically, I employ current ETR to construct a measure of tax avoidance. Although ETR can take values outside the interval [0, 1], I censored it to be between 0 (current taxes are zero) and 1 ($current\,taxes = pretax\,income$). This is because values outside the interval [0, 1] are not meaningful for studying tax avoidance behavior.

Further, I identify a firm as having a sustainable tax strategy if the coefficient of variation of annual ETRs over a period of five years is low. For this reason, I take the negative of the coefficient of variation as a measure of sustainability. Due to the estimation issues associated with bounded dependent variables, I employ a fractional response model (FRM) as an alternative estimation technique (Papke and Wooldridge, 1996).

Results indicate a negative association between tax avoidance behavior and the application of sustainable tax strategies. This finding suggests that firms that engage in higher tax avoidance behavior are not able to sustain their tax positions over time. The paper also establishes that the TRA1986 diminishes the benefits of sustainable tax strategies in tax avoidance behavior. The weaker relationship between tax avoidance and tax sustainability could also imply that TRA1986 triggered firms to switch between the tax strategies as well as engage in more tax avoidance behavior. The results are robust to using GAAP effective tax rate to construct an alternative measure of tax avoidance, and to employing alternative estimation techniques including Beta regression and Tobit.

My paper makes two main contributions to the literature. First, I incorporate

the "sustainable tax strategy" phenomena into the tax avoidance model and examine the effect of major tax reform on firms' tax avoidance strategies. To my knowledge, no study examines the effect of a major tax reform on the benefits of firms' chosen tax strategy. Second, the paper contributes to the literature by employing an estimation technique that is more appropriate for bounded dependent variables, thereby providing robustness to the theoretical econometric methods (e.g. OLS). I do so by following recommendations indicating that ordinary least squares (OLS) is not adequate when the dependent variable is a proportion and estimate a fractional response model (FRM) (Papke and Wooldridge, 1996; Baum et al., 2008). Finally, this paper extends the research investigating the interaction between tax sustainability and tax minimization strategies.

2.2 Tax Strategies and the Tax Reform Act of 1986

2.2.1 Tax Avoidance

In this paper, I categorize any activity aimed at reducing the tax burden of the firm as tax avoidance (Hanlon and Heitzman, 2010). Additionally, I follow the accounting literature and use effective tax rates to construct measures of tax avoidance. Low effective tax rates signify higher tax avoidance and vice versa for higher effective tax rates.

There is evidence that shows that tax avoidance tends to exhibit significant variation (Dyreng et al., 2008). This variation in the tax avoidance outcomes could be attributed to the costs and benefits associated with tax avoidance behavior. The ben-

efits of tax avoidance mainly include a reduction in tax related costs and uncertainties and potential to increase firm value. Costs include the penalties that apply if caught by the tax authorities as well as the agency costs (Desai and Dharmapala, 2009). Others have also argued that the differences in firm characteristics such as size, the extent of foreign operations, capital intensity, leverage, and research and development expense could explain the variations in tax avoidance (Frank et al., 2009; Gupta and Newberry, 1997; McGuire et al., 2013; Rego, 2003). One variable that has received considerable attention is profitability. While it is expected that more profitable firms will engage in less tax avoidance, there is literature that argues that more profitable firms tend to have greater incentive to avoid taxes (McGuire et al., 2013). Rego (2003) argues that firms with more extensive foreign operations engage in more tax avoidance, while Dyreng et al. (2008) establishes a positive association between firm size and tax avoidance. Differences in ownership structure also explain the variations in tax avoidance. For example, Chen et al. (2010) finds that family-owned firms avoid less taxes than other non-family owned firms.

Despite the significant focus on firm-level characteristics, ownership structure and managerial incentives, it remains unclear why tax avoidance varies across firms with similar characteristics. In response to this, some studies have examined how tax reform affects tax avoidance (Slemrod, 1990). This paper extends this literature on tax avoidance by analyzing how the interaction between the tax reform and tax strategies influences tax avoidance.

2.2.2 Sustainable Tax Strategies

I follow McGuire et al. (2013) and label a firm as following a sustainable tax strategy if it focuses on maintaining consistent tax outcomes over time. The consistent tax outcomes will be reflected in stable effective tax rates over time. There is evidence that suggests that maintaining a sustainable tax strategy is an important objective for the firms' tax departments. McGuire et al. (2013) reports that major accounting firms indicated a commitment to providing sustainable tax strategies for their clients.

One of the reasons firms are attracted to sustainable tax strategies is that investors tend to view the firms that follow these strategies as better performers. Additionally, investors also use the sustainable tax strategies to predict earnings. For example, McGuire et al. (2013) finds that firms that maintain sustainable tax strategies tend to have more persistent and predictable earnings, and this information is relevant for investors. Furthermore, there is evidence that firms that pursue sustainable tax strategies tend to be larger; be less leveraged; be less likely to have tax loss carry-forwards; have more extensive foreign operations; have better governance and transparency and have fewer tax planning opportunities (Neuman, 2014).

In this paper, I argue that incorporating the aspect of sustainability into the model of tax avoidance helps extend the literature. In particular, I seek to analyze how the 1986 reform impacted the relationship between the tax avoidance and sustainability strategies.

2.2.3 Tax Reform Act of 1986

The Tax Reform Act of 1986 (TRA1986) remains the most significant and comprehensive reform to the USA federal income tax code. The reform sought to level the playing field for the corporate sector so as to reduce the disincentive effects of income tax. Unlike previous tax reforms that offered various incentives and disincentives to the corporate sector, TRA1986 entailed simplifying the tax code by broadening the tax base and lowering tax rates.

Table 2.1 summarizes the specific changes to the tax code. The main changes included a reduction in the corporate tax rate from 46% to 34%; a repeal of investment tax credit; the shortening of depreciation periods; the elimination of the top two marginal tax rates; a reduction in the middle rates; an increase in the corporate alternative minimum tax (AMT) rate from 15% to 20%; the creation of uniform capitalization rules; among others (Slemrod, 1990; Weinberg, 1987).

However, individual elements of the reform resulted in increased double taxation. One such element is the repeal of the 50% net capital gains exclusion and the General Utilities doctrine that had allowed corporations to distribute assets tax-free in liquidation under certain circumstances (Wilkie et al., 1996).Also, by setting top individual tax rates lower than the top corporate tax rate, TRA1986 provided incentives for corporations to switch to tax liability minimizing behaviors and alternate forms of organization. For instance, Omer et al. (2000) argues that there was an increase in switches from C-corporation to favored S-corporation status following the enactment of the reform. Wilkie et al. (1996) also establishes that S-corporations experienced increased profits and that small C-corporations resorted to a compensation scheme that increased deductible dividends (homemade S-corporations) as a means of reducing the

corporate tax liability.

Table 2.1: Corporate Income Tax Schedules (1982-1988)

Tax Components	ERTA:1982- 1986	TRA1986: 1988-1992
Brackets and rates	15% (0-$25,000) 18%($25,000-$50,000) 30%($50,000-$75,000) 40%($75,000-$100,000) 46%($100,000 -1 million) 51%($1-$1.405 million) 46%($1.405 million+)	15% (0-$50,000) 25% ($50,000-$75,000) 34% ($75,000-$100,000) 39% ($100,000-$335,000) 34% ($335,000+)
Capital Gains	28% if tax payer is in *bracket* > 28	Normal corporate rate
Investment Tax Credit	10% credit allowed for certain Accelerated Recovery System (ACRS) property	Repealed
Alternative Minimum Tax (AMT)	15%	20%

Source: IRS, Atkinson (2005).

2.3 Data and Variables

2.3.1 Data

The study uses a sample of USA firms from Compustat database over the period 1982-1992. I only include the firms with complete data for the entire study period. I divide the sample into pre-reform (1982-1986) and post-reform (1988-1992) periods. Additionally, I follow prior literature (Mayberry et al., 2015; Neuman, 2014) and exclude financial sector and public utility firms. I omit these firms from the sample

because their tax and regulatory environments are different from those of businesses in other industry classifications.

2.3.2 Variables

Even though tax avoidance is of interest to tax economists and revenue authorities, there remains issues with regards to how best to measure it. Since taxpayers do not publicly disclose their tax avoidance behavior and strategies, most researchers have had to rely on estimates based on financial statements. I follow Hanlon and Heitzman (2010)(p. 137) and define tax avoidance as "all transactions that have any effect on the firm's explicit tax liability." The accounting literature employs effective tax rates (ETR) as proxies for tax avoidance (Mayberry et al., 2015; McGuire et al., 2014). I draw on this literature to create the measures of tax avoidance employed in this study. Specifically, I use current ETR to construct a measure of tax avoidance. Lower levels of current ETR signify high tax avoidance and vice versa for higher levels of ETR. Furthermore, because of the cross-sectional and time-series variability in current ETR, a five-year measure is adopted. The choice of a five-year measure of ETR is also informed by the data availability. My sample includes five years of pre-reform and five years post-reform data. The five-year current ETR is computed as follows[2]:

[2]Special items in Equation 2.31 refers to infrequent or non-recurring events or transactions (Riedl and Srinivasan, 2010).

$$current\,ETR_5 = \frac{\sum_{t=1}^{t=5}(federal\,income\,taxes + foreign\,income\,taxes)}{\sum_{\mathrm{t=1}}^{\mathrm{t=5}}(\mathrm{pretax\,income} - \mathrm{special\,items})} \tag{2.3.1}$$

Although cash ETR is also a measure used in prior studies, I do not use it because of data constraints in the pre-reform period. However, the variables needed to construct GAAP ETR are available for the entire study period. As a robustness check, I also use GAAP ETR to construct an alternative measure of tax avoidance. The GAAP ETR is computed as follows:

$$GAAP\,ETR_5 = \frac{\sum_{t=1}^{t=5}(total\,income\,taxes)}{\sum_{\mathrm{t=1}}^{\mathrm{t=5}}(\mathrm{pretax\,income} - \mathrm{special\,items})} \tag{2.3.2}$$

For ease of interpretation, I use $1 - ETR$ as a measure of tax avoidance[3] . For this analysis, current ETR is restricted to be between 0 and 1 because negative ETRs and values more than 1 are not meaningful. Hanlon and Heitzman (2010)argues that the current and GAAP ETRs only capture non-conforming tax avoidance - "tax avoidance transactions accounted for differently for book and tax purposes". Hence, none of the measures employed in this paper accurately reflect activities aimed at reducing accounting profits. Additionally, the two measures do not include the same aspects of tax avoidance, and so caution should be exercised when interpreting or comparing the results.

Sustainability is the explanatory variable of interest. I adopt the measures of

[3]Where ETR is either current ETR (Equation 2.3.1) or GAAP ETR (Equation 2.3.2).

sustainability of a firm's tax strategy from accounting literature (McGuire et al., 2013; Neuman, 2014). Consequently, I measure sustainability using the coefficient of variation of annual ETRs over a five-year period as follows:

$$Coefficient\,of\,variation\,ETR_5 = \frac{\sqrt{\sum_{t=1}^{t=5}\left(current\,ETR_{it} - Avg\,current\,ETR_i\right)^2/4}}{\text{Avg current ETR}_\text{i}} \tag{2.3.3}$$

Lower values of the coefficient of variation of annual ETRs over a period of five years (CV_ETR) indicate sustainability. In this study, I use an indicator variable equal to one if CV_ETR is in the lowest quintile and zero otherwise, as a measure of sustainability.

My model also includes control variables found to have an effect on tax avoidance behavior in the prior literature(Gupta and Newberry, 1997; Mills et al., 1998; Rego and Wilson, 2012; Rego, 2003). The tax avoidance research has established that economies of scale and firm complexity explain tax avoidance behavior. To capture the effect of these variables, I control for firm size; research and development (R&D), leverage, foreign operations, capital intensity, and inventory intensity. I also control for profitability by including return on assets, and net operating losses (NOLs). Additionally, the market-to-book ratio is included to capture firms' growth opportunities. Detailed definitions of the variables are in the Appendix (Table 5).

I include interaction terms, $TRA{*}higherR\&D$,$TRA{*}forinc$,$forinc{*}sustainability$ and $TRA{*}higherprofit$ in the model to control for the potential effects of differences in R&D, foreign operations, and profitability on tax avoidance. Specifically, I construct an indicator variable $higherR\&D$ equal to one if R&D is in the highest quintile and zero otherwise. I also include $higherprofit$ which is an indicator variable equal to one if the return on assets is in the highest quintile and zero otherwise. I base my

construction of indicator variables on the practice by prior literature to use quintiles to rank variables of interest and to create dummy variables (Guenther et al., 2013; Higgins et al., 2015).

2.4 Empirical Modeling Strategy

Although ETR can take values outside the interval [0, 1], it is usually censored between 0 (current taxes are zero) and 1 ($current\,taxes = pretax\,income$). The artificial censoring results into alteration in the distribution of ETR. Additionally, the outcomes of various tax strategies make it possible for a significant proportion of agents to pay no taxes thereby producing ETRs with a substantial mass at zero thereby further altering the distribution. The bounded nature of the dependent variable, coupled with the over-dispersion at zero, presents estimation and inference challenges. For example, the standard linear models such as ordinary least squares (OLS) cannot guarantee that predicted values of the dependent variable lie within the interval (0, 1). There are also arguments that ordinary least squares (OLS) is no longer appropriate for bounded dependent variables since it assumes a normal distribution. Additionally, there are concerns that linear estimation techniques fail to take into account the lower and upper bounds. In this study, that would mean failure to take into account the firms decisions to avoid taxes completely ($ETR = 0$) (Gallani et al., 2015; Papke and Wooldridge, 1996; Ramalho et al., 2011).

Techniques such as the censored (Tobit) and truncated regression models have been widely employed as alternative estimation methods for models with fractional dependent variables. However, these models are unsuitable in the presence of artificial censoring and the piling-up of ETRs at zero Gallani et al. (2015). Specifically, Ra-

malho et al. (2011) argues that the Tobit is hard to justify for fractional dependent variables since the observations at the boundaries are a consequence of individual choices and not just a result of censoring. For example, firms may be choosing to pay no taxes in which case ETRs will be equal to zero. Others have pointed out that the stringent assumptions required make the Tobit model too restrictive (Papke and Wooldridge, 1996).

Although beta regression would be the appropriate technique for a fractional dependent variable,Papke and Wooldridge (1996) argues that it is not suitable when the dependent variable has over-dispersion at zero or one or both. There are also concerns that the beta model makes assumptions that are too restrictive, and is not robust to distributional failures. Given the outlined estimation issues with bounded dependent variables, Papke and Wooldridge (1996) recommend a fractional response model (FRM) as an alternative estimation technique. The FRM extends the general linear model (GLM) to include functional forms that overcome the outlined estimation issues. Estimation of FRM parameters uses quasi-maximum likelihood method (QMLE) which provides more robust and relatively efficient estimates (Papke and Wooldridge, 1996).The detailed description of the FRM is presented in Appendix.. FRM is particularly useful for my study where the extreme values (0 and 1) have theoretical and practical interpretations. For example, an ETR of zero suggests that firms' strategies result in no payment of explicit taxes, while ETRs of one suggest that firms' strategies have minimal avoidance. FRM also allows for separate modeling of 'zero-tax' behavior.

FRM allows for functional forms that are better suited to handle the estimation issues associated with bounded dependent variables. Specifically, I estimate a GLM that utilizes the logit link function and the binomial distribution (Papke and

Wooldridge, 1996)[4]. I apply these estimation methods to the following regression equation:

$$Taxavoid = \beta_0 + \beta_1 TRA + \beta_1 sustainability_{it} + \beta_3 TRA * sustainability_{it} + \sum_{j=4}^{j=15} \beta_j X_{it} + \varepsilon_{it} \tag{2.4.1}$$

Where $Taxavoid = 1 - ETR$[5]; sustainability is an indicator variable equal to one if the coefficient of variation computed in Equation 2.3.3 is in the lowest quintile and zero otherwise; TRA is an indicator variable which equals 1 if the year is 1988-1992 and zero otherwise; X is a vector of firm-specific characteristics or controls. I provide a detailed definition for the rest of the variables in the Appendix (Table 5).

I also estimate a model that includes a number of interaction terms so as to capture the differential effect of the 1986 reform:

$$Taxavoid = \beta_0 + \beta_1 TRA + \beta_1 sustainability_{it} + \beta_3 TRA * sustainability_{it} + \sum_{j=4}^{j=15} \beta_j X_{it} + \sum_{j=16}^{j=20} \beta_j Z_{it} + \varepsilon_{it} \tag{2.4.2}$$

Where Z is a vector of interaction terms including $TRA * higherRD$; $TRA * foreignoperations$; $sustainability * foreignoperations$ and $TRA * higherprofit$[6] . I explain the construction of these variables in section 2.3 and all other variables are as defined in Table 5 (Appendix A).

[4]Papke and Wooldridge (1996) refers to the GLM that utilizes the logit link function, and the binomial distribution as a fractional logit model (FLM).

[5]ETR is either current ETR or GAAP ETR

[6]I interact TRA which is an indicator equal 1 if the year is 1988-1992 with indicators for higher R&D, higher profitability. These indicators are equal to 1 if the variables are in the top quintile and zero otherwise.

2.5 Results

2.5.1 Descriptive Analysis

Although the ETR variable includes values outside the interval [0 1], I follow prior literature and censor it so that the values remain within the range. In the additional analysis, I also truncate the ETRs by dropping all values of ETR outside the [0, 1] range. For the descriptive statistics presented in Table 2.2, I use the sample with censored ETRs. The statistics show that post-reform mean and median ETRs are slightly higher than their pre-reform counterparts. A look at the statistics reveal mean ETRs of 24%, and 28% for the pre-reform and post-reform periods, respectively. These mean ETRs are below the period top tax rate of 34% implying that firms engaged in tax avoidance behavior over the study period. Further, the statistics suggest that firms engaged in more tax avoidance behavior in the pre-reform period than the post-reform period.

Table 2.2: Descriptive Statistics

	Pre-reform					Post-reform				
VARIABLES	N	mean	min	max	p50	N	mean	min	max	p50
inventory intensity	9,204	0.198	0	0.637	0.186	8,679	0.183	0	0.637	0.165
Intangible assets	7,996	0.027	0	0.413	0	7,386	0.053	0	0.413	0.006
Leverage	9,238	0.224	0	0.834	0.201	8,714	0.246	0	0.834	0.229
size	9,186	4.74	0.649	9.95	4.665	8,626	5.172	0.649	9.95	5.143
Return on assets	9,240	0.116	0.002	0.393	0.102	8,710	0.097	0.002	0.393	0.081
Capital intensity	9,220	0.579	0.022	1.833	0.515	8,674	0.645	0.022	1.833	0.57
NOL	8,427	0.044	0	2.117	0	7,858	0.105	0	2.117	0
Change in NOL	5,904	-0.002	-0.168	0.071	0	5,269	-0.007	-0.168	0.0708	0
Market-to-book ratio	8,333	0.539	-0.083	3.669	0.294	7,604	0.316	-0.083	3.669	0.157
R& D	4,821	0.035	0	0.226	0.02	4,640	0.036	0	0.226	0.018
ETR	9,366	0.235	0	1	0.24	8,882	0.275	0	1	0.282

Where size = log (assets); all other variables are proportions; A detailed definition of the other variables is presented in Appendix A (Table 5); pre-reform = 1982-1986; post-reform = 1988-1992

Figure 2.1 presents the distribution of ETR for the pre-reform and post reform periods for both the truncated and censored samples. Specifically, row 1 depicts the distribution of ETR for the censored ETRs, while row 2 presents the distribution of ETR for the truncated sub-sample. The distributions of the ETRs for both samples indicate substantial mass at zero which implies that a significant proportion of firms engage in 'zero-tax' paying behavior. Specifically, the results show that the zero-tax paying is more prominent in the pre-reform than the post-reform period. These results could also explain the higher tax avoidance behavior in the pre-reform period. Based on the results in Figure 2.1, one could conclude that the zero-taxing behavior is responsible for the differences in tax avoidance behavior for the pre and post-reform periods.

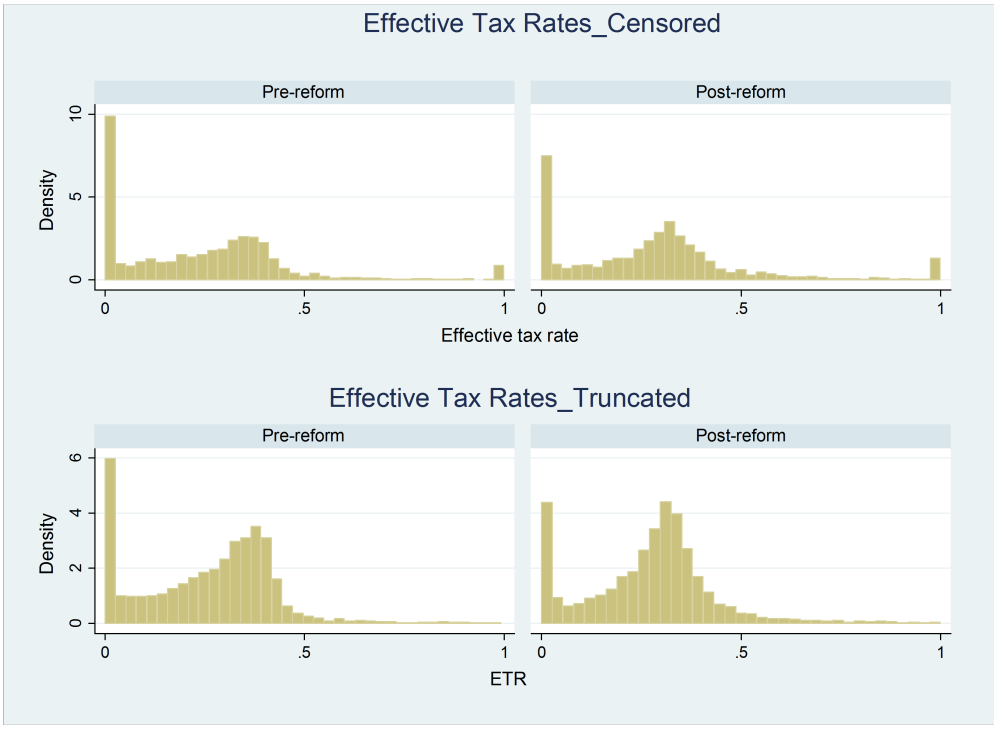


Figure 2.1: Distributions of Effective Tax Rates (ETRs)

For the remainder of the analysis, I use the censored sample. Table 2.3 shows the proportion of firms by tax strategy. The percentage of firms pursuing sustainable tax strategies stood at 17% in the pre-reform period in contrast to 14% for the post-reform period. This result implies that the more firms followed sustainable tax strategies before the enactment of the 1986 reform, suggesting that the reform had an effect on firms' tax strategies.

Based on the distributions of ETR by the five quintiles of sustainability (Appendix B), I follow McGuire et al. (2013) and argue that firms pursue sustainability as a separate tax strategy. The results also imply that a tax sustainable firm does not always stick to a particular tax outcome. As reported in Appendix B, the distribution of ETR ranges from zero (or close to zero) to one across all the five quintiles of sustainability. Despite having the similar range of tax outcomes, the distributions

show slight differences by quintile suggesting that sustainability could play a role in firms' tax avoidance behavior.

Table 2.3: Proportion of Tax Sustainable Firms

	(1) Pre-reform	(2) Post-reform
Tax Strategy	Frequency (Percent)	Frequency (Percent)
unsustainable	7,735	7,669
	(82.59)	(86.34)
sustainable	1,631	1,213
	(17.41)	(13.66)
Total	9366	8882

2.5.2 Regression Analysis

Table 2.4 presents results of the regression model in Equation 2.4.1. For ease interpretation and comparison across the different models, I only report average marginal effects. The rest of the discussion is based on the FRM (column 2)[7]. A look at the results for both models does not reveal any differences in signs nor the statistical significance of the regression coefficients. However, there are differences in the magnitudes. Specifically, the coefficients for the FRM (Table 2.4, column 2) appear to be larger than those for the OLS model. Given that the OLS coefficients are biased when the data is artificially censored, I only present its results for comparison purposes. All ensuing discussions will be based on the model in column 2.

[7]For robustness checks, I show the results for Beta model (BRM) and OLS. I have chosen FRM as the preferred estimation technique due to the estimation issues raised in the literature (Gallani et al., 2015; Papke and Wooldridge, 1996; Ramalho et al., 2011).

Regarding the analysis for the variables of interest, the coefficient on sustainability is negative and statistically significant, suggesting that tax avoidance is lower for firms that pursue sustainable tax strategies as compared to those that focus on minimization strategies. The coefficient on the tax reform (TRA) is negative and statistically significant, implying that TRA1986 is associated with lower tax avoidance behavior. This finding is line with my descriptive analysis which revealed that tax avoidance was less in the post-reform period than the pre-reform period. Given that the TRA1986 reform was partly enacted to respond to tax avoidance, this result could be interpreted as an indication that the reform succeeded curbing long-term tax avoidance behavior.

The coefficient on the interaction term TRA1986*sustainability is positive and statistically significant, implying that the association between sustainability and tax avoidance differs for the pre-reform and post-reform periods. Specifically, the result indicates that the TRA1986 reduces and possibly eliminates the magnitude of the association between tax avoidance and tax sustainability. Specifically, the reform reduces the effect of sustainability on tax avoidance by approximately 9%. Since sustainability appears to be negatively associated with tax avoidance behavior, this finding also implies that this relationship is weaker in the post-reform period. Therefore, it can be argued that the reform eliminated the influence of sustainability on tax avoidance.This finding could also be taken to mean that the benefits of a pre-reform sustainable tax strategy were reduced in the post-reform period and that the reform increased incentives for tax avoidance for some firms. Further, the results suggest that TRA1986 affected firms' choice of tax strategies.

Regarding control variables, the negative and significant coefficients on return on assets (profitability), size, and foreign operations suggest that firms that are more profitable, have more extensive international operations tend to engage in less tax avoidance behavior. The lower tax avoidance behavior among better-performing firms

and those with extensive foreign operations could be attributed to the fact that such types of firms tend to be more visible to tax authorities and subject to more political costs (Zimmerman, 1983). Additionally, the negative association between tax avoidance and size suggests that larger firms do not enjoy economies of scale in tax avoidance. This result is contrary to prior research (e.g., Rego (2003)) that found that larger firms engage in more tax avoidance behavior. The results also indicate that tax avoidance is negatively associated with market-to-book ratio,capital intensity and inventory intensity.

The positive and significant coefficients on net operating losses ($NOLs$), $Leverage$ and R&D indicate that firms with more substantial $NOLs$, higher $Leverage$ and larger investments in R&D engage in more tax avoidance behavior. However, the change in NOLs ($\Delta NOLs$), is negatively associated with tax avoidance. This result arises from the knowledge that the firms use $NOLs$ to influence their tax liabilities. Thus, a larger change in $NOLs$ signifies that a firm is not utilizing tax advantages that the $NOLs$ offer. This argument explains the positive relationship between change in $NOLs$ and tax avoidance behavior. Overall, the results for the control variables are in line with most prior literature(McGuire et al., 2014; Rego, 2003).

Table 2.4: Tax Avoidance and Tax Sustainability: Main Model

VARIABLES	(1) OLS	(2) FRM	(3) BRM
TRA	-0.0376**	-0.0386**	-0.0589***
	(0.0157)	(0.0157)	(0.0152)
Sustainability	-0.0773***	-0.0759***	-0.0461***
	(0.0133)	(0.0127)	(0.0151)
TRA*sustainability	0.0863***	0.0858***	0.0772***
	(0.015)	(0.0143)	(0.0157)
Leverage	0.0918***	0.0952***	0.0287
	(0.0331)	(0.0336)	(0.0363)
Size	-0.0164***	-0.0165***	-0.00473
	(0.0032)	(0.0031)	(0.003)
Return on assets	-0.2100***	-0.205***	-0.3360***
	(0.0613)	(0.0601)	(0.0663)
Capital intensity	-0.0495**	-0.0490**	0.0525**
	(0.021)	(0.0208)	(0.0263)
Intangible assets	0.0884	0.0897	-0.069
	(0.0704)	(0.0697)	(0.0756)
Inventory intensity	-0.0778*	-0.0780*	0.0346
	(0.0442)	(0.0439)	(0.0494)
Net operating losses	0.6040**	0.6370**	0.5610**
	(0.268)	(0.301)	(0.279)
ΔNet operating losses	-0.9530**	-1.030**	-0.931**
	(0.411)	(0.463)	(0.397)
R&D	0.6130***	0.6290***	0.5650***
	(0.145)	(0.152)	(0.135)
Market-to-book ratio	-0.0233***	-0.0221***	-0.0145*
	(0.0085)	(0.0082)	(0.0076)
Foreign operations	-0.0220**	-0.0219**	-0.0125
	(0.0091)	(0.009)	(0.0085)
Observations	2,324	2,324	2,080
Industry & Year FE	YES	YES	YES

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
FRM is Fractional Response Model; BRM is Beta Regression Model
Dependent variable = Tax avoidance; Coefficients = Average marginal effects

Although Papke and Wooldridge (1996) does not recommend the beta regression model (BRM) when the dependent variable exhibits piling-up at zero, I estimate the BRM for robustness checks (Table 2.4, Column 3). It should be noted that the BRM

does not include the values at the boundary of the interval [0, 1]. The results in Table 2.4 show that estimating the BRM does not alter the main findings and conclusions of the study.

Table 2.5 presents results for the model that analyzes whether or not the TRA1986 impacts firms differently based on their levels of profitability, R&D intensity, and extent of foreign operations. The results reveal that the coefficient on Higherprofit is negative and significant, but the coefficient on the interaction term,$Higherprofit * TRA$ is positive and significant. This finding suggests that the reform potentially weakened the relationship between higher profitability and tax avoidance. Overall, these results can be interpreted to mean that the association between high profitability and tax avoidance differs for the pre-reform and post-reform periods.

The coefficient on $higherR\&D$ is positive and significant but the interaction term, $TRA * higherR\&D$ is positive and insignificant. These results imply that the TRA1986 has no effect on the association between higher R&D investments and tax avoidance. It should be noted that R&D can also proxy for firm's potential to employ tax credits to lower ETRs[8]. Although there is a negative association between tax avoidance and having foreign operations, both interactions terms, $forinc * TRA$ and $forinc * sustainability$ are positive and insignificant. This result implies that the reform and sustainability have no effect on the association between having foreign operations and tax avoidance[9].

[8]I also construct the indicator variable for higherR&D equal one if R&D is greater than the median. Results based on this measure indicates that firms with higher R&D reduced their tax avoidance in the post-reform period.

[9]These interaction terms are only significant under the Beta model (BRM) and the signs of the coefficients differ from those obtained in the FRM and OLS.

Table 2.5: Tax Avoidance and Tax Sustainability: Interaction Terms

VARIABLES	(1) OLS	(2) FRM	(3) BRM
TRA	-0.0603***	-0.0633***	-0.0635***
	(0.0121)	(0.0122)	(0.0108)
Sustainability	-0.0736***	-0.0726***	-0.0348***
	(0.0101)	(0.0096)	(0.0105)
TRA*sustainability	0.0675***	0.0667***	0.0545***
	(0.0121)	(0.0115)	(0.0114)
Leverage	0.1990***	0.2060***	0.1730***
	(0.0216)	(0.0226)	(0.0218)
Size	-0.0226***	-0.0229***	-0.0102***
	(0.0022)	(0.0022)	(0.002)
Higherprofit	-0.0532***	-0.0516***	-0.0618***
	(0.0098)	(0.0093)	(0.0086)
TRA*Higherprofit	0.0666***	0.0663***	0.0756***
	(0.015)	(0.0143)	(0.0106)
Capital intensity	0.0103	0.0106	0.0460***
	(0.0148)	(0.0148)	(0.0156)
Intangible assets	-0.003	0.0029	-0.056
	(0.0416)	(0.0411)	(0.0406)
Inventory intensity	-0.0821***	-0.0816***	-0.0149
	(0.0313)	(0.0314)	(0.0315)
Net operating losses	0.2720***	0.6140***	0.3180**
	(0.04)	(0.151)	(0.124)
Δ Net operating losses	-0.7080***	-1.0600***	-0.9320***
	(0.187)	(0.317)	(0.323)
HigherR&D	0.0257*	0.0245*	0.0248*
	(0.0142)	(0.0142)	(0.0139)
TRA*HigherR&D	0.0149	0.0154	0.0172
	(0.0179)	(0.0177)	(0.0161)
Market-to-book ratio	-0.0207***	-0.0213***	-0.0197***
	(0.0062)	(0.0061)	(0.0045)
Foreign operations	-0.012	-0.0135	0.0167*
	(0.0104)	(0.0106)	(0.0097)
TRA*Forinc	0.0131	0.0142	-0.0218*
	(0.0123)	(0.0121)	(0.0111)
Forinc* Sustainability	-0.0043	-0.001	-0.0242**
	(0.012)	(0.0113)	(0.0116)
Observations	4,251	4,251	3,738
Industry & Year FE	YES	YES	YES

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
FRM is Fractional Response Model; BRM is Beta Regression Model
Dependent variable = Tax avoidance; Coefficients = Average marginal effects

2.5.3 Robustness Checks

The measure of tax avoidance employed in the detailed analysis above includes ETRs above the top tax rate of 34%, which could affect the accuracy of my estimates. For additional robustness checks, I restrict my sample to firms with ETR less than 34% to exclude firms with tax expenses above the top tax rate. By so doing, the study is able to focus on firms that actively engage in tax avoidance or planning behavior.

The results for the sample with $ETRs < 0.34$ are presented in Table 6 (Appendix C). Making this adjustment to the sample changes the conclusions of the study in that sustainability is no longer significant, and it also switches the sign from negative to positive. This finding suggests that sustainability is not a factor in explaining the tax avoidance behavior for this group of firms.

I also use GAAP ETR to construct an alternative measure of tax avoidance. The distribution of GAAP ETR is presented in Appendix (B7), and the regression results are shown in Table 7 (Appendix D). A few points are worth taking note of with regards to the results in Table 7. First, contrary to my earlier findings, using this measure of tax avoidance changes the main conclusions of the study. In particular, I now find that sustainability is not statistically significant in the model. Additionally, a few coefficients switch signs when the GAAP ETR is used to construct a measure of tax avoidance. For example, the coefficient on the TRA1986 switches from negative to positive implying that the reform led to an increase in tax avoidance among firms. This finding is in line with some of the literature that found that TRA1986 resulted into increased tax avoidance behavior (e.g Wilkie, 1985).

The change in the signs of most coefficients could be attributed to the differences between the two measures of ETR (i.e. Current ETR and GAAP ETR). These

measures do not capture the same aspects of tax avoidance behavior, and neither do they reflect similar strategies[10]. For example, while GAAP ETR impacts accounting earnings, current ETR may not. Additionally, unlike current ETR, GAAP ETR does not reflect deferral strategies such as applying accelerated depreciation for tax purposes (Hanlon and Heitzman, 2010). Given these differences in what the two measures of tax avoidance capture, one must exercise caution while interpreting the findings or when comparing the results. In any case, my results do not depart that much from the empirical literature that employed GAAP ETR as a measure of tax avoidance (e.g. Gupta and Newberry, 1997; Rego, 2003).

In other analysis, I use a truncated sample which involves dropping all ETRs outside the [0, 1] interval. I show the results for this sample in Appendix B (B1 to B4)and Appendix E. The results reinforce my main findings that TRA1986 reduced the value of pursuing sustainable tax strategies for the firms. Finally, since most prior literature that employ effective tax rates as proxies for tax avoidance behavior have mostly used the Tobit and Truncated regression models, I present the results based on these techniques in Appendix F. The results do not change the main conclusions of the paper.

2.6 Conclusions

Most countries including the US instituted major reforms to their tax systems. The tax reforms were aimed at making tax systems simpler and more efficient. Of all the reforms undertaken in the US, the Tax Reform Act of 1986 (TRA 1986) is the

[10]Hanlon and Heitzman (2010) also caution that careful consideration is needed when using these different measures of effective tax rates. It is also important to note that neither of these measures captures conforming tax avoidance (deliberate strategies aimed at reducing accounting profits).

most comprehensive. Not only did the 1986 reform entail changing the number of tax brackets, and making drastic reductions to the top tax rates, it also included making major adjustments to some of the provisions in the tax code. It is, therefore, not surprising that most researchers have used the reform to study various effects of tax policy on taxpayers, economic decisions and the economy as a whole. The interest in studying the 1986 reform also comes from a realization that such a major reform could have significant consequences on economic activity, and the economy as a whole. Additionally, the TRA1986 has received intense focus from researchers because it provides a natural experiment that is useful for studying taxpayer responses to changes in tax policy.

While most studies have mainly focused on studying the effect of the reform on agents' tax avoidance behavior (low levels of tax avoidance outcomes), this paper recognizes the existence of evidence that firms also emphasize sustainable tax strategies (stable tax avoidance outcomes). Consequently, the paper examines how the TRA1986 influenced the value of pursuing a sustainable tax strategy. I motivate my writing using evidence that numerous firms do not pursue tax planning objectives intended to minimize tax payments but rather focus on stabilizing their tax outcomes over time.

Despite the intense focus on tax avoidance behavior, measuring tax avoidance remains a major challenge for tax economists and public sector economists in general. This study draws on the accounting literature that has developed several proxies for tax avoidance to analyze the effect of TRA1986 on tax strategies. The effective tax rate (ETR), which refers to the ratio of taxes paid or tax expenses to pre-tax income is the most widely used proxy for tax avoidance behavior. It worth noting that these measures may not accurately capture tax avoidance behavior because most of them only reflect non-conforming tax avoidance behavior. Because the effective tax rates

can lie outside the interval $[0, 1]$, the practice has been to truncate or censor the tax avoidance variable so that to remove negative values and values greater than one. This artificial censoring creates estimation issues that the past works do not address adequately. I address this estimation issue by employing a fractional response model (FRM), a technique that is better suited to handle models with bounded dependent variables.

Using a sample of US firms drawn from Compustat for the period 1982 to 1992, I find that that TRA1986 eliminated the association between sustainability and tax avoidance. This result implies that the TRA1986 created incentives for firms following a sustainable tax strategy to participate in more tax avoidance behavior. Further, my findings suggest that firms that engage in tax planning that produced stable tax outcomes before the reform were unable to sustain those strategies without additional levels of tax avoidance in the post-reform period. This finding has implications for the persistence of tax avoidance behavior as well as the effectiveness of tax policy. Contrary to its objective of raising effective tax rates, the 1986 reform contributed to the increase and persistence of tax avoidance by eliminating the negative effect of sustainability. These findings are particularly important given that the TRA1986 was expected to reduce incentives for tax avoidance.

My findings suggest that tax reforms that are designed to reduce the incentives for tax avoidance behavior could be more effective if they also took into account firms' overall tax strategies. Having knowledge that tax minimization is not the only tax strategy available to firms is useful for designing tax reforms that are aimed at enhancing efficiency. Furthermore, the lower benefits of a pre-reform sustainability strategy in the post-reform period suggests that the reform generated incentives strong enough to alter firms' tax strategies. The results also imply that the reform made tax avoidance behavior a more attractive or necessary option for firms following a

sustainable tax strategy because benefits from the pre-reform period could not be sustained. This result is contrary to what the reform set out to achieve. The findings also suggest that firms are more willing to forgo the benefits of tax sustainability in preference for the rewards of tax avoidance in post-reform period.

This study makes two main contributions to tax research. First, the study incorporates the sustainable tax strategy into the model of tax avoidance behavior. Second, my study provides robustness to the theoretical econometric techniques usually employed to model tax avoidance. I do so by using a modeling technique (FRM) that is better suited to handle bounded dependent variables. These contributions could help improve the modeling of tax avoidance behavior and extend the tax avoidance literature.

The analysis in this study relies on commonly used measures of tax avoidance behavior in the accounting literature. In future research, it would be beneficial to employ alternative measures of tax avoidance such as cash ETR, and construct a measure of tax avoidance based on the density of taxable income. Such measures of tax avoidance would be an improvement on the inability of existing measures to accurately reflect all aspects of tax avoidance that a firm may engage in. The current and GAAP effective tax rates only reflect non-conforming tax avoidance which does not include activities aimed at reducing income. Despite these measurement issues, the paper still provides a starting point for understanding the interactions of tax policy, tax strategy and tax avoidance behavior.

2.7 Appendix 1

A: Table 5: Description of Control Variables

Variable	Definition
Leverage	The ratio of current and long term debt (DLC + DLTT) to assets (AT)
Size	Natural log of assets
Foreign operations	An indicator variable equal to one if foreign income (PIFO) is greater than zero and equal to zero otherwise
Market-to-book ratio	The ratio of a firm's market value of equity (PRCC_F*CSHO) to book value of equity (CEQ)
Return on assets	The ratio of pretax income (PI) to total assets (AT)
R&D	The ratio of research and development expenses (XRD) to sales (SALE)
Capital intensity	The ratio of gross property, plant, and equipment (PPEGT) to assets (AT)
Inventory intensity	The ratio of a firm's inventory (invt) to assets (AT)
Intangible assets	The ratio of total intangible assets (intan) to total assets (AT)
Net operating Losses (NOL)	Total loss carry-forwards (TLCF) scaled by total assets

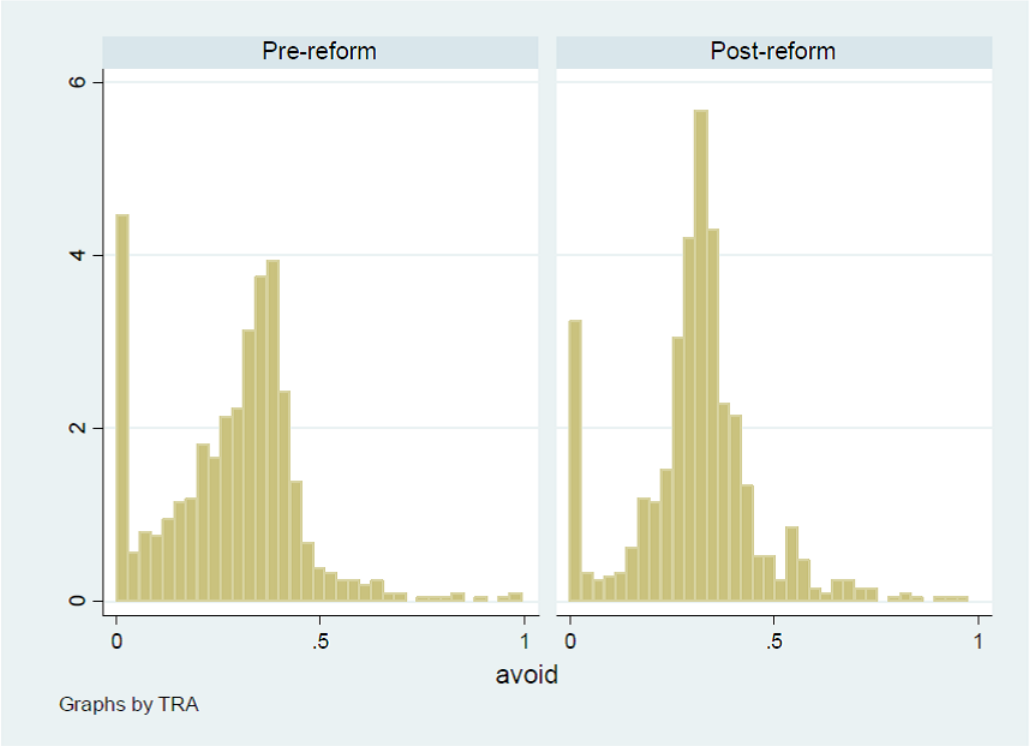
B: Descriptive Statistics

B1: Descriptive Statistics (Truncated Sample)

	Pre-reform					Post reform				
VARIABLES	N	mean	min	max	p50	N	mean	min	max	p50
inventory intensity	3,784	0.191	0	0.637	0.182	3,791	0.174	0	0.637	0.160
Intangible assets	3,302	0.0260	0	0.413	0	3,197	0.0579	0	0.413	0.0138
Leverage	3,801	0.192	0	0.834	0.174	3,814	0.216	0	0.834	0.210
size	3,810	5.364	0.649	9.950	5.283	3,818	6.031	0.649	9.950	5.989
Return on assets	3,806	0.144	0.0019	0.393	0.130	3,815	0.117	0.0019	0.393	0.104
Capital intensity	3,801	0.612	0.0224	1.833	0.541	3,793	0.655	0.0224	1.833	0.586
NOL	3,669	0.0063	0	2.117	0	3,675	0.0036		0.623	0
Change in NOL	2,893	-0.0004	-0.168	0.0708	0	2,918	-0.0002	-0.168	0.0708	0
Market-to-book ratio	3,338	0.446	-0.0834	3.669	0.236	3,282	0.237	-0.0834	3.669	0.120
R& D	1,936	0.0269	0	0.226	0.0142	1,952	0.0280	0	0.226	0.0148
ETR	3,710	0.281	0	0.993	0.310	3,760	0.307	0	0.976	0.315

Where size = log (assets); all other variables are proportions; A detailed definition of the other variables is presented in Appendix A (Table 5); pre-reform = 1982-1986; post-reform = 1988-1992.

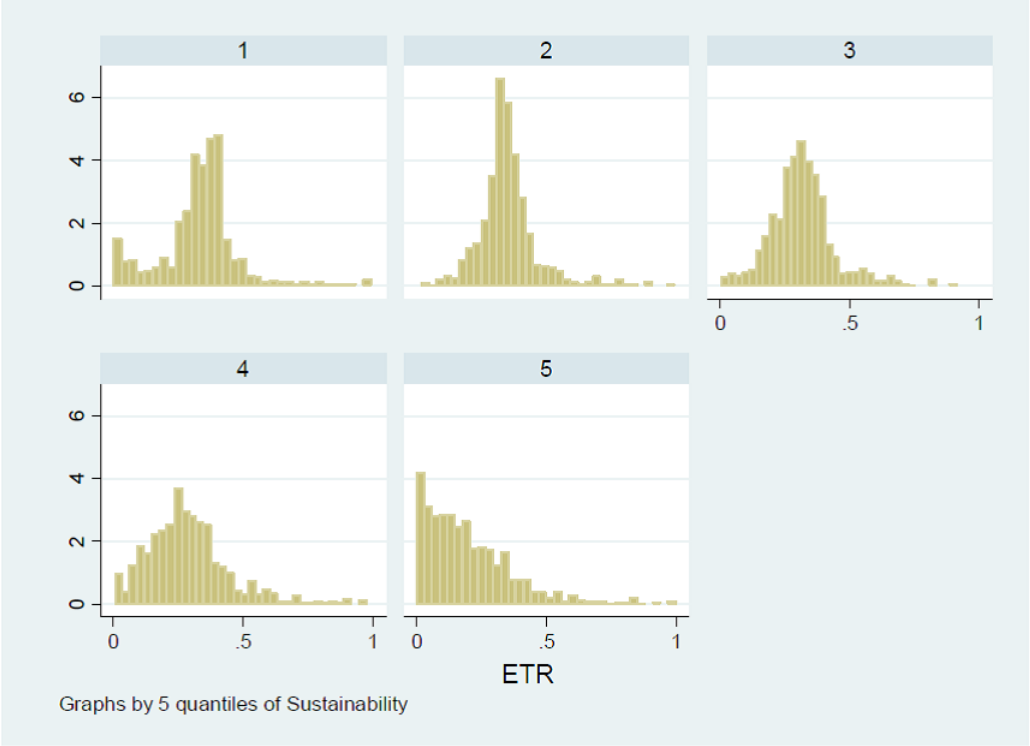
B2: Distribution of Tax Avoidance (1- Effective Tax Rates): Truncated Sample



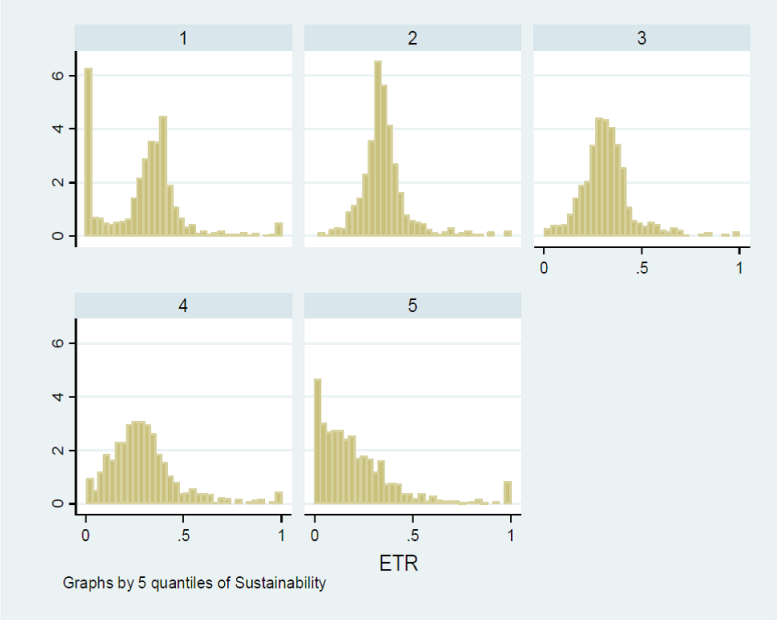
B3: Proportion Tax Sustainable Firms (Truncated Sample)

	(1)	(2)
	Pre-reform	**Post-reform**
	Frequency	Frequency
Tax Strategy	(Percent)	(Percent)
unsustainable	2,940	2,875
	(75.97)	(74.29)
sustainable	930	995
	(24.03)	(25.71)
Total	3870	3870

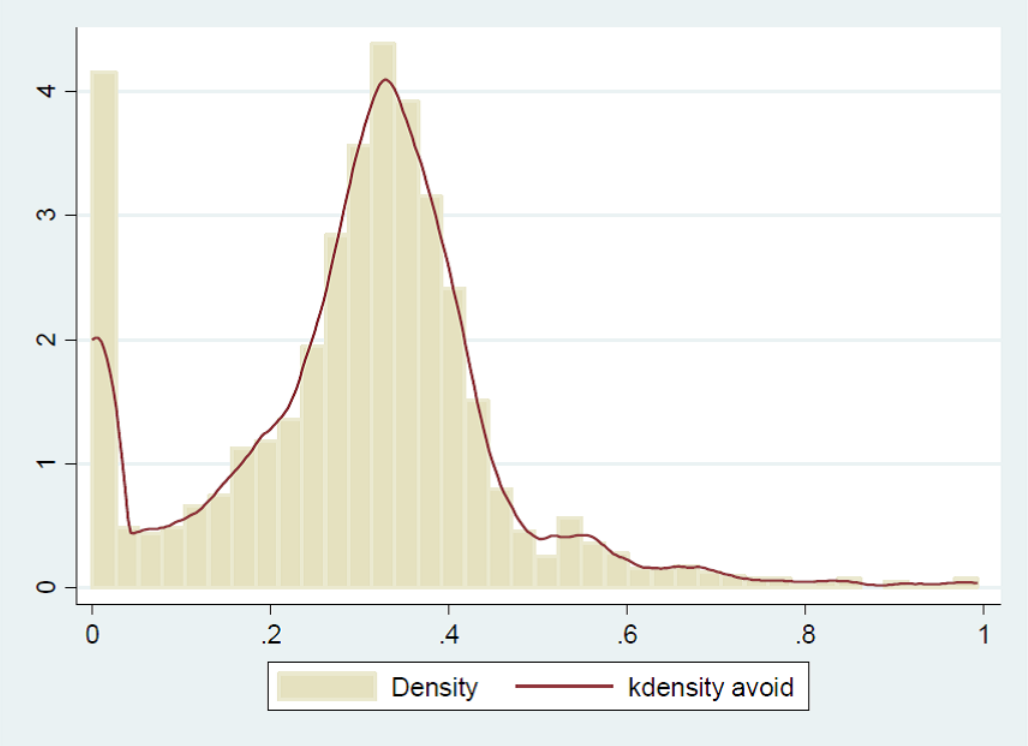
B4: Distribution of ETR by Quintiles of Sustainability (Truncated Data)



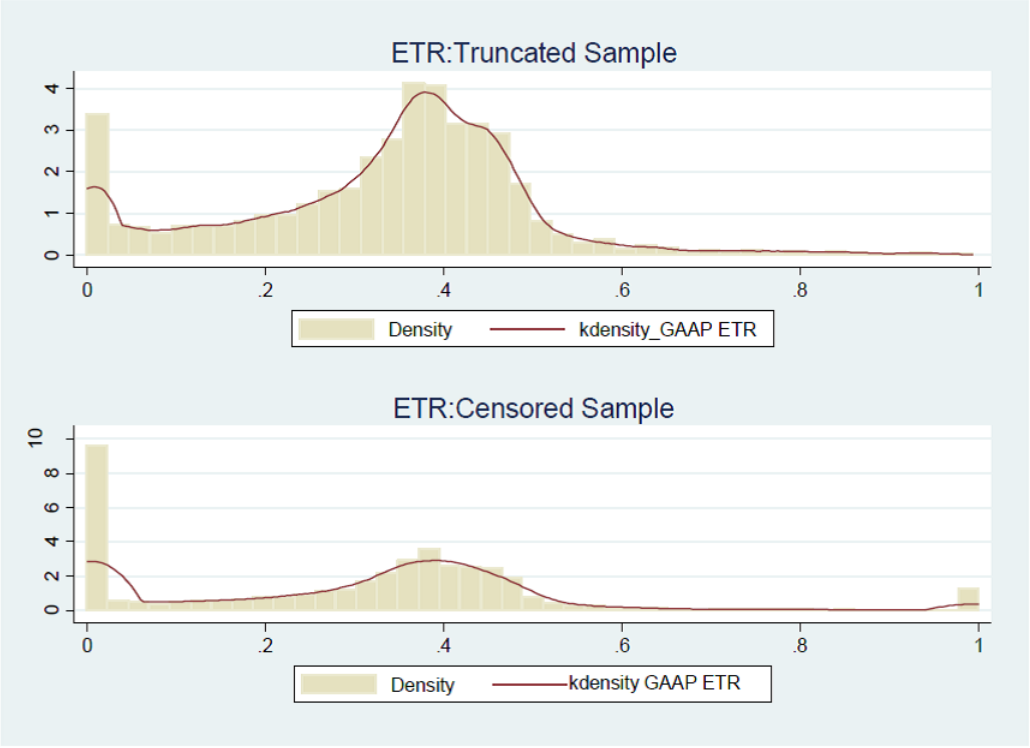
B5: Distribution of ETR by Quintiles of Sustainability (Censored Data)



B6: Overall Distribution of Current ETR



B7: Distribution of GAAP ETR



C: Table 6: Tax Avoidance Behavior (ETR<0.34)

VARIABLES	(1) OLS	(2) FRM
TRA	-0.0531***	-0.0551***
	(0.00693)	(0.00717)
sustainability	0.00240	0.00226
	(0.0140)	(0.0193)
TRA*sustainability	-0.0432**	-0.0319
	(0.0184)	(0.0208)
Leverage	0.0805***	0.0801***
	(0.0273)	(0.0286)
size	-0.0111***	-0.0118***
	(0.00258)	(0.00264)
Return on assets	-0.0372	-0.0425
	(0.0542)	(0.0543)
Capital intensity	-0.0543***	-0.0593***
	(0.0168)	(0.0151)
Intangible assets	0.128**	0.125**
	(0.0581)	(0.0633)
inventory intensity	0.000250	-0.00598
	(0.0341)	(0.0389)
Net operating losses	-0.0498	-0.0675
	(0.192)	(0.132)
Δ Net operating losses	-0.360	-0.393
	(0.252)	(0.263)
R&D	0.272***	0.277**
	(0.101)	(0.129)
Market-to-book ratio	-0.0221**	-0.0240*
	(0.0112)	(0.0122)
Foreign operations	-0.00755	-0.00723
	(0.00720)	(0.00704)
Observations	1,277	1,277
Industry FE	YES	YES

Robust standard errors in parentheses

*** $p < .01$, ** $p < .05$, * $p < .10$

D: Table 7: Tax Avoidance (GAAP ETR)

VARIABLES	(1) OLS	(2) FRM	(3) BRM
TRA	0.0479***	0.0475***	0.0561***
	(0.00536)	(0.00566)	(0.00503)
sustainability	-0.00445	-0.00131	-0.00826
	(0.00803)	(0.00780)	(0.00698)
TRA*sustainability	0.0158	0.0126	0.00649
	(0.0114)	(0.0104)	(0.00873)
Leverage	0.0472***	0.0492**	0.0201
	(0.0176)	(0.0222)	(0.0189)
size	-0.00593***	-0.00526***	-0.00289*
	(0.00166)	(0.00194)	(0.00167)
Return on assets	-0.350***	-0.338***	-0.272***
	(0.0346)	(0.0368)	(0.0338)
Capital intensity	0.00342	0.00830	0.0186*
	(0.0101)	(0.0126)	(0.00999)
Intangible assets	-0.0560	-0.0600	-0.0925**
	(0.0392)	(0.0501)	(0.0457)
inventory intensity	-0.0536**	-0.0485*	-0.0492**
	(0.0215)	(0.0249)	(0.0223)
Net operating losses	0.0670***	0.125***	0.0582*
	(0.00707)	(0.0397)	(0.0349)
Δ Net operating losses	-0.0940**	-0.115	-0.00282
	(0.0434)	(0.0824)	(0.0957)
R&D	0.350***	0.461***	0.309***
	(0.0435)	(0.0753)	(0.0633)
Market-to-book ratio	-0.0122***	-0.0117**	-0.000892
	(0.00432)	(0.00527)	(0.00500)
Foreign operations	-0.0124**	-0.0127**	0.00145
	(0.00556)	(0.00540)	(0.00482)
Observations	4,476	4,476	4,094
Industry FE	YES	YES	YES

Robust standard errors in parentheses
$^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$

E. Tax Avoidance (Truncated Sample)

VARIABLES	(1) OLS	(2) FRM	(3) BRM
TRA	-0.0443***	-0.0381***	-0.233***
	(0.00663)	(0.0126)	(0.0357)
sustainability	-0.0890***	-0.0937***	-0.386***
	(0.0106)	(0.0108)	(0.0620)
TRA*sustainability	0.0977***	0.0980***	0.446***
	(0.0139)	(0.0128)	(0.0674)
Leverage	0.00505	0.0136	-0.00886
	(0.0282)	(0.0296)	(0.159)
size	-0.00170	-0.00180	-0.00230
	(0.00241)	(0.00249)	(0.0123)
Return on assets	-0.157***	-0.174***	-0.886***
	(0.0489)	(0.0479)	(0.267)
Capital intensity	0.0195	0.0134	0.198
	(0.0150)	(0.0165)	(0.128)
Intangible assets	-0.0275	-0.0876	-0.0510
	(0.0551)	(0.0568)	(0.341)
inventory intensity	0.00494	-0.0255	0.323
	(0.0321)	(0.0298)	(0.214)
Net operating losses	0.412*	0.200	2.778**
	(0.214)	(0.185)	(1.284)
Δ Net operating losses	-0.690**	-0.662**	-3.823**
	(0.319)	(0.332)	(1.810)
R&D	0.425***	0.277***	1.958***
	(0.109)	(0.0882)	(0.511)
Market-to-book ratio	-0.00578	-0.00645	-0.0275
	(0.00811)	(0.00687)	(0.0360)
Foreign operations	-0.0123*	-0.0144**	-0.0799**
	(0.00679)	(0.00630)	(0.0348)
Observations	2,014	2,014	2,014
Industry FE	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

F. Alternative Estimations: Tobit and Truncated. Dependent Variable: Tax Avoidance

VARIABLES	(1) Tobit	(2) Truncated
TRA	-0.0342**	-0.0473***
	(0.0171)	(0.0140)
sustainability	-0.0880***	-0.0562***
	(0.0215)	(0.0120)
TRA*sustainability	0.0844***	0.0818***
	(0.0234)	(0.0138)
Leverage	0.184**	0.0304
	(0.0872)	(0.0320)
size	-0.0212**	-0.00385
	(0.00986)	(0.00270)
Return on Assets	-0.149	-0.310***
	(0.116)	(0.0529)
Capital intensity	-0.0278	0.0297*
	(0.0473)	(0.0173)
Intangible assets	0.100	-0.108*
	(0.138)	(0.0627)
inventory intensity	-0.0491	-0.00723
	(0.0830)	(0.0329)
NOL	0.0277	0.203
	(0.247)	(0.196)
ΔNOL	-0.942*	-0.734**
	(0.545)	(0.350)
R& D	0.465***	0.435***
	(0.154)	(0.110)
Market-to-Book ratio	-0.0271	-0.00779
	(0.0226)	(0.00767)
Foreign operations	-0.0281**	-0.00891
	(0.0135)	(0.00709)
Constant	0.859***	0.736***
	(0.0668)	(0.0247)
Observations	2,324	2,080
Year FE	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

G: Fractional Response Model (Papke and Woodridge, 1996).

$$E(y_i/x_i) = G(x_i\beta)$$

Where y is the fractional dependent variable in the range$[0,1]$; x is a vector of independent variables; and $G(.)$ is a distribution function.

Specifically, $G(.)$ is a logistic function specified as follows:

$$G(x_i\beta) = \frac{exp(x_i\beta)}{1 + exp(x_i\beta)}$$

In this paper, the dependent variable Y (effective tax rates) is modelled as:

$logit[E(y_{it})] = x_i\beta$, y follows a normal distribution (Papke and Woodridge, 1996, p.627).

Chapter 3

Essay 2: Firms' Strategic Responses to Tax Policies

3.1 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 of tax schedules. In the public finance literature, these discontinuous jumps in the marginal tax rates are referred to as "kinks". 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 behavior that is usually aimed at influencing the tax liability has been termed strategic responses in the public finance literature (Chetty et al., 2011; Saez, 2010). These 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 minimizing their tax liability (Slemrod et al., 2017).

Firms would opt to engage in this behavior to minimize the tax related costs and uncertainties. Most studies on the strategic responses to taxation have mostly focused

on estimating the elasticity of taxable income for individual taxpayers (Chetty et al., 2011; Feldstein, 1995; Saez, 2010), as opposed to the examining the responses of firms to tax policies. This paper focuses on analyzing the strategic responses of US firms to taxation, in order to highlight this gap in the literature. Specifically, the paper seeks to establish whether firms engaged in manipulation of their incomes in response to the incentives generated by the graduated federal income tax schedule.

Although the proportion of corporate income tax in total revenue is not as significant as that of personal income, the strategic role that firms play in economic organizations necessitates the need to investigate 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 others. Such responses could result into 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 changes in tax policy cannot be overemphasized.

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 rates and has been a major focus of research. The US federal corporate tax code features these convex kinks for greater portions income. 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 kind of kink is not common, this paper 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.

This paper examines the tax schedules for the period 1982-2010. Three main Reforms, namely the Economic Recovery Tax Act (ERTA; 1982 to 1984); the Tax

Reform Act of 1986 (TRA1986; 1988-1992); and the Omnibus Reconciliation Act (OBRA; 1993) were in effect during the study period. I omit the years before 1988 because of the data limitations. Specifically, some of the key variables needed to compute taxable income are not available for the period 1982 to 1984. The reforms that were undertaken during the study period mainly involved changing the number of brackets and adjusting tax rates. I follow prior literature (Altig and Carlstrom, 1994) and argue that tax policies that entail simplifying the tax codes generate substantial jumps in marginal tax rates which may stimulate incentives for tax avoidance behavior. Any evidence of clustering or bunching around tax bracket thresholds indicates strategic responses to tax codes.

Understanding and quantifying how taxpayers respond to changes in tax policy is critical for estimating the incidence and efficiency of a tax system. 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 important aspect of public finance. Furthermore, by studying how firms respond to incentives generated by tax reforms, this study hopes to also provide useful information about the effectiveness and efficiency of the tax changes.

To investigate the strategic responses of firms, I build on the literature that has focused on strategic responses of economic agents to changes in tax policy. Saez (2010) applies bunching methods to investigate strategic responses to US individual income schedule from 1979 to 1994. The bunching approach has also been applied to the study of strategic responses to social security, Earned Income Tax Credit (EITC), and taxpayers' behavior (Chetty et al., 2009; Liebman, 1998). It is worth noting that most of these studies have found none or limited evidence of bunching at kink points in the tax schedule. This paper makes a departure from the focus of prior literature

by investigating the strategic responses to the kinks in the corporate income tax schedule, and by employing an alternative estimation technique that has minimal data requirements. Unlike strategic responses to personal income tax schedules that have been more widely investigated, responses to corporate income tax codes have only received limited attention.

The paper also draws on the literature that has applied regression discontinuity design (RDD) approaches to study the impact of taxation (Bruhn and Loeprick, 2014; Kneller and McGowan, 2013; Sanchez et al., 2014). Rather than applying RDD to investigate the impact of taxation, this paper exploits McCrary's 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. These incentives can lead to strategic distortions as firms seek to game the rules.

Due to the challenges of obtaining actual tax return data, I use data from financial statements to compute a measure of taxable income. Specifically, I obtain the variables of interest from the Compustat database that consists of publicly traded C corporations. I focus on the period 1982-2010 since it has complete data for all the variables needed to construct a measure of taxable income. I then use a combination of graphical techniques (histogram analysis) and explicit statistical tests (RDD validity test) for the presence of bunching behavior around kinks in the tax code implied by strategic cost shifting behavior. The advantage of using these estimation techniques is that they only require one variable (taxable income) to analyze 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, I establish 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.

3.2 Overview of the US Corporate Income Tax Code

Table 3.1 summarizes the corporate income tax schedules from 1982 to 2010. It should be noted that the federal income tax code underwent three major reforms during the study period. The Economic Recovery Tax Act (ERTA) lasted from 1982 to 1984. This reform was followed by the enactment of the Tax reform Act of 1986 (TRA1986) which was in effect until 1993 when the Omnibus Reconciliation Act (OBRA) entered into force. It is also worth noting that the TRA1986 remains the most comprehensive change to the US tax code. A common feature of these tax schedules is a progressive tax system 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 neutralize 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 and Marples, 2014).

A look at table Table 3.1 also reveals a variation in the number of tax brackets over the period. Specifically, the TRA1986 has the lowest number of tax brackets and lowest tax rates while the OBRA schedule has the highest number of tax brackets. Highest tax rates characterized the ERTA . Table 3.1 also shows that the top tax rates experienced significant changes over the study period. For example, the top rate declined from 46% under the ERTA to 34% under the TRA1986 and OBRA (1988-2010). Table 3.1 also reveals that the size of the discrete change in marginal

tax rates ranged between 1% and 10% over the study period.

Table 3.1: Corporate Income Tax Schedules (1982-2010)

Tax Code	ERTA:1982- 1986	TRA1986: 1988-1992	OBRA:1993-2010
Brackets and rates	15% (0-$25,000) 18%($25,000-$50,000) 30%($50,000-$75,000) 40%($75,000-$100,000) 46%($100,000 -1 million) 51%($1-$1.405 million) 46%($1.405 million+)	15% (0-$50,000) 25%($50,000-$75,000) 34%($75,000-$100,000) 39%($100,000-$335,000) 34%($335,000+)	15% (0-$50,000) 25%($50,000-$75,000) 34%($75,000-$100,000) 39%($100,000-$335,000) 34%($335,000- 10 million) 35%($10-15 million) 38%($15-18.3 million) 34%($18.33 million)

Source: IRS, Tax Policy Centre;Economic Recovery Tax Act (ERTA)
Omnibus Reconciliation Act (OBRA)

The size of the discrete changes in marginal tax rates is made clearer in Figure 3.1, which presents a relationship between tax rates and taxable income for TRA1986 tax code. The graph also demonstrates the graduated or kinked nature of the tax code. The first portion of the schedule ($0 to $100,000) depicts the convex (or upward) kinks while the non-convex (or downward kink) appears the end of the schedule ($335,000). Specifically, the marginal tax rate drops from 39% to 34% at the bracket threshold of $335,000. This represents a drop in marginal tax rate of 5%.

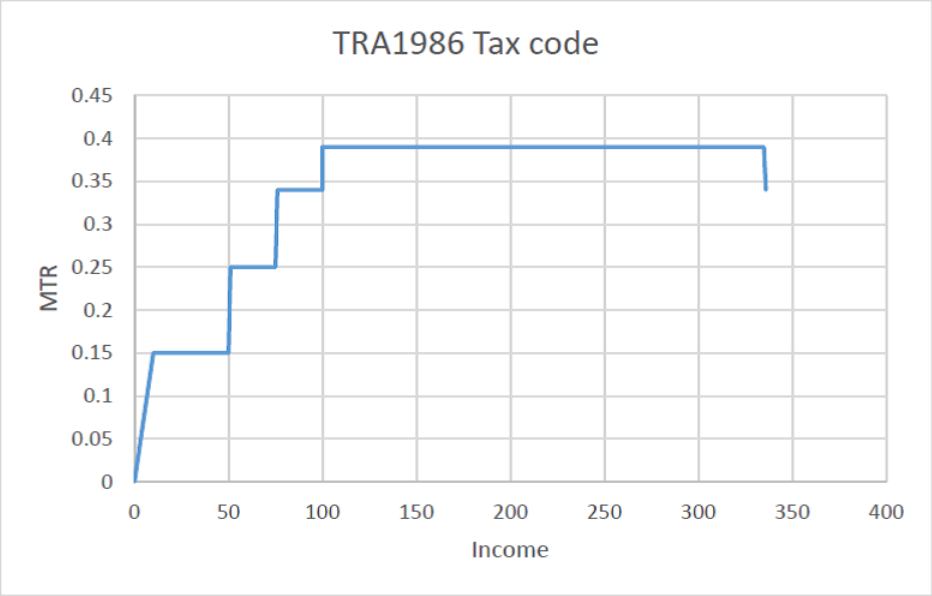
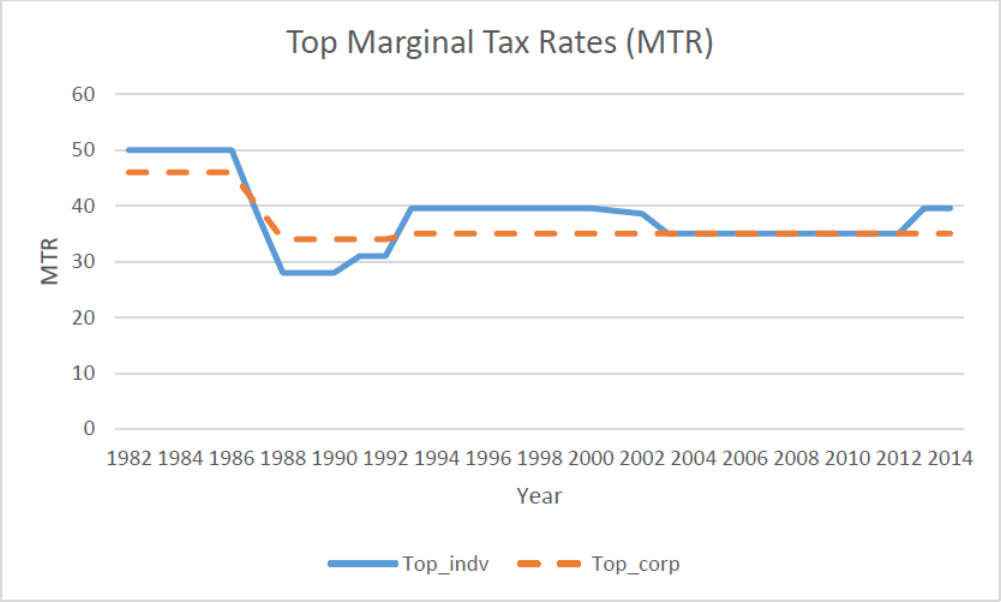


Figure 3.1: Tax Reform Act of 1986:Tax Code

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 the income shifting behavior. 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 3.2 shows that the top corporate tax rate has remained below the top individual rate for most of the period. However, the top corporate rate fell below the top individual tax rate after TRA1986. Also noteworthy is the fact that the top corporate and individual rates were on par between 2000 and 2010.



Source: Tax Policy Centre

Figure 3.2: Top Corporate and Individual Tax Rates

3.3 Data and Descriptive Statistics

3.3.1 Data

I use US firm-level data from the Compustat database for the period 1988 to 2010. Compustat data set consists of publicly traded C corporations and only contains reported income from financial statements. Because firm-level tax return data is not publicly available, I use the data from financial statements to construct a measure of taxable income. I divide the sample into TRA1986 (1988-1992) and OBRA (1993-2010) to reflect the differences in tax policy that characterized the study period.

Additionally, I exclude financial institutions (SIC codes 6000–6999), utilities (SIC codes 4900– 4999), and firms that are not incorporated the US because they are subjected to different tax rules and regulations (Ayers et al., 2009). My 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. I compute taxable income as follows (Hanlon et al., 2005):

$$Taxable\,income_i = \frac{Tax\,expense}{tax\,rate} - \Delta NOL \tag{3.3.1}$$

Where tax expense is a sum of foreign and federal income taxes; tax rate is as depicted in Table 3.2; ΔNOL is the change in tax loss carryforwards[1].Using the information in Table 3.2, I am able to determine the appropriate tax rate for each of the tax expense brackets, and use it to construct the measure of taxable income. To obtain a more accurate estimate of taxable income from the financial statements, I follow the accounting literature and subtract the change in net operating loss carryforwards (NOLs)(Ayers et al., 2009). While the measure of taxable income employed in this study is not based on the actual tax return, there is evidence that shows that it is a reasonable estimate for actual taxable income (as reflected on tax return) (Ayers et al., 2009; Plesko, 2003, 1999).

[1]Under the US tax code corporation reporting an operating loss for income tax purposes in the current year are allowed to carry this loss back or forward in order to offset previous or future taxable income (Wahlen et al., 2012).

Table 3.2: Tax expense brackets and tax rates

Tax rate	Taxable Income Bracket ($ million)	Tax expense Bracket ($ million)
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+

3.3.2 Descriptive Statistics

Table 3.3 presents summary statistics for the variables of interest in this study. Since the analysis is done for two different tax policies or schedules, I report summary statistics separately for the two tax periods. Panel A of Table 3.3 presents summary statistics for the TRA1986 tax code (1988-1992), while Panel B reports statistics for the 1988-1992 period. The sample in Panel A is much smaller than the one in Panel B because it only includes firms with taxable income between $0 and $0.5 million. I restrict the sample this way because the highest tax bracket under TRA1986 starts at $0.335 million, and the methods employed in this study only rely on observations in the neighborhood of the bracket thresholds. Correspondingly, I restrict the sample for Table 3.3 Panel B to include firms with taxable income between $0 and $25 million since the top tax bracket for the 1993-2010 (OBRA) tax code starts from $18.33 million.

The statistics in Panel A show that the average firm in the sample has about $109 million in assets, $27,000 in tax expenses, a negative change in net operating

loss carryforwards amounting to $39,000 and $119,000 in taxable income. When put in the context of the applicable tax schedule, the mean taxable income of $119,000 implies that an average firm falls in the fourth tax bracket (Table 3.1, Column 3). 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 higher effective tax rate. Having the mean income that falls within this high-tax bracket is somewhat unexpected given my hypothesis that firms would opt to avoid the higher tax side of the bracket threshold. This result further suggests that an average firm faces higher effective tax rate in the post- 1986 reform period. Further, the presence of NOLs also indicates that businesses have opportunities to influence their tax liabilities.

Panel B reports statistics for the period 1993-2010 which corresponds to a different tax reform (OBRA). Results show that the mean tax expense is $2.4 million, while mean assets is $431.5 million. The results also reveal that mean taxable income is $7.3 million which places most of firms in my sample in the 5th tax bracket of ($335,000 to $10 million) (Table 3.1, Column 4). This tax bracket attracts a tax rate of 34%, and it is above 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 favor 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.

Table 3.3: Descriptive Statistics (1988 -2010)

Panel A: 1988-1992 Tax Code ($ million)

VARIABLES	N	mean	Std deviation	min	max	p50	p75
Tax expense	804	0.027	0.0845	-1.605	1.111	0	0.042
ΔNet operating losses	804	-0.039	0.161	-1.7	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

Sample includes taxable income in interval [0, 0.5]

Panel A: 1993-2010 Tax Code ($ million)

VARIABLES	N	mean	Std deviation	min	max	p50	p75
Tax expense	4,508	2.373	3.766	-90	58	1.262	3.854
ΔNet operating losses	4,508	-0.333	7.69	-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	4.96	11.81

Sample includes taxable income in interval [0, 25].

3.4 Estimation Strategy

I use graphical techniques (histogram analysis) and specific statistical tests (McCrary's (2008)) density test to test for the presence of bunching behavior around kinks in the tax code. Using a combination of these techniques, I examine the distribution of taxable income around the applicable tax bracket thresholds. 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)[2]. RDD exploits discontinuities in likelihood of treatment as a function of some continuous variable also referred

[2]RD design that was first introduced by Thistlethwaite and Campbell (1960) as an alternative to the randomized experiment for evaluating social programs and interventions.

to as the assignment or running variable (Lee and Card, 2008). The experimental units (individuals or firms) are assigned to treatment or control categories based on some cut-off point or threshold for the assignment variable,. Successful implementation of RDD relies on the key identifying assumption of continuity in the density of the running variable at the threshold. Unlike other studies that have used RDD to investigate the impact of taxation (Bruhn and Loeprick, 2014; Kneller and McGowan, 2013; Sanchez et al., 2014), this paper 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 one can 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 behavior. The size of the jump which represents an estimate for discontinuity in the running variable (θ) is useful for determining the responsiveness of taxable income to change in tax rate (elasticity). Figure 3.1 depicts the discontinuity in taxable income (θ) at the threshold equal to z_0.

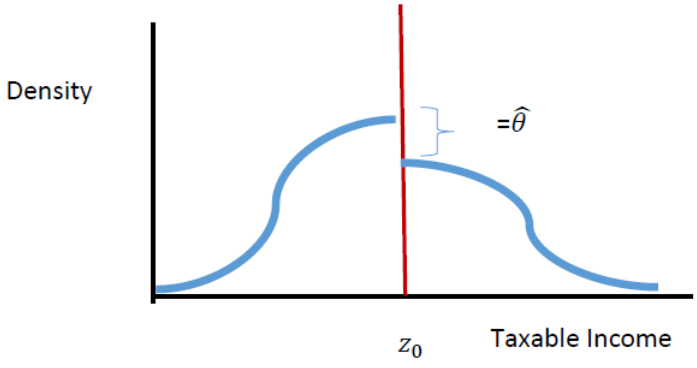


Figure 3.1: Estimate for Discontinuity in the running variable

The density test depicted in figure 3.1 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 reported income in this study. Firms which find it profitable to manipulate will self-select so that they bunch around the threshold. I use the density test to detect and quantify this manipulative or sorting behavior among firms. I expect to see manipulation in reported income at the various thresholds in the tax code. McCrary (2008) density test is based on an estimator for the discontinuity at the threshold in the density of running variable. The discontinuity will be taken as a measure of tax avoidance (Saez, 2001; Chetty, 2011). McCrary (2008) further explains that the test is implemented as a Wald test. 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 local linear regression technique to smooth the histograms on each side of the threshold. The estimate of the density, ($\hat{\theta}$) is found by taking the log difference in heights of the distribution on either side of the threshold as follows:

$$\hat{\theta} \equiv \ln \hat{f}^{+} - \ln \hat{f}^{-} \tag{3.4.1}$$

where $\ln \hat{f}^{+}$ is log of distribution of taxable income on the right of the threshold, and $\ln \hat{f}^{-}$ is the log of the distribution of taxable income on the left side of the cutoff.

3.5 Results

3.5.1 Histogram Analysis

I construct histograms of taxable income to test whether taxpayers locate at various tax bracket cut-off points. Figure 3.1 displays the histogram analysis for the TRA1986 tax code. Given that the top tax bracket starts at $0.335 million, the histogram analysis is restricted to include taxable income in the range ($0 to $0.5 million). The vertical lines correspond to the thresholds of interest (0, 0.05, 0.075, 0.1, 0.335 in $ millions). I include taxable income of zero (non-tax paying firms) so as to illustrate and pinpoint 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 behavior.

The histogram also reveals moderate clustering at thresholds of $0.075 million ($75,000) and $0.1 million ($100,000) and a gap or hole around $0.335 million ($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 $0.335 million while the rest are convex kinks. The clustering is even more pronounced when the analysis only includes observations in the neighborhood of $0.075 million and $0.1 million. Appendix A shows more visible clustering at the thresholds of $0.075 million and $0.1 million where the convex kinks are located.

The results also show a hole around the highest bracket threshold $0.335 million rendering support to theoretical predictions that taxpayers opt to avoid the region around the non-convex kink point. Additionally, the noticeable gap in the range ($

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 B) also point to the evidence of bunching and holes around bracket thresholds.

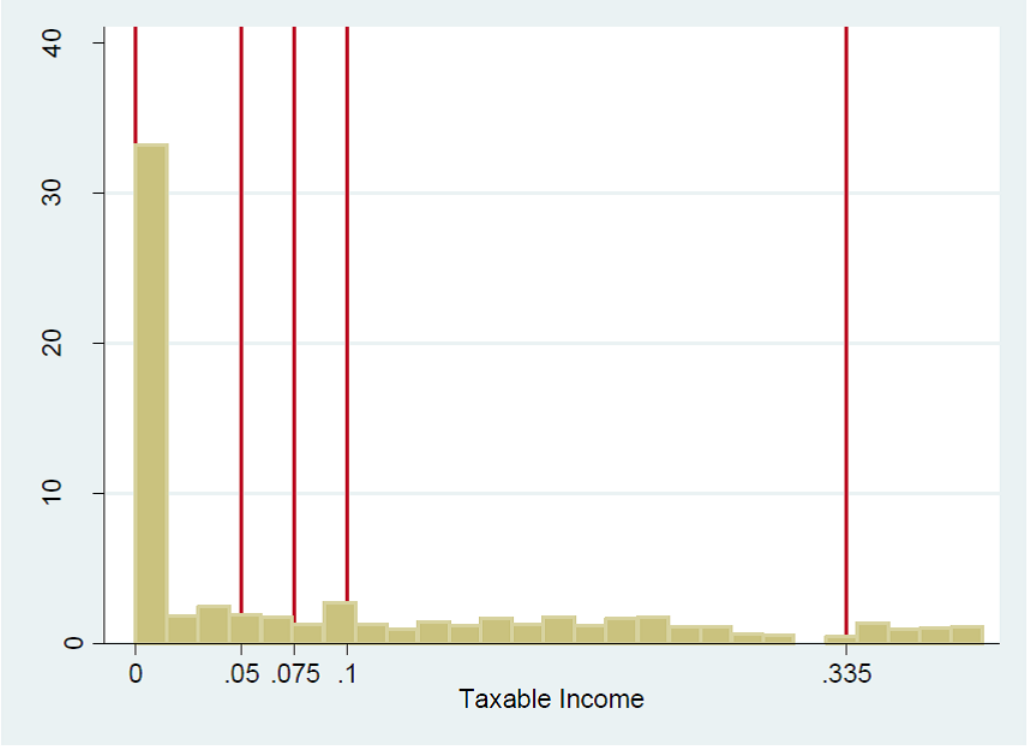


Figure 3.1: Density of Taxable Income for TRA1986 (1988-1992) Tax Code

Figure 3.2 presents the histogram analysis for 1993-2010 tax code. The vertical lines correspond to the thresholds of interest (0, 10, 15 and 18.33 in $millions).The graph reveals moderate clustering around $10 million and some evidence of holes at the top bracket threshold of $18.33 million. Also notable is the gap around the top bracket cut-point of $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 $millions)

reveals a pattern similar to that of the TRA1986 (Appendix C). I also present results for kernel density analysis in Appendix D. The kernel density reveals some evidence of bunching at the threshold of (0.05, 0.1 and 10) $ million and close to $ 15 million. Overall, these findings suggest that firms opt to locate on lower tax sides of the kink in order to affect their tax liabilities.

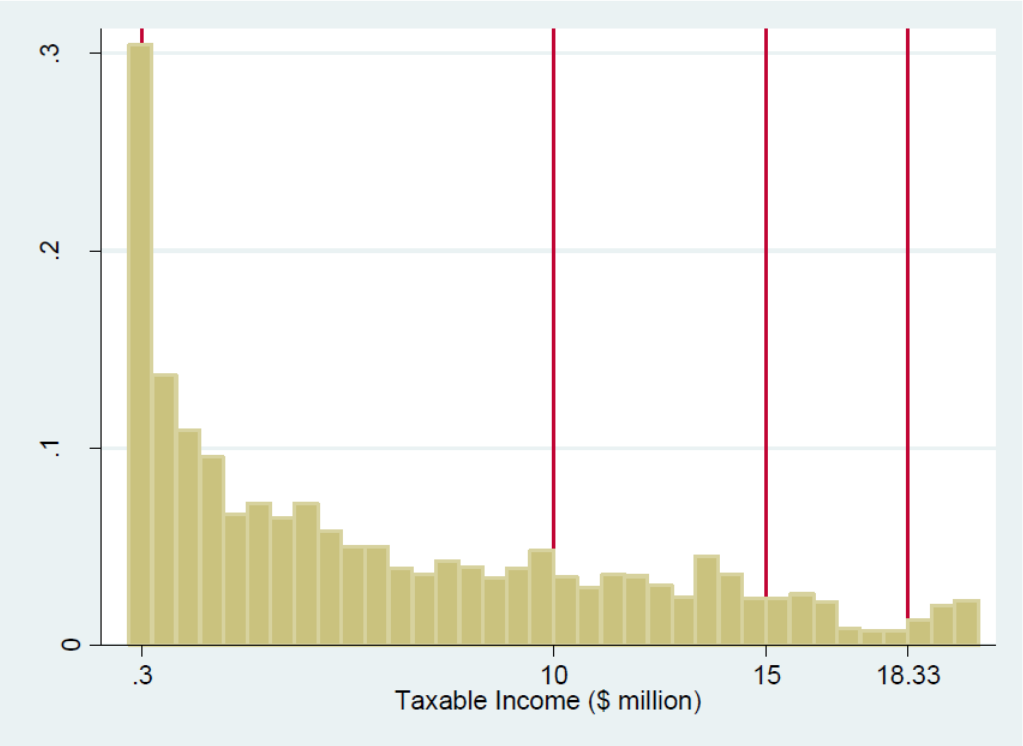


Figure 3.2: Density of Taxable Income: 1993 – 2010

3.5.2 Statistical Tests: McCrary's Density Test

Because the histograms may not accurately capture bunching at all tax thresholds and do not allow for point estimation or inference, I turn to statistical tests for dis-

continuity in the distribution of taxable income. I apply the McCrary's density test to the two tax codes spanning period 1988-2010. Table 3.4 presents results of the McCrary density test for the TRA1986 tax code (1988-1992). The analysis involves determining whether taxpayers engage in strategic behavior around tax bracket cut-points (thresholds). I consider cut-points where the tax rate increased (0, 0.05, 0.075, and 0.1 in $ millions) as well the top bracket threshold of $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. 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. These findings suggest that a kinked tax code provided incentives for firms to engage in tax avoidance behavior.

Table 3.4: McCrary's Density Test for 1988-1992 Tax Code

Threshold	$0	$0.05	$0.075	$0.10	$0.34
coefficient	1.433	-1.307	-1.137	-0.8	1.138
bin size	0.014	0.014	0.014	0.014	0.014
Band width	0.318	0.367	0.451	0.365	0.37
Standard error	0.072	0.076	0.072	0.081	0.176
P value	0	0	0	0	0

Tax bracket thresholds are in $ millions

The graphical results of McCrary's density are presented in Figure 3.3 .The graphs show a drop in the density of taxable income at thresholds of $0.075 million and $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 top tax bracket of $0.335 million where there is a decrease in the tax rate. These results suggest that firms engage in activities that ensure that they minimize their

tax liabilities.

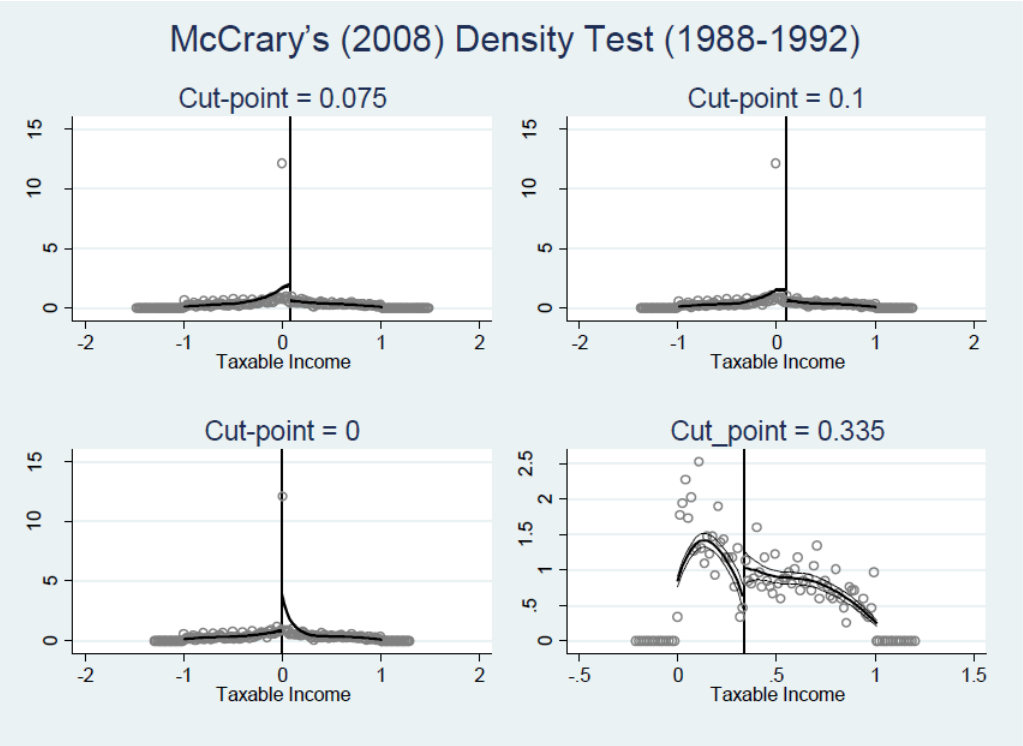


Figure 3.3: McCrary's Density Test (1988-1992)

Table 3.5 presents McCrary's density test results for the 1993-2010 tax code. I consider the thresholds of 0.075; 0.1, 0.335,10,15, and 18.3 ($ million). The estimates of discontinuity are negative at thresholds where the tax rates increase (.075; 0.1; 10; 15 $million), suggesting that firms tend to choose the lower tax side of the threshold. Additionally, the positive coefficients are associated with declines in the tax rates that occur at $0.335 million and $18.33 million. This behavior confirms my argument that firms make decisions to ensure that they locate at the lower tax side of the kink.

Table 3.5: McCrary's (2008) Density Test (1993-2010)

threshold	$0	$0.05	$0.075	$0.10	$0.34	10	15	18.33
coefficient	1.71	-1.406	-1.3	-0.978	1.32	-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	0	0	0	0.026	0.047	0.08	0

Tax bracket thresholds are in $ millions

Figures 3.4 and 3.5 display the results for the density test in Table 3.5. Results in figure 3.4 show that firms respond to increases in marginal tax rates by bunching below the bracket threshold. This is demonstrated by the drop in the density of taxable income to the right of the bracket cut-point. Figure 3.5 reveals that firms respond to the fall in marginal tax rates by avoiding the area to the left of the bracket cut-point. This behavior is reflected in Figure 3.5 where we see the drop in the density of taxable income to the left-side of the bracket threshold.

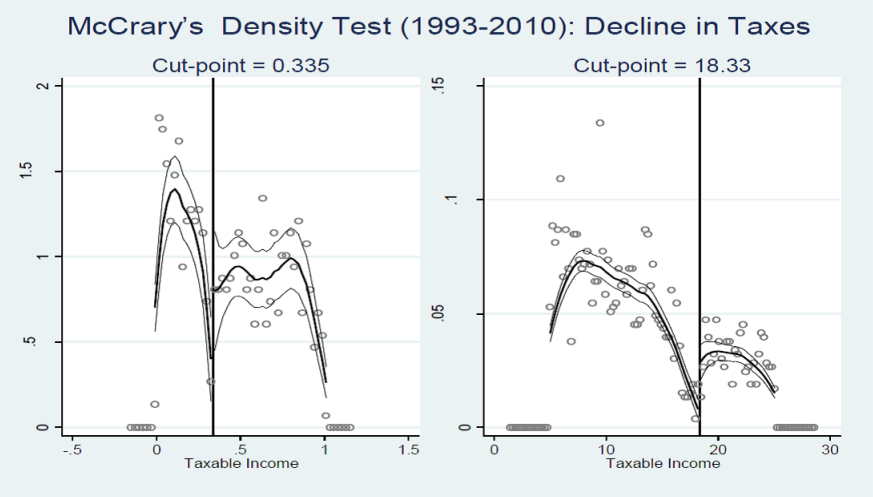


Figure 3.5: McCrary's Density Test for fall in marginal tax rates

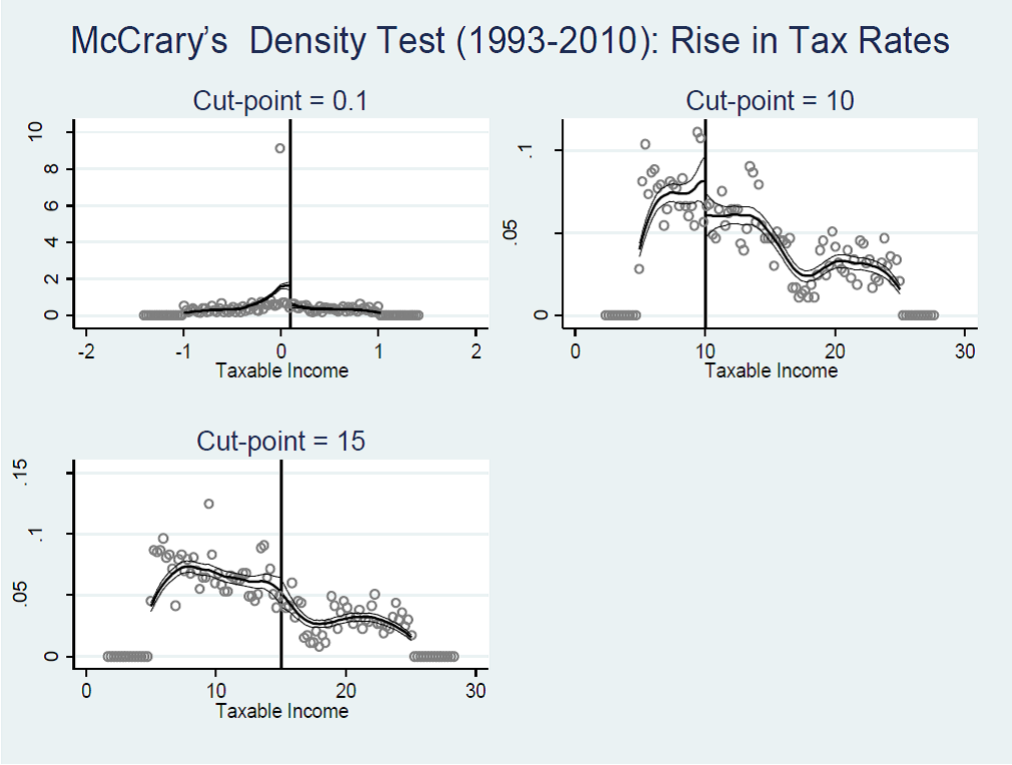


Figure 3.4: McCrary's Density Test for rise in marginal tax rates

3.6 Conclusion

Graduated tax codes feature tax brackets with different marginal tax rates. Although the idea behind designing such tax systems is to ensure progressivity and efficiency, having such tax structures could induce incentives for taxpayers to engage in the manipulative behavior. This manipulative behavior comes about because profit-maximizing agents will seek to find ways to game the system so as to influence their tax liabilities. As is well recognized in the public finance literature, tax policies have been known to create discontinuities (kinks) in choice sets of taxpayers. Such discontinuities provide evidence of strategic responses to tax codes. In this paper, I investigate how the tax policies for the period 1988 to 2010 impacted the behavior of US firms.

Given that the study period includes two tax reforms, I conduct the analysis separately for each reform period. TRA1986 was in effect from 1988 to 1992, while the OBRA was enacted in 1993. Using a combination the graphical techniques (histogram and density analysis) and explicit statistical tests (validity test from RDD), I investigate the reporting behavior of US firms by focusing on examining the distributions of taxable income around the threshold. While the histogram analysis only allows for detection of clustering behavior, it does not provide estimates of discontinuity. To obtain these estimates, I employ the McCrary's density test which was developed for testing the validity assumption in RDD. The study finds evidence of clustering behavior 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. This evidence implies that kinked tax codes create incentives for taxpayers to engage in manipulation of taxable income around the thresholds. Such of manipulation of taxable

income will be taken to be an indication of tax avoidance behavior. These findings suggest that firms manipulate their taxable income to locate on the tax-favored side of the kink, and point to the existence of strategic responses to changes in tax policy. The evidence of manipulative behavior around the thresholds could have implications for the effectiveness and efficiency of the tax reforms. The knowledge of strategic responses at kink points is essential for estimating tax price elasticities as well as welfare costs of the tax policy.

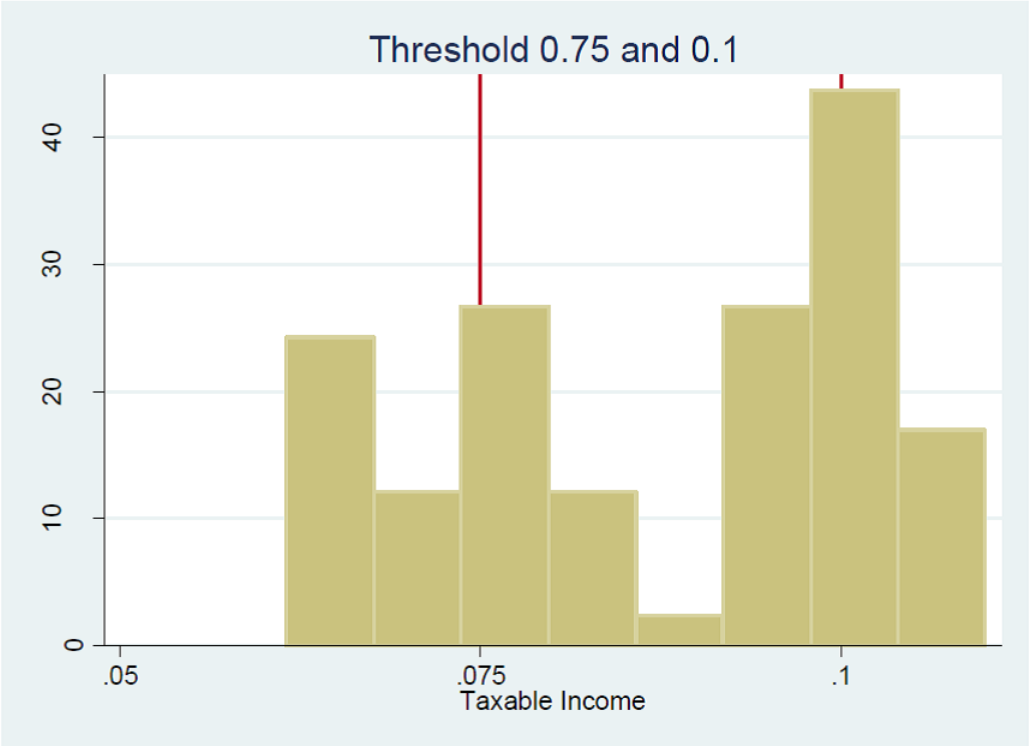
My study makes a contribution to the literature by constructing measure of taxable income from financial statements using a slightly different approach than that widely utilized in the accounting literature. Unlike the accounting literature that calculates taxable income by dividing tax expenses by the top tax rate, I allow the tax expenses to have varying tax rates. I do so by constructing tax brackets for tax expenses that I then use in the formula for taxable income. This study also contributes to the literature by focusing on studying strategic responses to corporate tax schedule. To my knowledge, strategic responses to personal income tax schedules have received more attention than responses to corporate income tax codes. Additionally, I contribute to the literature by applying a density test to quantify the strategic responses over an extended study period that spans two different tax reforms.

One of the challenges that continue to trouble researchers in the public finance and tax avoidance literature has to do with the lack of firm-level and individual 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 problems involve measurement errors that may have an adverse effect of inferences. Despite, these data issues, my study helps to extend this literature by using an estimate of taxable income and methods that are more accurate at detecting and quantifying tax avoidance activities. For instance, while essay one indicated that the 1986 reform was effective in reducing

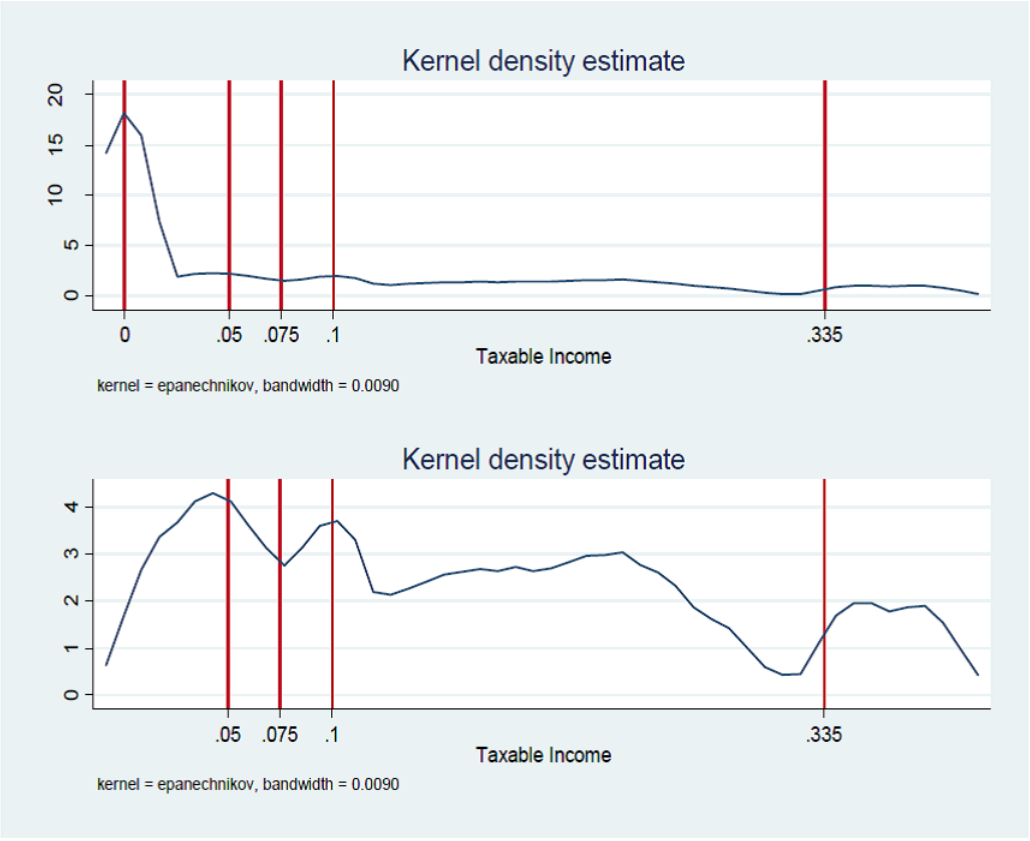
tax avoidance, this study shows evidence of manipulative behavior. This finding is an important addition to the study of tax avoidance behavior and the design of more effective and efficient tax systems.

3.7 Appendix 2

A: Density of Taxable Income (1988-1992)

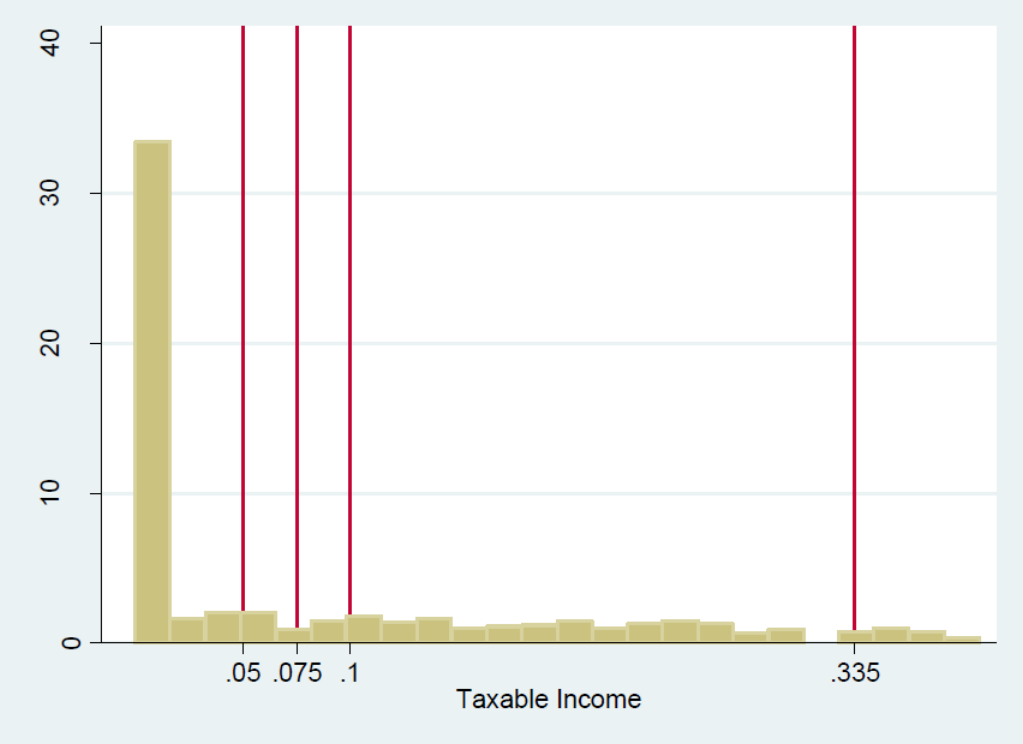


B: Kernel Density (1988-1992)

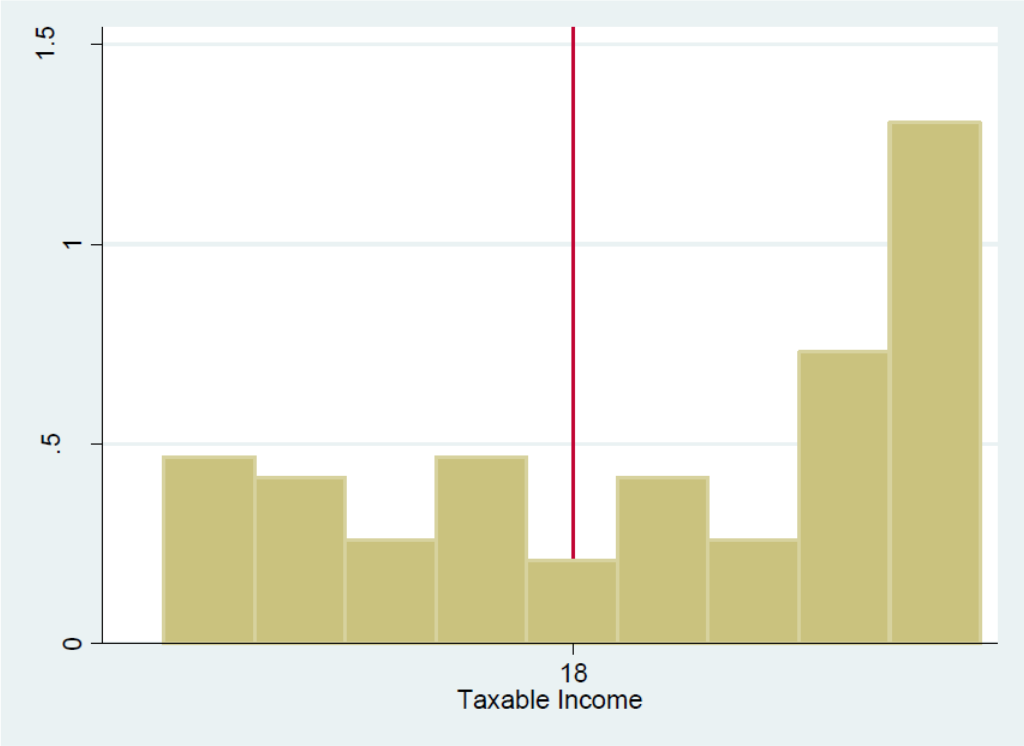


C: Density of Taxable Income (1988-1992; Lower and Top Brackets)

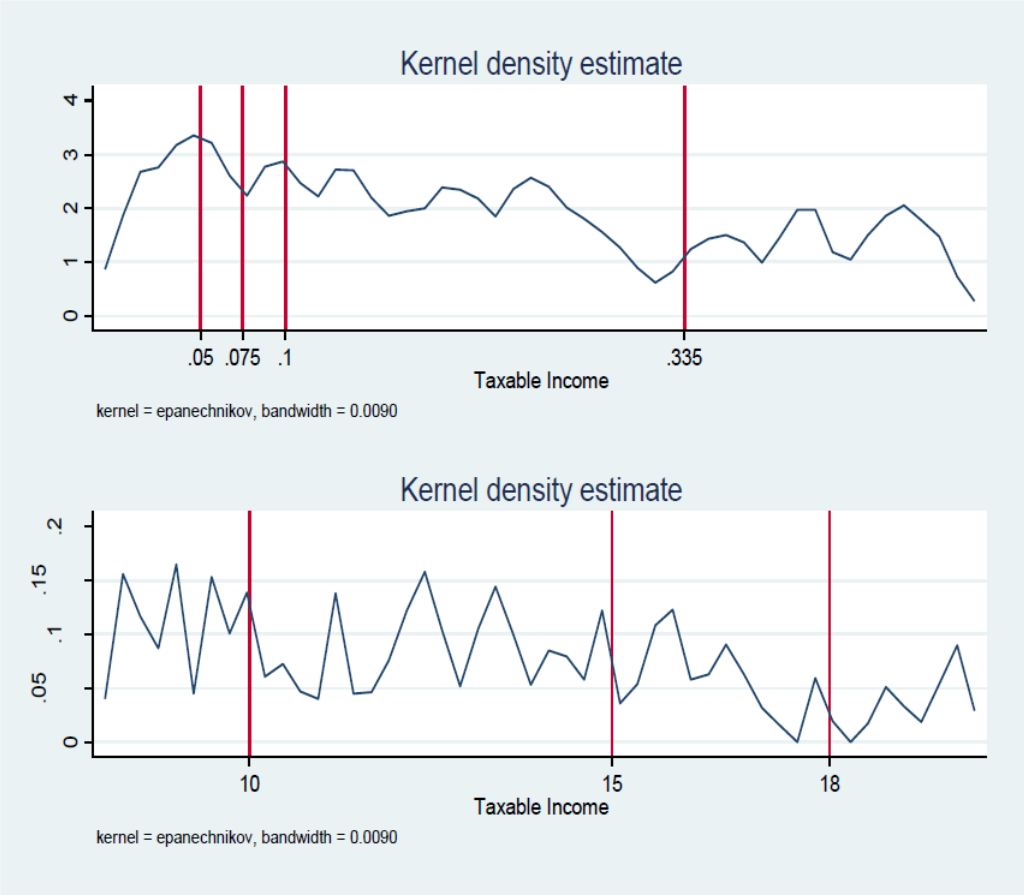
C1: Lower Income Tax Brackets



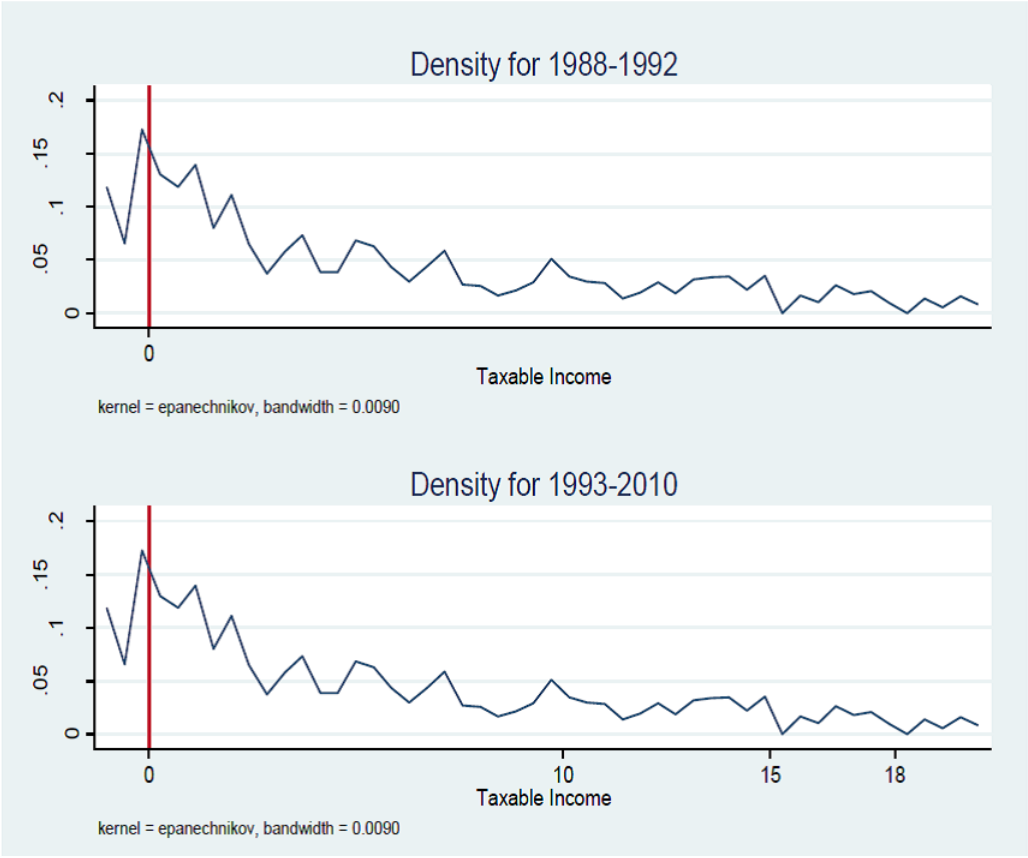
C2: Top Tax Bracket



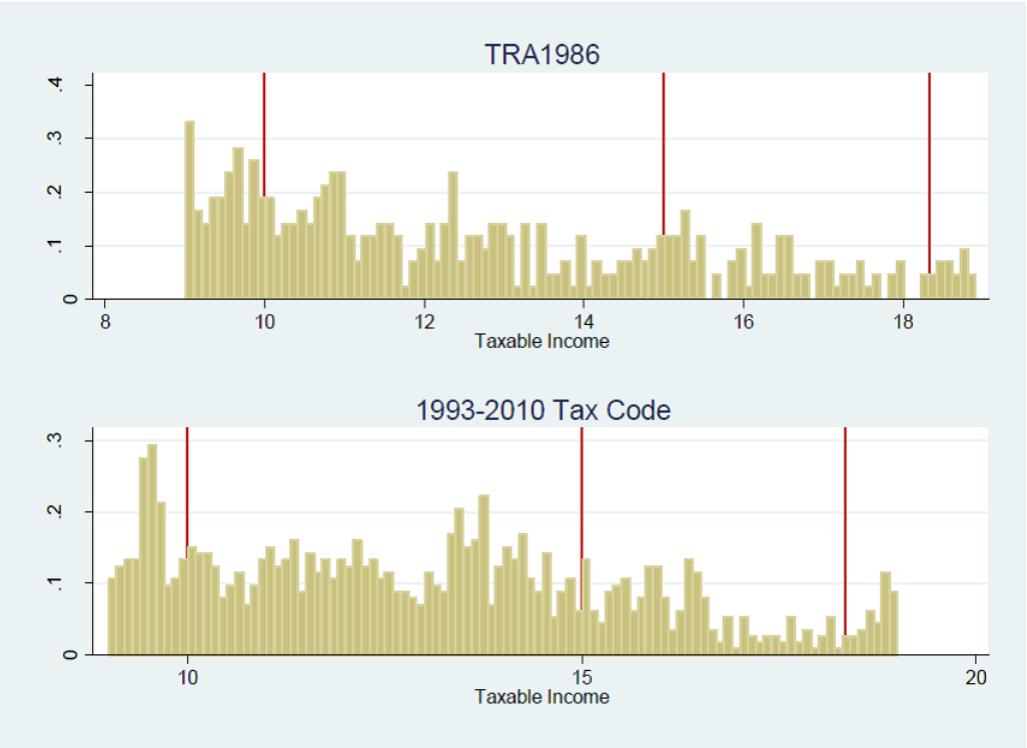
D: Kernel Density Analysis for 1993-2010 Tax Code



E: Density for 1988 to 2010



F: Robustness Check



Chapter 4

Essay 3: Optimal Taxation in the Face of Strategic Behavior

4.1 Introduction

Most countries have moved to adopt recommendations of optimal tax theory to simplify and flatten the marginal tax schedules. This is evidenced by the worldwide reforms that were a characteristic of the 1980s, with most of them involving a significant reduction in the number of tax brackets, and tax rates. The proponents of these reforms argued that there would be efficiency gains from simplifying tax codes, while opponents are of the view that such changes could aggravate tax avoidance behavior by generating huge jumps in marginal tax rates (kinks). This argument emanates from the belief that having a combination of flat tax schedules connected by huge jumps in marginal tax rates could induce incentives for strategic behavior. In this paper, I provide an explicit model that illustrates the incentives for strategic cost shifting behavior when the tax code exhibits kinks. I then use the model to analyze welfare consequences of tax reforms aimed at reducing the number of brackets. Specifically, I examine whether 'complicated' tax systems that avoid kinks in the marginal tax rates can retain the progressivity inherent in the current tax code while

avoiding the costs associated with large jumps in marginal tax rates.

I define a tax code that exhibits discrete changes in marginal tax rates as a kinked graduated (or discrete) tax code. This tax code features fewer tax brackets and huge jumps in marginal tax rates. The current US corporate tax system fits this description. On the other hand, I refer to a tax code with many brackets and smaller jumps in marginal tax rates as a smoothly graduated or 'complicated' tax system. While both tax systems are designed to be progressive, the smoothly graduated tax code also avoids kinks. I also make a distinction between an upward kink — referring to a discrete jump in the marginal tax rate, and a downward kink which relates to a discrete drop in the marginal tax rate [1]. This distinction is important given the empirical evidence that the responses of taxpayers differ depending on the direction of the kink. For example, taxpayers respond to an upward kink by bunching around the kink point. However, a downward kink results in gaps or holes around the kink point as taxpayers opt to avoid the region around the kink point. My study focuses on the convex kink since the real world occurrence of the non-convex kink is rare.

Despite most countries moving towards simpler and discrete tax codes, there is limited empirical evidence to support the efficiency arguments advanced by the proponents of tax reform (Altig and Carlstrom, 1994). Specifically the research into how such tax policy changes impact firms, is surprisingly limited, despite the worldwide calls to reform tax systems. While some work has been done on investigating the distortionary effects of kinked tax structures on household or individual decisions (Altig and Carlstrom, 1994), not much has been done to assess how such policies impact firms' behavior. However, Best et al. (2015) make a departure from the literature's focus on individual behavior by examining the welfare implications of switching from

[1] Burtless and Hausman (1978)and Hausman (1985) make a distinction between convex kink (when marginal tax rate discretely increases) and a non-convex kink (marginal tax rate discretely falls).

profit tax to production tax policies such as the turnover tax. They found that changing from profit to turnover tax increases welfare. Unlike Best et al. (2015), this paper focuses on welfare implications of switching from a flat tax structure to a discrete rate structure. Additionally, while the model developed in this study takes output as given, Best et al. (2015) takes output as a choice variable.

The motivation for focusing on the corporate tax code comes from the belief that corporations and individuals differ regarding what roles they play in the economy. For example, firms hire labor and incur investment expenditure of a different kind. Apart from playing distinct roles in the economy, firms and individuals also face different constraints and different tax schedules. Given these differences, I expect firms and individuals to behave differently with regards to tax avoidance. While firms have more resources at their disposal to spend on tax avoidance activities, they are also more visible to tax authorities than individuals. Additionally, the fact that firms also interact with the individual tax code through their labor expenses also provides further justification for investigating how a shift from a flat tax code to a kinked system impacted them. There are also views about how corporate tax policy may end up affecting individuals through tax incidence shifting (Harberger, 1962).

Even though one would argue that the contribution of corporations to tax revenue is not that significant, the vital role they play in the economy and the significant costs of imposing taxes on them necessitates a particular focus on the implications of corporate tax policy (Fehr et al., 2013). As already noted, corporations also tend to have wider options for tax avoidance including tax shelters and other avenues for tax planning. These factors could make the strategic responses of firms to differ considerably from those identified for individual taxpayers. Given these factors, investigating whether a kinked tax code resulted in more distortionary investment, employment and overall reporting behavior is important.

To conduct the analysis, I provide an explicit model that illustrates the incentives for strategic cost shifting behavior when the tax code exhibits kinks. Using a simulation approach, I evaluate the effectiveness of the model and use it to analyze strategic investment and reporting behavior.

To estimate the welfare costs, I posit that a cost-minimizing firm will choose an optimal plan for investment and labor under the baseline (flat) tax code, while a firm facing a kinked tax code will choose a sub-optimal plan for investment and labor to achieve a similar level of output. Based on this hypothesis, I argue that a firm facing a kinked tax code will engage in strategic timing of investment to influence its tax liability, and such behavior comes at a cost in terms of lost revenue and profits. Thus, I expect the tax base (profits) to be smaller under a kinked-tax system than under a flat tax code. The study uses change in after-tax profits relative to the world with the flat tax code as a measure of welfare costs.

In this paper, the analysis of welfare implications is not only limited to manipulation of pre-tax profits (taxable income) but goes further to examine whether the shift to a kinked tax code may have also affected the firm's investment and employment decisions. Such effects would be considered as second-order welfare effects of tax policy and may have an impact on quantities or productivity[2]. These effects are of interest to economists as they represent real strategic responses to tax policies (Akerlof and Yellen, 1985).

Studying the role of tax structure or policy in influencing investment and employment decisions is crucial for designing more effective and efficient tax systems. Additionally, given that the degree of bunching is proportional to the responsiveness of agents to tax policy (elasticity of taxable income), I expect that estimates of wel-

[2]Akerlof and Yellen (1985) argues that small deviations from rationality can have larger first-order implications for quantity. In my model, the second-order welfare effects correspond to the deviations alluded to in the Akerlof-Yellen theory.

fare costs will vary by size of the tax kink as well as nature (shape and smoothness) of the tax code. For example, a tax code with the least number of brackets (kinked) could generate different welfare implications than the tax code with a higher number of tax brackets (smooth tax code). I argue that a kinked tax code induces greater welfare losses than a smooth tax code. Similarly, I expect the welfare estimates to vary by marginal tax rates, with larger changes in marginal tax rates generating more substantial welfare effects, and vice versa for smaller changes in marginal tax rates.

Using a numerical example, I show that a profit-maximizing firm will maintain its pre-tax profits to stay around the kink point when an upwards kink is introduced. Results also reveal that a downward kink is associated with significant fluctuations in pre-tax profits, suggesting that a firm manages its pre-tax profits to avoid the area around the kink point. Results from welfare analysis indicate that a move from a flat tax code to a smoothly graduated or kinked graduated tax system is not welfare enhancing. However, a switch to a smoothly graduated tax system is less distortionary than a move towards the kinked graduated tax code.

Further, my results reveal evidence of firms employing strategic investment behavior as a tax avoidance strategy. Specifically, I establish that the timing of investment will differ depending on whether or not the tax code is flat, kinked graduated or smoothly graduated. In particular, I find that some evidence supporting my hypothesis that firms make sub-optimal investment decisions when the tax code is kinked.

The approach employed in this study is similar to Lindsey (1987), who used a micro-simulation model to analyze taxpayer strategic responses to the tax cuts associated with the Economic Recovery Tax Act of 1981. This essay also draws on Altig and Carlstrom (1992) who used a dynamic fiscal policy framework and established that a move from a linear tax system to a two-bracket tax code is not Pareto improving.

4.2 The US Corporate Income Tax Code and Alternative Tax Schedules

The U.S. federal tax code has undergone significant changes that include reducing the number of tax brackets and tax rates. Table 4.1 summarizes the corporate income tax schedules from 1982 to 2010. Three major reforms were instituted during this period, including the Economic Recovery Tax Act (ERTA) that lasted from 1982 to 1984; the Tax Reform Act of 1986 (TRA1986), which was in effect until 1993 when the Omnibus Reconciliation Act (OBRA) came into force. It is also worth noting that the TRA1986 remains the most comprehensive change to the US tax code.

As Table 4.1 shows, the reform to the corporate tax code has mainly involved altering the tax rates and changing the number of tax brackets. Specifically, the TRA1986 has the lowest number of tax brackets and lowest tax rates while the OBRA schedule has the highest number of tax brackets. The ERTA was characterized by highest tax rates. Table 4.1 also shows that the top tax rates experienced major changes over the study period. For example, the top rate declined from 46% under the ERTA to 34% under the TRA1986 and OBRA (1988-2010). The results also reveal that the size of the jump in tax rates ranged between 1% and 10% over the study period.

Table 4.1: Corporate Income Tax Schedules (1982-2010)

Tax CodeTax	ERTA:1982- 1986	TRA1986: 1988-1992	OBRA:1993-2010
Brackets and rates	15% (0-$25,000) 18%($25,000-$50,000) 30%($50,000-$75,000) 40%($75,000-$100,000) 46%($100,000 -1 million) 51%($1-$1.405 million) 46%($1.405 million+)	15% (0-$50,000) 25%($50,000-$75,000) 34%($75,000-$100,000) 39%($100,000-$335,000) 34%($335,000+)	15% (0-$50,000) 25%($50,000-$75,000) 34%($75,000-$100,000) 39%($100,000-$335,000) 34%($335,000- 10 million) 35%($10-15 million) 38%($15-18.3 million) 34%($18.33 million)

Source: IRS, Tax Policy Centre;Economic Recovery Tax Act (ERTA)
Omnibus Reconciliation Act (OBRA)

Figure 4.1 presents a relationship between marginal tax rates (MTR) and taxable income for the TRA1986 tax schedule and includes five upward kinks and one downward kink. The upward kinks are in the income range $0 to $100,000 while the downward kink occurs at income of $335,000. Specifically, the graph shows that the first kink for this schedule is at taxable income of $0 where the marginal tax rate jumps from 0 to 15%; with the next kink occurring at an income of $50,000. The marginal tax rate then drops from 39% to 34% representing a downward kink at $335,000.

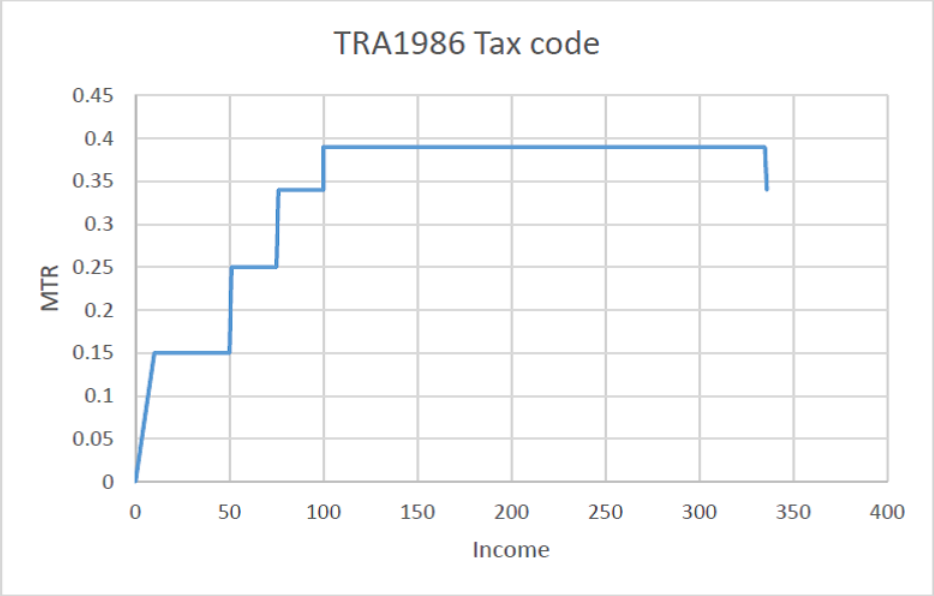


Figure 4.1: Kinked Tax Schedule

Although the corporate tax does not contribute as much to national revenue and GDP as the individual income tax, studying it is worthwhile given its contribution to the economy, the cost of imposing taxes on it, and its contribution to the individual tax code through employment. Figure 4.2 shows that the contribution of corporate tax to GDP has consistently lagged behind that of individual income taxes for the entire period.

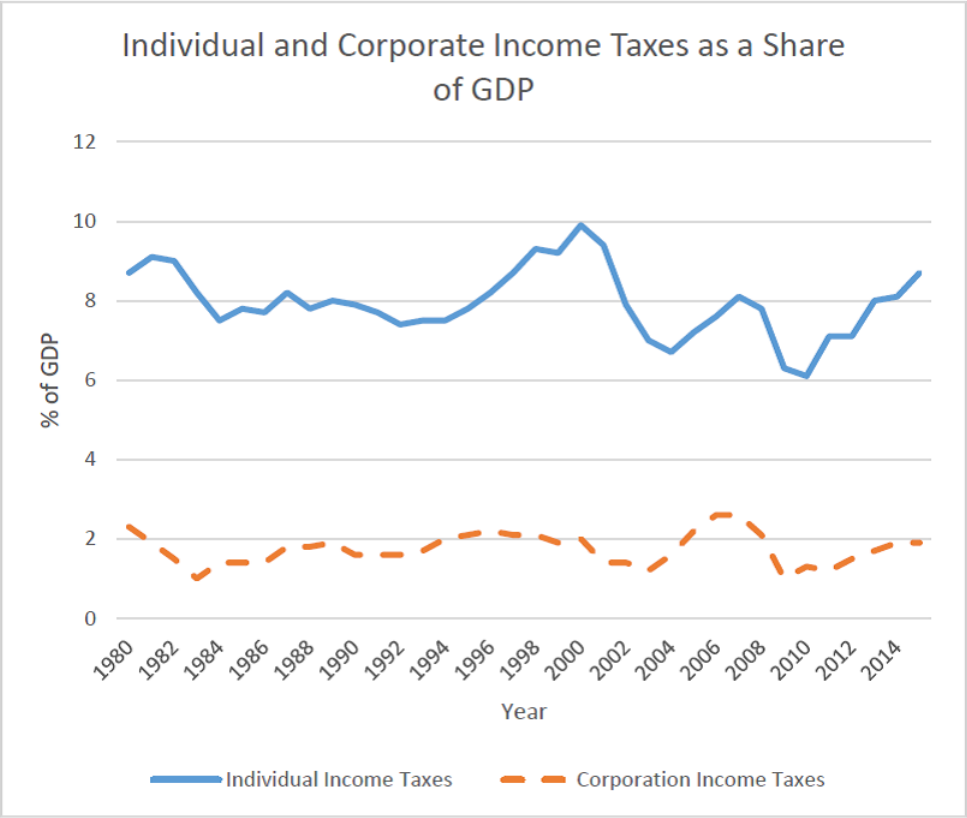


Figure 4.2: Contribution of Corporate Income Tax and Individual Income Taxes to GDP

4.3 Simulation Model

I build an explicit model that illustrates the incentives for strategic cost shifting behavior when the tax code exhibits kinks. The model assumes a sales constrained firm that adjusts labor (L) and investment (I) to maximize profits given the following

Cobb-Douglas production function[3].

$$Y_t = \lambda A_t^{\alpha} L_t^{1-\alpha} \tag{4.3.1}$$

Where λ is an arbitrary scale parameter which captures total factor productivity; L is labor; α and $1-\alpha$ correspond to share of the stock and labor,respectively; A = $measure\,of\,productive\,stock\,of$ assets[4].

The firm incurs investment and labor costs resulting in pre-tax profits (π_b) expressed as follows:

$$\pi_b = Y_t - I_t - L_t \tag{4.3.2}$$

Where I = investment; L = labor. For simplicity, I assume that the prices of labor (wages) and investment are fixed.

The idea is to compare the reporting behavior under a flat tax regime to that under the kinked tax code or smooth tax code. I, therefore, formulate a tax liability equation with a flat tax component (first term) and a kinked or discrete portion (second term):

$$TR = \tau\pi_b + \Delta\tau\left[max\left(\pi_b, Z_1\right) - Z_1\right] \tag{4.3.3}$$

Where τ = the marginal tax rate for the linear tax code; $\Delta\tau$ = corresponds to the marginal tax rate for the kinked tax code; $Z_1 = tax\,bracket\,cut\,point$. Further, I define the firm's after-tax profits (π_a) as the difference between pretax profits (π_b) and taxes paid (TR):

[3]Output is purely exogenous. For simplicity, I model the cyclical behavior of output as a pure sine wave pattern.

[4]A includes any stock of productive assets that do not require depreciation but can be expensed immediately.

$$\pi_a = \pi_b - TR(\pi_b) \tag{4.3.4}$$

where TR is tax liability as defined in equation 4.3.3. A firm then maximizes total discounted profits of the form

$$\pi_t = \sum_{t=0}^{T} \beta^t \pi_a \tag{4.3.5}$$

Where β = the discount factor.

The model also includes productive stock of assets (A) at time $t+1$

$$A_{t+1} = (1-\delta) A_t + I_t \tag{4.3.6}$$

Where A = measure of productive stock of assets[5] ; I = *investment*; δ = *rate of depreciation*.

In this model, labor and investment are the choice or decision variables, and output is exogenous. I hypothesize that a firm will respond to changes in tax policy by adjusting pre-tax profits through strategic management of investment and labor expenses.

Since the study only considers the behavior of a small firm in a small sector, I make an assumption that the prices of labor and investment are given. This simplified setup and the assumption of fixed factor prices imply that the welfare analysis is undertaken within the partial equilibrium framework. This assumption also presupposes that tax policy has no effect on the prices of the decision variables.

[5]A includes any expenses or payments that do not require depreciation but can be expensed immediately.

4.4 Model Estimation and Simulation

Even though the tax schedule is nonlinear, I assume a logistic function to make the model easily solvable. The logistic function also allows for parameterization of a movement from a system with huge kinks to a smoothly graduated system. Consequently, I model the tax schedule as follows [6]:

$$MTR\left(\pi_b\right) = MTR_0 + \sum_{j=1}^{n-1} \frac{MTR_j - MTR_{j-1}}{1 + e^{-k(\pi_b - Z_j)}} \tag{4.4.1}$$

Where MTR is the marginal tax rate as a function of pre-tax profits (π_b) ;(MTR_0) is the initial marginal tax rate; Z_j is the tax bracket threshold; and the MTR_j are the marginal tax rates corresponding to each tax bracket. The k in Equation 4.4.1 captures the smoothness of the tax code. Lower values of k correspond to a more smoothly graduated tax system, while as k increases, the jumps in the marginal tax rate at the thresholds become more pronounced. As k nears zero, the tax code approaches a flat tax. In comparison with $k = 0$, a large k involves changing the degree of tax progressivity, while $k = 20$ retains progressivity but avoids kinks. Adopting the logistic function to model the relationship between marginal tax rates and taxable income (pre-tax profits) is justified given that the marginal tax rates for the US decrease as income increases before leveling off at the top tax rate. By making this assumption, this study ignores a unique feature associated with the US federal income tax schedule, where the tax code is progressive for larger sections of income and regressive at the end. My approach is similar to Caragata and Giles (2000)) who opted for the logistic function to model the relationship between the size of the

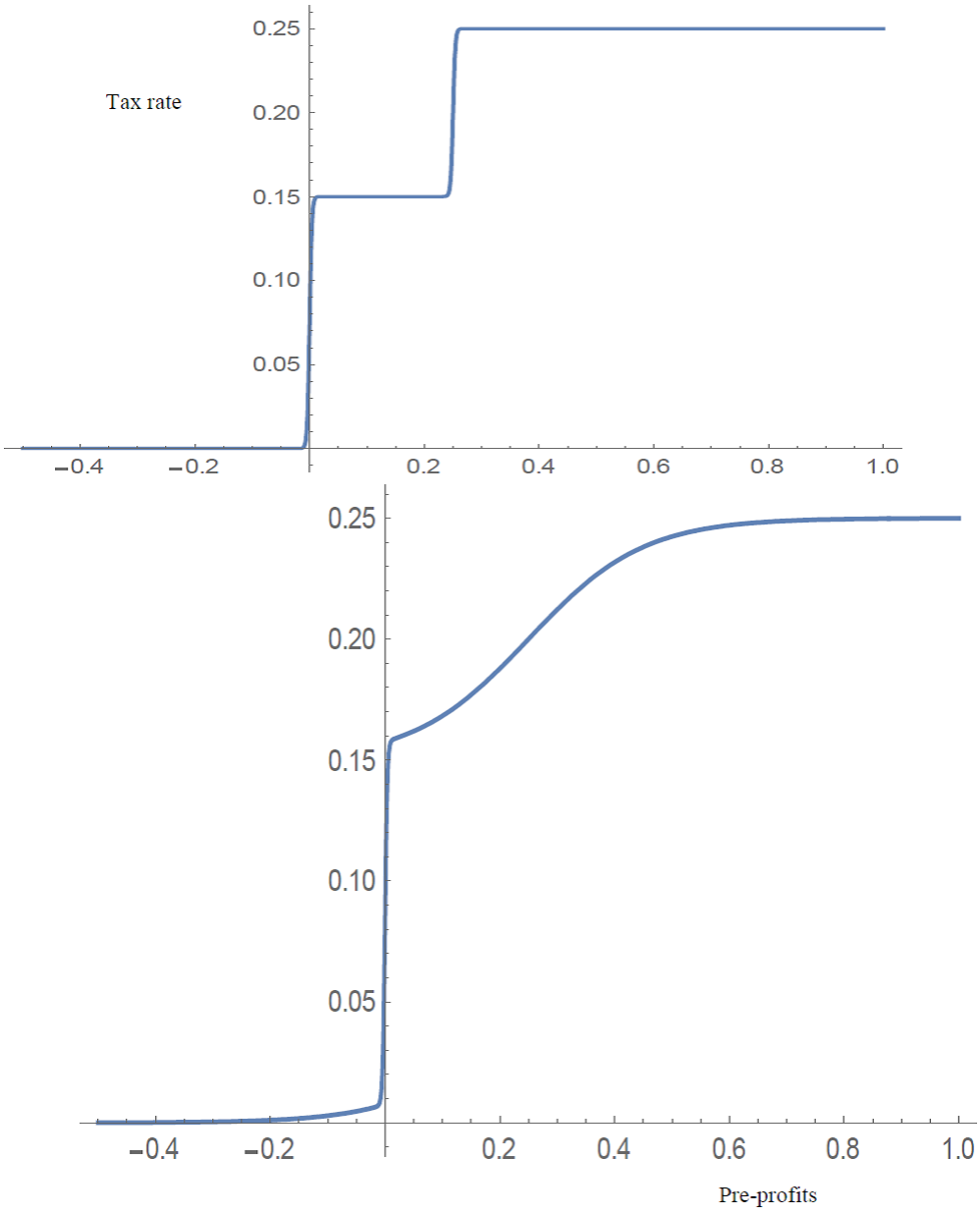
[6] Additional benefits of using the logistic function are purely computational in the sense that solving models with discrete jumps in MTR is cumbersome. But choosing a large finite k makes it easier to obtain numerical solutions.

hidden economy and effective tax rates.

In this paper, I take the flat tax code as the baseline or non-distortionary state, and examine how a switch from that to a distortionary discrete (kinked) tax code impacts the income and expenditure behavior of firms. A flat tax code refers to a tax schedule in which all taxpayers face the same tax rate and is presented by a horizontal tax schedule. A smoothly graduated tax code involves much smaller changes in marginal tax rates, thereby making it a fairly continuous function of income as displayed in Figure 4.1 (bottom panel). On the other hand, a kinked graduated tax code is a step function of taxable income (pre-tax profits) and involves discrete jumps in marginal tax rates (kinks). The US corporate tax code presented earlier fits this description. Figure 4.1 (row 1) also depicts a simplified version of the kinked tax code. The figure shows that taxpayers with negative income face negative marginal tax rates and that the first kink appears for firms that have positive incomes. Specifically, taxpayers with incomes below 0.25 ($25,000) face a flat tax rate of 15%. Figure 4.1 (row 1) also demonstrates that a kink is introduced at $25,000 where the marginal tax rate jumps from 15% to 25%. Alternatively, the simplified version of the kinked tax code can be said to include two flat tax codes that are connected by a big jump in marginal tax rate at $25,000.

In contrast, the lower panel of Figure 4.1 depicts a smoothly graduated version of the tax code. While this tax code is graduated, it does not feature the kind of discrete jumps observed in the top panel. Unlike the top panel, this tax code does not have long portions of flat tax rates. Given these highlighted differences, I expect these tax systems to induce different types of responses. I posit that the kinked graduated tax code will elicit huge strategic responses and greater welfare effects due to the sizes of kinks associated with it. Conversely, I expect the smoothly graduated tax code to stimulate moderate responses and welfare effects. Given these hypotheses, I argue

that the smoothly graduated tax code will be closer to the flat tax or non-distortionary tax system.



This figure shows the kinked tax code (top panel) and the smoothly graduated tax code (lower panel).

Figure 4.1: The Kinked and Smoothly graduated tax codes

Table 4.2 presents the parameters used in the initial simulation analysis. The choice of parameter values in the model is guided by the need to make the model solvable and to obtain steady state values for the variables of interest. As already alluded to, a firm makes the investment and employment decisions given the output, and prices of the decision variables.

Table 4.2: Model Parameters

Parameter	Value
α Labor share	0.7
1- α capital stock share	0.3
λ total factor productivity	1.5
τ marginal tax rate	0.1
δ depreciation	0.3
β discount factor	0.98
amplitude	\$60,000
period	10

This table presents the parameter values used in the simulation
I make alterations to the parameters for the welfare estimates, and for sensitivity analysis.

To keep the analysis tractable, I follow the behavior of a single firm over the period and introduce a kink at \$25,000 of taxable income. This threshold is mainly chosen for illustrative purposes and to mimic one of the bracket cut-points in the TRA1986 tax code. To obtain the data and to solve the model, I simulate and solve over 671 periods (1990 to 2660) and pick out some middle stationary states. Specifically, I choose years 100 to 109 corresponding to a ten periods for output[7]. This is done to obtain steady state solutions that are not affected by the initial and terminal conditions. It is noteworthy to explain that I choose a representative ten year period corresponding to a steady state and that ten is the period for output. The stationary state that I consider in this study is for a firm facing a sinusoidal output function.

[7]I choose the sample from somewhere in the middle in order to ensure that I obtain values closest to the steady state.

4.5 Results

4.5.1 Income and Expenditure Reporting

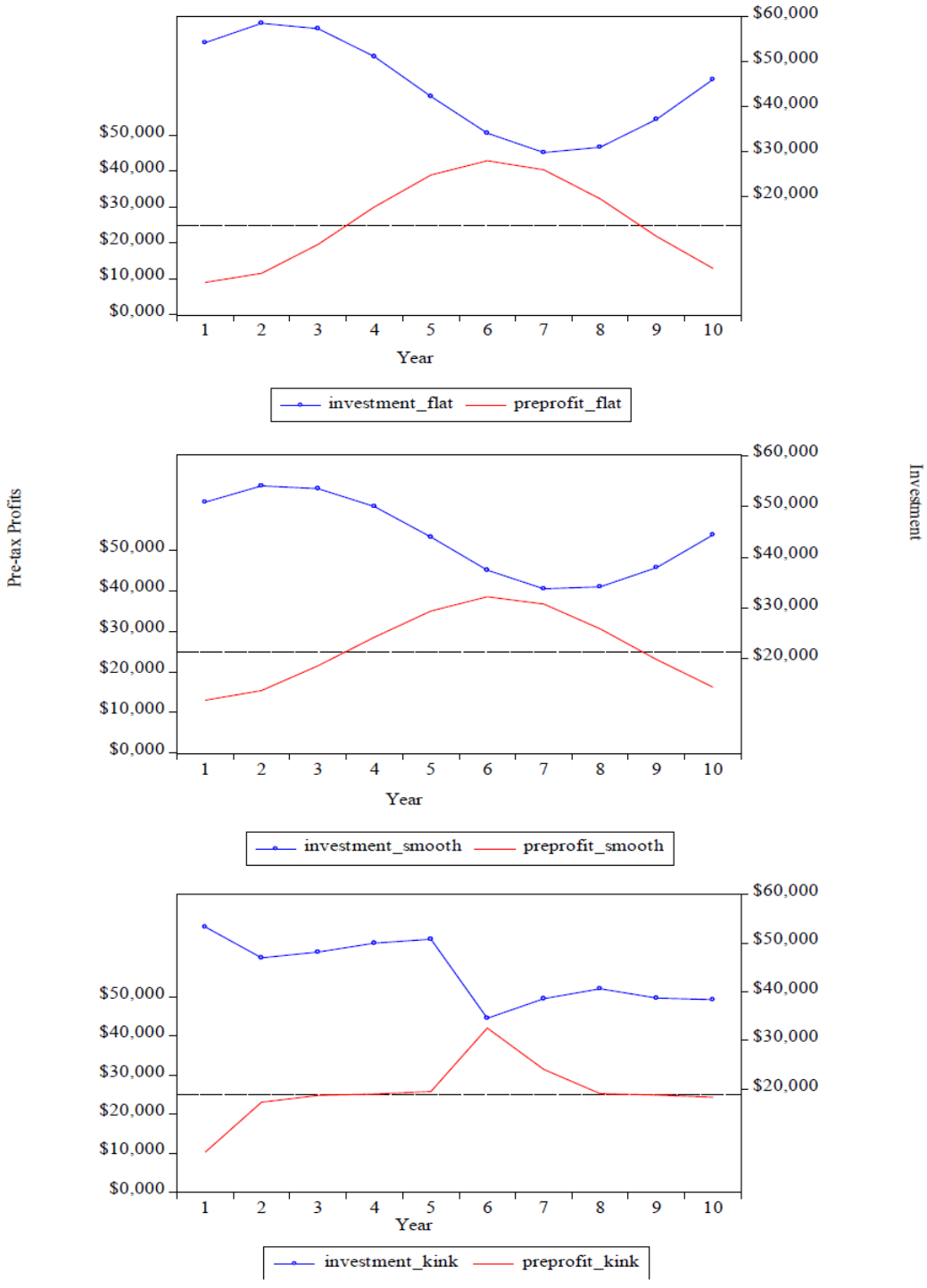
The analysis proceeds by first examining the distribution of pre-tax profits around the kink point for the kinked and smoothly graduated tax systems. The distribution of pre-tax profits is then compared to the flat tax (baseline) system. Any difference in the reporting behavior between the kinked tax code and the baseline system is taken to mean that firms are strategically managing their expenses to lower their tax liability.

Figure 4.1 presents the distribution of pre-tax profits for a single firm over a ten year period. The results indicate minimal deviations around bracket cut-point of $25,000, suggesting that a firm manipulates its taxable income to stay around the kink time over time. The pattern of pre-tax profits differs from that obtaining under baseline tax system in that there is no evidence that a firm is strategically managing its income by either keeping it around the kink point or avoiding the area around the kink point altogether.

Having established that firms do indeed manipulate their pre-tax profits in response to incentives generated by a kinked tax code, I then examine how firms go about manipulating their incomes. The knowledge on what strategies firms employ for tax avoidance is of interest to economists and tax authorities. This study is particularly interested in establishing whether or not the structure of the tax code influences the investment or employment patterns of the firms. Thus, I observe the behavior of investment and labor vis-à-vis pre-tax profits.

The results also reveal that the patterns of investment differ depending on the

nature of the tax code. Specifically, the results show a marked similarity in the patterns of investment under the flat and smooth tax codes. These findings suggest that the smooth tax system does not result in strategic investment behavior. With regards to the kinked tax code, the results indicate that the firm opts to keep its investment fairly stable during periods when it maintains its profits around the kink point. This tendency by a firm to stabilize investment during periods of bunching could be interpreted as an effort to strategically manage its investment when the tax code is kinked. Additionally, results in Figure 4.1 (row 3) indicate some evidence of the firm opting to increase investment expenditure during periods of bunching. Specifically, the results reveal that investment exhibits an increasing trend in segments where pre-tax profits appear to be managed to stay around the kink-point, and is lowest when pre-tax profits reach the maximum. This result suggests that a firm engages in strategic investment behavior when faced with an upward kink.

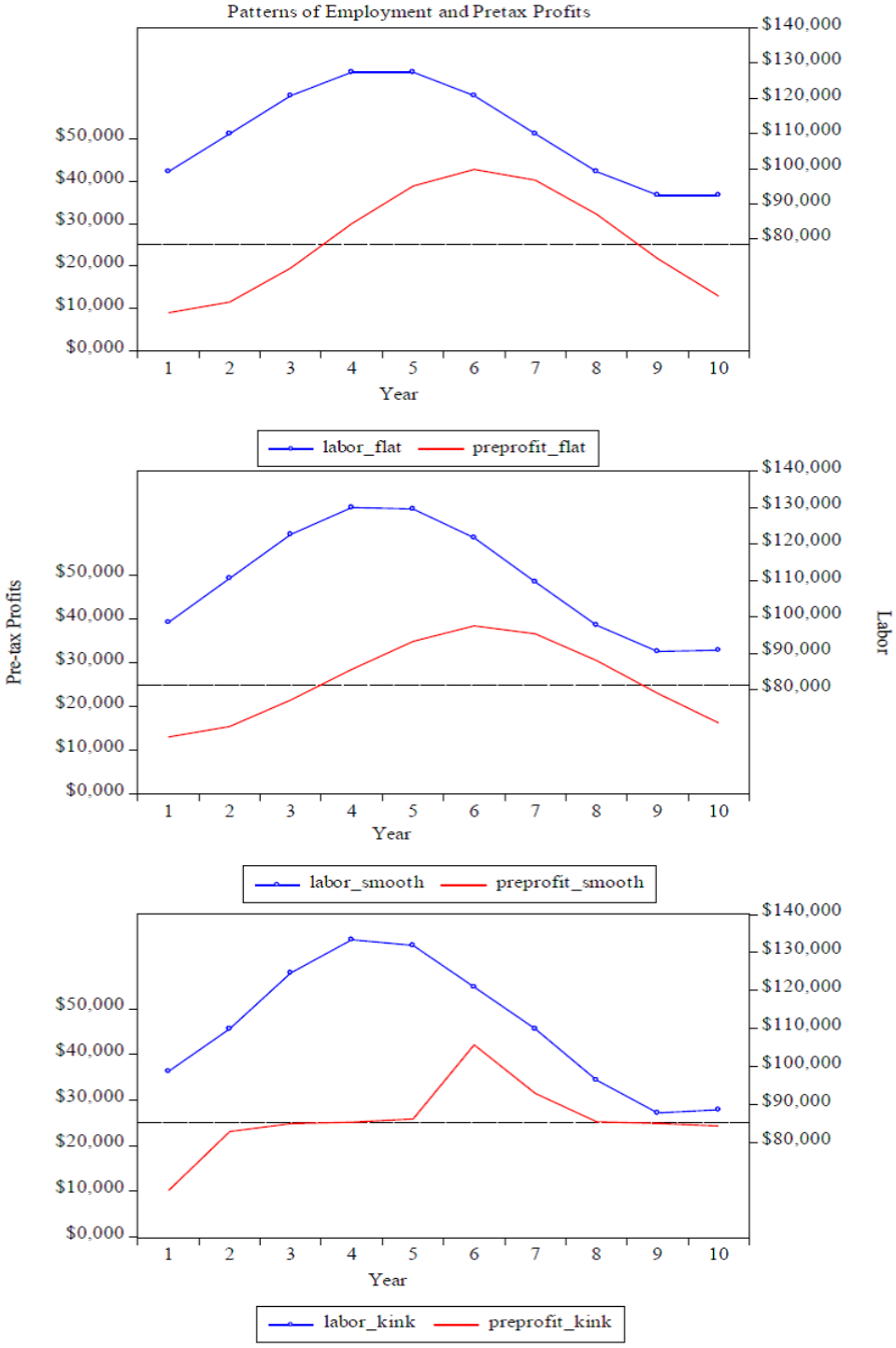


This figure compares the patterns of investment and pre-tax profits under the flat tax, smooth tax code and kinked tax code. The dashed line corresponds to the kink point at $25,000.

Figure 4.1: Patterns of Pre-tax Profits and Investment

Using a similar approach, I analyze the patterns of employment and pre-tax profits. Results in Figure 4.2 show that there is no difference in the pattern of labor for the kinked, flat and smoothly graduated tax codes. In fact, the pattern of employment appears to follow the cyclical pattern of output suggesting that a firm does not respond to changes in tax policy by altering its employment.

The income and expenditure analysis point to evidence that tax policy could explain the differences in reporting behavior. Firms respond to a kink introduced in the tax code by stabilizing their pre-tax profits around the threshold. If I observe a number of firms at a point in time, I am likely to observe notable bunching at the threshold. Additionally, given the indications that employment profiles are similar for all three tax codes considered, an argument can be made that firms are not strategically managing their employment profiles.



This figure compares the patterns of employment and pre-tax profits the flat tax, smooth tax code and kinked tax code. The dashed line corresponds to the kink point at $25,000.

Figure 4.2: Patterns of Pre-tax Profits and Employment

4.5.2 Steady-State Welfare Analysis

The welfare analysis is based on the hypothesis that a profit-maximizing firm will choose an optimal plan for investment and labor under the baseline tax code, while a firm facing a kinked tax code will choose sub-optimal plan to achieve a similar level of output. Therefore, I argue that a firm facing a kinked tax code will engage in the strategic timing of investment and labor to influence the tax liability thereby resulting into a potential loss of revenue and profits. These losses constitute the welfare costs that come about because firms end up choosing a costly method of production, which will, in turn, affect revenue and productivity.

Based on the hypothesis stated above, I expect the tax base (profits) to be smaller under a kinked-tax system than under a baseline tax code. The change in after-tax profits relative to the world with kink-free tax code represents a measure of welfare loss that this study uses. This measure of welfare is justified since the study assumes a sales constrained firm implying that revenue is neutral. One can also look at the welfare measure as a percentage change in pre-tax profits that must be taken away from a firm in the kink-free regime to generate the same after-tax profits the firm would have produced if the kinked tax code had not been introduced. This measure is informed by the compensating differential measures that remain widely used in the literature (Altig and Carlstrom, 1992; Fehr et al., 2013).

The welfare effects considered in this study are two-fold: first order and second order. The first order effects encompass the change in pre-tax profits under the different tax systems relative to the baseline tax regime. On the other hand, second order effects will include any effects on the patterns of expenditure (investment and labor) as well as how they vary over the business cycle. In this study, total welfare is

calculated as follows:

$$Total\,Welfare = After\,tax\,profits - tax\,revenue \tag{4.5.1}$$

If the proposed tax change is revenue neutral, then taxes do not change resulting into the the following: $Total\,Welfare = pretax\,profits$. Using this measure of total welfare, I estimate the welfare costs of a switch from a flat to a kinked tax code as [8]:

$$Welfare\,Change = Pre\,tax\,profits_{kink} - Pre\,tax\,profits_{flat} \tag{4.5.2}$$

Where $Pre\,tax\,profits_{kink}$ refers to profits obtaining under a distortionary tax code (kinked graduated tax code or smoothly graduated tax code); $Pre\,tax\,profits_{flat}$ refers to the profits under the baseline (flat tax) economy.

A negative value of the welfare measure entails a welfare loss, while a positive value signifies a gain. Because I cannot guarantee that changes in tax policy are revenue neutral, I also incorporate revenue changes in my welfare analysis.

Using the set of parameters in Table 4.2 as a starting point, I conduct welfare analysis of switching from a flat tax code to a kinked graduated tax code. Specifically, I focus on estimating the welfare effects of switching from a flat tax to either a kinked or a smooth tax code. Results in Table 4.3 reveal that a switch from a flat tax to a kinked graduated tax code induces greater welfare costs than a move to a smooth graduated tax code. For example, when the marginal tax rate jumps by 0.1, a kinked tax code is associated with welfare loss of \$182 compared to only \$49 for a smooth tax code. This result means that welfare costs are higher by about 73% for the kinked tax code compared to the smooth tax code. I observe the same trend when I alter the amplitude, with the kinked tax code consistently generating greater welfare losses.

[8] This measure of welfare change is similar to that developed by Auerbach and Kotlikoff (1987).

Overall, the results suggest that a move towards more discrete tax systems is not welfare enhancing.

Table 4.3 also presents the welfare estimates for varying parameter values. I present the results from varying the values for marginal tax rates, and adjusting the measure of output fluctuations (amplitude). The results indicate that the welfare cost is increasing in marginal tax rates when the tax code is graduated (kinked or smooth). Specifically, the welfare cost increases by 70% (from \$54 to \$182) when the tax rate rises from .05 to .1 under the kinked graduated tax code. The results are different when the tax code is smoothly graduated. In this case, results show that the welfare cost increases by 59% for the same change in marginal tax rates. These findings are in line with empirical evidence and theoretical arguments that the degree of bunching increases with larger jumps in marginal tax rates. Additionally, these findings also offer support to the findings in essay two where I show that the coefficient of discontinuity is positively related to the size of the jump in marginal tax rates.

Table 4.3: Welfare Estimates: Relative to Flat Tax

Parameters		Mean Pre-Tax Profits			Welfare Loss Relative to Flat Tax	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Amplitude	Marginal Tax Rate Increase	No Kink (Flat Tax)	Kink at \$25,000	Smoothly Graduated	Kink (4)-(3)	Smooth (5)-(3)
\$60,000	0.1	\$25,899	\$25,717	\$25,850	\$182	\$49
\$60,000	0.05	\$25,899	\$25,845	\$25,879	\$54	\$20
\$90,000	0.1	\$25,897	\$25,690	\$25,804	\$207	\$93
\$100,000	0.1	\$25,896	\$25,682	\$25,787	\$214	\$109
\$120,000	0.1	\$25,873	\$25,659	\$25,748	\$214	\$125

This table shows welfare estimates for smooth and kinked graduated tax codes.

I also examine how the welfare estimates change when amplitude (output fluctuations) changes. The results in Table 4.3 reveal that the welfare estimates are sensitive to changes in amplitude. Specifically, I find a positive association between welfare

losses and amplitude for both types of graduated tax codes. For example, under the kinked tax code, doubling the amplitude raises the welfare cost by 15%. However, the welfare loss increases by 57% under the smooth tax code for the same change in amplitude. These results suggest that the welfare costs are more sensitive to changes in amplitude when the tax code is smoothly graduated.

To put these welfare estimates into context, I present the welfare losses that I calculated in Table 4.3 as a percentage of revenue raised. Table 4.4 displays the welfare estimates relative to revenue (percentage). The study finds that a kinked tax code results into welfare loss amounting to 3% of revenue when the marginal tax rate increases by 0.1. This estimate reduces to 1% of revenue when the marginal tax rate only increases by 0.05 for the kinked tax code. In line with the results in Table 4.3, the welfare losses are lower under the smooth tax code than the kinked tax code. For the smooth tax code, an increase of 0.1 in marginal tax rates results into welfare losses of about .7% of revenue. This estimate reduces to .4% of revenue when the marginal tax rate drops by 0.05. The results also reveal that the estimates of welfare loss as a percentage of revenue do not vary that much with changes in amplitude. These results strengthen my earlier findings and conclusions that the kinked tax code is more distortionary than a smooth tax code.

Table 4.4: Welfare Estimates: Proportion of Revenue

Parameters		Mean Tax Revenues			Welfare Loss Relative to Flat Tax		Welfare Loss Relative to Revenue	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Amplitude	Marginal Tax Rate Increase	No Kink (Flat Tax)	Kink at $25,000	Smooth	Kink	Smooth	Kink (6)/(4)	Smooth (7)/(5)
$60,000	0.1	$3,885	$6,609	$7,209	$182	$49	2.75%	0. 68%
$60,000	0.05	$3,885	$5,323	$5,563	$54	$20	1.01%	0.36%
$90,000	0.1	$3,935	$6,838	$7,314	$207	$93	3.04%	1.27%
$100,000	0.1	$3,885	$6,917	$7,360	$214	$109	3.09%	1.48%
$120,000	0.1	$3,884	$7,074	$7,458	$214	$125	3.03%	1.68%

This table presents estimates of welfare costs as a percentage of tax revenues.

Although the welfare estimates in Tables 4.3 and 4.4 appear to be small, the welfare impact of changes in tax policy could be larger if the effects of tax policy on the profiles of investment and employment are incorporated. Such effects constitute second-order welfare effects. These second-order effects are of great interest to economists since they could be associated with first order effects on quantity. My arguments are in line with Akerlof and Yellen (1985) who point out that small deviations from rationality can have larger first-order implications for quantities. In this study, the second order welfare effects correspond to the deviations alluded to in the Akerlof and Yellen (1985) paper. Hence, the presence of second welfare effects in this study could have first order effects on quantities resulting into greater welfare consequences.

Figure 4.3 presents patterns of investment for the flat tax, kinked graduated tax and smoothly graduated tax codes. Two points are worthy making with regards to the investment behavior. First, I observe great similarity in patterns of investment between the smoothly graduated and the base tax code. Specifically, I see that in-

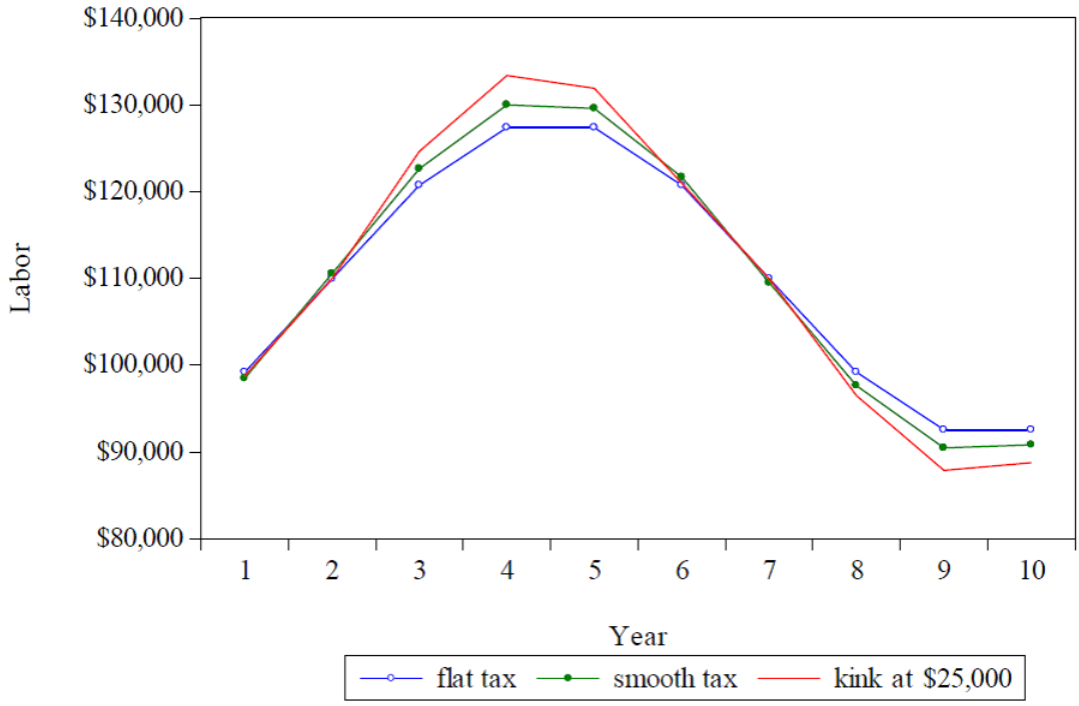
vestment has a relatively smooth and cyclical pattern under the flat and smoothly graduated system. Second, I observe a distinct pattern of investment under a kinked tax code. Also notable is the observation that investment exhibits significant fluctuations when the tax code is kinked than when it is flat or smooth. The observed deviation of investment profile under the kinked tax code from that prevailing under the flat tax code (optimal strategy) constitutes a welfare loss. A look at Figure 4.3 reveals a deviation of investment from the optimal strategy amounting to about $10,000. Drawing on Akerlof and Yellen (1985), my study makes a case that such deviations can have more far-reaching welfare consequences. These results also suggest that a kinked tax code could explain strategic investment behavior.

I conduct a similar analysis for labor and show the results in Figure 4.4. The results indicate that the patterns of employment are fairly similar for all three tax codes and appear to follow the pattern of output. Based on these results, I conclude that firms do not engage in strategic employment behavior in response to changes in tax policy.

The second order welfare effects could also operate through the influence of tax code on investment and employment over the business cycle. Therefore, I conduct additional analysis to determine the role of tax policy in the behavior of investment and employment behavior over the business cycle. My analysis is similar to Jang-Ting and Lansing (1997) who analyze how the kinked tax code affects the comovement and fluctuations of investment and labor over the business cycle. The argument is if the tax code has an effect on the behavior of labor and or investment over the business cycle, then there could be concerns that the tax policy could be exacerbating the business cycle. If that is indeed the case, then the costs of the tax code to the economy is even larger than the estimates I earlier presented. I analyze the behavior of investment and employment relative to output for the kinked, smooth and flat tax

This figure presents investment patterns under the flat tax system, kinked graduated tax system and smooth graduated tax code.

Figure 4.3: Patterns of Investment



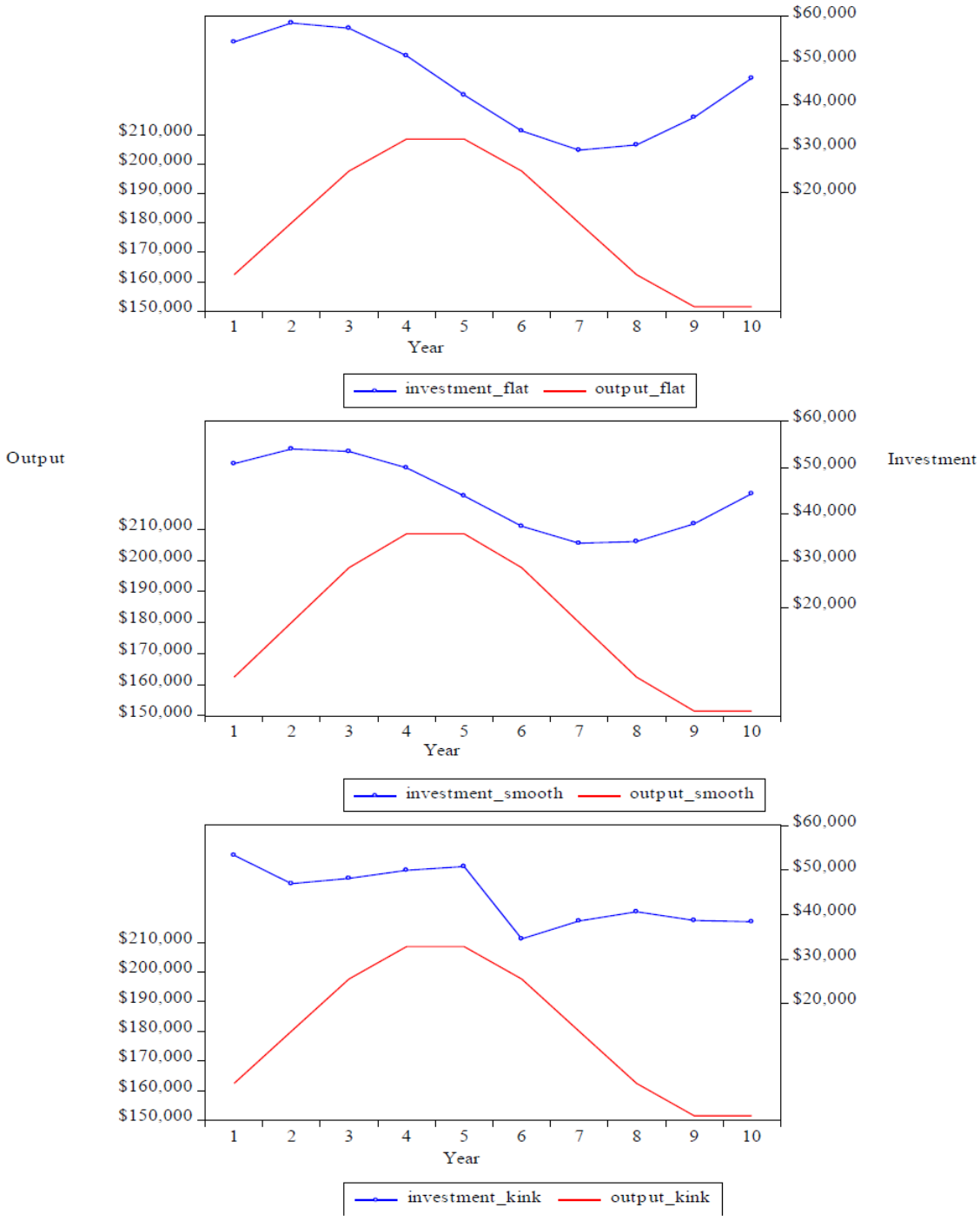
This figure presents employment behavior under the flat tax system, kinked graduated tax system and smooth graduated tax code.

Figure 4.4: Patterns of Employment

systems.

Figure 4.5 presents results for the pattern of investment and output for kinked graduated and smoothly graduated tax codes relative to the flat tax code (baseline). The results indicate that a firm will employ optimal investment strategies when the tax code is flat or smooth but engage in strategic investment behavior when the tax code is kinked. I base my conclusion on the stark difference in the investment pattern under kinked graduated tax code. Unlike the smooth and flat tax codes, investment profile exhibits higher variability under the kinked tax code and also portrays sub-optimal behavior. Rather than increasing investment in anticipation of a future increase in output as is the case under the flat and smooth tax codes,

the firm focuses on making strategic investment in order to affect the time profile of taxes. Additionally, these results support my earlier finding that investment responds to changes in the tax system.



This figure presents the patterns of investment and output for the flat tax, smooth graduated, and kinked graduated tax codes.

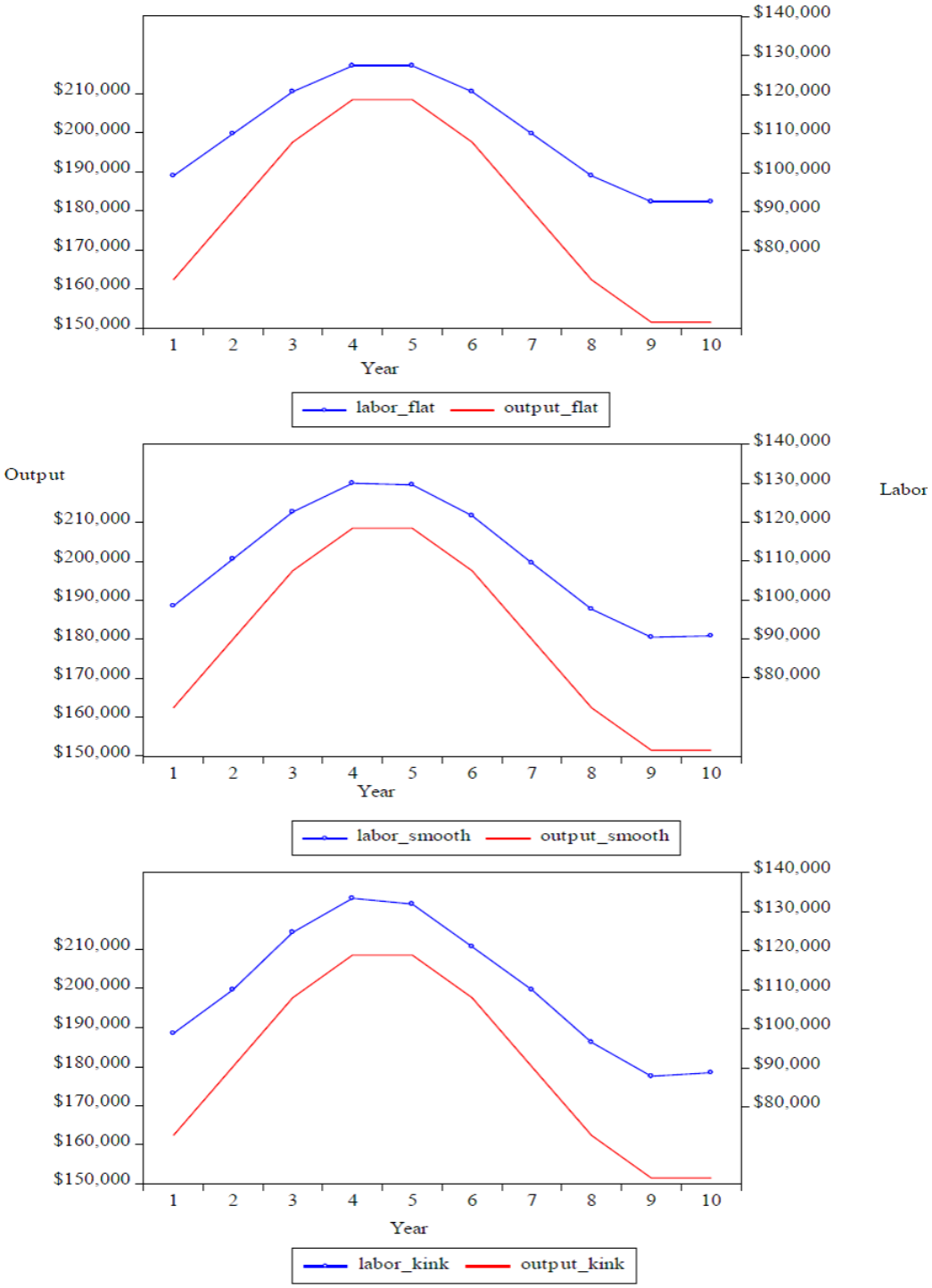
Figure 4.5: Patterns of Investment and Output

Figure 4.6 presents the employment profiles for the flat tax, smooth and kinked tax codes. The results indicate that labor is procyclical under all tax systems considered in this study, suggesting that the kinks do not explain the comovement of labor and output. This result renders support to my earlier findings that showed no evidence of strategic employment in response to kinks.

Even though a non-convex (downward) kink is rare in practice, I make an attempt to study it since the US federal tax code features it. Results in the Appendix show significant variability in all variables of interest over time. The notable variation in pre-tax profits, labor and investment could be explained by the prediction that taxpayers tend to avoid the area around the kink point when the marginal tax rate declines, thereby generating gaps in the distribution of pre-tax profits.

4.5.3 Sensitivity Analysis

It should be noted that I have designed the base-case model so that the firm is around the kink point. In this section, I relax this condition to include firms that are distant from the threshold or kink point of $25,000. Such firms would have no incentive to bunch at the kink point since their pre-tax profits are either way too low or too high. The idea behind this analysis is to establish whether or not the kink is only relevant for firms in the neighborhood of the threshold. To conduct this sensitivity analysis, I consider two types of firms. Those that are always to the right of the threshold (high income) and those that are always to the left of the threshold (low income). Both types of firms have no incentive to bunch and would behave as though they faced the flat tax. In essence, having one big kink would make every firm on either far side of the kink face the flat tax.



This figure presents the patterns of output and labor for flat tax, smooth graduated, and kinked graduated tax codes.

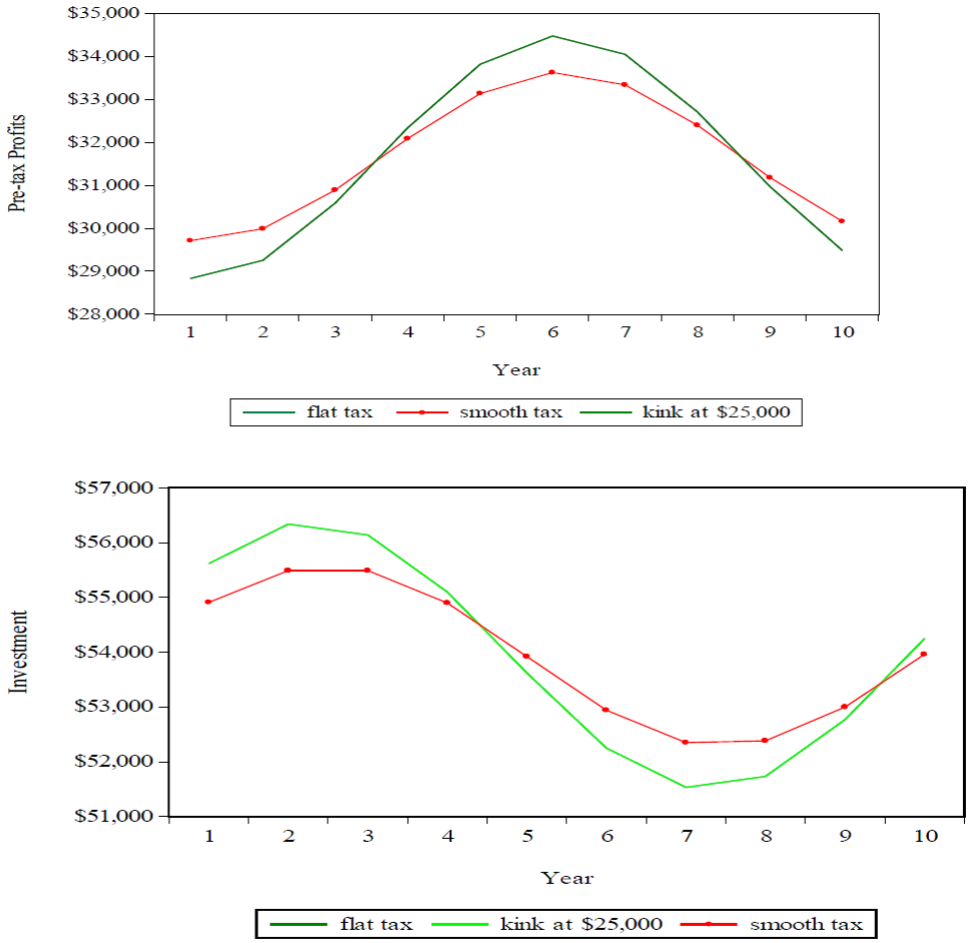
Figure 4.6: Patterns of Output and Employment

With regards to the effect of the tax code on bunching behavior, I examine the distribution of pre-tax profits for the firm that is always below the kink, and for the one that always locates above the kink. I then compare the pre-tax profits for each type of firm under the smoothly graduated tax code and the kinked tax code.

Figure 4.7 reports the patterns of profits and investment profiles for the firm with pre-tax profits that are greater than the kink point of $25,000. A few points are worth noting about this graph. First, the results show that the kinked tax code is now equivalent to the flat tax implying that a firm is not affected by the kink. However, the smooth tax code appears to have an effect on this firm. In particular, I find that the median profits are much lower under the smooth tax code than the kinked and flat tax codes. This result could be interpreted to mean that a smoothly graduated tax code tends to have effects across a wider range of income than the kinked tax code. The results reveal that investment profiles are similar across the tax codes,suggesting that the kinked tax code has no effect on investment behavior for a firm outside the neighborhood of the threshold.

The analysis for a firm with pre-tax profits lower than the kink point reveals similar behavior (Figure 4.8). Overall, these results indicate that the kinked tax code is only relevant for firms with incomes in the neighborhood of the threshold. However, it appears like the smoothly graduated tax code maintains some effect on tax code.

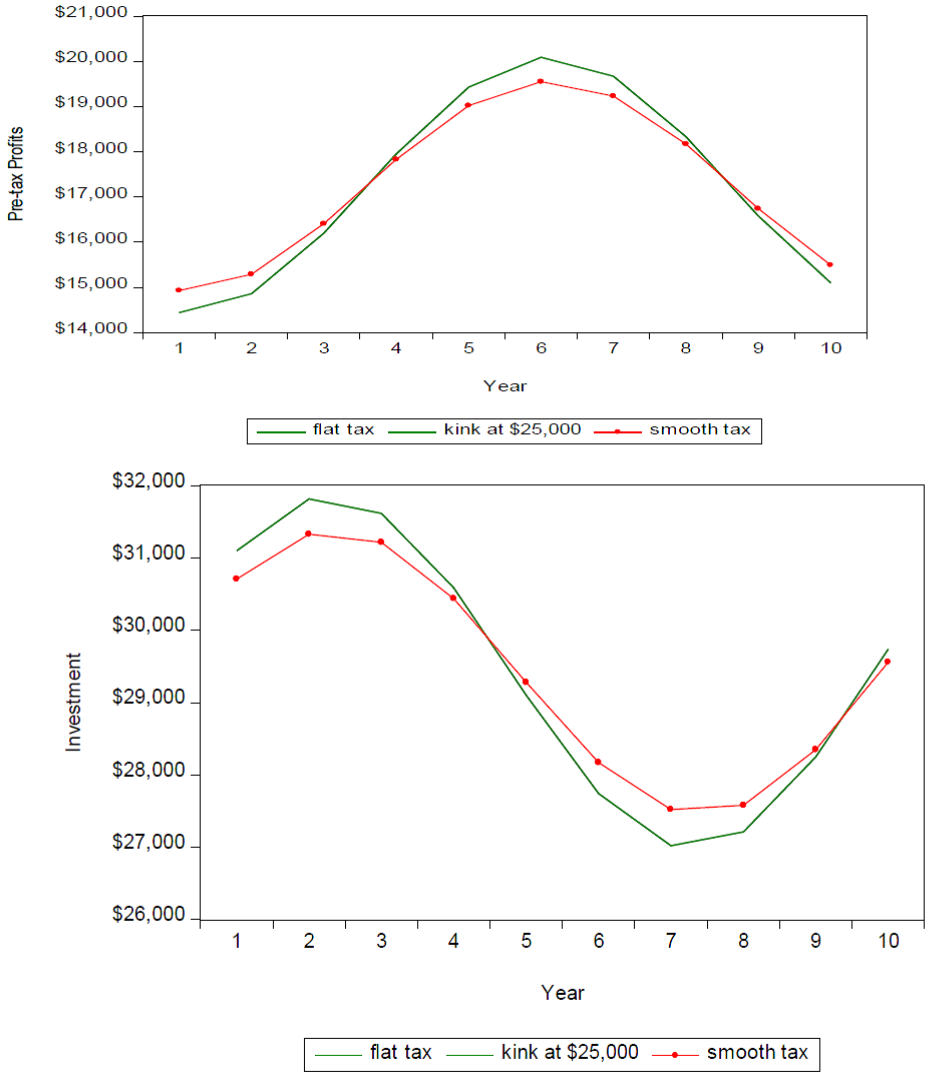
Table 4.5 presents the welfare estimates for non-bunching firms when the marginal tax rate is 0.1. In the first row, I consider a firm with mean pre-tax profits that are greater than $25,000 while the second row shows the estimates for a firm with mean profits that are less than the kink point. The results from welfare analysis reveal that there are no welfare costs for these firms. In fact, the smoothly graduated tax code generates welfare gains of $1 for both types of firms. These results suggest that the kinked tax code only affects the behavior of firms that are in the neighborhood of the



This figure shows reporting behavior for a firm with mean pre-profits greater than $25,000.

The flat tax and kinked tax codes coincide in this case.

Figure 4.7: Reporting behavior for a firm with mean pre-tax profits to the right of threshold



This figure shows reporting behavior for a firm with mean pre-profits lower than $25,000.

The flat tax and kinked tax codes coincide in this case.

Figure 4.8: Reporting behavior for a firm with mean pre-tax profits to the left of threshold

kink.

Table 4.5: Welfare Loss for non-bunching firms

	Parameters		Mean Pre-tax Profits			Welfare Loss Relative to Flat Tax	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mean Pre-tax Profits	Amplitude	Marginal Tax Rate Increase	No Kink (Flat Tax)	Kink at $25,000	Smooth	Kink (4)-(3)	Smooth (5)-(3)
$> \$25,000$	$60,000	0.1	$31,655	$31,655	$31,635	$0	-$1
$< \$25,000$	$60,000	0.1	$17,625	$17,625	$17,266	$0	-$1

This table presents welfare estimates for firms with mean pre-tax profits outside the neighborhood of the kink point ($25,000).

Thus, the sensitivity analysis provides support for my model which is designed to include a firm with profits in the neighborhood of the threshold. Including firms of different characteristics would not change the model performance and the main conclusions of the study. In fact, simulating over a large number of firms would reproduce the bunching graphs that I discussed in essay 2. While the analysis makes reference to how changing scale of output impacts the behavior of firms, this study does not attempt to provide or investigate the theory of firm size. Moreover, firm size is exogenous in the model. Rather, this study focuses on establishing how tax codes influences investment dynamics.

4.6 Conclusion

Whether or not a move to simpler and discrete tax schedules enhances efficiency remains a central question for tax economists. Despite these unsettled issues, there is a general consensus that the structure of the tax code has implications for revenue,

economic growth, and welfare. With proponents of tax reform arguing that tax code simplicity brings about efficiency, questions examining how a switch from a relatively flat tax schedule to a simpler (step function-type tax code) have assumed importance in tax literature. In this study, I provide a simulation model of strategic cost shifting behavior when the tax code exhibits kinks. The model is also useful for studying firms' strategic responses to tax policy as well as assessing the welfare implications of the trend towards simplified tax codes. The model could also shed some light on the existence and consequences of real responses to tax policy.

Using a numerical simulation approach, my study finds that a kinked tax code induces strategic responses including misreporting income, and strategic expenditure decisions. Specifically, I find that an upward kink is associated with bunching behavior whereby a firm chooses to manipulate its income to stay around the kink point. The results also indicate that firms engage in strategic timing of their investment to stay at the kink point. I do not find evidence of strategic management of labor expenses, suggesting that the distortionary effects of a kinked tax code operate through investment. The results also reveal that a downward kink brings about volatility in the choice variables as firms opt to avoid the area around the kink point.

Additionally, the welfare analysis reveals that a kinked tax code results in welfare costs that are increasing in size of the kink (marginal tax rate) and declining in smoothness of the tax schedule. The numerical welfare estimates indicate that a kinked graduated tax code is accompanied by greater welfare costs than a smoothly graduated tax code. This finding also infers that 'complicated' tax systems that avoid kinks in the marginal tax rates can retain the progressivity inherent in the current tax code tend to be less costly than graduated tax codes with large jumps in marginal tax rates. This paper also finds that there are possible second welfare effects that include sub-optimal investment as firms prioritize tax avoidance. Overall, I argue that

a move to simpler and flatter tax schedules is costly to tax system and the economy as a whole.

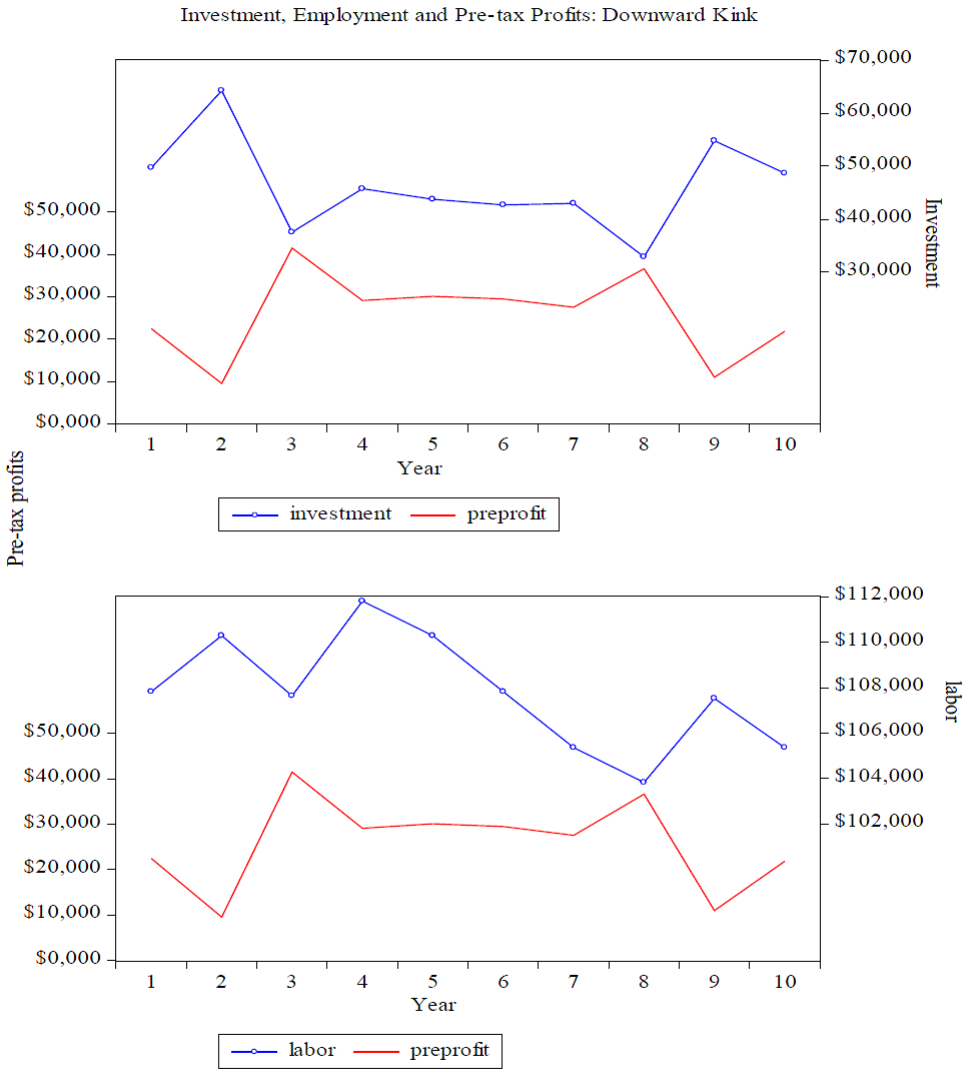
This study makes some important contributions to the tax avoidance and public finance literature by providing a model of strategic cost shifting behavior when the tax code exhibits kinks. The model employed in this study could be useful for comparing graduated tax codes under different scenarios. For example, one can compare the responses for graduated tax codes with fewer brackets to that with a higher number of tax brackets. My model makes this type of analysis and comparison possible. The model could be further developed to include more kinks or tax brackets so as to enable analysis of how added kinks impacts taxpayers.

Additionally, the model could be used to assess real and avoidance responses to tax policies. The distinction between these types of responses is significant of interest to economists. Given that the most commonly used measures of tax avoidance behavior do not adequately distinguish between real and avoidance responses, the model could help shed some light on this. The paper also makes a contribution by providing a framework for analyzing investment behavior and conducting welfare analysis in the face of a kinked tax code.

It should be noted that this is not a study of the theory of firm size, rather the paper seeks to establish how tax codes influence behavior over time. The model provided in this study is a model of an individual firm over time which I adjust to simulate the behavior of different firms over time. One of the main findings of the paper is that over time, profits fluctuate cyclically, and firms manipulate expenditure so as to spend much of their time around the kink point. When one looks at the behavior of several firms at one point in time, one will find that many firms are observed around the kink point. This would,in turn, explain the bunching behavior that was established in essay two.

The model I use in this paper is a stylized one. In my future work, I would like to calibrate the model to US tax code. This would allow for estimations of aggregate welfare costs of the US corporate tax system.

4.7 Appendix 3



This figure shows the patterns of investment, pretax profits and employment when there is a drop in marginal tax rates (downward or non- convex kink).

Chapter 5

Conclusions

The need to reform tax systems to make them more efficient remains a critical issue for countries world over. One of the major issues of the debate has to do with whether or not tax codes should be complicated (featuring a larger number of tax brackets and smaller kinks) or much simpler (discrete: having fewer tax brackets but bigger kinks). The proponents of tax reform and tax authorities tend to favor simpler tax codes over complicated schedules.

As the wind of tax reform was blowing all over the world, the US was not spared from the reform effort. The US instituted several reforms to the federal tax code (individual and corporate) that included changing tax rates, varying the number of tax brackets, and changing certain provisions in the tax code. Of all the reforms, the TRA1986 remains the most comprehensive and significant change to the tax code. Recognizing the potential effects of changes in tax policy on taxpayers, scholars have devoted a significant amount of resources to studying the topic. In particular, researchers have sought to understand the strategic responses of taxpayers to changes in tax policy using various methods.

Additionally, given the large scale changes that came with TRA1986, there is ample literature on its effect on tax payers and economic activity. Nevertheless, most prior research has focused more on studying the strategic responses of households, thereby creating a gap in the literature.

Studies that have been undertaken on the effect of TRA1986 have also focused more on individual taxpayers, and how the reform impacted economic activity (saving and investment). Other studies have also examined how the reform impacted tax avoidance behavior among both individuals and tax payers. Despite this focus on studying the TRA1986 and its effect on tax avoidance behavior, issues remain as to how best to measure tax avoidance, as well as what estimation methods to use. In essay 1, I address this issue by employing better estimation techniques to capture the effect of TRA1986 on tax reform accurately. Specifically, my study provides robustness to the theoretical econometric techniques usually employed to model tax avoidance by using a fractional response model (FRM), a modeling technique that is better suited to handle bounded dependent variables. Additionally, my study also contributes to tax avoidance literature by incorporating the role of tax sustainability (a tax strategy to maintain low levels of tax avoidance outcomes) into the tax avoidance research. By recognizing that firms do not only concern themselves with tax avoidance strategies but also have sustainability goals, this study makes a significant contribution to tax avoidance literature. These contributions could help improve the modeling of tax avoidance behavior.

Results in essay 1 indicate that tax avoidance is not the only strategy pursued by firms but that firms also focus on maintaining a stable level of tax outcomes (sustainability). As detailed in Chapter 2, incorporating the sustainability aspect into the model of tax avoidance behavior is important for accurately modeling tax avoidance. Given that tax avoidance continues to be an issue for most countries, the benefits of having a more accurate model of tax avoidance cannot be overemphasized.The results suggest that TRA1986 created incentives for firms following a sustainable tax strategy to participate in more tax avoidance behavior. Specifically, my study establishes that firms that engage in tax planning that produced stable tax outcomes

before the reform were unable to sustain those strategies without additional levels of tax avoidance in the post-reform period. This finding has implications for persistence of tax avoidance behavior as well as the effectiveness of tax policy, especially if the objectives of tax policy changes are expected to reduce incentives for tax avoidance. The findings in this essay suggest that tax reforms that are aimed at reducing the incentives for tax avoidance behavior could be more effective if they also considered firms' overall tax strategies. As the results show, tax sustainability plays a role in determining how the tax reform impacted tax avoidance. In fact, the results reveal that most firms abandoned their sustainability strategy in preference for the rewards of tax avoidance in post-reform period. These findings also imply that the reform made tax avoidance behavior a more attractive option for firms following a sustainable tax strategy.

Essay 2 focuses on analyzing how firms respond to incentives generated by discrete graduated tax codes. By focusing on the responses to the corporate tax code, this study contributes to the scanty literature on strategic responses to the corporate tax code. This study also contributes to the literature by employing a validity test developed in regression discontinuity designs (RDD) to examine strategic responses to tax policy. This method is particularly useful for studying strategic responses since it has minimal data requirements. Given the difficulty of obtaining tax return data and firm level data, using a method that only uses one variable presents the better option and opportunity to study strategic behavior. The knowledge of strategic responses at kink points is essential for estimating tax price elasticities as well as welfare costs of the tax policy.

Using a validity test developed in RDD, essay 2 finds evidence of firms manipulating their taxable income to minimize their tax liabilities. The results show that most firms opt to locate on the lower tax side of the threshold for the two tax codes con-

sidered. Given the differences in the number of tax brackets and marginal tax rates for the tax schedules studied, it is important to make a note on how the estimates of discontinuity vary with respect to the change in marginal tax rates. In support of the theoretical arguments and my hypothesis, the study confirms that the estimates of discontinuity are increasing in marginal tax rates. The findings also imply that larger changes in marginal tax rates will elicit larger estimates of discontinuity, suggesting that taxpayers are more responsive to more substantial changes in tax rates. Additionally, the results also show a negative discontinuity estimate when there is a drop in marginal tax rates, supporting the hypothesis that most taxpayers seek to minimize tax related costs.

While prior literature has examined various aspects of strategic responses to tax policies including welfare analysis, a gap remains as to how taxpayers go about their tax avoidance behavior, and what the efficiency implications of tax policies are.

In essay 3, I provide a model of strategic cost shifting behavior and use it to examine reporting behavior and to estimate welfare effects of tax policy. This model represents a contribution to the literature in that it is useful for comparing welfare estimates across tax schedules. For example, I use the model to estimate welfare effects of a smooth tax code and a kinked tax code by just altering the smoothness parameter. Doing so also allows one to approximate the welfare effects of tax policies that involve changing the number of tax brackets. This information is useful for designing more effective and efficient tax systems.

Even though there have been calls to move from complicated (or approximately smooth tax codes), there is scanty evidence to support the efficiency arguments advanced by the proponents of tax reform. Using simulation techniques to investigate benefits of alternative corporate tax schedules that avoid kinks while maintaining progressivity, my study finds that a kinked tax code induces greater strategic re-

sponses including misreporting of income, and strategic expenditure decisions, than a smooth tax code. This result calls into question the justifications for moving from smoothly graduated tax codes (complicated tax codes) to kinked tax codes. Results from welfare analysis also do not render support for simpler tax codes. As detailed in Chapter 4, the results show that simpler tax codes induce greater welfare losses than complicated tax regimes. These findings are robust to changes in marginal tax rates and to variability in output.

The fact that the welfare analysis is done within the partial equilibrium framework could explain the smaller welfare estimates obtained in this study. Therefore, when looking at the estimates of welfare costs, one has to bear in mind that the study only considers a small representative firm, in a small sector. Despite these restrictive assumptions, I believe that the welfare effects could be larger once the effects of the tax codes on investment and employment are adequately taken into account. In this study, I find evidence that firms alter their investment strategies to influence their tax liabilities. In particular, the distinct investment profile under the kinked tax code could be understood as an attempt by firms to manipulate their investment profiles over time. Further, based on the results, I argue that a kinked tax code is associated with sub-optimal investment strategies. Overall, I argue that a move to simpler tax schedules would stimulate strategic responses in the form of strategic cost shifting behaviors, and is not welfare enhancing.

Finally, the model developed in the third essay provides a useful framework for understanding the bunching behavior that essay two focuses upon. Even though the model assumes a single small firm in a small sector, it is possible to recreate the cross-sectional graphs obtained in essay two by drawing on the findings in essay 3. By observing the distribution of pre-tax profits for a single firm over time, one could generate simulations that look like the graphs presented in essay two.

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