Does the District of Columbia 2012 Income Tax Policy Reform Increase Tax Revenue? Evidence from a Regression Discontinuity Design

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January 2019

Abstract

The use of the city level of Washington, D.C. individual income tax data (IIT) and regression discontinuity design (RDD)for the analysis of local fiscal income tax policy reform is crucial for this paper. It is important because using the city level administrative IIT data allows researchers to analyze many unaddressed questions in the literature because they rely on Federal level tax data. Moreover, RDD is a way of estimating treatment effects and establishing causality in a nonexperimental setting. It is a pretest-posttest design that elicits the causal effect of interventions by assigning a cutoff or a threshold above or below which intervention is assigned. By comparing observations lying closely on either side of the threshold. Causal inferences from RDD designs are potentially more credible and transparent than those from typical "natural experiment" strategies (Difference-in-Differences or Instrument Variables). In 2012 the District of Columbia implements a new income tax rate on taxpayers who earn over $350,000. This research assesses the impact of Washington, D.C. government income tax policy change (that increase tax rate from 8.5 to 8.95 percent in the year 2012) on tax revenue and taxpayers' behaviors in response to income tax policy change. My findings show that income tax policy is effective to the purpose that local government use it. However, taxpayers around the threshold of $350,000 manage their income (use tax shelter) to reduce their tax liability.

Key words: Regression Discontinuity Design; Income Tax Policy Reform; Revenue; Tax Payers Behaviors.
JEL Classification Codes: H2; H3.

1. Introduction

The District of Columbia government combines both the expenditure responsibilities and the authority to generate their own-source revenues of a state and local (municipal, county, school district) system. The District of Columbia's unique fiscal structure flows from its status as the federal capital with no state level of government but retaining features of the fiscal federalism of the United States. Since 1995, when a rapid deterioration in District government finances led the U.S. Congress to create the District of Columbia Financial Responsibility and Management Assistance Authority to oversee the finances of the District, the District has undergone significant changes in its economy, finances, and demographics. The District of Columbia's tax policy generates the revenue.

During the millennial, the District income tax revenue was the largest and primary source of income. The individual income tax base consists of the income of individuals who maintain a permanent residence in the District for either part of or the full taxable year and individuals who maintain a residence for a total of 183 days or more during the taxable year, even if their permanent residence is outside of the District. Today, Washington, D.C.'s income tax is the second largest sources of tax revenue that comes after real property tax it accounts of 25 percent share of total tax revenue paid to government.

Over the past six years, in 2012 the District of Columbia has implemented a rise of income tax rate aiming to increase government budget by $17,300,000 from high income bracket of tax payers who earn over $350,000. These tax payers are required to pay additional 0.45 percent of their income. Their income tax rate rises from 8.5 to 8.95% in 2012 as a new income tax policy. Tax revenue from the top 2 percent income earners (taxpayers who earn over $350,000) contributes a share of about 30 percent of the total city's income tax revenue. In Washington, D.C. the income tax is progressive because higher income residents pay a larger share of their income in taxes than lower income residents do. This new tax bracket will help protect the District of Columbia services that they provide to citizens against deeper and painful budget cuts as many services prior to this policy start to decline such as affordable housing development programs, families with children monthly benefit reduced, and the District homeless services system stop accepting new families. At the same time, it is crucial to the District of Columbia to maintain an optimal level of tax revenue. Therefore, the income tax policy in 2012 aims to increase income tax revenue.

Local fiscal income tax policy is viewed by some economists as an economic growth tool that helps foster and enhance economic growth in the city. (Gale and Samwick, 2014) However, many

conclude that timing and other avoidance behaviors are the most responsive to tax change, while the changes in real productive activities are the least responsive. These timing and avoiding behaviors explain why studies find that high income tax payers tend to reduce their taxable income more than low income taxpayers in response to tax increase (Gruber and Seaz, 2002). Critics of increase income tax rate also say that progressivity of income taxes negatively affect GDP growth. (Chernick,1997). Opponents of raising the taxes that high income individuals face often point to findings that high income taxpayers respond to tax rate increase by reporting less income. Moreover, (Slemord and Auerbach, 1997) state that such reductions in reported income largely reflect timing and other tax avoidance strategies that tax payers adopts to minimize their taxable income, not change in real work, savings, and investment behavior. However, policy makers can limit high income tax payers' ability to respond to increases in tax rates by engaging in tax avoidance activities and enhance the efficiency of the tax code by broadening the tax base.

One possible reason why there tends to be a scarcity of accurate empirical evidence of significant economic benefits of state income tax policy is that consistent and reliable data are not often widely available for economic analysis on the city level. To help determine if the District of Columbia government 2012 income tax rate policy reform on high income level generate more tax revenue to the government and influence taxpayers to change the way they report their income, this study conducts an economic analysis on the city level of individuals who earn over $350,000. The objective is to assess if the 2012 increase in income tax rate indeed resulte in increase tax revenue and change taxpayers' behavior in response to income tax policy reform. This city level economic study uses parcel level administrative city individual income tax data. The data are used to assess whether the 2012 income tax policy significantly increased the local government tax revenue (i.e. the treatment group of taxpayers who earn over $350,000) in 2012 after implementing this policy in comparison to the control group. Unlike some studies that base broad and equivocal conclusions of the Federal income tax revenue on increase income tax rate and use imprecise economic indicator or limitation of particular approach to address the issue (Gale, Kearney, and Orszag, 2015), this study draws conclusions using a Regression Discontinuity Design methodology and micro-city-level administrative data for every resident in the target group. Results show an over all increase in the city level tax revenue due to the income tax policy and shows a behavior change of taxpayers at the threshold of $350,000 to reduce their tax liabilities using tax shelter.

2. Literature review

The theoretical foundation of how taxpayers respond to an increase in income tax rate goes back to the consumer behavior theory. The decisions that individuals make about what and how much to consume are among the most of important factors that shape the evolution of the overall economy, and this decision is analyzed in terms of their underlying preferences. As consumer preference use utility function to make prediction about what consumer will do when they have a given income and can purchase goods at a given price. This give information help analyze decision and how much individuals choose to work. (Jung, Snow, & Trandel, 1994; Kesselman, 1989; Pestieau & Possen, 1991, 1992; Watson, 1985; although see Parker, 2003, for a critique).

Analyzing the mechanical and behavioral change of increasing the income tax rate is very crucial to assess the income tax policy effectiveness of the of taxpayers whose taxable income is over $350,000 in Washington, D.C. The objective of this research paper is to determine whether mechanical or behavioral change is the dominant in each income level over $350,000. A literature review on this subject is divided into two sections. The first section reviews the literature on the impact of 2012 income tax policy reform on total government tax revenue and tax payers' behavior. The second section reviews the literature on the analysis techniques of income tax policy reform.

2.1 Income Tax Reform Policy analysis:

Income tax policy is one of many important keys that government use to finance their budget. Therefore, evaluating this policy effectiveness is very crucial. Many researchers look in the relationships between increasing taxable income of top income earners and variety of indicators as a measure of effectiveness of the policy. In evaluating the impact of increase in income tax rate policy, many studies investigated the responsiveness of income tax rate change to total government revenue. Slemord and Auerbach (1997), studied the federal level income tax rate change impact. They find that for high income taxpayers' reduction in reported income largely reflected timing and other tax avoidance strategies such as using tax shelter to reduce their tax liabilities and not tend to reduce the hour worked as what the consumer theory states.

Gale W, Kearney M, and Orszag P (2015), investigated the relationship between the increase of tax on top income earners and income inequality. On the other hand, Gale W. and Samwick A. (2014), estimated the relationship between Elasticity of Income Tax Changing on Economic Growth using GPD as the indicator of economic growth, which is a broad indicator of income tax policy effect.

These studies look at the income tax policy impacts from the federal level. From there, this research contributes to the literature by using Washington, D.C. individual income tax data and assess the District income tax policy reform on the local government revenue and the District Taxpayers behavior change in response to income tax policy reform.

2.2 The analysis techniques of income tax policy reform.

Researchers use simulation to show the dynamic in the relationship between variables. Gale W., Kearney M, and Orszag P (2015), use Tax policy center micro simulation model. They used different income tax percentage to simulate the impact of total tax from different tax levels and assess the impact on inequality and whether certain income tax percentage will reduce inequality. Findings show there is a small impact of increasing income tax rate of 50% on inequality reduction.

Gale W. and Samwick A. (2014), use simulation model to study the effects of income tax changes on economic growth (expansion of the supply side and potential gross domestic product).

In both simulation and elasticity models study the relationship between change in tax and economic activities. However, they do not quantify the increment change.

Regression Discontinuity Design (RDD) goes back to the early 60's (Thisthlewait and Cook, 1960). As an empirical method (along with instrumental variables (IV), and Difference-in-Differences (DD), both of which economist are using to get closer to the gold standard of empirical research—randomized experiment. Subjects are randomly assigned to a control group and a treatment group, and the outcome are compared to statistically estimate that treatment's effect on the outcome. A randomized experiment is the most foolproof way of establishing causality between variables and measuring treatment effects. Unfortunately, randomized experiments are often not feasible in economics for ethical and practical reasons. So most of the time we are stuck with nonexperimental data or, nowadays, economists look for "natural experiments" to exploit in empirical research. RDD is a way of estimating treatment effects and establishing causality in nonexperimental setting. Observations in a data set are separated into a control group and a treatment group when an "assignment variable" exceeds a cutoff point. Think of say, the income level requirement for the income tax. Where an age threshold ($350,000) in 2012 separates taxpayers, who pay one rate (control) from those with 0.45 percent increment rate (treatment). Under some fairly week assumptions (subjects must not be able to precisely control the assignment variable, e.g., income. Data

from RDD can be analyzed as if it is from a randomized experiment. RDD is a pretest-posttest design that elicits the causal effect of interventions by assigning a cutoff or threshold above or below which intervention is assigned. By comparing observations lying closely on either side of the threshold.
The importance of RDD is that causal inferences from RDD designs are potentially more credible and transparent than those from typical "natural experiment" strategies (DD or IV). Moreover, the theoretical justification is formally showing that one need not assume the RDD isolates treatment variation that is "as good as randomized". Instead, such randomized variation is a consequence of agents' inability to precisely control the assignment variable near the known cutoff. RDD can be used in a wide variety of context covering a large number of important economic questions. RDD is very useful for program evaluation, whether it is tax incentives to promote business development, individual income tax policies to promote work and savings, and so on.

Regression discontinuity method works best in an environment where:

- A threshold in a continues forcing variable such as (income) generates a large change in a policy variable (the income tax rate a taxpayer must pay);
- The threshold is strictly enforced;
- There are very dense data near the threshold for the forcing, policy, and outcome variables;
- Other factors that might affect the outcome (total revenue) do not change discontinuously at the threshold;
- People do not manipulate the forcing variable near the threshold in an attempt to make themselves eligible.

This paper adds to the existing literature because it uses the city level administrative IIT data to analyze many unaddressed questions in the literature because they rely on Federal level tax data. Moreover, RDD is a way of estimating treatment effects and establishing causality in a nonexperimental setting. That is quantifying the average treatment effect at the cutoff threshold and it is impact on total revenue and taxpayers' behavior. Moreover, this study indicates some tax payers' behavioral change such as using tax shelter to minimize the income tax subject to tax payers.

3. Descriptive Analysis

Many argue that increase in income tax policy would cause displacement of individuals who earn over $350,000. Figure 1 shows that the number of taxpayers that their taxable income is over $350,000 has increase over years from 2011-2016. This is an evidence that the District attracts high income taxpayers.

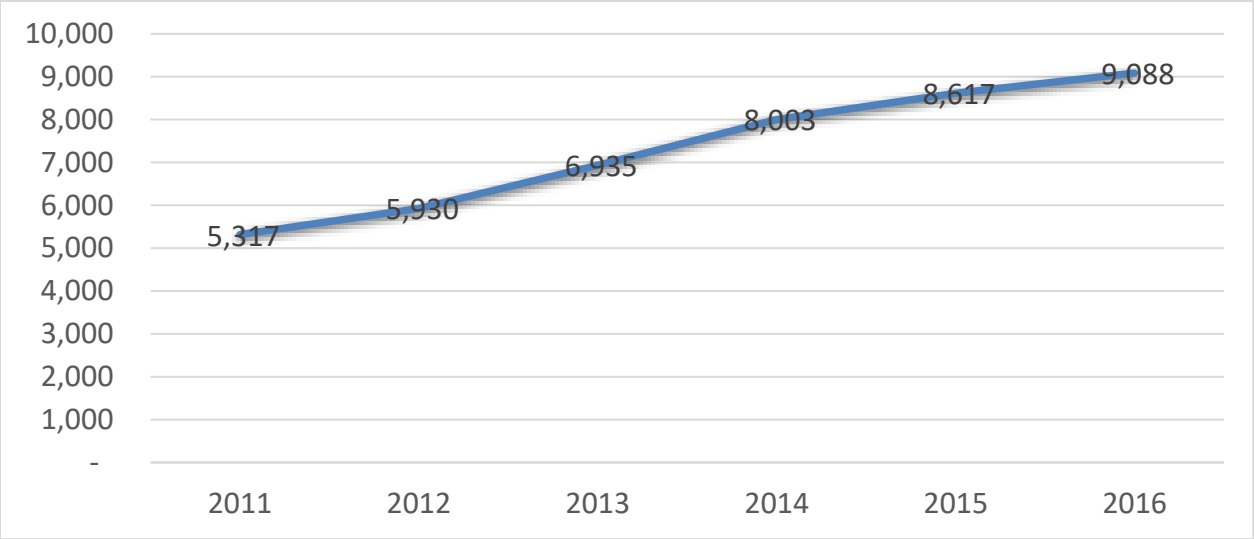

Figure 1 Number of Taxpayers who Earn Over $350,000 Over time 2011-2016

Although, high income earners that this study focus on are only top two percent of the city population, their importance come from the share of income tax paid to the government. That is account for one third of what the entire D.C. income taxpayers' pays to the government. This makes it an easy form of policy for a quick way to increase government budget. Table 1 illustrate the number (N), taxable income (TI), Federal Adjusted Gross Income (FAGI), and Total Tax (TT), paid to the government from taxpayers who earn over $350,000 (the treatment group) and taxpayers who earn equal or less than $350,000 (the control group).

Also, table 2 shows that the share of the treatment group to the control group has always been 2 percent and 98 percent over the time from 2011 to 2016 although the number of each group has increased dramatically throughout the years.

Table 1 The Number, Taxable Income, FAGI, and Total Tax paid of Tax payers Who Earn Above and below$350,000

Year	Group	N	Taxable Income	Federal Adjusted Gross Income	Total Tax
2011	Taxable Income =<$350,000	279,354	$11,492,422,479	$16,710,224,956	$827,828,725
	Taxable Income >$350,000	5,317	$ 6,141,367,177	$5,747,928,337	$348,551,919
2012	Taxable Income =<$350,000	279,064	$12,694,811,364	$17,295,054,210	$861,347,557
	Taxable Income >$350,000	5,930	$ 6,483,174,610	$7,230,709,763	$451,980,872
2013	Taxable Income =<$350,000	345,132	$14,756,335,036	$ 21,834,270,207	$1,049,366,895
	Taxable Income >$350,000	6,935	$ 6,544,922,087	$ 7,320,418,110	$465,852,411
2014	Taxable Income =<$350,000	343,173	$13,902,182,789	$ 22,743,281,459	$1,119,002,523
	Taxable Income >$350,000	8,003	$ 8,103,818,862	$ 9,043,982,326	$591,121,397
2015	Taxable Income =<$350,000	348,860	$15,393,578,998	$ 23,728,406,127	$1,119,981,581
	Taxable Income >$350,000	8,617	$ 9,293,094,150	$ 10,216,330,131	$648,017,254
2016	Taxable Income =<$350,000	354,569	$17,330,717,981	$ 24,619,447,565	$1,161,351,228
	Taxable Income >$350,000	9,088	$ 9,107,283,160	$ 9,977,289,721	$607,721,055

Table 2 Ratio of the number, Taxable Income, FAGI, and Total Tax of the Taxpayers who Earn Above and below $350,000

Year	Group	Share of N	Share TI	Share FAGI	Share TT
2011	Taxable Income =<$350,000	98%	65%	74%	70%
	Taxable Income >$350,000	2%	35%	26%	30%
2012	Taxable Income =<$350,000	98%	66%	71%	66%
	Taxable Income >$350,000	2%	34%	29%	34%
2013	Taxable Income =<$350,000	98%	69%	75%	69%
	Taxable Income >$350,000	2%	31%	25%	31%
2014	Taxable Income =<$350,000	98%	63%	72%	65%
	Taxable Income >$350,000	2%	37%	28%	35%
2015	Taxable Income =<$350,000	98%	62%	70%	63%
	Taxable Income >$350,000	2%	38%	30%	37%
2016	Taxable Income =<$350,000	98%	66%	71%	66%
	Taxable Income >$350,000	2%	34%	29%	34%

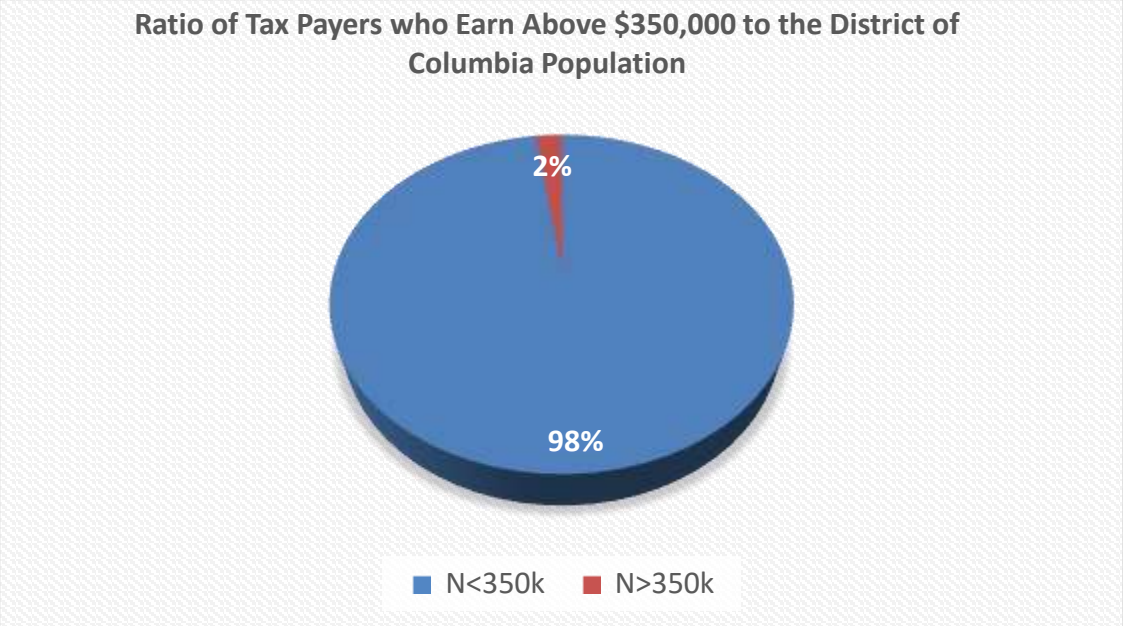

Figure 2 Ratio of Taxpayers who Earn Above $350,000 to the Rest of the District of Columbia Population

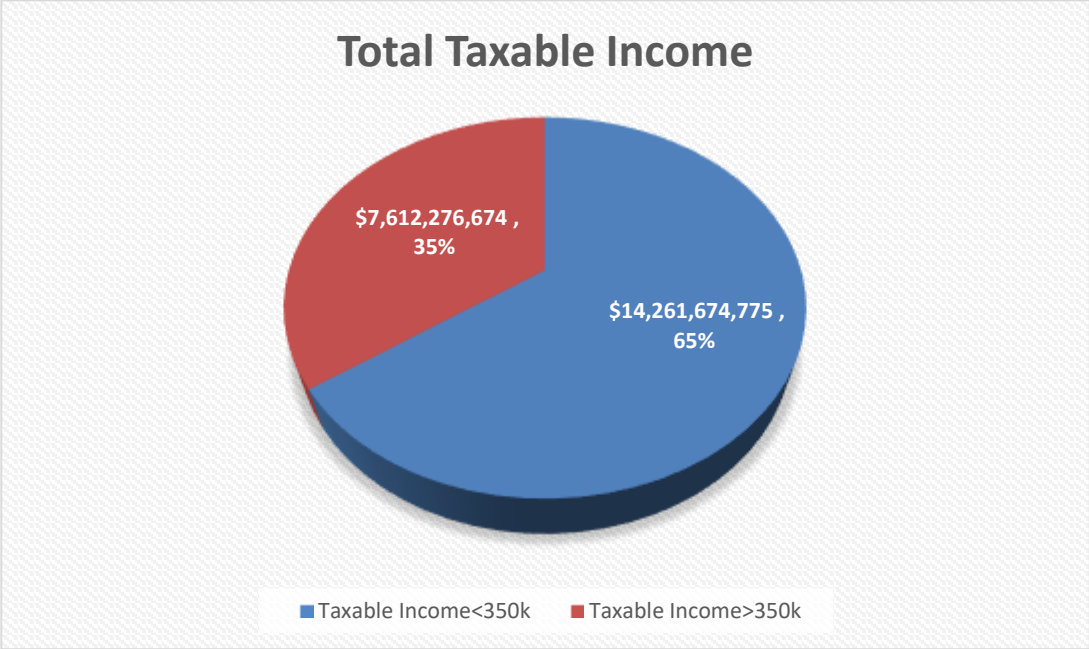

Figure 3 Share of Total Taxable Income of Taxpayers who Earn Above $350,000 to the Reset of D.C. Taxpayers

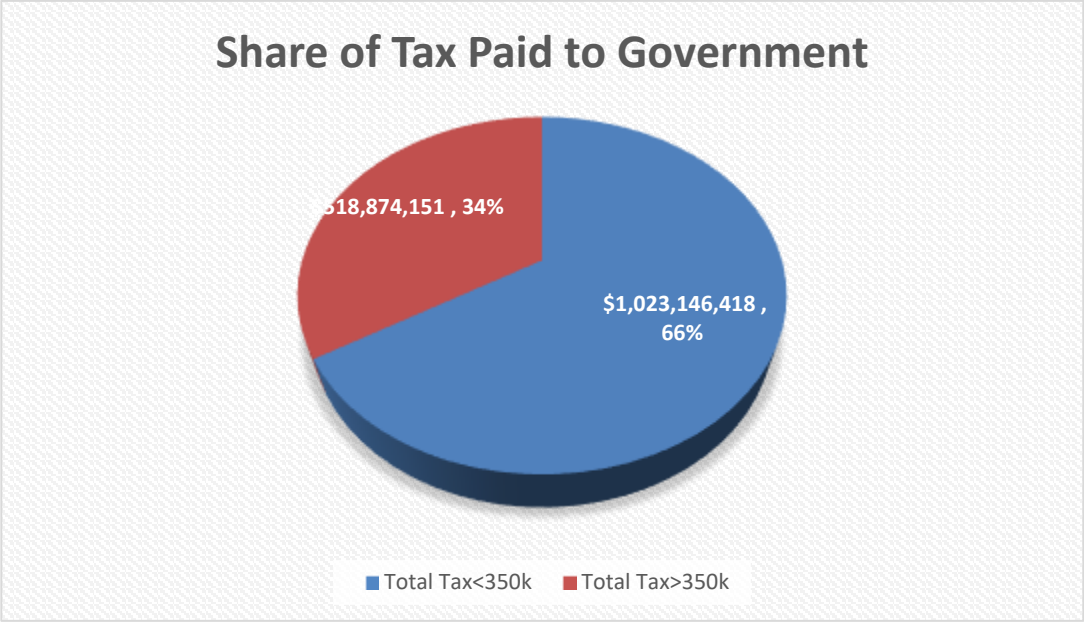

Figure 4 Share of Total Tax Paid to the Government from Taxpayers Who Earn above $350,000 in Comparison to the Rest of the District Taxpayers

4. Methodology: Regression Discontinuity Design (RDD)

Graphical analyses are an integral part of RDD analysis. The nature of RDD designs suggests that the effect of the treatment of interest can be measured by the value of the discontinuity in the expected value of the outcome at a particular point. Inspecting the estimated version of this conditional expectation is a simple yet powerful way to visualize the indentation strategy. Figure 5 illiterates the treatment group (taxpayers who earn over $350,000 to $500,000) overtime and at the threshold year 2012. It shows a discontinuity at the year 2012 indicating a change in the taxpayers' behavior in response to income tax rate change.

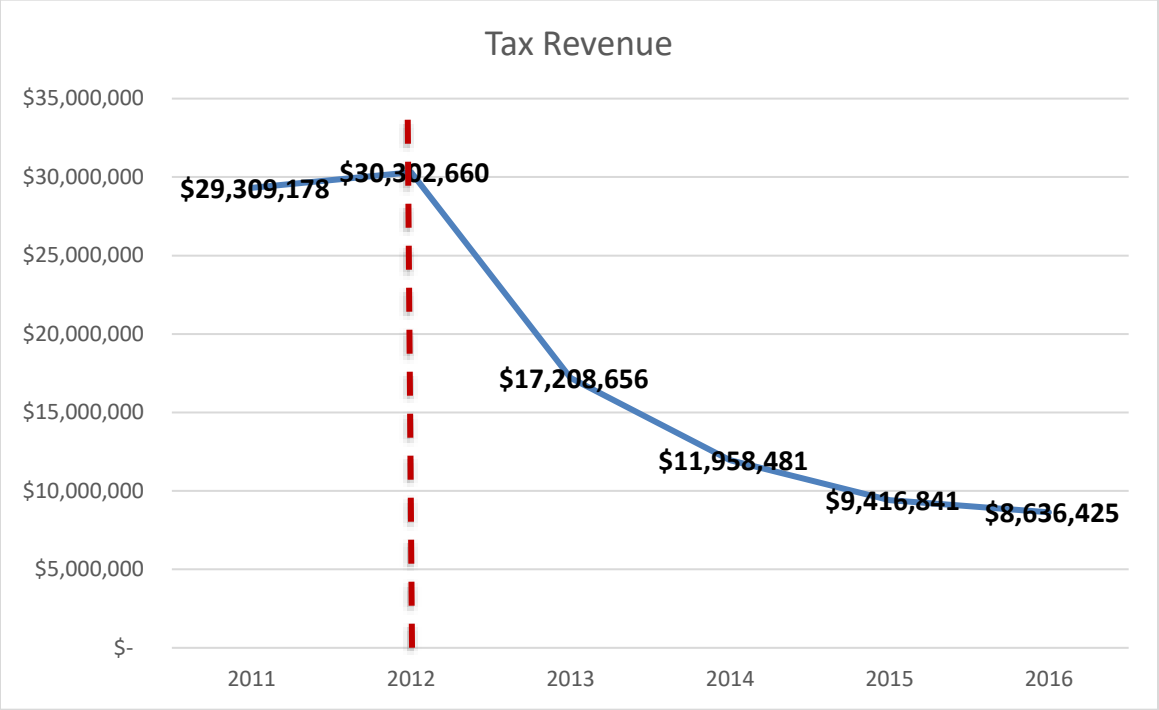

Figure 5 the Effect of Taxpayers at the threshold on Tax Revenue

Figure 6 below illustrates the treatment group (taxpayers who earn over $350,000 to $500,000) overtime and at the threshold year 2012. It shows a discontinuity at the year 2012 indicating a change of reporting their income.

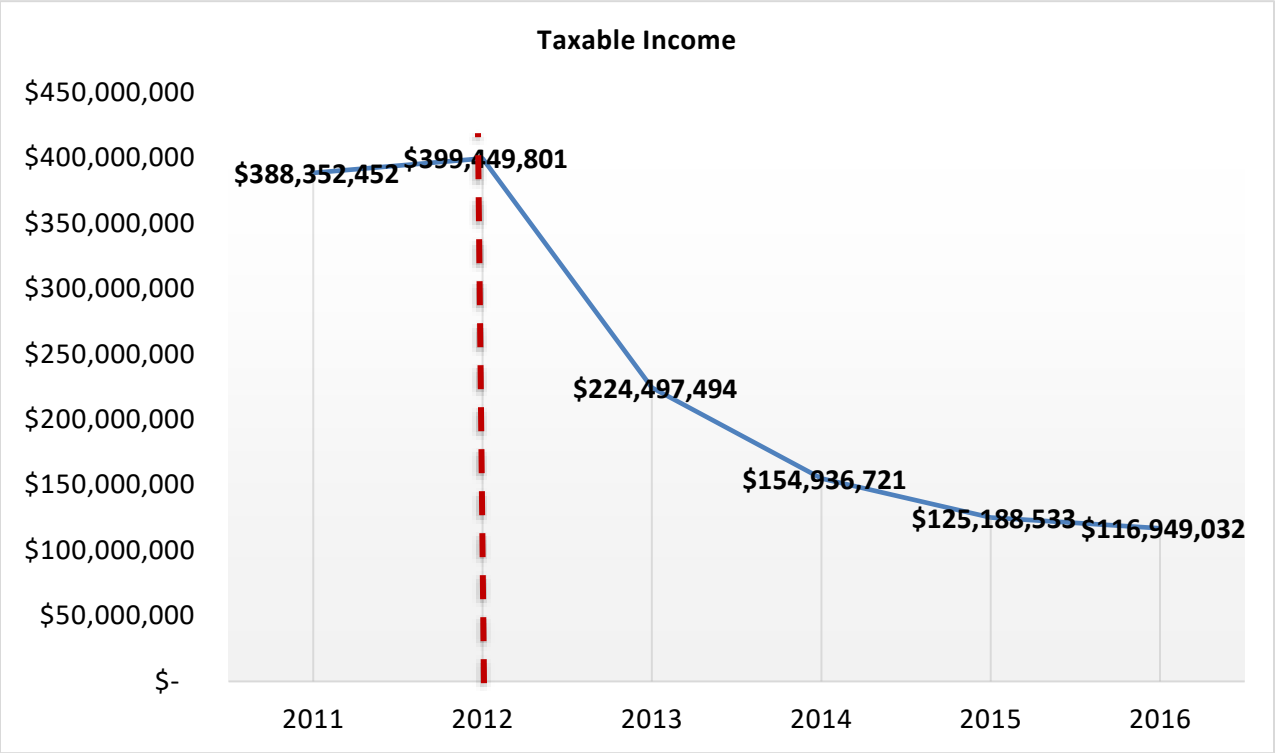

Figure 6 The Effect of Taxpayers at the Threshold on Taxable Income

4.1 Estimation of the Average Treatment Effect (ATE) in a Sharp Regression Discontinuity Design (SRDD):

The average effect on the total tax revenue for the population who would have paid the proposed increase in income tax (the treatment group) versus population that this policy does not apply to (the control group). Casual effect analysis this example enables us to estimate the ATE with casual interpretation, which is of general scientific interest. For policy making purposes, it is more interesting to examine the effectiveness of a program or treatment for those who did participate. The average treatment effect for the treated (ATT) is the concept. It measures the treatment effect conditional on those who are subject to the income tax rate change. Assumptions: (i)The Probability of treatment receipt must be discontinuous at cutoff. More of those receiving treatment should be on treatment side of cutoff than the other side. If all are, then "sharp" RD. (ii) No discontinuity in potential outcomes in the cutoff (the "continuity restriction"). That is, no alternative interpretation should also show a discontinuity at the cutoff. If so, it would serve as a causal confound. In this research, the interest is in the causal effect of a binary treatment. The sample N has about 4,000 units of individuals, drawn randomly from a large population. For individual i, $i = 1, \ldots, N$, the variable $Yi(1)$ denotes the potential outcome for unit i (total tax revenue) given treatment, and $Yi(0)$ the potential outcome without treatment. For individual I, the observation is based on if the treatment has received, Wi, equal to one it individual i was exposed to the treatment (pay additional tax rate) and 0 otherwise, and the outcome corresponding to the treatment received:

$$Y_i = (1 - W_i).\ Y_i\ (0) + W_i.Y_i(1) = \begin{cases} Y_i(0) & if\ W_i = (0), \\ Y_i(1) & if\ W_i = (1). \end{cases}$$

The observation also, include a scalar covariate for each individual "the forcing variable", denoted by Xi. $m(x) = \mathbb{E}[Y_i \backslash X_i = x]$, Since this paper is interested in estimating the Sharp regression discontinuity design (SRDD), the treatment Wi is determined only by the value of the forcing variable

Xi (the increase of income tax of individuals who earns $350,000 and more), being on either side of a fixed, known threshold c, or: $W_i = (1x_i \geq c)$. The average treatment effect for individuals with covariate values equal to the threshold of (new income tax policy):

$$\mathcal{T}\text{SRD} = \mathbb{E}[Y_i(1) - Y_i(0)|X_i = c] = \lim_{x \downarrow c} m(x) - \lim_{x \uparrow c} m(x),$$

The difference of the two regression functions evaluated at boundary points. This research focus on estimating $\mathcal{T}$SRD by local linear regression on the $W_i = 1\{X_i \geq c\}$ side of the threshold.

$$\hat{T}\text{SRD} = ATE = \lim_{d \downarrow c} E[Y|d] - \lim_{d \uparrow c} E[Y|d] = \beta + \lim_{d \downarrow c} E[\mathrm{E}|d] - \lim_{d \uparrow c} E[\mathrm{E}|d].$$

The causal effect on increase income tax rate on total tax revenue. Where d is the distance between Taxable Income and the tax-rate (x-c) from either side of the cut-off.

All other factor stays fixed at the cutoff, then: $\lim_{d \downarrow c} E[\mathrm{E}|d] - \lim_{d \uparrow c} E[\mathrm{E}|d] = 0$

β, is change in total tax revenue outcome at the tax-rate-increase threshold, is the causal effect of the new income tax rate policy. This implies the standard estimating equation:

$$Y_{ih} = \beta_0 + \beta_1 f(d_h) + \beta_2 . tax\_rate_h + \beta_3 f(d_h) . tax\_rate_h + \mathrm{E}_{ih}$$

Where i indexes potential individuals, h indexes taxable income thresholds, f is a continuous function a polynomial (taxable income). Tax rate is an indicator for the binary variable of household who earns over $350,000 and thus, is subject to the new income tax policy on the basis of its taxable income.

4.2 How individuals respond to increase in income tax rate?

There are two cases:

(i) Individuals who always understand the Increase in Taxable Income rule and accept paying the increase rate of income tax.

(ii) Individuals who always understand the Increase in Taxable Income rule and try to use tax shelter to avoid paying the increased amount of tax. The concern is about how these cases imply for the analysis because there is a substantial behavioral economic interest. In additional

to assess whether this is an effective tax policy or not, how taxpayers think about the state tax increase matters. Thus, the regression discontinuity should be set up with year t choices as the dependent variables and year t tax increase enforcement and distance from the cutoff as the independent variables, I used 2012 for all income tax payers:

$$Y_{iht} = \beta_0 + \beta_1 f(d_{ht}) + \beta_2 . tax\_rate_{ht} + \beta_3 f(d_{ht}) . tax\_rate_{ht} + \varepsilon_{iht}$$

Where β_3 is interpreted as the effect of a change in the income tax rate policy on individuals who earn over $350,000 and it is equal the change in tax revenue paid to government.

4.3 Robustness check: Doughnut-hole Regression Discontinuity Design:

Following (Barreca et al. 2011) approach, as an alternative to covariate adjustment, we are also considering a "Doughnut-hole Regression Discontinuity Design" analysis that ignores data immediately surrounding the threshold. In settings where the sorting appears to be limited to the immediate neighborhood of the threshold, this approach has the advantage that one does not need to measure and control for all potentially unbalanced covariates, nor does one need to worry about measurement error due to misreporting of the running variable. Since tax-payers may be who are compliance to the new income tax policy change, the all in the same tax year (2012) regression with a doughnut-hole will be estimated (Hoxby, 2015):

$$Y_{ih} = \beta_0 + \beta_1 f(d_{ht}) + \beta_2 . tax\_rate_{ht} + \beta_3 (d_{ht}) . tax\_rate_{ht} + \varepsilon_{ih}, \qquad \{h : r < d_{ht} < b\}$$

Where r is the radius of the doughnut-hole (I used, $150,000 on either side of the cut-off) and b is the bandwidth (for example, $50,000 on either side of the cut-off).

5. Data

This study uses administrative city level individual income tax (IIT) data for the years 2011 to 2012. The study focusses of top taxable income of taxpayers who earn over $200,000 as a measure of household income that is subject to tax. For the new income tax policy that was implemented in 2012, a panel of data is constructed to measure the effectiveness of the income tax policy of the individuals who earn over $350,000 on tax revenue. This entails comparing the income tax data for the individuals who earn over $350,000 (treatment group) and comparison individuals within Washington, D.C. who earn less than $350,000 (control group). The panel contains IIT data for years 2011 to 2012 which

covers the pre- tax increase period and the post-tax increase period for each of the two groups. The pre-tax increase period and post-tax increase period covers both the group earns over $350,000 and the group earn less than $350,000 to $200,000. This study investigated whether there was a statistically significant effect of the income tax increase of 0.45 percent on the total tax revenue at the city level of their treatment group (individuals earn over $350,000) during year 2012. The data for top income earners values are adjusted for inflation and are in 2016 dollars.

Taxpayers who earn over $350,000 are the targeted households for this income tax policy because although they represent 2 percent of the District's population, their share of tax revenue paid to the government is about one third, 34 percent, of total income tax generated from the entire Washington, D. C. income taxpayers. In addition, income tax is the most dynamic sector of the city's total tax revenue and tax database.[1] Individuals Income Tax (IIT) data is used to assess the new income tax policy impacts and how the RDD is implemented and results are interpreted in two cases: individuals who always understand the income tax rules and accept paying the 0.45 percent increase in 2012 and individuals who always understand the income tax rules and try to use tax shelter. The concern is about how these cases imply for the analysis because there is a substantial behavioral economic interest. In addition to assess whether this is an effective income tax policy or not, how taxpayers think about the District income tax increase matters.

The treatment group (individuals earn over $350,000) exposes the new income tax policy while control group are comparable individuals in the same City (Washington, D.C.) the control group were selected based on the individuals in income level that new policy is not applicable to but are close enough to the threshold of $350,000. The sharp regression discontinuity and doughnut- hole RDD only consider the Taxable Income of top income filers in the city, that is individuals who earn over $350,000 a year in 2012. The effects for the new income tax policy will be assessed in terms of taxpayers' behavior and total tax revenue that government receives.

6 Results

6.1 Average Treatment Effect:

Table 3: Estimation of the Average Treatment Effect (ATE) in a Sharp Regression Discontinuity Design (SRDD) in 2012

	Parameter estimate	Standard Error	t-Value	Pr>|t|	Pr>F	R-Square
Average Treatment Effect	-0.04	0.001	-37	<.0001	<.0001	0.81

Table 3 show a significant discontinuity at the threshold of %-4, indicating that the treatment group who are expose to additional %5 increase in their income tax rate because they earn over $350,000 decrease total revenue. However, comparing individuals who earn $350,000 in 2012 and being subject to the new tax policy to 2011, a year prior to income tax change, findings in table 4, show a positive discontinuity at the threshold, indicating that the new income tax policy increased total revenue.

Table 4 RDD simulation on Individuals who earn over $350,000 in year 2011

	Parameter estimate	Standard Error	t-Value	Pr>|t|	Pr>F	R-Square
Average Treatment Effect	0.035	0.0001	293.89	<.0001	<.0001	0.6

Table 4 shows the coefficient of the simulated regression discontinuity design in prior to 2012 of the new income taxes to see if the target group would have paid more. This result based on year 2011 with simulated income tax rate of 2012. The results show that increase in tax rate increase total revenue.

6.2 Breaking individuals who earn over $350,000 to five income levels:

In this section, the individuals who earn over $350,000 are break down to five groups to be able to see the diversity of income taxpayers' behaviors at different income levels. As shown in table 5.

Table 5 The Average treatment effect at five income levels:

Variables	Parameter estimate	t-Value	Pr >|t|	R-Square
ATE (350-375K)	52.060 (1079.14)	0.05	0.9616	0.02
ATE (375-400K)	-3840.40 (1176.89)	-3.26	0.0012***	0.04
ATE (400-450K)	-4854.89 (1176.13)	-4.13	<.0001***	0.1375
ATE (450-500K)	-8511.38 (1765.32)	-4.82	<.0001***	0.1010
ATE (500K-∞)	4612.48 (623.84)	7.39	<.0001***	0.6770

Table 5 shows that the ATE of income of five income group. It clearly shows that there are two significant impacts on total tax revenue: negative impact from taxpayers who earn from $375,000 to $500,000 and positive impact from taxpayers who earn over $500,000. This prompt us to think of what economic behavior individuals who earn less than $500,000 due to reduce their tax liabilities.

6.2.1 Doughnut-hole regression discontinuity design:

Following (Barreca et al. 2011) approach, this model ignores the data that are immediately surrounding the threshold. Since sorting appears to be limited to the immediate neighborhood of the threshold, this approach has the advantage that one does not need to measure and control for all potentially unbalanced covariates, nor does one need to worry about measurement error due to misreporting of the running variable. Applying this method by excluding income taxpayers who earn between $200,000 to $500,000, we find that the increase in income tax policy by one percent cause tax revenue to increase by 3.5 percent as shown in table 6 shows that the doughnut-hole is imposed on (2012) because, the type of tax-payers is unknown, and this is the only way to exclude bias due to taxable-income management.

Table 6 Doughnut-hole regression discontinuity design excluding taxpayers who earn $200,000-$500,000.

	Parameter estimate	Standard Error	t-Value	Pr>|t|	Pr>F	R-Square
Average treatment effect	0.035	0.0004	74	<.0001***	<.0001	0.6

To confirm that income taxpayers from the taxable income level between $200,000 to $500,000 has a negative impact on the total tax revenue, an RDD is implemented using this sample of taxpayers. Table 7 shows a significant negative impact of income tax policy on total revenue from these tax payers, which suggest that taxpayers form this group change their behavior in response to income tax rate increase to reduce their liabilities.

Table 7 Doughnut-hole regression discontinuity design of taxpayers who's taxable income between $200,000- $500,000.

	Parameter estimate	Standard Error	t-Value	Pr>|t|	Pr>F	R-Square
Average treatment effect	- 6.086	0.37	-16.15	<.0001***	<.0001	0.28

7. Tax Shelter:

Tax shelter is a tool that taxpayers use to minimize their taxable incomes and as a result, tax liabilities. Tax shelter can be from investments such as capital gain deferral or expedite or from transactions that lower taxable income such as reporting income as business loss to become eligible for the generous deductions that the District offers. Figure 7 illustrate the idea of tax shelter.

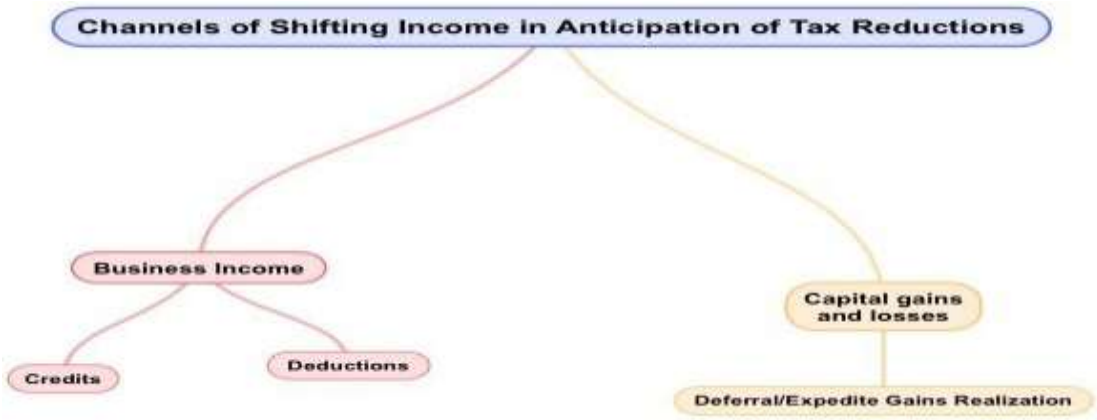

Figure 7 Strategies That Taxpayers Use to Manage their Income

Table 8 Self-employment Income (Business Income):

Business income (Self-employment Income)				
Variables	Parameter Estimate	t-Value	Pr >|t|	R-Square
ATE (350-500K)	-127,208	-2.00	0.08*	0.6
ATE (500K-∞)	-224.96	-0.01	0.99	0.003

Table 8 shows that the group of income level that earn less than $500,000 significantly report their income as income generated from their business and claim a significant toss than group of income level that earn $500,000 and more, where they have insignificant claim of business income loss.

Table 9 Deduction reported at different income levels

Deduction				
Variables	Parameter Estimate	t-Value	Pr >|t|	R-Square
ATE (350-500K)	-2,818.539	-3.39	0.0007***	0.6
ATE (500K-∞)	-3,266.78069	-0.19	0.0944	0.0009

Table 9 confirms our findings that the group of income level that earn less than $500,000 significantly claim deduction from loss of business income.

8. Conclusion:

The District of Columbia implemented a new income tax policy on the top 2 percent taxpayers' income earners in 2012 due to the role that they play as their share of tax paid to the government represents one third of what the rest of the District taxpayers' pay. This study conducts the empirical analysis of the impact of increasing income tax rate from 8.50 to 8.95 percent in the District of Columbia of individuals who earn over $350,000 in 2012 on local government revenue and taxpayers' behavior. This study is unique because it studies the local government income tax policy impact on tax revenue. Previous literature focus on the Federal level income tax policy impacts. The importance of RDD is that causal inferences from RDD designs are potentially more credible and transparent than those from typical "natural experiment" strategies. It shows that this income tax policy reform increased the city level tax revenue. However, tax-payers of income level that earn less than $500,000 use tax shelter significantly to reduce their tax liability. Therefore, the 2012 income tax policy seems to be more effective on the tax payers that earn over $500,000. Tax increase was born primarily of group earning over $500,000.

9. Further research:

In 2015 the District of Columbia government realized that they had excess revenue. The District of Columbia decide to implement an income tax cut in 2016 for tax payers who earn over $350,000 to $1 million, whereas taxpayers who earn over $1 million stay pay the same tax rate of 8.95%. These tax payers' income tax rate declined by 0.2 % from 8.95-8.75%. This income tax policy aims to reduce government budget by $5 million.

Estimating the 2016 income tax policy reform on taxpayers' behaviors and government revenue.

Table 10 shows a preliminary result of the impact of government income tax policy reform in 2016 of income tax filers who earn over $1milion. It does support the findings earlier. It shows that the new income tax policy reform of tax payers who earn over $1milion. A 0.45 percent increase in income tax rate increases income tax revenue 8.7 percent.

I am interested to conduct the empirical analysis to observe taxpayers in the income bracket between

$350,000 to $1 million behavior response to income tax cut.

Table 10 Average Treatment Effect of Income Tax Policy Reform in 2016 on Taxable Income of over $1million on Government Tax Revenue.

	Parameter estimate	Standard Error	t-Value	Pr>|t|	Pr>F	R-Square
Average treatment effect	8.7	2.14	4	<.0001	<.0001	0.24

DISCLOSURE

I have no financial arrangement that might give rise to the conflicts of interest concerning the research reported in this paper

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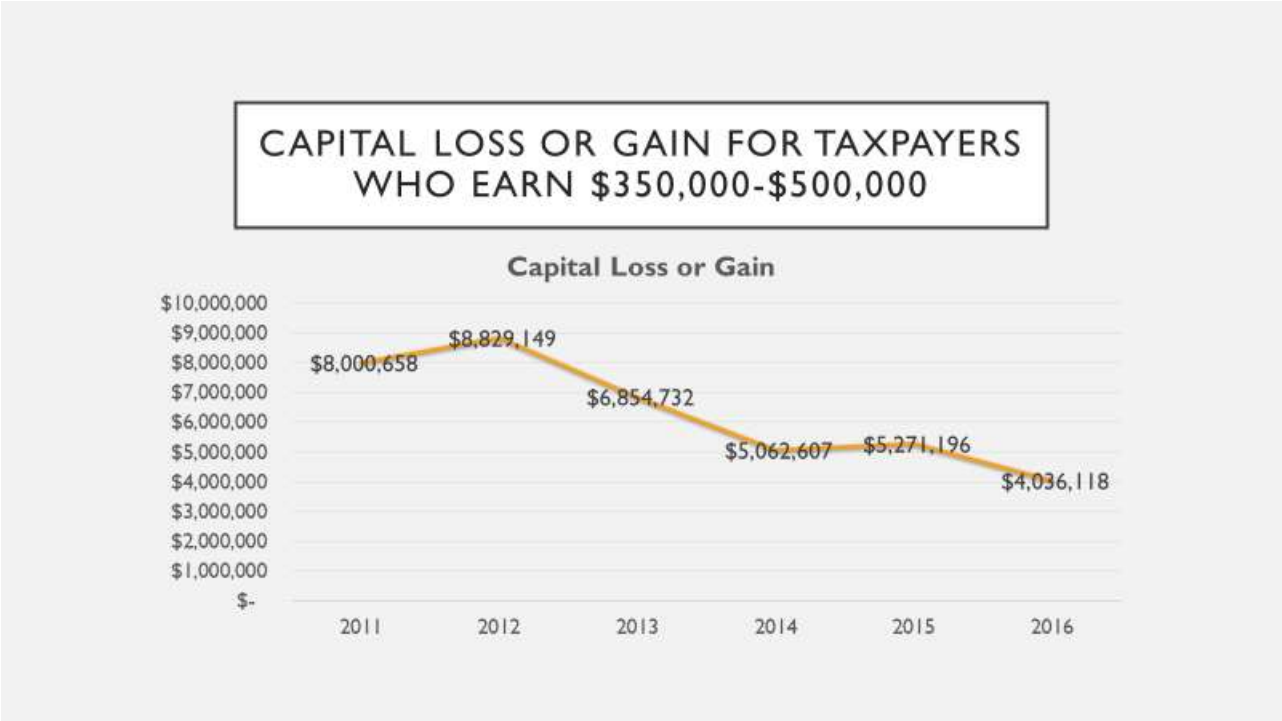
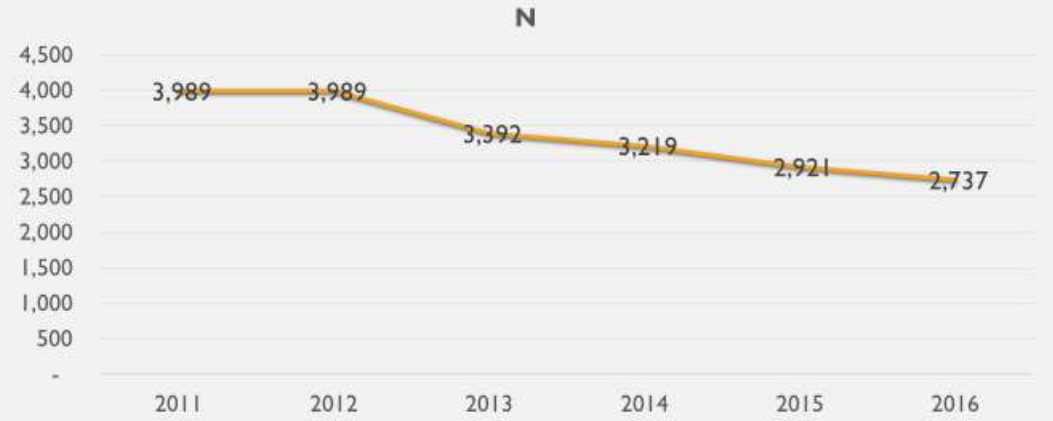
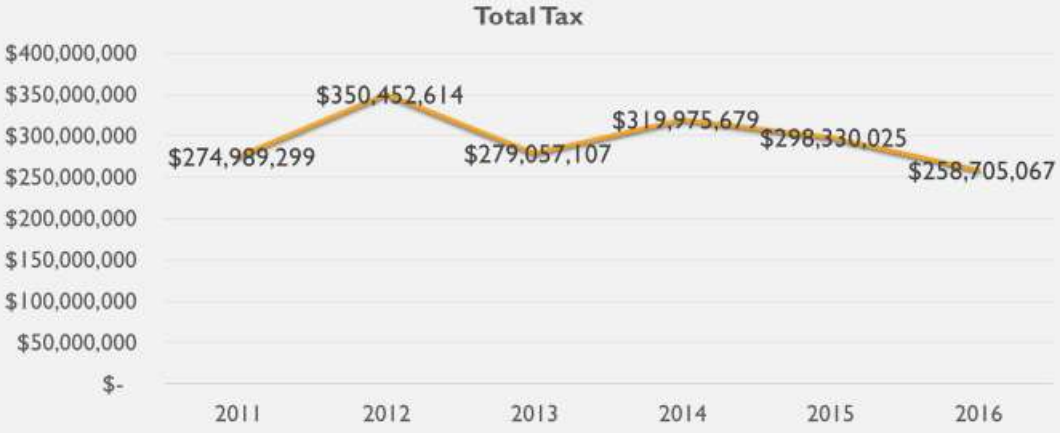
Appendix


CAPITAL LOSS OR GAIN FOR TAXPAYERS WHO EARN $350,000-$500,000
Capital Loss or Gain
$10,000,000
$9,000,000
$8,000,000
$7,000,000
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$-
$8,000,658
$8,829,149
$6,854,732
$5,062,607
$5,271,196
$4,036,118
2011
2012
2013
2014
2015
2016

NUMBER OF TAXPAYERS WHO EARN OVER $350,000 (BALANCED DATA)



TOTAL TAX REVENUE FROM TAXPAYERS WHO EARN OVER $350,000 (BALANCED DATA)



CAPITAL LOSS OR GAIN FOR TAXPAYERS WHO EARN OVER $350,000 (BALANCED DATA)

TAX REVENUE FORM TAXPAYERS WHO EARN OVER $350,000 OVER TIME 2011-2016(UNBALANCED DATA)