2014

Exploring the Laffer Curve: Behavioral Responses to Taxation

Samuel B. Kazman
skazman@uvm.edu

Exploring the Laffer Curve: Behavioral Responses to Taxation

By: Samuel Kazman

Economics Department

Thesis advisor: Nathalie Mathieu-Bolh

College of Arts and Sciences Honors Thesis

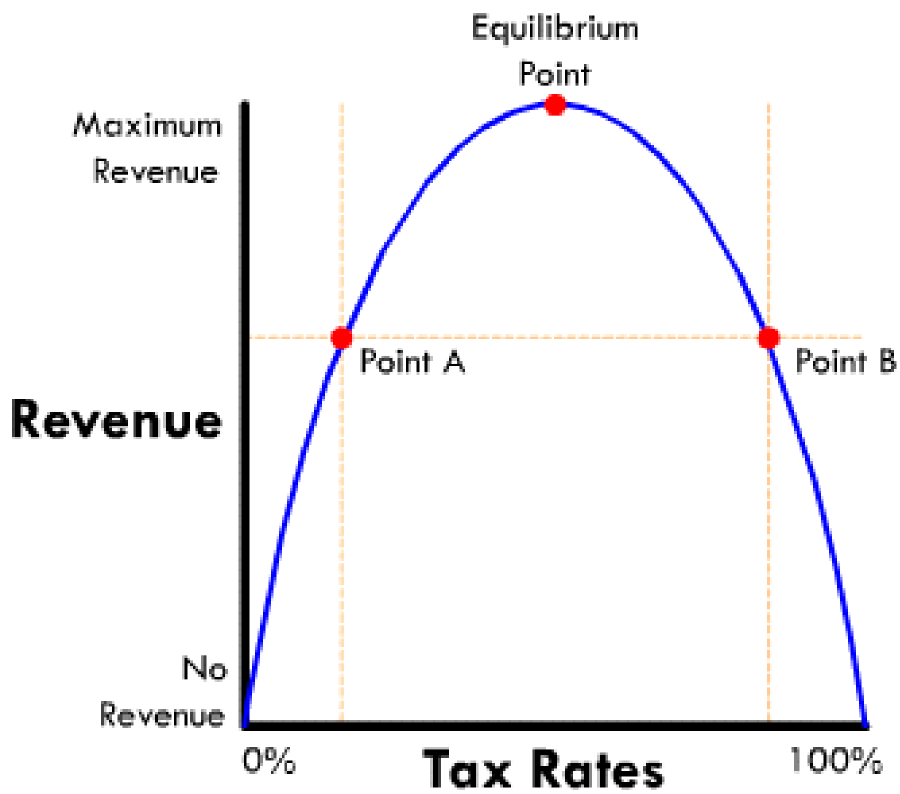
Spring 2014

Table of Contents

I. Introduction:

Arthur Laffer was not the first person to study the relationship between tax rates and tax revenues. This relationship has been debated ever since taxes were first instated to raise government revenue, but he is given credit for coining the widely known theoretical concept of the Laffer curve, which is shown in figure (1).

Figure 1



The Laffer curve provides a graphical representation of the relationship between tax rates and tax revenues where the tax rates of 0% and 100% provide no revenue and every other rate generates some revenue. On this curve, tax revenue increases with the tax rate until a certain point. After this point is reached, any further increase in the tax rate decreases the government's revenue. To this day, economists disagree on the overall effect of tax reforms on tax revenues and on the shape or even the presence of the Laffer curve.

In order to understand the Laffer curve theory, it is necessary to understand how tax revenue is created. Tax revenue is a function of the tax rate times the tax base. Government revenue can decrease after a tax increase if the tax base falls by a large enough margin. Whether tax increases increase or decrease tax revenue relates to how individuals and firms respond to tax changes since their reactions alter the size of the tax base. However, the estimation of their responses to various taxes imposed by the U.S. government (the income tax, the corporate profits tax, etc.), has proved to be a contentious challenge. The debate over the Laffer curve and behavioral responses to taxation has extremely important ramifications on the policy measures regarding taxation that the government could adopt. It is crucial that government officials be able to predict the effects of a given tax reform on tax revenue so that it can accomplish the desired goals after enactment. This estimation is of great importance during a period of high deficits because the government needs to raise more revenue, and increased taxation is often seen as a viable way to accomplish this goal. Opponents of tax increases often cite the logic employed by the Laffer curve by saying that an increase in tax rates lowers or only causes a small increase in tax revenue because people avoid taxation, which lowers the tax base. They also say that the revenue effects of tax cuts are minimal. For example, the senate minority leader Mitch McConnell stated that there is “no evidence whatsoever that the Bush tax cuts actually diminished revenue”[1]. Proponents of increasing taxes acknowledge that individuals might take actions to decrease the amount of taxes they pay, but they still say that significant tax revenue can still be received through tax rate increases.

---

[1] http://voices.washingtonpost.com/ezra-klein/2010/07/mcconnell_no_evidence_whatsoev.html

This thesis attempts to contribute to this tax responsiveness literature, which studies how individuals respond to taxation. Many different estimates of behavioral responses to taxation have been made in the past thirty years. There are large differences between these estimates in terms of the magnitude of the responsiveness of taxpayers. The tax responsiveness literature has generally measured how changes in the income tax rate affect taxable income to isolate behavioral responses to tax rate changes. They seek to calculate an elasticity that shows how taxable income changes when income tax rates are raised or lowered. I do not measure behavioral responses directly. Instead I focus on estimating the Laffer curve. This involves measuring the revenue effects of tax rate changes, which encompasses the results of a behavioral response to taxation. To better understand the link between tax revenues and tax rates, I also seek to show that tax rates other than the income tax rate can have an effect on income tax revenue. People earn income in a variety of different forms that are all taxed at different rates. If the tax rate on a certain form of income increases, there is an incentive to switch income to a different form that is taxed at a lower rate to avoid paying additional taxes.

Many scholars have explored this issue, but I create a comprehensive model that incorporates a variety of factors that could affect income tax revenue. My research seeks to show that income tax revenue is a function of the income tax rate and multiple other tax rates as well. This draws on the theory that income switching between different forms of income occurs when tax rates are changed. These reactions occur because an individual’s optimal economic decision after an income tax change involves microeconomic incentives to switch income to a different form to take advantage of different tax rates. After providing an intuition for the Laffer curve using standard microeconomics, I use data to investigate whether the Laffer curve accurately reflects the link between tax rates and tax revenue. The data set I use encompasses forty eight years of tax return data from 1948 to 2009 to analyze general trends in tax responsiveness over a variety of tax rate changes. Most other scholars choose to look at individual rate change episodes, but I choose to analyze many years to assess tax responsiveness in the long run. Performing research on individual rate change episodes might produce results that do not describe the overall trends in the ways people respond to tax rate changes. There could be factors present that affect a person's decision making during a certain period of time that are not apparent in other years. An economic expansion, for example, could make people more willing to accept a tax rate increase without any income switching response.

The structure of this paper involves five distinct steps. First, a literature review is conducted to examine previous research that can offer insight onto my own methods. The literature review helps me identify distinct methodologies, data sets, and a variety of other factors that are taken into account to strengthen the research I carry out. Second, I present a simple theoretical model to explain how a utility maximizing individual's reaction to tax rate changes can alter tax revenue. The third section outlines the methodology for the research conducted, including the process of data treatment as well as building the regressions used to model tax responsiveness. In the fourth section I test the Laffer curve theory, build regression equations, present the results of the regressions, and provide interpretations of each equation. The last section offers a discussion of the results of the research along with the ramifications of the findings.

II. Literature Review:

There has been extensive research conducted on individuals' behavioral responses to taxation and the ramifications on tax revenue with a wide variety of results that lead to opposite policy conclusions. It is important to use the valuable conclusions of these studies to guide and shape my own research.

The value of studying behavioral responses to tax rate changes is supported by the theory that there is a dead weight loss whenever individuals are taxed. Giertz (2008) provides a summary of the various ways that tax changes can induce a response from an individual. He shows that in response to a tax change, a person can alter her or his behavior by changing personal consumption or leisure. This reaction alters an individual's tax liability. Changing the timing of income receipt also enables a person to take advantage of a favorable tax change. One example involves receiving income before a scheduled tax increase. Lowering an individual's tax burden while keeping income constant takes place when someone either illegally evades taxes or legally avoids taxes. Tax evasion occurs when income is not reported to the government while tax avoidance occurs when an individual receives income in a form that gets favorable tax treatment. The administration and compliance policies of the government are additional factors that affect behavioral responses to tax rates because they shape the ability of people to evade or avoid taxes.

There are many different ways to assess the ramifications of tax rate changes. The analyses carried out by Diamond (2005) and Romer and Romer (2007) take a broad perspective by looking at the macroeconomic effects of tax policy changes on the whole economy. Diamond creates a model to simulate the effects of permanently extending the 2001 and 2003 tax cuts on employment, investment, and output. Romer and Romer conduct an analysis of the political narrative surrounding tax change episodes to tie tax changes to movements in output. These papers attempt to answer the question, “are tax increases or decreases good for the economy?”, but their main focus is not on isolating the effects of tax changes on government revenue.

There is a broad literature that is devoted to estimating the effect of a change in the net-of-tax-rate on taxable income. The net-of-tax-rate is the percent of income an individual keeps after taxes are deducted. In these studies, the main focus is to discern what effects tax changes have on taxable income, which directly affects government revenue. Some authors, such as Canto, Joines, and Laffer (1981) argue that decreasing tax rates might actually increase government revenue. Unlike most other scholars they predict the direct revenue effects of a tax change, and they create these predictions by using a time-series model. Goolsbee (1999) and Saez (2004) measure the effects of net-of-tax-rate changes on taxable income and do not come to the same conclusion as Canto, Joines, and Laffer (1981). Although Saez (2004) does not study the same time period, Goolsbee (1999) shows that during the same period studied by Canto, Joines, and Laffer (1981), the taxpayer response to changing tax rates was not significant. Goolsbee (1999) also uses a difference in differences method instead of a time series regression. The difference in differences method compares the percent change in taxable income between two different groups of taxpayers who pay separate marginal tax rates.

Feldstein (1995) points out that tax revenue can be affected by a multitude of factors other than just a tax rate itself. An individual’s ability to change his or her form of compensation, defer compensation, take fringe benefits, and many other factors could be part of the equation. Altering labor supply is one of the most fundamental ways that an individual can react to tax rate changes that would have an impact on tax revenue. Gordon and Slemrod (1998) provide an interesting take on tax revenue fluctuations by asking the question "are 'real' responses to taxes simply income shifting between corporate and personal tax bases". They bring up the issue that as tax rates change, individuals can shift their income to a different form that is taxed at a preferable rate instead of outright tax evasion or other behavioral responses. These authors address the central issue of income switching that I incorporate into my own analyses.

During the period Gordon and Slemrod (1998) study, the income tax rate falls below the corporate tax rate, which could induce income switching behavior. The authors find convincing evidence that income switching behavior occurs between corporate and personal income tax bases. They show that a one percentage point increase in corporate income taxes relative to personal income taxes raises reported personal income by 3.2 %. This result is highly significant and points to the fact that reported income increases of a certain type could be a result of shifting income out of another form. This theory provides another essential underpinning for the research conducted for this paper in an effort to explain changes to income tax revenue in relation to other tax rates.

Gordon and Slemrod (1998) find evidence that individuals respond to incentives to switch income between corporate and personal tax bases. When the marginal income tax rate is lower than the marginal corporate tax rate, individuals who have the ability change the way in which their corporations file taxes so that the company's income is subject to a lower tax rate. Corporate, income, and capital gains taxes are the main ways in which the federal government raises revenue, with a small portion raised by excise taxes. It is possible that individuals react to changes in all three of these tax rates when they make decisions about which form to report their income in. Therefore, when calculating revenue that is received by the federal government for a certain type of tax, it could be important to include tax rates on multiple forms of income in explaining government revenue movements.

Looking into reactions to changes in tax rates other than the income tax rate is important for understanding how total government revenue changes when different taxes change. Auerbach and Poterba (1988) look into behavioral responses to capital gains tax rate changes. This form of income differs from wage income in that people who receive capital gains income can easily change the timing of their income receipt while wage income is more constant from year to year. Auerbach and Poterba find that impending capital gains tax changes affect the timing of capital gains income receipts. If capital gains taxes are set to increase for example, there would be an increase in the amount of capital gains income that is declared before the increase. They show that there is a significant short term elasticity, but there is an insignificant elasticity in the long term.

Although some people might react to changes in tax rates, this is not true for the whole population. Certain individuals only receive income in one form, wage income for example, and therefore do not have the ability to switch income to a different form. Additionally, not all those who receive income in different forms can switch willingly between them. Labor supply reactions could also differ after a tax rate change. If the income tax rate increases proportionally for someone who earns $30,000 and someone who earns $1,000,000, the person with the higher income could sacrifice some of their income for increased leisure. On the other hand, the poorer person might not have that option since they might need all of their income to cover basic expenses and could not allot extra leisure time.

The literature addressing behavioral responses of individuals to tax rates has generally found that higher income individuals have stronger reactions to tax rate changes. Goolsbee (1999) analyzes the responses of high income earners to various tax rate changes while Saez (2004) notes that only the top 1% of earners respond to tax rate changes from 1960-2000. Feldstein (1995) and Lindsey (1987) also find the highest responsiveness rates with income earners at the top of the marginal tax rate scale. This evidence leads to the conclusion that when studying tax rate responsiveness, higher income earners should be focused on. Those who are in the top quintile hold a disproportionate share of the stock and bonds in the U.S. so they are more likely to report capital gains income. Higher income individuals also have more tools at their disposal to take part in tax avoidance or outright tax evasion. If an individual earns $1,000,000 per year then he or she has a strong incentive to avoid a higher tax rate on income earned over $400,000. For the purpose of this paper, only data on high income earners is used to isolate the most prevalent forms of tax responsiveness.

In order to study individual responses to tax rate changes, tax return data needs to be analyzed to assess the necessary trends. IRS data is generally the most widely cited source used by scholars to analyze tax responsiveness. The data on tax returns from before 1960 is not as complete as modern data because there is no data on individual level tax returns. Goolsbee (1999) addresses this problem by analyzing annual histograms on *Statistics of Income* produced by the IRS, which give the total income reported for several income classes. The data he uses is cross sectional, which measures many subjects over one period of time. Since Feldstein (1995) analyzes more modern tax rate change episodes, he has access to a set of panel data, which tracks the same individuals before and after the Tax Reform Act of 1986. This data has an advantage in that Feldstein can study the same group of people, which lets him isolate that group's responsiveness. Panel data has been used under the assumption that it can control for non-tax related changes in reported income but Saez (2004) says that it might not control for changing income inequality. He shows however that while some scholars choose repeated cross sectional data, that panel data can be more useful for the study of income mobility. Canto et al. (1981) provide a different approach by creating a model that can incorporate time series data.

Previous scholars have assessed the results of behavioral responses to tax rate changes by estimating a Laffer curve. Canto et al. (1981) provide a theoretical model of a Laffer curve to prove that there is a tax rate that maximizes government revenue and any tax rate above that would decrease revenue. Although they do not provide a model based on data to create a Laffer curve for the U.S., others have done so. Trabandt and Uhlig (2006) estimate a Laffer curve for the U.S. using a neoclassical growth model while Hsing (1996) uses a quadratic regression to model the Laffer curve. Like these scholars, I try to create a Laffer curve model to represent the revenue implications of tax rate changes in the U.S. Trabandt and Uhlig (2006) make the point that the revenue maximizing tax rate is not often a goal sought by governments because it is not the rate at, which welfare is maximized. Raising the tax rate to the revenue maximizing rate could have harmful effects on the economy. Because of this, the authors argue that governments should set the tax rate below the revenue maximizing point in order to improve overall well-being. The empirical literature, however, generally calculates elasticities to measure behavioral responsiveness to tax rates instead of a Laffer curve. Goolsbee (1999), Feldstein (1995), Lindsey (1987), and many others calculate the elasticity of taxable income related to the net-of-tax rate. Goolsbee (1999) points to the importance of this tool because it shows the dead weight loss of a certain tax and its revenue implications. He also mentions that the conventional Laffer curve does not exist in an easily determinable form because of our marginal tax rate structure.

For the conventional Laffer curve to exist, our tax rate structure would have to be flat. When the tax rate is changed and a flat tax rate is imposed, every dollar that an individual earns is taxed at the new rate. This could incite a behavioral response where an individual works less under the new tax rate if she or he deems it to be unfairly high. With a progressive tax rate structure people face different incentives with respect to the schedule of tax rates. If the top marginal tax rate is raised, individuals have an incentive to avoid the increased tax on income subject to the higher marginal rate. However, an individual does not change her or his behavior regarding income that is subject to a lower rate that was not changed during the tax reform. Therefore any labor supply response is limited to the labor used to earn income subject to the tax rate being changed. Behavioral responses under a progressive tax rate structure would only resemble those under a flat tax rate structure if all marginal tax rates changed proportionately during a tax reform. This does not mean that the Laffer curve does not exist, but it shows the value of calculating elasticities given the American tax structure.

The methods that others have used to measure individual responsiveness to tax rate changes have varied widely over the past twenty five years. They can vary depending on the time period that a scholar chooses to analyze and they also vary depending on the type of technology available with computers being the most important technology. Canto et al. (1981) build a time-series model and fit it to the data surrounding tax rate changes to create elasticity estimates. Lindsey (1987) uses two separate cross sections of data and uses a difference-in-differences method of study to create elasticities. He does this by comparing individuals in two different time periods that he ranks by adjusted gross income. The regression equations that are calculated are specified in the log-log functional form because this functional form generates elasticities for the independent variables. Feldstein (1999) compares changes in taxable income to changes in the net-of-tax-rate using a difference-in-differences calculation similar to Lindsey's except that he uses panel data and not cross sectional data. Goolsbee (1999) makes difference-in-difference calculations as well, but he has to revert back to separate cross sectional samples since he does not have any panel data available. He also uses log-log equations to estimate the elasticity of taxable income with respect to tax rates. Saez (2004) takes an approach more similar to Canto by creating a time-series model while using the log-log functional form to gain elasticity estimates. Like Saez (2004), Goolsbee (1999), and Feldstein (1995) I also use a log-log functional form to try to explain the revenue implications of tax rate changes. He notes that serial correlation is a problem with this approach and that Newey-West standard errors need to be computed to mitigate this issue.

The literature that estimates the elasticities of taxable income related to net-of-tax-rates has produced a wide variety of results with greatly varying policy implications. In articles where the marginal income tax has been the point of focus, the work of Lindsey (1987) and Feldstein (1995) is noted for the high elasticities that are reported from their analyses of tax rate changes in the 1980's. In general, Lindsey finds elasticities of 1.6-1.8 with the highest estimates ranging up to 2.5 for the highest income earners. Feldstein's study produces similarly high elasticity estimates that range from 1.04 to 3.05. Although the largest elasticities relate to the responses of top income earners, elasticities that are this high have severe policy ramifications. A consequence of these findings is that higher income earners were on the right side of the Laffer curve during this period when a tax increase (decrease) would decrease (increase) government revenue. Feldstein predicted that the 1993 tax increase would only slightly increase revenue and that the treasury could experience losses for high income taxpayers. These two influential articles support the conclusions of Canto et al. (1981) that "increases in tax rates could as well reduce as increase government tax revenues.” The tax cuts that occurred during the 1980’s seemingly created a win-win situation for the public and for the government. People got taxed at a lower rate while the government got more tax revenue.

Recent literature, however, has not supported the conclusions made by Feldstein and Lindsey. Goolsbee’s (1999) goal is to mimic the work of Lindsey and Feldstein whose work he categorizes with others studying the 1980’s tax cuts. He names this literature “New Tax Responsiveness” literature or NTR and says that the authors contributing to this body of research support the Laffer curve theory and claim that there is little or no revenue to be gained by raising taxes. Goolsbee points out that comparing high income people to lower income individuals with the difference-in-differences calculation could lead to biased elasticity estimates. Yet, he states that his work is not a critique but an extension of the methodology of NTR scholars to other tax changes to see if the same elasticities are present in different time periods. Goolsbee studies five tax rate changes from 1920 to 1966 and his results show that the findings of NTR literature are not typical. He produces elasticity estimates generally ranging from 0.2 to 0.7 while sometimes finding negative elasticities.

Saez (2004) also produces results that would support the elasticity estimates that Goolsbee (1999) finds. He points out that only comparing data comprising the years directly before and after a tax change could reveal a short term elasticity when a long term elasticity might actually be different. Also income inequality increased greatly during the 1980’s, which could have biased the elasticity estimates of high income earners upward. Saez (2004) introduces a time trend in his regressions to control for income inequality and produces elasticity estimates generally ranging from 0.6-0.7. These findings show that the high elasticities found for the 1980’s tax reforms are most likely not indicative of general elasticity estimates since they might be inflated due to an increased share of income accruing to wealthy income earners. Table (1) provides a summary of the papers that estimate elasticities as well as the paper by Canto, Joines, and Laffer (1981) that predicts future tax revenue. This table represents the evidence that other scholars have uncovered about the presence of a Laffer curve in the U.S.

Table 1: Literature Summary

Article	Data	Findings
Canto, Joines, Laffer (1981)	Dependent Variable: Income Tax Revenue Key Independent Variable: Income Tax Rates Years Covered: 1951-1964 Unit of Analysis: Group (all taxpayers in time series data sets)	Summary of Results: Through their regression simulation, the authors find that in the years following 1964, decreasing tax rates could raise tax revenue. This points to the presence of the Laffer curve during this time period and implies that the U.S. was on the right side of this curve.
Lindsey (1987)	Dependent Variable: Taxable Income Key Independent Variable: Top marginal income tax rate Years Covered: 1980-1984 Unit of Analysis: Group (all taxpayers in cross sectional data sets)	Summary of Results: The author obtains elasticity estimates of 1.6 to 1.8 for the elasticity of taxable income with respect to the top marginal tax rate. Lindsey finds the greatest responsiveness to tax rate changes in high income earners. He shows that the U.S. is on the right side of the Laffer curve during this time period because the tax cuts are associated with an increase in tax revenue.

Article	Data	Findings
Feldstein (1995)	Dependent Variable: Taxable Income Years Covered: 1985 and 1988 Key Independent Variable: Top marginal income tax rate Unit of Analysis: Group (taxpayers in the specific panel data set)	Summary of Results: Feldstein creates elasticity estimates of 1.04 to 3.05 for the elasticity of taxable income with respect to the marginal tax rate. He also finds increased tax rate responsiveness in high income earners. These elasticities show that the U.S. is on the right side of the Laffer curve during this time period. The author predicts that the 1993 tax increases should only marginally increase tax revenue.
Goolsbee (1999)	Dependent Variable: Taxable Income Key Independent Variable: Top marginal income tax rate Years Covered: 1922-1926, 1931-1938, 1948-1952, 1962-1966 Unit of Analysis: Group (all taxpayers in cross sectional data sets)	Summary of Results: Goolsbee creates elasticity estimates of 0.0 to 0.7 for the elasticity of taxable income with respect to the top marginal tax rate. These findings do not show any evidence of a Laffer curve in the U.S. during these time periods. These elasticities show that the percentage decrease in taxable income after a tax increase will not be as large as a one percent increase in the tax rate. This shows that tax revenue will still increase if tax rates increase. Goolsbee discounts the notion that lowering tax rates could increase tax revenue.
Saez (2004)	Dependent Variable: Income share of top decile of income earners (multiple groups of income shares were used) Key Independent Variables: Top marginal tax rates, Time trends to control for exogenous factors that affect taxable income Years Covered: 1960-2000 Unit of Analysis: Individual (tax unit)	Summary of Results: Saez produces long-term elasticity estimates of 0.6-0.7 for the elasticity of the top 1% income share with respect to the top marginal tax rate. He only finds tax rate responsiveness in the top 1% of income earners. These findings also do not show evidence of the Laffer curve because the elasticities are less than one. The elasticities that Saez calculates show that the percentage decrease in the top 1% income share after a tax increase will not be as large as a one percent increase in the tax rate. This shows that tax revenue will still increase if tax rates increase. Saez does not find evidence that there are negative revenue effects of tax rate increases.

This table shows that there is conflicting evidence regarding behavioral responses to taxation in the U.S. Feldstein (1995), Lindsey (1987), and Canto, Joines, and Laffer (1981) show that tax increases can have a negative effect on tax revenue. This points to the presence of a Laffer curve during the time periods that these scholars study. Goolsbee (1999) and Saez (2004), however, come to quite different conclusions. They find that tax rates are positively related to tax revenues, which does not support the Laffer curve theory. My research modeling the Laffer curve is meant to add clarity to the debate about the revenue effects of tax rate changes.

III. Theoretical Background:

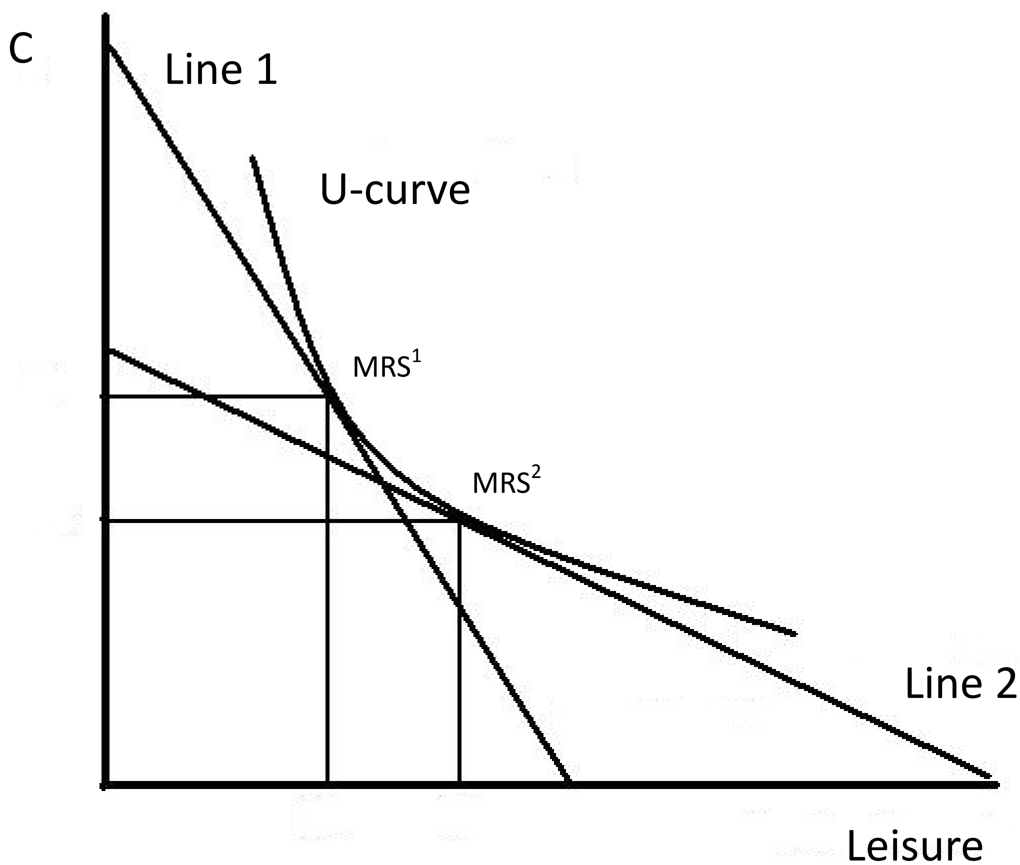
Before directly estimating the Laffer curve, we need to understand behavioral responses to taxation, which potentially explain the shape of the curve. It is important to first take a step back and asses how individuals make decisions regarding consumption and leisure. This provides a theoretical basis that explains why individuals change their behavior when a tax rate is raised or lowered. Taxation distorts the optimal choices of an individual when after tax prices change. This distortion can manifest itself in two ways. Taxes on labor income can change an individual's marginal rate of substitution between consumption and leisure in the present. Also, capital gains taxation can alter an individual's marginal rate of substitution between consumption in the present and consumption in the future. Therefore, microeconomic theory supports Laffer's idea that changes in the tax base occur in response to tax changes. In the following analyses I show why individuals respond to changes in taxes on both labor and capital income. I assume that interest rates and wages are fixed to isolate the effects of tax rate changes.

Microeconomic theory represents the standard choice of individuals between consumption and leisure. Rational individuals strive to maximize their utility, which is a function of these two variables. Graphically an individual's optimal choice between leisure and consumption occurs when the indifference curve representing individual preferences is tangent to the budget constraint. It denotes the fact that the choice of the individual is both on the highest possible indifference curve and affordable. At the optimum, this point represents the marginal rate of substitution between leisure and consumption. This equals the rate at, which the market trades leisure for consumption, the negative of the after tax wage, which is presented in equation (1). U_L represents the marginal utility of leisure, U_C represents the marginal utility of consumption, and $\hat{w}$ is the after tax wage.

$$(1)\ \frac{UL}{UC} = -\hat{w}$$

Graph (1) shows how individuals react when a tax on labor income changes after tax prices.

Graph 1



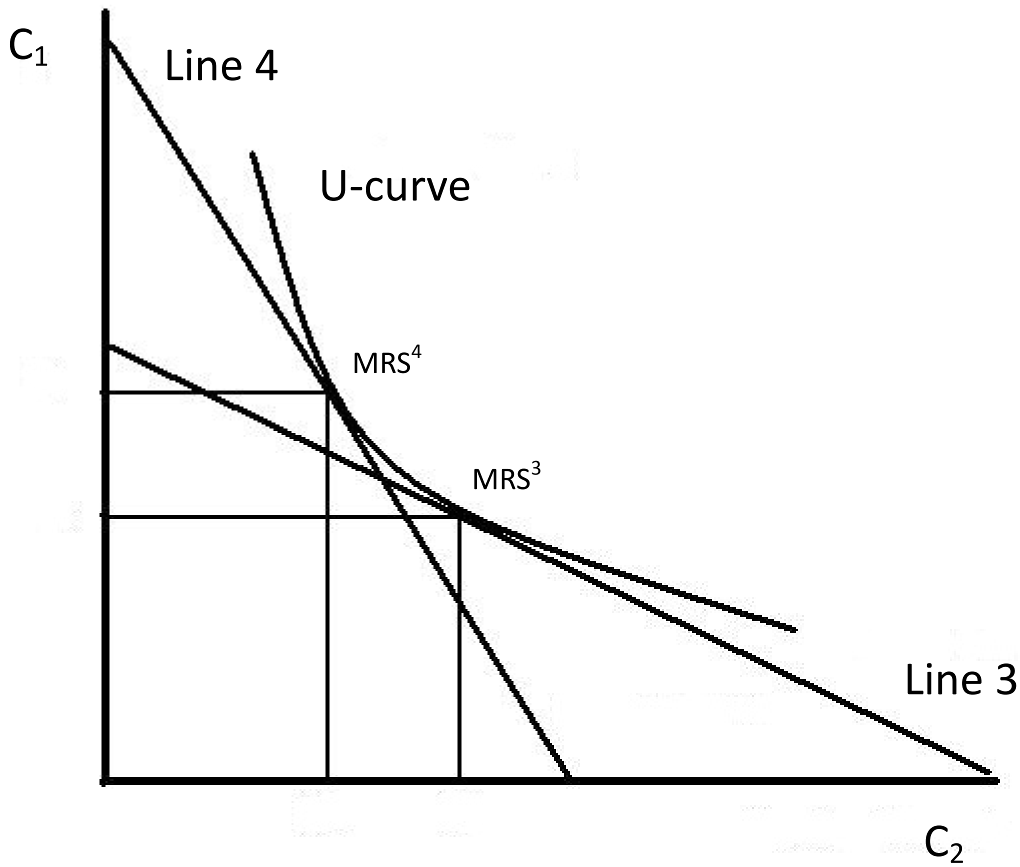
Before tax rates are changed, an individual's marginal rate of substitution between consumption and leisure is assumed to be at MRS^1. If labor income taxes increase, the after tax wage decreases and consumption becomes more expensive relative to leisure. This triggers a substitution effect away from consumption towards leisure. On the graph, the change in the labor income tax changes the slope of the budget constraint from line (1) to line (2). An individual's optimal response yields a new marginal rate of substitution, MRS^2, which represents a new valuation of consumption versus leisure. As a result individuals take more leisure time and work less to remain at the same level of utility. When the level of consumption and the number of hours worked decline, the tax base for labor income taxation shrinks.

The microeconomic theory that represents the tradeoffs between consumption in the present and consumption in the future is similar to the theory supporting the previous example. Rational individuals seek to maximize their utility by maximizing consumption over their lifetimes. As a simplification, I represent a lifetime as two distinct periods that individuals value equally. This optimal choice between consumption in two different periods occurs when the indifference curve representing individual preferences of consumption in period one and consumption in period two is tangent to the budget constraint. At the optimum, the marginal rate of substitution between consumption in period one and consumption in period two is presented in equation (2). This equals the negative of the inverse of one plus the after-tax return on capital. UC_1 represents the marginal utility of consumption in period one, UC_2 represents the marginal utility of consumption in period two, and represents the after tax return on capital.

$$(2)\quad \frac{UC1}{UC2} = -\frac{1}{1+}$$

Graph (2) shows how individuals react when a tax on capital income changes the after-tax return on capital.

Graph 2



Before tax rates are changed an individual's marginal rate of substitution between consumption in period one and consumption in period two is assumed to be at MRS^3. If tax rates on capital are increased then the after tax return on capital goes down. This causes consumption in the first period to increase in value relative to consumption in the second period. Graphically, the change in the relative price of consumption results in a change of the slope of the budget constraint from line (3) to line (4). In order to maintain the same level of utility, individuals increase first period consumption and decrease second period consumption. As a result, an individual has a new marginal rate of substitution, which is represented by MRS^4. Therefore, the after tax return on capital decreases, and an individual saves less in the present. Since saving decreases, the base for capital income taxes declines.

The Laffer curve theory shows that these behavioral responses to taxation occur at every tax rate, but the magnitude of each behavioral response differs. For example, when the tax rate increases from zero to five percent an individual's marginal rate of substitution between consumption and leisure will change, but this response will most likely not cause income tax revenue to fall because it is relatively small. Changing the tax rate from thirty to eighty percent, however, could cause a much larger behavioral response that could decrease tax revenue. Tax revenue changes can be better understood by reviewing the factors that affect tax revenue. Tax revenue equals the tax rate times the tax base. Equivalently, the percent change in tax revenue is equal to the percent change in the tax rate plus the percent change in the tax base. The upward sloping section of the Laffer curve shows that until the revenue maximizing point, the percentage change in the tax rate will be larger than the percentage change in the tax base. On this part of the curve the magnitude of behavioral responses to taxation, in the form of decreasing taxable income, is still smaller than the percent increase in the tax rate. Therefore increasing tax rates will increase tax revenue. The right side of the curve is where the magnitude of the behavioral responses to taxation becomes greater than the percent increase in the tax rate. This causes the Laffer curve to slope downward and shows that revenue will decrease if tax rates are raised.

In order to judge the revenue effects of these behavioral responses, it is helpful to view the government accounting equation, which is presented in equation (3). In this example I exclude all taxes other than the tax on labor income and the tax on capital. R represents total revenue, T_w represents the tax on wages, H represents hours worked, T_k represents the tax on capital, and K represents capital.

$$(3)\ R = T_w H + T_k K$$

When a tax increase occurs, this equation can be used to judge if the tax change raises or decreases tax revenue. If the decrease in the tax base is larger than the increase in the tax rate then total revenue decreases. In the following sections, I develop various versions of equation (3) to assess the magnitude of behavioral responses to taxation and ultimately determine how tax revenues relate to tax rates.

IV. Methodology:

1. Overview:

In contrast with a large section of the literature, I directly estimate the Laffer curve. I incorporate some key elements from the papers mentioned in the literature review into my own statistical models. I focus on all tax units who were subject to a marginal income tax rate at or above the 29% rate during the period being studied. Most scholars who have studied this topic have focused on the elasticity of taxable income related to the net-of-tax-rate. This research attempts to estimate the government revenue implications of tax rate changes. Instead of using taxable income as the dependent variable in regressions, I use income tax revenue. This is similar to the approach of Canto, Joines, and Laffer (1981) who use income tax revenue as the dependent variable in the regressions they create. Like Feldstein (1999) and many other scholars, I use the top marginal tax rate as an independent variable to explain movements in government income tax revenue. This method shows the direct effect of changes in income tax rates on tax revenue. In this case, the elasticity of tax revenue with respect to the income tax rate is obtained as a variable coefficient. This elasticity shows the impact of a one percentage point increase in the tax rate on tax revenue, and it encompasses the response of individuals to tax rate changes. I also draw a great deal from the article by Saez (2004). Like him, I create a time series model, but my data set includes eight more years of data.

Another way that this research differs from previous studies is that I include a variety of tax rates as independent variables in a model that are used to explain movements in tax revenue. This draws on the conclusions of Gordon and Slemrod (1998), who show that that people switch income between personal and corporate tax bases so that their earnings are subject to a favorable tax rate. Since individuals switch income between corporate and personal tax bases, the corporate tax rate is included as an independent variable. The capital gains tax rate is also included as an independent variable because high income earners garner a large portion of their income through capital gains. If the capital gains tax rate is lower than the income tax rate then individuals have an incentive to receive capital gains income instead of wage income. In this thesis I create various models that are used to assess the revenue implications of tax rate changes along with income switching behavior.

2. Data:

Data gathering provides the fundamental building blocks for any estimation or modeling effort, but before this can occur, the type of data that needs to be found has to be specified. The goal of this study is to assess a period including multiple tax rate changes, not just a single episode, so time series data is necessary to carry out this analysis. Canto et al. (1981) and Saez (2004) both use a time series methodology to create elasticity estimates. Carrying out a time series analysis requires historical data on tax returns, and I strive to use the largest data set possible to incorporate many important tax rate changes. Since one of the main goals of this project is to test how well the Laffer curve represents behavioral responses to tax rate changes, data on marginal income tax rates and income tax revenue has to be procured. In an effort to study income switching behavior, historical data on capital gains tax rates and corporate tax rates is also necessary. The data for marginal income tax rates and corporate tax rates that I use is put together by the tax foundation[2]. I procure the data for capital gains income tax rates and the yearly percentage of all tax revenue received at or above the 29% marginal rate using the tax

[2] http://taxfoundation.org/data

policy center database[3]. I also use the IRS[4] and the Congressional Budget Office databases[5] to get the data for income tax revenue and average tax rates respectively.

I use the highest marginal income tax rate because as Saez (2004) and others have stated, tax responsiveness is highest for those who have the greatest incomes and these people are subject to the highest marginal rate. This same explanation is expanded to encompass the use of the highest corporate tax rate as well. Corporations that are subject to the highest marginal tax rate have a large incentive to avoid taxes so that profits are taxed at a lower rate. The corporate tax rate from 1958-1978 had a surtax imposed on the marginal tax rate related to the highest bracket of corporate income. This surtax has been incorporated into the values for the highest marginal corporate tax rate for those years. The surtax increased the tax burden of corporations and it needs to be included in the corporate tax rate because it could have induced a behavioral response to increased taxation. A surtax is a tax imposed above and beyond the marginal tax rate already present. Take for example a marginal tax rate of 10%. If a surtax of 10% is imposed on the marginal tax rate, then anyone subject to this marginal rate would pay an additional 10% of the marginal tax rate. This would equate to increasing the marginal tax rate by 1%.

The historical values for various tax rates are readily available, but gathering data on income tax revenues is an entirely different task. Data on total revenue generated from income taxes are published by the IRS and other sources, but under the scope of this project, that variable is not sufficient. Since high income taxpayers are the most likely people to react to tax changes, the tax revenue that they produce is what needs to be gathered to assess the revenue effects of behavioral responses to taxation. If total tax revenue were used, tax revenue generated

[3] http://www.taxpolicycenter.org/taxfacts/listdocs.cfm?topic2id=20
[4] http://www.irs.gov/uac/Tax-Stats-2
[5] http://www.cbo.gov/publication/43373

by other taxpayers who do not react to tax rate changes could dilute or hide the real responses of high income taxpayers. Ideally, there would be data tracking high income taxpayers over an extended period of time that shows the tax revenue that they produce, but this information is not publicly available. Even though it cannot be assured that the same people are always represented in a given sample because of income changes throughout time, the general reactions of high income earners as a whole is still be taken into account.

In order to isolate the reactions of high income tax payers, it is important to only analyze the revenue that they produce. Since marginal tax rates vary by income, only using the government revenue produced from income at or above certain marginal tax rates can offer the necessary data. The Tax Policy center has a useful data set that shows the percentage of income tax generated at each marginal tax rate from 1958 to 2009. The regression analysis is based on this time period because this is the smallest data set. These percentages can then be multiplied by the total income tax revenue for each year to get the amount of revenue generated at each marginal tax rate.

Even though changing top marginal tax rates creates an environment where behavioral responses to taxation can occur, there is also a problem associated with these changes. Over time the tax code has become less progressive, which means that top marginal tax rates have generally decreased, but the number of people included in these top brackets has grown. This base broadening could create biased elasticity estimates because revenue generated at the top marginal tax rate could increase after a tax cut because more people are in a given tax bracket. If this is the case, it could appear that a revenue change associated with a behavioral response to the tax cut occurs since revenue increases after the cut when it is only a result of taxing more people at that rate. To control for these possible biasing effects of changing the top marginal tax rate, the best solution is to look at the same group of people over time. Since the necessary data is not available to do this a different strategy needs to be taken. For nearly the whole time period this data set represents, top marginal tax rates do not fall below twenty nine percent. Including all of the income generated at and above the twenty nine percent marginal income tax bracket would mediate some of the effects of a changing tax base. Although this no longer only samples the highest income earners, it reduces the percent change in tax base during a given tax reform. The changes in the tax base for those who are subject to the twenty nine percent marginal tax rate or above vary less than the tax base changes for those subject to the top marginal tax rate.

Admittedly, this includes income earners in the sample who are not subject to the top marginal tax rate even though the top marginal tax rate is an independent variable in the regression. This is a drawback of using the larger sample of taxpayers by assessing government tax revenue at or above the twenty nine percent marginal tax rate bracket. Not taking this step however, would most likely cause a significant upward bias in the regression results. I believe the positive aspects of taking this approach outweigh the negative aspects.

This method also excludes three years from the data set, which are 1988-1990. This decision is being made because it is the best alternative in a situation in which only limited data is available. The downsides to removing this data are far greater than the benefits of keeping it in the data set. This is because during these three years the top marginal tax rate falls below 29%. Using the data currently available, keeping these three years would necessitate the inclusion of all of the tax revenue generated at and above the 16% marginal tax rate. The goal of this thesis is to assess the responsiveness of tax revenues to marginal tax rates, and it has been shown in many scholarly articles that the top tier of income earners shows the greatest response to tax rate increases. Therefore, in order to best represent the revenue response to a tax rate change in an econometric regression, only revenue generated at and above the highest marginal tax rate that the data presents should be included in the regression. If these three years were included in the data set, the accuracy of the results would be offset because of the sizeable amount of revenue generated historically from the 16% to 28% marginal tax rates. Empirical results have shown that this tax bracket shows little, if any responsiveness to tax rate changes. This data set is also missing the values for the year 1978. As a result this year also has to be excluded from the regression analysis.

To check different theories of the relationship between tax rates and tax revenues, a series of regressions are run where the top marginal income tax rate is lagged. This tests the theory that people cannot immediately react to marginal tax rate changes and that it takes time to either adjust income or labor supply. To test these assumptions, the tax revenue from any given year is matched with the top marginal tax rate from the year before so that past tax rates can explain tax revenue movements. Various lags are be used to examine, which number of years (a lag of one, two, or three years for example) has the greatest explanatory power.

3. Statistical Treatment:

After the data is properly inspected and formatted, I use regression software to create equations that model the relationships between variables. In this case the software that is used is GRETL, which is similar to the more commonly known STATA program. The coefficient for the variable, which relates to the top marginal income tax rate is of particular importance in log-log regressions because it is the elasticity of the tax revenue with respect to the tax rate. A table of results is also created for each equation, which is necessary for the interpretation of the regression results and can point to any issues in the data that need to be addressed.

The most important aspect of creating regression equations is making sure that they are specified in the correct functional form. Various theories about the relationship between tax rates and tax revenues can be tested to see, which form most accurately models the data. Testing the Laffer curve requires the use of the quadratic functional form, which fits the supposed shape of the Laffer curve. If the Laffer curve theory holds true then the quadratic functional form will show significant results supporting the notion that an upside down parabolic model is the best way to model this relationship. The Laffer curve theory states that increasing income tax rates increases tax revenues at a decreasing rate until increasing taxes actually decreases tax revenues. To model this relationship, both a top marginal income tax rate variable and the same variable raised to the second power are included as independent variables to create a quadratic equation.

After testing the Laffer curve using the quadratic functional form, the log-log functional form is used as well. As noted earlier, this is one of the most commonly used functional forms for relating tax rate changes to tax revenue. Saez (2004), Goolsbee (1999), and many others have referenced the usefulness of this functional form because the coefficients produced using this functional form are elasticities. This allows for the direct interpretation of the effect that an independent variable has on the dependent variable in percentage terms holding all other variables constant. The log-log functional form also compares the percentage change in the independent variables to the percentage change in the dependent variable. Comparisons of this nature are useful when the value changes in the variables might vary greatly while the percent change could show a smaller variance. Since tax rates only vary slightly in absolute value compared to tax revenue, the log-log functional form could be pertinent for addressing the actual relationship between these variables without providing biased results that might be produced through comparing the actual values of the variables.

One of the most common and important problems with time series regressions is the presence of serial correlation. Studenmend (2006) points out that this phenomenon occurs when the error terms of a regression are correlated, and it can cause serious problems with the validity of the regression output. In particular it leads to the creation of t-scores that are unreliable because they are artificially inflated by serial correlation. If this issue is present, the significance of the individual t-scores cannot be trusted. Therefore I correct for serial correlation using a special program in Gretel software. This option can be selected before running a regression that computes Newey-West standard errors that take account for the effects of serial correlation. It creates t-scores that are not biased upwards, which yields accurate results. When serial correlation is detected in a regression then Newey-West standard errors are computed to correct for this problem. Choosing the HAC standard errors option in Gretel creates these standard errors that are corrected for serial correlation.

V. Regressions:

1. Motivation for Regressions:

The main goal of this thesis is to assess and model the revenue effects of tax rate changes. The popular notion of the Laffer curve is often cited to describe the way people react to tax rate changes, but Goolsbee (1999) and others show that there are other, more accurate ways to more model this relationship. A thorough analysis of tax return data and simple models can show the trends that explain how people react to tax rate changes. The regressions below take on a variety of different functional forms that encompass different theories used to describe tax rate responsiveness. First, the log-log functional form (natural log) is used since it has been cited by scholars such as Feldstein (1995) to accurately model behavioral responses to tax rate changes. After that, the quadratic functional form is used to try and model the Laffer curve using tax data. The sequence of regressions presented below maps out the process of examining many regressions with different functional forms and variables to see, which one can most precisely represent the trends in the data.

2. Functional Forms

Log-log Functional Form: This functional form is very useful because it can be used to compare variables that vary greatly in size. It compares the percent changes between variables, which could provide more accurate results when comparing two variables that vary greatly in magnitude such as tax rates and GDP. Also, in a log-log regression equation, Studenmund (2006) shows that each regression coefficient can be interpreted as the percent change in the dependent variable divided by the percent change in the independent variable, which creates an elasticity. Auerbach and Poterba (1988) use a log-log regression to show a relationship between the marginal tax rate and capital gains realizations while generating an elasticity that highlights the relationship. Saez (2004) also mentions log-log equations in the generation of elasticities for research purposes.

Quadratic Functional Form: This is the functional form that represents the Laffer curve, which takes the form of an upside-down parabola. The theory that supports this regression states that as tax rates increase, tax revenue also increases at a decreasing rate until a maximum revenue point. After the maximum revenue point is reached, any further increase in tax rates decreases tax revenue at an increasing rate. Since the utility of every pre-tax dollar earned decreases as tax rates increase, individuals does not put in as much effort to earn more money as the tax rate increases. After the tax rate increases beyond its revenue maximizing point, individuals work less and use more of their time for leisure activities instead of labor. When the tax rate passes the revenue maximizing point, the marginal utility of consumption falls below the marginal utility of leisure, and individuals start to substitute leisure for consumption at an increasing rate. These actions would serve to decrease overall tax revenue.

3. Regression Output Values:

The regression software used to obtain the regression equations presented below produces a table below the regression with a series values associated with various tests done on the regression data. Many of these statistics are necessary for the interpretation of the regression results, and the relevant ones need to be defined to show why they add any insight.

T-ratio: The t-test that produces the t-ratio is used to test if an individual regression variable can significantly explain movement in the dependent variable. Studenmund (2006) shows that the t-ratio needs to be examined to see if an individual variable is a relevant addition to a regression equation. A t-ratio needs to be greater than a certain critical value to show that a variable is relevant. If the critical value for a variable is 2.2 for example, an actual t-score of 2.77 would show that the variable significantly explains movement in the dependent variable.

P-value: The p-test that produces the p-value is an alternative to the t-test. The p-value of a given t-score shows the probability of observing a t-score that is of equal or greater value when the regression coefficient is not actually significant. There is always a chance that the regression software will show a significant t-value when an independent variable is not significant and the p-value shows the likelihood of that happening. Studenmund (2006) shows that low p-values are sought after because they show that there is a small chance that the variable in question is not significant. The numerical value of a low p-score would be below .05.

Adjusted R-squared: The adjusted R-squared value represents the percentage variation of the dependent variable around its mean that can be explained by the regression equation. It is adjusted for the number of coefficients in the equation. This value provides an indicator of how well the regression equation fits the data points. Studenmund (2006) shows that adjusting for the number of coefficients is important because coefficients have to be relevant for them to increase the adjusted R-squared value.

Durbin Watson Statistic: The Durbin Watson Statistic can be used to measure serial correlation in a regression. Studenmund (2006) says that serial correlation can be a problem because it can lead to biased (often inflated) t-scores although it does not change the values of the coefficients. The time series data used in this research produces serial correlation because as data grows over time, it often creates a pattern of increasing error terms. Serial correlation can be detected if the Durbin Watson statistic for a regression is below a certain critical value. The critical value depends on the number of observations and the number of independent variables in a regression. Every regression that I run shows evidence of serial correlation because the Durbin Watson statistics produced are all lower than the respective critical value, which shows evidence of serial correlation. In order to remedy this problem, the Newey-West (or HAC) standard errors are computed for all of the regressions to correct for the adverse impacts of serial correlation.

Statistically Significant: If a variable is statistically significant, it means that the effect it has on the dependent variable is most likely not due to chance. This means that there is an underlying relation between the two variables where the movement in an independent variable explains movement in the dependent variable.

4. Coefficient Interpretations:

In the log-log regressions, the coefficients can be interpreted as elasticities. The coefficients show the effect on the dependent variable in percentage terms of a one percent change in an independent variable holding all other variables constant. For instance the coefficient 3.61 on GDP in equation (8) shows that a one percent change in GDP will change income tax revenue by 3.61 percent. Although every variable in the logarithmic regressions has a coefficient that can be interpreted in this way, the only coefficient that has been used by previous researchers is a coefficient similar to the one for the top marginal income tax rate. I include other variables in the regression equations to control for other factors that could affect income tax revenue that are not explained by the top marginal tax rates. If the other variables that I add are of the expected sign and significant then they serve the desired purpose in the regression. Since the focus of this thesis is to assess the effects of income tax rate changes on income tax revenue the top marginal income tax rate coefficient is the only coefficient that will be interpreted with respect to its policy implications.

It is important to understand how to interpret the regression coefficients produced in the output tables for the quadratic formula. In equation (10), if TMI increases by one unit, tax revenue increases by β_1 plus two times β_2 times TMI. The sign of β_2 determines if the function is concave or convex. If β_2 is negative, the function is convex (like the Laffer curve). For equations (10), (11), and (12) representing the Laffer curve, the data for income tax revenue are denoted in thousands of dollars so the coefficients for the variables in the quadratic regressions are in thousands as well. The GDP variable is denoted in billions of dollars so a one unit increase in GDP means increasing GDP by one billion dollars.

5. Definition of variables:

IR = income tax revenue generated at or over the 29% marginal income tax rate

GDP = gross domestic product

TMI = top marginal income tax rate

AEC = average effective capital gains tax rate

TCO = top corporate tax rate

CR = total revenue collected on capital gains

ATI = average top income tax rate

LTMI= top marginal tax rate lagged one year

INEQ = income share of the top decile of income earners

α = constant term

ε_i = error term

Table 2: Regressions and Expected Signs

	1	2	3	4	5	6	7	8	9	10	11	12
Dependent Variables												
IR	I	I	I			I	I	I	I	I	I	I
CR				I	I							
Independent Variables												
TMI	(+)	(+)	(+)		(+)					(+)	(+)	(+)
TMI^2										(-)	(-)	(-)
INEQ									(+)			(+)
LTMI							(+)	(+)	(+)			
AEC		(+)	(+)	(+)	(+)	(+)		(+)	(+)		(+)	(+)
TCO			(+)			(+)					(+)	(+)
ATI						(+)						
GDP	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)

Table (2) provides a template for the regressions that have been run for this thesis. The top row lists the number of each equation that is run. For each equation, the dependent variables have an "I" next to them if they are used as the dependent variable in a given regression. The independent variables have the expected sign next to them if they are included in a regression. If a space is left blank, this means that a given variable is not included in a specific regression. The GDP variable is used in every regression because GDP is directly related to tax revenue. As GDP changes, incomes change along with it. Changing incomes alter the tax revenue that the government receives. I control for GDP to account for changes in income tax revenue that cannot be accounted for with changes in the other independent variables. GDP is always expected to have a positive relation to tax revenue because as GDP rises, income rises and so does tax revenue.

6. Regressions and Interpretations[6]:

This section explores different theories about the relationship between tax rates and tax revenues. I test to see if the log-log functional form or the quadratic functional accurately captures this relationship.

6.1 Log-log regressions: One functional form that could be relevant to the discussion of the results of behavioral responses to tax rate changes is the log-log functional form. It creates elasticities as coefficients for each variable, and unlike the Laffer curve, it is not based on the assumption that increasing tax rates lowers tax revenue if tax rates are above a critical point. Since the tax code in the U.S. has a series of marginal income tax rates, people could stop earning more money, but not necessarily actively earn less money and take more leisure time with income tax rate increases. Individuals might also switch income to a different form, such as capital income, so that it is subject to a different tax rate. The hypothesis concerning the following equations is that the Laffer curve does not exist in the U.S. and that there is a positive relation between tax rates and tax revenues.

The regression in equation (1) shows a log-log relationship between the dependent variable, income tax revenue (IR), and the independent variables, the top marginal income tax rate (TMI) and GDP. This is a baseline regression used to show that the income tax rate is positively related to income tax revenue. The coefficients for the top marginal income tax rate (TMI) and GDP are expected to be positively related to income tax revenue (IR). Since the log-log functional form creates coefficients that are elasticities, the beta coefficient for the top marginal income tax rate (TMI) variable is the elasticity of tax revenue related to the top

[6] The regression output tables and a table with descriptive statistics for each variable are presented in the appendix.

marginal tax rate. It shows the percentage change in tax revenue that would result from a one percent change in marginal tax rates holding other variables constant.

Equation 1: $\ln IR = \alpha + \beta_1 \ln TMI + \beta_2 \ln GDP + \varepsilon_i$

IR = income tax revenue generated at or over the 29% marginal income tax rate
TMI = top marginal income tax rate
GDP = gross domestic product

The results of this regression are shown in table (4) in the appendix. The t-score for the top marginal tax rate is not significant in this case. The top marginal income tax rate (TMI) variable should be significant because it controls what percent of an individual's income is received by the government as taxes. It could be the case that other relevant variables need to be included in the equation to improve the t-score. There also could have been errors with the data collection that affected the equation as well. The t-score for the GDP variable is significant so a change in GDP significantly affects tax revenue. A high adjusted r squared value of .919 indicates that the equation fits the data very well. Theory would indicate that tax rates should have a strong influence on the amount of revenue received by the government. Although the top marginal tax rate is not significant in equation (1), other variables that also explain how much income tax revenue the government receives may need to be added to better assess the significance of that variable.

<u>Testing for Income switching:</u> Capturing the relation between tax rates and tax revenue necessitates further research to better understand how individuals respond to tax changes, which involves exploring possible income switching between tax bases. In equation (2), the

independent variable, average effective capital gains tax rate (AEC), has been added to the regression because it might be an important factor in explaining the movement in income tax revenue (IR), and it could increase the significance of other variables. Adding this variable tests the hypothesis that individuals switch income from wage to capital gains tax bases when relative tax rates change. This step provides an extension of the work of Gordon and Slemrod (1998) by explaining movements in income tax revenue through income switching behaviors. The inclusion of this variable shows that people might switch the ways they receive income in order to be subject to a lower tax rate. The average effective capital gains tax rate (AEC) is expected to have a positive relationship to income tax revenue (IR) because, as the average effective capital gains tax rate (AEC) increases, individuals have a greater incentive to take their compensation as wage income, which would increase income tax revenue (IR). Conversely, if the average effective capital gains tax rate (AEC) decreases, individuals would have a greater incentive to take their income as capital gains, which would lower IR.

Equation 2: $\ln IR = \alpha + \beta_1 \ln TMI + \beta_2 \ln AEC + \beta_3 \ln GDP + \varepsilon_i$

IR = income tax revenue generated at or over the 29% marginal income tax rate
TMI = top marginal income tax rate
AEC = average effective capital gains tax rate
GDP = gross domestic product

The results of this regression are shown in table (5) in the appendix. The t-scores for both the top marginal income tax rate (TMI) and average effective capital gains tax rate (AEC) variables are not significant in this case. There could have been errors with the data collection or omitted variables that affected the accuracy of this equation. The t-score for GDP is significant so a change in GDP significantly affects tax revenue. The high adjusted r squared value for this equation indicates that the regression fits the data very well.

Again, even though the top marginal tax rate and the average effective tax rate on capital gains are not significant in this equation, the addition of another important variable, the top corporate tax rate, could increase the significance of those two variables by further explaining income switching behavior.

Equation (3) adds another independent variable, the top corporate tax rate (TCO), to the equation so that the movement in the dependent variable can be more accurately explained by the movement in the independent variables. This tests the hypothesis that individuals switch income between personal and corporate tax bases when relative tax rates change. Movements in the top corporate tax rate (TCO) variable could affect income tax revenue (IR) because individuals could shift income from corporate income to wage income depending on the respective tax rates. The top corporate tax rate (TCO) is expected to have a positive relationship to income tax revenue (IR) because as the top corporate tax rate (TCO) increases, individuals have a greater incentive to take their compensation as wage income, which would increase income tax revenue (IR). Conversely, if the top corporate tax rate (TCO) decreases, individuals would have a greater incentive to take their income as corporate income, which would lower income tax revenue (IR).

Equation 3: $\ln IR = \alpha + \beta_1 \ln TMI + \beta_2 \ln AEC + \beta_3 \ln TCO + \beta_4 \ln GDP + \varepsilon_i$

IR = income tax revenue generated at or over the 29% marginal income tax rate

TMI = top marginal income tax rate

AEC = average effective capital gains tax rate

TCO = top corporate tax rate

GDP = gross domestic product

The results of this regression are shown in table (6) in the appendix. In this case the t-score for the top marginal income tax rate (TMI) variable is significant. The inclusion of the top corporate tax rate (TCO) variable increases the significance of the top marginal income tax rate (TMI) variable since it is significant in this regression while it has not been significant in the previous log-log regressions. Still, the average effective capital gains tax rate (AEC) variable is not significant. This could possibly be explained by an omitted variable. There could also be errors with the data collection that affect the equation. The top corporate tax rate (TCO) variable is significant, but not in the direction that was initially expected. The negative sign on the coefficient in this case could be explained by actions outside of income switching. As the corporate income tax increases people could evade taxes by hiding their income from the IRS in some manner (Slemrod 2007). It is impossible to assess tax evasion accurately because most of it is hidden and cannot be measured so it cannot be included in a regression model. The t-score for GDP is significant so a change in GDP significantly affects tax revenue. A high adjusted r squared value indicates that the equation fits the data very well.

It is possible that using a different variable as the dependent variable can show a stronger relationship between tax rates and tax revenues. Using capital gains tax revenue as the dependent variable in an equation instead of income tax revenue could lead to more accurate results because a different data set is being used to estimate the regression. It is also possible that individuals treat capital gains income differently than wage income, which might lead to unique behavioral responses to tax rate changes that could affect tax revenue.

<u>Testing alternate dependent variables:</u> The Laffer curve theory does not exclusively relate to income tax revenue. I am exploring whether the log-log form captures the relation between tax rates and capital gains tax revenue. Equation (7) uses the log-log form to explain the relationship between capital gains tax revenues (IR) and average effective capital gains tax rates (AEC) and GDP (independent variables). The average effective capital gains tax rate (AEC) should have a positive relation to capital gains revenue (CR) because, as the tax rate increases, the government should receive more revenue. This is similar to the regression relating income tax revenues to the marginal income tax rate and GDP, but there might be a relationship present with capital gains tax revenue as the dependent variable that is not present when income tax revenue is the dependent variable. This is because people can control when they receive income from capital gains since they choose when to sell an asset. Auerbach and Poterba (1988) show that capital gains realizations vary greatly directly before and directly after a tax reform.

Equation 4: $\ln CR = \alpha + \beta_1 \ln AEC + \beta_2 \ln GDP + \varepsilon_i$

CR = total revenue collected on capital gains

AEC = average effective capital gains tax rate

GDP = gross domestic product

The results of this regression are shown in table (7) in the appendix. In this case, the t-scores for both the average effective capital gains tax rate and GDP are highly significant, and the adjusted r squared value is very high showing that the equation is an excellent fit for the data.

Again the log-log form has shown high explanatory power in modeling the relationship between tax rates and tax revenues.

Even though this regression has shown significant results, it is necessary to include other variables to see if tax rates on other forms of income can explain changes in capital gains tax revenue. The inclusion of other tax rates as independent variables tests the hypothesis that income switching occurs between personal and capital gains tax bases. If the income tax rate can explain movements in capital gains tax revenue then there would be evidence of income switching behavior. The top marginal income tax rate (TMI) is included in equation (5) to account for these income switching behaviors. The top marginal income tax rate (TMI) should also have a positive relation to capital gains tax revenue (CR) because, as the marginal income tax rate rises, people might switch more of their wage income to capital gains income, which would increase the revenue from capital gains taxes.

Equation 5: $\ln CR = \alpha + \beta_1 \ln AEC + \beta_2 \ln TMI + \beta_3 \ln GDP + \varepsilon_i$

CR = total revenue collected on capital gains

AEC = average effective capital gains tax rate

TMI = top marginal income tax rate

GDP = gross domestic product

The results of this regression are shown in table (8) in the appendix. The t-score for GDP is still highly significant in this case. The t-score for average the effective capital gains tax rate, although still being significant, is less significant with the inclusion of the marginal tax rate variable. The t-score for the marginal tax rate variable is not significant. This could possibly be explained by an omitted variable or the erroneous inclusion of the marginal tax rate variable in a regression where it does not have explanatory power. There could also be errors with the data collection that affect the equation. Although the adjusted r-squared value is still high, the top marginal income tax rate is insignificant so this equation cannot conclusively show evidence of income switching behavior.

<u>Testing average tax rates:</u> It is possible that a different representation of the income tax variable could more accurately explain movements in income tax revenue. The formatting of the income tax variable, if changed, might be able to better reflect income switching behavior. Equation (6) uses income tax revenue as the dependent variable and the average individual income tax for the highest quintile (ATI), the average effective capital gains tax rate (AEC), the highest corporate tax rate (TCO), and GDP as independent variables. All of the independent variables are expected to be positively related to income tax revenue. The average effective capital gains tax rate (AEC) and the highest corporate tax rate (TCO) are included to account for income switching behaviors. The data from this regression differs from the data used in the previous regressions because data was only available back to 1979 instead of 1958. This fact could possibly account for some of the variation in the results of this regression.

Equation 6: $\ln IR = \alpha + \beta_1 \ln ATI + \beta_2 \ln AEC + \beta_3 \ln TCO + \beta_4 \ln GDP + \varepsilon_i$

IR = income tax revenue generated at or over the 29% marginal income tax rate

ATI = average top income tax rate

AEC = average affective capital gains tax rate

TCO = top corporate tax rate

GDP = gross domestic product

The results of this regression are shown in table (9) in the appendix. The t-scores are significant for both the average income tax and GDP in this regression. The t-score for the highest corporate tax rate is significant, but in this regression the value is positive, which differed from its negative value in equation (3). This could be accounted for by the smaller data set or the use of average income tax rates instead of top marginal tax rates. The t-score for the average effective capital gains tax rate was not significant possibly because of an omitted variable, errors with data collection, or a mis-specified variable. The adjusted r-squared value is still high, which shows that the equation fits the data well. Since the top corporate tax rate (TCO) variable is highly significant, this regression shows evidence of income switching behaviors between personal and corporate tax bases.

Testing lagged tax rates: So far, tax revenue received by the government in one year has been compared to tax rates from the same year. It might be the case, however, that individuals are unable to react instantly to tax rate changes. This applies mostly to changes in marginal income tax rates because it might be extremely difficult to alter one's wage income right after a tax change occurs. Since this process might not be immediate, lagging the marginal income tax rate by one year might better capture when people decide to change the form in, which they receive their income because of a tax rate change. This addition could lead to more significant regression results. It is also possible that individuals could react before tax changes occur, but there is little evidence to support this reaction to income tax rate changes. Saez (2004) also points out that taxpayers imperfectly control their incomes or are not aware of details in the tax code. These factors could contribute to a delayed response to tax rate changes.

Although Romer and Romer (2007) use lags of four to five years in their paper, there are marked differences in this research that make a one year lag more suitable. The most important difference is that I study tax revenue while Romer and Romer (2007) study economic output which, is a far more complex variable. I also ran regressions with lags of one to three years and the one year lag was the only one that had significant results. This could show that the likelihood that someone would shift income as time goes on decreases every year after a tax reform.

Equation (7) shows the relationship between income tax revenue as the dependent variable and GDP and the top marginal income tax rate with a one year lag (LTMI). The top marginal tax rate lagged one year (LTMI) is expected to have a positive relation to IR since an increase in tax rates should increase tax revenue.

Equation 7: $\ln IR = \alpha \;\; \beta_1 \ln LTMI + \beta_2 \ln GDP + \varepsilon_i$

IR = income tax revenue generated at or over the 29% marginal income tax rate
LTMI= top marginal tax rate lagged one year
GDP = gross domestic product

The results of this regression are shown in table (10) in the appendix. In this case, the top marginal tax rate lagged one year (LTMI) is not significant, which could be explained by an omitted variable or an error in the data. The regression still has a very high adjusted r squared value, which shows that it fits the actual data very well. The values of the coefficients are both positive as expected.

The inclusion of another independent variable could increase the explanatory power of the previous regression and increase the explanatory ability of the top marginal tax rate lagged one year (LTMI). Equation (8) adds another independent variable, average effective capital gains tax rates, to the regression equation to complement the lagged top marginal income tax rate and GDP. This variable is included to test the hypothesis that income switching occurs between wage and capital gains tax bases when relative tax rates change. As in previous regressions, the value of the average effective capital gains tax rate (AEC) coefficient should be positively related to income tax revenue (IR).

Equation 8: $\ln IR = \alpha \;\; \beta_1 \ln LTMI + \beta_2 \ln AEC + \beta_3 \ln GDP + \varepsilon_i$

IR = income tax revenue generated at or over the 29% marginal income tax rate
LTMI= top marginal tax rate lagged one year
AEC = average effective capital gains tax rate
GDP = gross domestic product

The results of this regression are shown in table (11) in the appendix. All of the t-scores of the independent variables are significant although to varying degrees. The inclusion of the new variable increases the t-scores of the other variables as well as slightly increasing the adjusted r-squared value improving the overall fit of the regression. This regression shows evidence that individuals shift income between capital gains and wages as a response to changes in taxes that make one form of income more favorable than the other.

Controlling for Inequality: The coefficient for the lagged top marginal tax rate (LTMI) variable in equation (8) is higher than expected at 1.6. This result shows that a one percent change in tax rate causes a 1.6 percent change in tax revenue. Since people most likely do not increase the amount of income they report when tax rates are raised, there could be another variable that could account for tax revenue movement. Increases in inequality, with top earners gaining a larger income share, could explain the large coefficient of the lagged top marginal tax rate (LTMI) variable. In what follows, I include data on the income share of the top decile of income earners in the regression[7]. I use this variable (INEQ) as a proxy for inequality, which could account for some tax revenue movement. I expect this variable to have a positive relation to income tax revenue because I expect tax revenue of high income taxpayers to increase as their share of total income grows.

Equation 9: $\ln IR = \alpha \;\; \beta_1 \ln LTMI + \beta_2 \ln INEQ + \beta_3 \ln AEC + \beta_3 \ln GDP + \varepsilon_i$

IR = income tax revenue generated at or over the 29% marginal income tax rate
LTMI= top marginal tax rate lagged one year
INEQ = income share of the top decile of income earners
AEC = average effective capital gains tax rate
GDP = gross domestic product

The results of this regression are shown in table (12) in the appendix. The added variable, the income share of the top decile of income earners (INEQ), is negatively correlated to tax revenue. This could reflect the ability of higher income earners to avoid taxes as their incomes increase. The inclusion of the income share of the top decile of income earners (INEQ) did significantly reduce the coefficient on the lagged top marginal tax rate (LTMI) variable to 1.15

[7] http://elsa.berkeley.edu/~saez/TabFig2012prel.xls

so the desired effect was produced in this equation. All of the variables are significant in this equation and the R squared value is very high so both the full equation and the individual variables can accurately explain movements in the data.

6.2 Quadratic regressions: The following regressions are intended to model the Laffer curve based on tax data for the U.S. Unlike the log-log functional form, the quadratic functional form tests if there is a negative relationship between tax rates and tax revenues beyond a certain tax rate as Laffer curve theory would predict. These equations test this central hypothesis while also taking steps similar to the previous regressions in order to capture income switching behavior.

Equation (10) is derived from the work of Canto et al. (1981). This equation is intended to show that as tax rates increase, there is a point where an increase in tax rates no longer increase tax revenue and tax revenue actually decreases as tax rates are raised. The coefficient for the top marginal income tax rate (TMI) should be positively related to income tax revenue (IR) since the Laffer curve theory says that increased tax rates increase revenue up to a certain point. The top marginal income tax rate squared (TMI^2) variable should have a negative relation to IR because this variable shows that after a certain point, increased tax rates decreases tax revenue. If the top marginal income tax rate squared (TMI^2) variable is negative and significant then there is evidence that increasing tax rates have negative effects on income tax revenues when tax rates are high.

Equation 10: $IR = \alpha + \beta_1 TMI + \beta_2 (TMI)^2 + \beta_3 GDP + \varepsilon_i$

IR = income tax revenue generated at or over the 29% marginal income tax rate

TMI = top marginal income tax rate

GDP = gross domestic product

The results of this regression are shown in table (13) in the appendix. This simple regression does not support the Laffer curve theory because the t-scores for the top marginal income tax rate (TMI) and the top marginal income tax rate squared (TMI^2) variables are not significant. There are several possible reasons why the coefficients of this regression are not significant. It is possible that the t-scores are not significant because some important variables were omitted. There could also have been data inaccuracies that have decreased the significance of certain variables. The t-score for GDP is significant so a change in GDP significantly affects tax revenue. The high adjusted r squared value does show a relatively strong overall fit for the regression. This can occur if all of the variables together can explain movement in the dependent variable, but they cannot do so individually.

<u>Adding Relevant Variables:</u> Since variables representing tax rates other than the income tax rate and inequality were significant in the log-log regressions, including them in the quadratic regressions could improve the significance of the quadratic functional form. Equation (11) attempts to expand on the original quadratic regression presented that represents the Laffer curve by including more variables that should help to explain movements in income tax revenue. Omitting an important variable can bias the results of the variables included in a regression so it is important to try and include all relevant variables. The average effective capital gains tax rate (AEC) variable controls for income switching between wage and capital gains income while the top corporate tax rate (TCO) variable controls for income switching between corporate and wage

income. The values for all coefficients should be positive except for coefficient for the top marginal income tax rate squared (TMI^2), which should be negative.

Equation 11: $IR = \alpha + \beta_1 TMI + \beta_2 (TMI)^2 + \beta_3 AEC + \beta_4 TCO + \beta_5 GDP + \varepsilon_i$

IR = income tax revenue generated at or over the 29% marginal income tax rate

TMI = top marginal income tax rate

AEC = average effective capital gains tax rate

TCO = top corporate tax rate

GDP = gross domestic product

The results of this regression are shown in table (14) in the appendix. In this case, two variables have significant t-scores: the top corporate tax rate (TCO) and GDP. The other variables have insignificant t-scores. Although the adjusted r squared value is still relatively high, the fact that two out of the five variables included are significant shows that this functional form is most likely not the best way to represent the relationship between tax rates and tax revenues. One would expect that the top marginal income tax rate squared (TMI^2) variable would be significant in this equation, but it is not. This variable is highly important to the validity the Laffer curve theory because it represents the effect of excess taxation, which gives individuals the incentive to work less. If the Laffer curve theory is valid, this variable should have a significant effect on tax revenue.

Controlling for Inequality: Since the proxy used to represent inequality increased the accuracy of equation (9), it is possible that including it in an equation representing the Laffer curve could have the same effect. I expect this variable to have a positive relation to income tax revenue because I expect tax revenue of high income taxpayers to increase as their share of total income grows.

Equation 12: $IR= \alpha + \beta_1 TMI + \beta_2 (TMI)^2 + \beta_3 AEC + \beta_4 TCO + \beta_5 INEQ + \beta_6 GDP + \varepsilon_i$

IR = income tax revenue generated at or over the 29% marginal income tax rate
TMI = top marginal income tax rate
AEC = average effective capital gains tax rate
TCO = top corporate tax rate
INEQ = income share of the top decile of income earners
GDP = gross domestic product

The results of this regression are shown in table (15) in the Appendix. As in equation (11), the top corporate tax rate variable has a significant t-score. The average effective capital gains tax rate (AEC) and the proxy for inequality (INEQ) also have significant t-scores. Adding the (INEQ) variable to this equation, however, made the GDP variable insignificant, which is puzzling because it has been significant in every previous regression and theory would indicate that it should significantly affect tax revenue. Although the adjusted r squared value is relatively high in this equation, adding the (INEQ) variable still does not make the top marginal income tax rate (TMI) or the top marginal income tax rate squared (TMI^2) variables significant. The variable, top marginal income tax rate squared (TMI^2), that is included to make the regression resemble the Laffer curve does not have a significant t-score. Therefore the Laffer curve theory that states that tax rates can have a negative relationship to tax revenue cannot be strongly supported.

Table (16) in the appendix provides descriptive statistics for all of the variables that were included in the various regressions. It provides information on the number of observations, the mean values, and the distribution with respect to the mean for each variable. Table (3) below provides a summary of all of the regressions run for this project. The numbers in the top row refer to the number of the regression equation. The column on the left shows all of the variables that are included in the regressions. If a variable is included in a regression, the table shows if that variable is not significant if the letters (NS) are present. If a variable is included in a regression and is significant, then the coefficient value is displayed in the cell.

Table 3: Summary Statistics

	1	2	3	4	5	6	7	8	9	10	11	12
TMI	NS	NS	1.6		NS					NS	NS	NS
TMI^2										NS	NS	NS
INEQ									-4.17			1.50E+07
LTMI							NS	1.6	1.15			
AEC		NS	NS	0.79	0.78	NS		0.79	0.73		NS	-4.32E+06
TCO			-2.45			1.62					4.19E+06	-5.52E+06
ATI						1.97						
GDP	2.91	3.02	2.39	2.6	2.58	2.1	3.36	3.61	4.48	38395	32630	NS

Table (3) gives a comparison of the significance of variables used in the regressions. In all of the quadratic regressions, equations (10) to (12), the top marginal income tax rate (TMI) and top marginal income tax rate squared (TMI^2) variables are not significant. This shows that the quadratic model does not adequately explain the relationship between income tax rates and revenues in these instances. The top corporate tax rate variable (TCO) is significant in all of the regressions where it is used, but its sign switches between regressions. Therefore the effects of this variable cannot be accurately interpreted since the sign of the variable is not consistent.

Adding variables to explain income switching behaviors increases the significance of the top marginal income tax rate (TMI) and lagged top marginal tax rate (LTMI) variables in the logarithmic regressions. Including variables to account for income switching is important for explaining all of the revenue effects of tax rate changes.

VI. Discussion:

Although the research conducted in this paper does not totally discredit the notion of the Laffer curve, it shows that it is not the most accurate way to model the relationship between tax revenue and tax rates in the U.S. The top marginal income tax rate variable (TMI) and the top marginal income tax rate squared variable (TMI^2) were not significant in the regressions modeling the Laffer curve whereas they support the essential underpinnings of the Laffer curve theory. If these variables were significant they could explain the shape of the Laffer curve, which resembles an upside down parabola. Since they are not significant this theory cannot be given significant support.

Every log-log regression that was run has a high R squared value, which shows that the log-log functional form can be used to accurately depict the relationship between tax rates and tax revenues. Out of all of these equations, equation (3) and equation (9) stand out because of the significance of the individual variables that the regressions contain. The residual plots for both of these regressions are shown below in figure (2) and figure (3). The y-axis for both plots represents the actual tax revenue for every year while the x-axis represents the tax revenue predicted by the regression equation. The points on the graph show the actual tax revenue for every given year while the line on the graph is the regression line I create. These figures provide a visual representation of how well the regressions fit the actual data by presenting the actual data points and the regression equation in the same graph. The significance of multiple variables in these log-log regressions points to a linear relation between tax revenues and tax rates. In equation (3) both the top marginal income tax rate and the top corporate tax rate are highly significant even though the coefficient value for the top corporate tax rate was not expected to be negative. In equation (9) the lagged top marginal tax rate variable is highly significant while the average effective capital gains tax rate variable is significant as well. These variables explain movements in income tax revenue in log-log regressions while they did not in quadratic regressions. The variable representing inequality is significant as well. The results of these regressions show that individuals respond to tax rate changes but not in the same ways that the Laffer curve theory would predict. Instead of changing their labor supply, which rarely happens according to Goolsbee (1999), high income taxpayers switch the form in, which they receive their income.

Figure 2: Residual plot of equation (3)

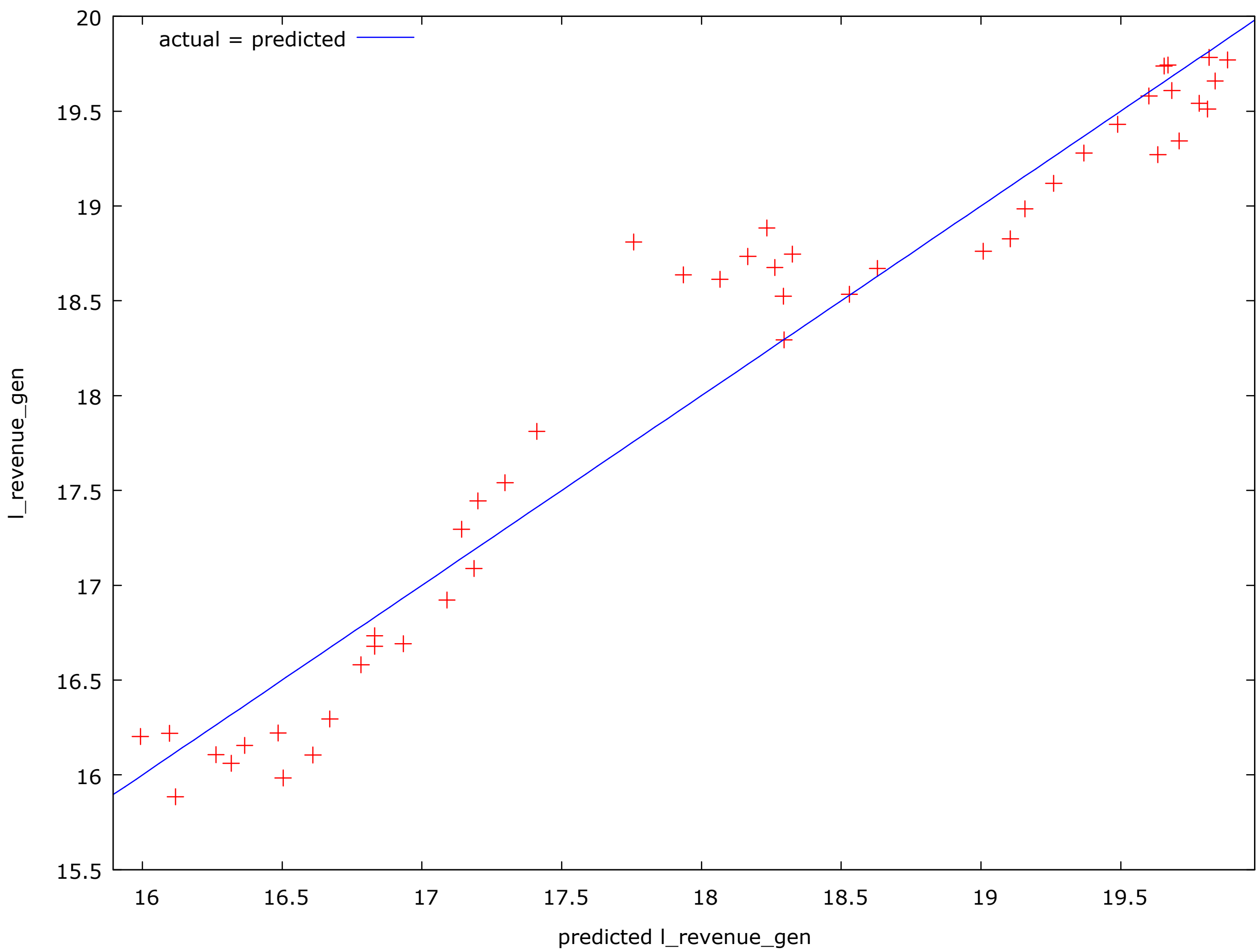
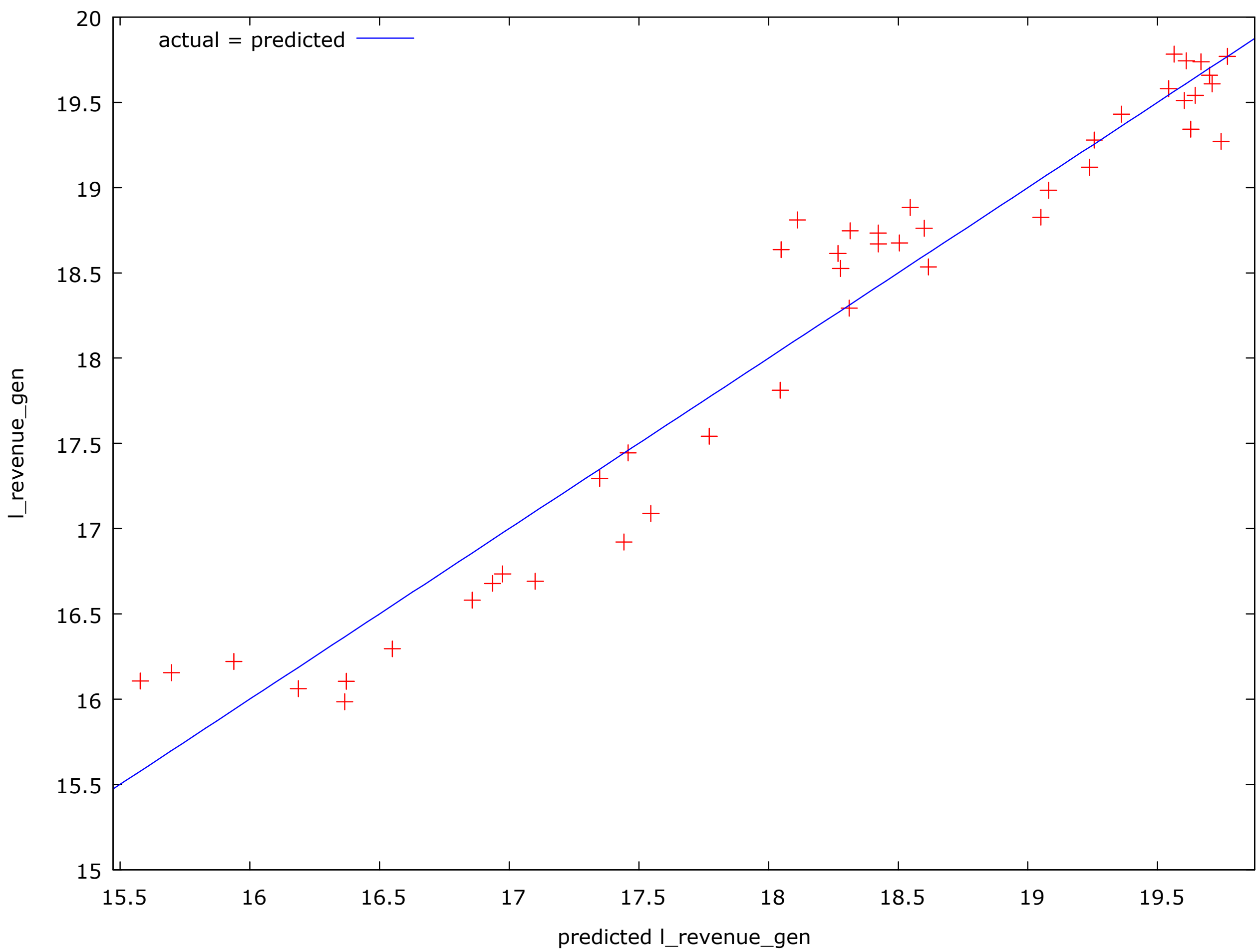


Figure 3: Residual plot of Equation (9)



Many scholars such as Feldstein (1995) have pointed to the importance of elasticities for interpreting the effects of tax rate changes on taxable income and therefore tax revenue. The log-log functional form conveniently calculates elasticities as the coefficients that represent how each independent variable affects income tax revenue. As I mentioned previously, the elasticities created through this research show the direct revenue effects of a change in the top marginal income tax rate. For equation (3) the elasticity of income tax revenue with respect to the top marginal income tax rate is near 1.6. (this is a positive elasticity). This elasticity shows that a one percent increase in the marginal income tax rate would cause a subsequent increase in tax revenue of 1.6 percent. The fact that the elasticity is greater than one is surprising since individuals would not have the incentive to switch more income to wage form if the tax rate increases. Increased income inequality as evidenced by Atkinson et al. (2009) could have contributed to rising tax revenue unrelated to tax rate changes. Therefore, I use a variable to represent inequality in equation (9), and the elasticity of tax revenue with respect to the tax rate is reduced to 1.15. Although this elasticity is still above one, increasing the accuracy of the data relating to tax revenue and inequality could lower the value of this elasticity. Based on this research, increasing marginal tax rates on high income taxpayers is an effective way to raise government revenue.

These results contradict the findings of both Feldstein (1995) and Lindsey (1987) because their research shows that a tax rate increase would lead to little or no revenue for the government. One factor to take into consideration is that I calculate a long-run elasticity for top income earners based on forty eight years of data. Feldstein and Lindsey only examine the years surrounding the tax reforms put in place in 1982, 1984, and 1986. It is possible that during the years after a tax rate change, individuals take part in behaviors that would lower government revenue while in the long run, government revenue increases. My research, however, points out that these behaviors do not describe long-term responses to taxation exhibited by high income earners since 1958. Another reason why my research could differ from that of Feldstein (1995) and Lindsey (1987) is that I use a different method to calculate elasticities. They use a difference-in differences calculation, which Goolsbee (1999) says can bias elasticity measures because it compares different income groups. The regression method that I use tries to isolate and then compare the same income group over time. Lastly, my use of an imperfect measure of income tax revenue could have inflated my elasticity estimates to make them significantly different from those of Feldstein (1995) and Lindsey (1987).

This research provides other valuable information that can have an impact on policy measures that seek to reform taxes by shedding insight on revenue effects of behavioral responses to taxation. Equations (8) and (9) provide the most important information on this subject. First, the significance of the lagged marginal tax rate variable shows that individuals do not respond immediately to tax rate changes. It takes people some time to adjust their working or earning tendencies in reaction to a tax rate change. Assessing the year when a tax rate change occurs might not produce results showing responsiveness, not because people do not respond, but because they have not yet had the time to do so. During any given year, income tax revenue could be better explained by the previous year’s tax rate than the current year’s tax rate. If policy makers are looking for evidence of behavioral responses to taxation they should wait for two, three, or four years after a tax measure is passed to fully gauge its impact.

Another important aspect of equations (8) and (9) is that the capital gains tax rate can significantly explain movements in income tax revenue. This might seem bizarre at first because the capital gains tax rate does not apply to wage income, but this finding is in keeping with the results of Gordon and Slemrod (1998). They show that the top half of income earners switch income from corporate to personal tax bases when personal income receives a favorable tax rate. This result is also supported by Piketty et al. (2011) who show that optimizing tax rates requires attention to elasticities relating to labor supply, tax avoidance, and compensation bargaining. These scholars show that raising tax revenue is a complex process that involves multiple types of behavioral responses to taxation, and my results confirm their findings. Since the capital gains tax rate can explain some of the movement of income tax revenue, my results show that income switching behavior can occur between wage income and capital gains income. This finding is very important for the ramifications of any change in income taxes on income tax revenue. Policy makers need to assume that if the income tax rate is raised and the capital gains tax rate is lower than the income tax rate, high income individuals switch their earnings to capital gains income to some degree. The amount of income tax revenue that is collected shrinks because of this behavioral response, but it does not represent a decrease in labor supply. Since people switch income from one tax base to another, the government still receives some tax revenue when income is switched to a different income form. The difference is that the government receives less total revenue when income is switched to be taxed at a lower rate. Policy makers need to be aware that this income switching behavior occurs if a tax rate change makes a certain rate higher than another.

VII. Conclusion:

The evidence presented in this paper adds substance to the heated debate on the revenue effects of tax rate changes. Whenever politicians propose tax rate changes, there is a bitter argument about the effects they will have on government revenue. One side claims that increasing taxes could actually lower government revenue while the opposition says that tax revenue will increase as a result. Since there is such a stark political divide concerning these effects, studying tax return data is essential to determine the actual repercussions of tax rate changes. The Laffer curve theory is a commonly cited model involving individual responses to tax rate changes. Testing this theory to see if its predictions actually match data trends can therefore be useful for policy making.

The results of my econometric analysis of high income earners show that the Laffer curve theory does not seem to accurately represent the evolution of government revenue. Since the quadratic regressions representing the Laffer curve are not significant, the claim that government revenue decreases when tax rates increase does not seem to be supported empirically. By contrast, Equation (9), which is a log-log regression, contains variables that significantly affect government revenue. In this equation the lagged top marginal tax rate variable is statistically significant. The elasticity of tax revenue related to the top marginal tax rate that is generated in this regression indicates that tax rate increases are positively related to increases in tax revenue. I find that an increase in the top marginal income tax rate of 1% causes income tax revenue to increase by more than 1%.

This finding is consistent with the estimates made by Saez (2004) and Goolsbee (1999) who show that raising tax rates increases government revenue. It does not support the research of Feldstein (1995) and Lindsey (1987) who say that tax increases could have a negligible or negative effect on tax revenue. As noted in the discussion, it is unusual that the elasticity is greater than one. Including a variable to represent the effects of inequality reduces this elasticity, and more accurate inequality specification could potentially bring its value under one. The other key finding of equation (9) is that the capital gains tax rate can significantly explain movements in income tax revenue. This shows that individuals take part in income switching behavior when the top marginal income tax rate changes relative to the capital gains tax rate. The direction of this income switching depends on the direction of the tax change.

These results provide important insights into the effects that policy makers need to consider when proposing tax rate changes If the federal government needs to raise additional revenue then increasing tax rates on top income earners seems like an effective way to accomplish this goal. Inversely, tax cuts decrease income tax revenue so tax cuts are not revenue neutral. Lawmakers also need to keep in mind that income switching behavior occurs when the capital gains tax rate is changed. This means that tax rate changes have repercussions other than just raising or lowering revenue associated with a single tax rate. If taxable income decreases after the top marginal income tax rate increases, some of this income is claimed as capital gains income. To mitigate the effects of this income switching, income and capital gains tax rates could be raised or lowered at the same time. The research presented in this thesis can guide policy makers so that they can accurately predict the effects of proposed tax reforms.

It is possible, however, that the Laffer curve might be better suited to show the revenue effects of behavioral responses to tax rate changes under a different tax code. If there was a flat tax imposed in the U.S. instead of a progressive tax, there might be a revenue maximizing tax rate supporting the Laffer curve theory. In the future others can expand on my research by collecting tax revenue data on a sample of the same high income earners over many years. This would isolate the revenue effects of behavioral responses of high income earners. Including a variable to represent the income share of a more precise group of individuals could give a better representation of the effects of inequality on revenue. Studying other countries with higher tax rates might lend more validity to the Laffer curve theory. If tax rates are raised high enough in another country or if there is a flat tax rate structure, individuals could significantly reduce their labor supply, which would lower tax revenue. Further research could also include various measures of income inequality over time, since accounting for inequality seems to significantly influence the analysis of the relation between tax rates and tax revenue.

References

Atkinson, Anthony B., Thomas Piketty, and Emmanuel Saez. *Top incomes in the long run of history*. No. w15408. National Bureau of Economic Research, 2009.

Auerbach, Alan J., and James Poterba. "Capital Gains Taxation in the United States: Realizations, Revenue, and Rhetoric." *Brookings Papers on Economic Activity* 2 (1988): 595-637.

Canto, Victor A., Douglas H. Joines, and Arthur B. Laffer. "Tax Rates, Factor Employment, and Market Production." *The Supply-side Effects of Economic-policy*. Vol. 1. N.p.: Springer, 1980. 3-32. Print.

Diamond, John W. "Dynamic Effects of Extending the 2001 and 2003 Income Tax Cuts."*International Tax and Public Finance* 12.2 (2005): 165-92. Print.

Feldstein, Martin. 1995. Effect of marginal tax rates on taxableincome: A panel study of the 1986 tax reform act. *Journal of Political Economy* 103(3): 551-572.

Giertz, S. H. How Does the Elasticity of Taxable Income Affect Economic Efficiency and Tax Revenues and What Implications Does this have for Tax Policy Moving Forward? Paper presented at the American Enterprise Institute's conference on Tax Policy Lessons from the 2000s. 2008, May.

Goolsbee, Austan. Evidence on the High-Income Laffer Curve from Six Decades of Tax Reform.", *Brookings Papers on Economic Activity*, 1999.

Gordon, Roger H., and Joel Slemrod. *Are" real" responses to taxes simply income shifting between corporate and personal tax bases?*. No. w6576. National Bureau of Economic Research, 1998.

Hsing, Yu. "Estimating the Laffer curve and policy implications." *The Journal of Socio-Economics* 25.3 (1996): 395-401.

Lindsey, Lawrence B. "Individual taxpayer response to tax cuts: 1982–1984: with implications for the revenue maximizing tax rate." *Journal of Public Economics* 33.2 (1987): 173-206.

Piketty, Thomas, Emmanuel Saez, and Stefanie Stantcheva. *Optimal taxation of top labor incomes: a tale of three elasticities*. No. w17616. National Bureau of Economic Research, 2011.

Romer, Christina D., and David H. Romer. *The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks*. No. w13264. National Bureau of Economic Research, 2007.

Saez, Emmanuel. "Reported incomes and marginal tax rates, 1960-2000: evidence and policy implications." *Tax Policy and the Economy, Volume 18*. MIT Press, 2004. 117-174.

Slemrod, Joel. "Cheating ourselves: the economics of tax evasion." *The journal of economic perspectives* 21.1 (2007): 25-48.

Studenmund, A. H. *Using Econometrics: A Practical Guide*. Boston, MA: Addison Wesley, 2005. Print.

Trabandt, Mathias, and Harald Uhlig. *How far are we from the slippery slope? The Laffer curve revisited*. No. w15343. National Bureau of Economic Research, 2009.

Appendix

This appendix contains the regression outputs for all of the regressions that were run for this thesis as well as a table of descriptive statistics including each variable used in the regressions.

Table 4: Results of Equation 1

Model 4: OLS, (N = 48)
Dependent variable: IR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-9.89	5.67	-1.74	0.08792	*
lnTMI	0.54	0.54	1.00	0.32422	
lnGDP	2.91	0.40	7.19	<0.00001	***

Mean dependent var	18.06	S.D. dependent var	1.35
Sum squared resid	6.67	S.E. of regression	0.39
R-squared	0.922	Adjusted R-squared	0.919
F(2, 45)	185.05	P-value(F)	1.95e-22
Log-likelihood	-20.75	Akaike criterion	47.50
Schwarz criterion	53.12	Hannan-Quinn	49.62
rho	0.90	Durbin-Watson	0.19

IR = income tax revenue generated at or over the 29% marginal income tax rate, the variable data is presented in thousands of dollars (dependent variable)

TMI = top marginal income tax rate

GDP = gross domestic product

Table 5: Results of Equation 2

Model 6: OLS, (N = 48)
Dependent variable: IR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-13.35	7.13	-1.87	0.06801	*
lnTMI	0.81	0.64	1.27	0.21244	
lnAEC	0.50	0.44	1.14	0.25852	
lnGDP	3.017	0.41	7.27	<0.00001	***

Mean dependent var	18.06	S.D. dependent var	1.35
Sum squared resid	6.41	S.E. of regression	0.38
R-squared	0.925	Adjusted R-squared	0.920
F(3, 44)	159.00	P-value(F)	1.25e-23
Log-likelihood	-19.77	Akaike criterion	47.54
Schwarz criterion	55.03	Hannan-Quinn	50.37
rho	0.87	Durbin-Watson	0.22

IR = income tax revenue generated at or over the 29% marginal income tax rate, the variable data is presented in thousands of dollars (dependent variable)

TMI = top marginal income tax rate

AEC = average effective capital gains tax rate

GDP = gross domestic product

Table 6: Results of Equation 3

Model 7: OLS, (N = 48)
Dependent variable: IR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.34	8.84	0.04	0.96932	
lnTMI	1.60	0.55	2.89	0.00607	***
lnAEC	-0.03	0.54	-0.07	0.94838	
lnTCO	-2.54	0.89	-2.84	0.00688	***
lnGDP	2.39	0.45	5.31	<0.00001	***

Mean dependent var	18.06	S.D. dependent var	1.35
Sum squared resid	5.18	S.E. of regression	0.35
R-squared	0.939	Adjusted R-squared	0.934
F(4, 43)	154.62	P-value(F)	6.35e-25
Log-likelihood	-14.68	Akaike criterion	39.36
Schwarz criterion	48.72	Hannan-Quinn	42.90
rho	0.83	Durbin-Watson	0.34

IR = income tax revenue generated at or over the 29% marginal income tax rate, the variable data is presented in thousands of dollars (dependent variable)

TMI = top marginal income tax rate

AEC = average effective capital gains tax rate

TCO = top corporate tax rate

GDP = gross domestic product

Table 7: Results of Equation 4

Model 9: OLS, (N = 48)
Dependent variable: CR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-15.69	0.97	-16.19	<0.00001	***
lnAEC	0.79	0.34	2.30	0.02625	**
lnGDP	2.60	0.12	21.20	<0.00001	***

Mean dependent var	9.62	S.D. dependent var	1.42
Sum squared resid	4.80	S.E. of regression	0.33
R-squared	0.949	Adjusted R-squared	0.947
F(2, 45)	362.56	P-value(F)	1.78e-28
Log-likelihood	-12.84	Akaike criterion	31.67
Schwarz criterion	37.29	Hannan-Quinn	33.79
rho	0.65	Durbin-Watson	0.74

CR = total revenue collected on capital gains, the variable data is presented in millions of dollars (dependent variable)

AEC = average effective capital gains tax rate

GDP = gross domestic product

Table 8: Results of Equation 5

Model 10: OLS, (N = 48)
Dependent variable: CR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-15.37	3.65	-4.21	0.00012	***
lnAEC	0.78	0.37	2.08	0.04364	**

lnTMI	-0.0008	0.008	-0.09	0.92743	
lnGDP	2.58	0.32	8.07	<0.00001	***

Mean dependent var	9.62	S.D. dependent var	1.42
Sum squared resid	4.80	S.E. of regression	0.33
R-squared	0.949	Adjusted R-squared	0.946
F(3, 44)	238.95	P-value(F)	3.06e-27
Log-likelihood	-12.83	Akaike criterion	33.66
Schwarz criterion	41.15	Hannan-Quinn	36.49
rho	0.65	Durbin-Watson	0.75

CR = total revenue collected on capital gains, the variable data is presented in millions of dollars (dependent variable)

AEC = average effective capital gains tax rate

TMI = top marginal income tax rate

GDP = gross domestic product

Table 9: Results of Equation 6

Model 2: OLS, (N = 28)
Dependent variable: IR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-10.88	5.06	-2.15	0.04222	**
lnATI	1.97	0.38	6.16	<0.00001	***
lnAEC	-0.24	0.28	-0.86	0.40028	
lnTCO	1.62	0.58	2.82	0.00963	***
lnGDP	2.10	0.28	7.41	<0.00001	***

Mean dependent var	19.11	S.D. dependent var	0.47
Sum squared resid	0.32	S.E. of regression	0.12
R-squared	0.945	Adjusted R-squared	0.935
F(4, 23)	180.56	P-value(F)	5.16e-17
Log-likelihood	22.83	Akaike criterion	-35.66
Schwarz criterion	-29.00	Hannan-Quinn	-33.62
rho	0.38	Durbin-Watson	0.96

IR = income tax revenue generated at or over the 29% marginal income tax rate, the variable data is presented in thousands of dollars (dependent variable)

ATI = average top income tax

AEC = average affective capital gains tax rate

TCO = top corporate tax rate

GDP = gross domestic product

Table 10: Results of Equation 7

Model 2: OLS, (N = 45)
Dependent variable: IR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-16.10	7.28	-2.21	0.03245	**
lnLTMI	1.08	0.70	1.53	0.13313	
lnGDP	3.36	0.51	6.55	<0.00001	***

Mean dependent var	18.20	S.D. dependent var	1.29
Sum squared resid	5.84	S.E. of regression	0.37
R-squared	0.920	Adjusted R-squared	0.916
F(2, 42)	141.63	P-value(F)	2.14e-19
Log-likelihood	-17.93	Akaike criterion	41.86
Schwarz criterion	47.28	Hannan-Quinn	43.88
rho	0.91	Durbin-Watson	0.20

IR = income tax revenue generated at or over the 29% marginal income tax rate, the variable data is presented in thousands of dollars (dependent variable)

LTMI= top marginal tax rate lagged 1 year

GDP = gross domestic product

Table 11: Results of Equation 8

Model 3: OLS, (N = 45)
Dependent variable: IR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-22.66	7.83	-2.89	0.00609	***
lnLTMI	1.61	0.73	2.2	0.03301	**
lnAEC	0.79	0.40	1.99	0.05362	*

lnGDP	3.61	0.48	7.49	<0.00001	***

Mean dependent var	18.20	S.D. dependent var	1.29
Sum squared resid	5.22	S.E. of regression	0.36
R-squared	0.929	Adjusted R-squared	0.923
F(3, 41)	167.68	P-value(F)	4.81e-23
Log-likelihood	-15.38	Akaike criterion	38.77
Schwarz criterion	46.00	Hannan-Quinn	41.46
rho	0.84	Durbin-Watson	0.32

IR = income tax revenue generated at or over the 29% marginal income tax rate, the variable data is presented in thousands of dollars (dependent variable)

LTMI= top marginal tax rate lagged 1 year

AEC = average effective capital gains tax rate

GDP = gross domestic product

Table 12: Results of Equation 9

Model 1: OLS, (N = 45)
Dependent variable: IR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-13.40	6.51	-2.06	0.04601	**
lnLTMI	1.15	0.51	2.23	0.03167	**
lnINEQ	-4.17	1.96	-2.13	0.03915	**
lnAEC	0.72	0.28	2.64	0.01189	**
lnGDP	4.48	0.60	7.50	<0.00001	***

Mean dependent var	18.20	S.D. dependent var	1.29
Sum squared resid	3.85	S.E. of regression	0.31
R-squared	0.947	Adjusted R-squared	0.942
F(4, 40)	102.75	P-value(F)	1.74e-20
Log-likelihood	-8.53	Akaike criterion	27.07
Schwarz criterion	36.10	Hannan-Quinn	30.43
rho	0.75	Durbin-Watson	0.42

IR = income tax revenue generated at or over the 29% marginal income tax rate, the variable data is presented in thousands of dollars (dependent variable)

LTMI= top marginal tax rate lagged 1 year

INEQ = income share of the top decile of income earners

AEC = average effective capital gains tax rate

GDP = gross domestic product

Table 13: Results of Equation 10

Model 1: OLS, (N = 48)
Dependent variable: IR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	2.97e+08	8.88e+07	-3.34	0.00170	***
TMI	2.91e+06	2.13e+06	1.37	0.17757	
TMI^2	-11324.2	15963.7	-0.71	0.48184	
GDP	38395.5	4112.13	9.34	<0.00001	***

Mean dependent var	1.37e+08	S.D. dependent var	1.26e+08
Sum squared resid	5.78e+16	S.E. of regression	36236491
R-squared	0.923	Adjusted R-squared	0.918
F(3, 44)	92.52	P-value(F)	4.98e-19
Log-likelihood	-901.49	Akaike criterion	1810.98
Schwarz criterion	1818.46	Hannan-Quinn	1813.81
rho	0.68	Durbin-Watson	0.65

IR = income tax revenue generated at or over the 29% marginal income tax rate, the variable data is presented in thousands of dollars (dependent variable)

TMI = top marginal income tax rate

GDP = gross domestic product

Table 14: Results of Equation 11

Model 2: OLS, (N = 48)
Dependent variable: IR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
const	1.03e+08	1.75e+08	-0.59	0.55863
TMI	5.44e+06	3.28e+06	1.66	0.10510

TMI^2	-22575.2	19081.1	-1.18	0.24342	
AEC	2.88e+06	2.83e+06	-1.02	0.31492	
TCO	4.20e+06	1.60455e+06	-2.62	0.01233	**
GDP	32630.3	5376.74	6.07	<0.00001	***

Mean dependent var	1.37e+08	S.D. dependent var	1.26e+08
Sum squared resid	4.97e+16	S.E. of regression	34411520
R-squared	0.934	Adjusted R-squared	0.926
F(5, 42)	67.89	P-value(F)	5.05e-19
Log-likelihood	-897.89	Akaike criterion	1807.78
Schwarz criterion	1819.01	Hannan-Quinn	1812.03
rho	0.58	Durbin-Watson	0.84

IR = income tax revenue generated at or over the 29% marginal income tax rate, the variable data is presented in thousands of dollars (dependent variable)

TMI = top marginal income tax rate

AEC = average effective capital gains tax rate

TCO = top corporate tax rate

GDP = gross domestic product

Table 15: Results of Equation 12

Model 2: OLS, (T = 48)
Dependent variable: IR
HAC standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-2.63e+08	2.48e+08	-1.8841	0.06665	*
TMI	5.17e+06	4.40e+06	1.61	0.11032	
TMI^2	-34393.5	25023.5	-1.44	0.13208	
AEC	-4.32e+06	2.67e+06	-1.99	0.05315	*
CORP	-5.52e+06	1.70e+06	-3.24	0.00239	***
INEQ	1.50e+07	6.42e+06	2.34	0.02452	**
GDP	12479.3	9750.35	1.28	0.20778	

Mean dependent var	1.37e+08	S.D. dependent var	1.26e+08
Sum squared resid	4.56e+16	S.E. of regression	33366587
R-squared	0.93	Adjusted R-squared	0.93
F(6, 41)	83.70	P-value(F)	2.06e-21
Log-likelihood	-895.83	Akaike criterion	1805.67

Schwarz criterion	1818.77	Hannan-Quinn	1810.62
rho	0.58	Durbin-Watson	0.85

Table 16: Table of descriptive statistics for all variables

The top row of this table displays all of the variables used in the regressions for this thesis. The first column displays the various calculations that were made for each variable.

	TMI	TMI^2	INEQ	LTMI	AEC	TCO	ATI	GDP (in billions)	IR (in billions)	CR (in billions)
Observations	48	48	47	47	48	48	28	48	48	48
Min	31	961	31.51	31	13.6	34	13.4	2919.5	7.91	1.3
Max	91	8281	45.96	91	25.5	64	17.6	14996.1	390.71	137.14
Mean	56.94	3626.22	36.61	57.4	16.97	47.96	15.2	8038.65	136.77	33.9
Standard Deviation	19.81	8281	5.22	19.76	3.33	12.27	1.19	3879.86	126.17	38.2