EASTERN CONNECTICUT STATE UNIVERSITY

It's All Very Taxing:
Interstate Tax Competition and the Balanced Budget

Senior Honors Thesis

by

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Abstract

In response to economic downturns, state governments respond to decreased business activity by lowering corporate tax rates, to lure in firms from other states. This behavior leads to states competing for firms, engaging in tax competition. Previous research has shown that tax competition is ineffective at attracting firms. This is due to a race-to-the-bottom effect caused by competitive behavior, leading each state to lose its competitive advantage. The research in this project focuses on both the effects of tax competition on small states compared to large states and the effects that it has on state government budget balances. Econometric modeling and location theory are used to test and measure these impacts. Multiple methods of regression are employed to determine the reliability of the models developed and explain the results of the project.

1 Introduction

In response to the potential loss of 600 jobs in Connecticut, in 2014, Governor Dannel Malloy forged a "once-in-a-generation opportunity," an agreement to provide $400 million in tax breaks to United Technologies, in exchange for the corporation to keep its headquarters in the state for fifteen years and to create 300 new jobs, among other conditions (Dowling & Gosselin 2014). Later in the same year, Nevada provided over $1 billion in tax breaks and incentives to Tesla Motors, to build a battery plant, promising upwards of 22,000 jobs, in the depressed city of Reno (Frank 2014). In Massachusetts, State Senator Eric Lesser is proposing a bill which would offer a 10 percent tax credit, up to $100,000 per year, on businesses that invest in Gateway Cities, "economically challenged cities with potential to anchor their regional economies" (Schoenberg 2015).

These situations are not unique. With the United States and world economies in the midst of recovering from one of the greatest financial catastrophes in recent memory, there have been many discussions over how to handle the most important issues facing individuals: unemployment and economic growth. Often times, state and local governments have attempted to provide tax abatements for individual businesses, some going as far as reducing their corporate tax rate for all businesses, to entice them to invest in their location, hoping they will either create jobs or sustain them.

However, because many states have been attempting to attract businesses from other states, tax competition has been a potent, albeit controversial policy tool. Because of the notion of corporate surplus, a byproduct of tax competition, where governments offer tax abatements larger than necessary to attract new businesses and retain those already existing, governments lose out on revenue from existing businesses (Cassell & Turner 2010). Research on tax competition in the United States and Switzerland has shown that reducing the corporate tax rate does very little to attract businesses to or create jobs in a particular state (Fox & Luna 2002, Prillaman & Meier 2014, Rossi & Dafflon 2004). This, effectively, means that when state governments engage in tax competition, there is a potential for lost corporate tax revenue. To the contrary, Genschel (2002) argues that corporate taxes make up a small amount of tax revenue, so corporate tax competition should not make a huge dent in government income. Wilson and Wildasin (2001) argue that tax competition has its merits, because as taxes are lower in the short run, governments have less revenue available for "wasteful activities." The United States is in the midst of an economic recovery at the moment, though, and according to Larsen's (2013) report, there are still many state governments sitting on large piles of debt, which means that governments have less funding to operate their states, since in addition to providing services, they have to pay off their debt obligations.

Given that state governments are not supposed to accumulate deficits directly and are required to balance their budget every year; this paper will focus on how these governments attempt to create that balance in the age of tax competition. Econometric modeling will be used to demonstrate how corporate tax rates at the state level can affect future state government spending habits and the future composition of state government revenue sources. By using publicly available data, the research performed in this project will determine whether spending cuts or increased taxes on non-corporate sources is the dominating method that states use to balance their budgets, in response to lost revenue caused by tax competition.

2 Literature Review

Tax competition, given its prevalence, is a topic which has been researched extensively by economists, throughout the world, from Switzerland to the United States. This section will contain a discussion of existing literature on tax competition and its effects at the national, state, and local levels.

2.1 Tax Competition throughout the World

Wilson and Wildasin (2001) provide an evaluation of the literature available at the time on tax competition, discussing the effects of tax competition on society, both positive and negative. They find that tax competition has benefits because it can encourage governments to become more efficient, because they have to close the budget deficit when tax revenue is lost. Further, they argue that governments which reduce tax rates on all businesses, instead of offering tax abatements to certain ones, help improve welfare, because these abatements are inherently inefficient, because two companies of the same size may be paying two different tax rates. The authors also find that tax competition only modestly reduces the welfare of residents, in addition to modestly reducing the amount of tax revenue received by governments. Worth questioning, however, is why there is such a modest decline in tax revenue and welfare. Could it be due to governments increasing tax rates that were not cut due to tax competition?

Genschel (2002) continues this discussion and provides a wealth of information on tax competition throughout the world, specifically focusing on how it can affect government services. He argues that while companies want low taxes, they also want access to high quality public goods, as well as a highly-educated workforce, which generally requires a fairly large government. As a result, corporate taxes are just one of many factors that can draw a business to a particular jurisdiction, especially since they can use creative accounting methods to find ways around high taxes. However, Genschel points out that corporate taxes make up only a small portion of government revenue, meaning that governments engaging in tax competition need not worry about reducing the quality of services they provide due to low tax revenues, even when new businesses may not be coming in. Instead, he argues that capital gains taxes are a more lucrative source of income, and are even more vulnerable than corporate taxes, due to the mobility of financial assets.

Genschel mentions in his paper, however, that governments may decide to increase taxes when dealing with tax competition, particularly when businesses leave high-tax jurisdictions for those with lower taxes, "in order to maintain the same revenue from an eroding tax base." This has led to some interesting implications in the United States, which will be discussed in the next section.

2.2 Tax Competition on the Large Scale: The United States

Chirinko and Wilson (2011) pose the question, does tax competition, at the state level, in the United States lead to a race to the bottom or is it like "riding on a seesaw"? In their empirical model, based on data from 1965 to 2006, they find that when one state increases its corporate tax rate, then surrounding states will respond by decreasing their taxes, to attract discouraged business owners. Further, they present an interesting finding, that tax competition may not necessarily be the primary cause of the overall downward trend in state corporate taxation in the United States. Instead, the researchers find that aggregate shocks, affecting the whole country, have been the main driver of this downward trend. This is an important issue

to consider, because it challenges the commonly held notion by politicians that their states must be driving businesses away. The researchers argue that, instead, negative firm entry may not be caused by individual states' economic policies, but generally poor economic conditions, affecting the country as a whole. In addition, Chirinko and Wilson (2011) find that surrounding states do not concern themselves so much with corporate tax rates, they tend to focus on investment tax credits, as they work to attract more mobile capital sources.

Felix's (2009) paper on the relationship between corporate taxation and wages presents some interesting findings which could prove useful for this project. The author finds that when a state increases its corporate tax rate, then capital will leave the state, in search of lower taxes, predicted by Chirinko and Wilson (2011). This means that workers in the home state are less productive, with less capital, which, essentially, gives their employers reason to reduce their wages. This finding is demonstrated using an econometric model which considers characteristics of employees, characteristics of individual states, state corporate taxes, state income taxes, and sales taxes. An interesting, additional finding by Felix is the more dramatic impact of increased corporate taxes on the reduction of wages after 1991, which she attributes to increased global competition.

Fox and Luna (2002) examine how corporate tax rates have been adjusted at the state level from 1960 to 2000. Their research specifically focuses on the impacts of legislation that affected both federal and state corporate taxes, including the Economic Recovery Tax Act of 1981 and the Tax Reform Act of 1986, which was famous for reducing the federal corporate tax rate in the United States from 46 percent to 34 percent. They also discuss the possibility that tax evasion and tax sheltering may be playing a role in state corporate tax revenue declination. Most importantly, however, is that they discovered that states may be losing tax revenue due to tax competition and the granting of tax abatements. Further, Fox and Luna mention that when these firms, which were meant to be attracted through the tax abatements, come to a state, they need to use that state's government services, and in these cases, the firms are not paying for them. This means that the tax burden is shifted to individuals, otherwise the government will have to cut the budget. It is up to politicians to decide which option is the lesser of the two evils.

Prillaman and Meier's (2014) research is most closely related to the research which will be done for this project. In their paper, econometric modeling is used to determine the impacts of business-friendly tax policy on state economies. They find that "the empirical effect of business tax policy on economic development clearly diverges from economic theory," which predicts that firms should always move to the state with the lowest taxes (Prillaman & Meier 2014). While the authors found that firms are less likely to leave a state in the event of a tax cut, they also discovered that these types of tax cuts generally have no impact on economic conditions in a state, if anything, they may result in worsening economic conditions. An issue to consider is firms' willingness to move to different states, some firms which have made large investments in a region, like the case of Tesla in the introduction of this paper, may be less likely to move than firms with more mobility. This idea will be described in more detail in Section 3.3.

With respect to Prillaman and Meier's models, they used multiple models to determine the impacts that state corporate taxes, as a share of gross state product (GSP), on multiple economic factors at the state level, factors that are generally considered to be keys to economic growth. These include GSP growth rate,

change in the employment rate, growth rate of per capita personal income, change in the net job creation rate, change in the poverty rate, and changes in the entry and exit rates of firms.

2.3 Tax Competition on the Small Scale: Ohio and Switzerland

Chirinko and Wilson's (2011) findings about the behavior of tax competition in the United States, as a whole, are dramatically different from the findings of others on tax competition on a smaller scale. Cassell and Turner (2010), Rossi and Dafflon (2004), and Feld, Kirchgassner, and Schaltegger (2010) found that in Ohio and Switzerland, tax competition behaved more like the traditional race to the bottom.

Cassell and Turner (2010) consider the impacts of investment tax credits on intermunicipal tax competition in Ohio. Their research entails a discussion of how tax competition has had a tendency to shift the power of bargaining in municipalities from governments to firms, especially in the cases of economically depressed communities and times of general economic hardship. This leads to what they describe as "corporate surplus," where this shift of power causes governments to feel compelled to offer inefficiently large tax abatements to businesses, which also becomes a bigger issue when increasingly many municipalities in the state are willing to offer such abatements. The researchers mention,

> "While the justification to expand the enterprise zone program [which introduced intermunicipal tax competition in Ohio] was to increase Ohio's competitiveness, its primary impact has been to affect the internal distribution of firms within the state." (Cassell & Turner 2010)

More specifically, their results show that, between 1983 and 2004, only two percent of abatements were granted to firms that relocated from outside the state, the remainder being firms that either expanded within the state or moved to a different municipality.

In their paper, Rossi and Dafflon (2004) explore the effects of tax competition in Switzerland on its cantonal, i.e. provincial, and local governments. Given the nation's size, about half that of Maine, Swiss firms have even more mobility between cantons than American firms have between states in the United States. They observe, consistent with other research on tax competition, that it can lead to three major problems: fiscal imbalances in the current budget, shifts in the tax burden to make up for the lost revenue as a result of tax competition, and the reduction of expenditures on public goods, such as roads and schools. The other issue that results, from the perspective of competitive cantonal governments, is the constant need to reduce the corporate tax rate, because there is an evident race to the bottom in corporate taxation in Switzerland. The researchers state,

> "Tax incentives cannot attract firms to a specific location eventually, because the ongoing process of tax competition removes any comparative advantages subnational governments might have one over the other in the short run by implementing such a downgrading policy." (Rossi & Dafflon 2004)

In addition, they discuss the notion that tax competition creates inefficiencies in the tax system, and creates inequality amongst corporate taxpayers, because it introduces a bias between taxpayers who are and are not "privileged" (Rossi & Dafflon 2004).

More recent research by Feld et al. (2010) studies the impacts of fiscal federalism, that is, the ability of local governments to make fiscal policy, on the size of cantonal governments in Switzerland. In their paper, Feld et al. find that tax competition has a statistically significant effect on cantonal government revenues, and had the most significant impact among their hypotheses. This is based on the different hypotheses of fiscal federalism and taxation they tested, the degree of fragmentation, tax competition, and tax exporting, to see which one had the greatest impact on the size of government. More specifically, they discovered, through their econometric model, that when the intensity of tax competition is less, i.e. when the corporate tax rate of competitive cantonal governments is higher, there is less competitive pressure, meaning that cantons do not feel compelled to reduce their tax rates to attract businesses.

2.4 The Role of this Project

The purpose of this project is to provide an empirical analysis of how state governments attempt to maintain a budget balance, while they are engaging in tax competition. There will be a particular concentration on which part of the budget balance is affected more by tax competition, do state governments try to gain back the lost revenue from other sources or do they opt to cut back on government spending?

This paper will be written in the context of an economic recovery, after what many consider to be the worst financial crisis since the Great Depression. There has been little attention paid to state governments and their budget crises during this time period, which is concerning, since they are responsible for funding many aspects of people's daily lives, from highways to public safety.

In addition, this project is expected to make a very important connection between the behavior of tax competition between smaller and larger governments. Chirinko and Wilson (2011) found that when a state in the United States learned of one of its neighbors increasing its taxes, the home state would reduce their taxes in response. In Switzerland, Feld et al. (2010) and Rossi and Dafflon (2004) have found that cantons all reduce their taxes, acting as a race to the bottom. Similar results have been found in Ohio and its intermunicipal tax competition (Cassell & Turner 2010). By using location theory, this paper should be able to explain why tax competition behaves like a race to the bottom in Ohio and Switzerland, while "riding on a seesaw" in the United States as a whole.

Further, this paper should open doors to further research on how states have been affected by the recession, and hopefully will start discussions on how politicians can help make their states competitive, leading them to maintain or improve the quality of life in their jurisdictions.

3 Theory

To form the basis for the models described in the next section, this section will provide a theoretical understanding of taxation, government spending, and firm choice, using the Laffer curve, Keynesian economics, and location theory, along with other relevant economic theories. This section will also include some mathematical background to justify the development of the empirical models used to test the hypotheses presented in Sections 2.4 and 4.5.

3.1 Supply Side Economics and the Laffer Curve

Providing firms with tax incentives is certainly nothing new. Dating back to the post-World War I era, the late 1910s, the notion of cutting taxes on businesses has been a vehemently debated issue in the United States (Wanniski 1978). Supply-side economics is the basis of justifications for cutting taxes, and it is clearly a very comprehensive topic. For this project, one of the most significant products of supply-side economics, the Laffer curve, will play a significant role. The Laffer curve is often cited as the basis of former President Reagan's tax policy, and it seems to have an influence in shaping the tax policy of states which are trying to pose themselves as being "business-friendly" today.

The Laffer curve is a relatively simple economic model, illustrated in Figure 1. It theorizes that as the tax rate increases, government revenue will increase with it, until a certain point. Once it reaches that point, then the government will start to lose revenue as it increases the tax rate. In other words, the Laffer curve is quadratic, as demonstrated by its functional form, in (1), where G represents government receipts, i.e. tax revenue, t represents the tax rate, p represents the price of products, and Q is the quantity produced, therefore pQ represents gross state product (Blinder 1981). This curve can be taken to an extreme: when the tax rate is zero percent, the government receives no revenue, for obvious reasons, and when the tax rate is one hundred percent, the government receives no revenue, because, speaking from classical economics, nobody has incentive to work when the government is taking all of their earnings away (Wanniski 1978). In the real world, however, people will not be comfortable without the government, so the zero percent extreme is non-existent. Pure communism would certainly allow for a government with a one hundred percent tax rate, but that is an extremely rare case, and is not something that would apply to supply-side economists' world, given its roots in Adam Smith's classical view. As a result, the middle of the Laffer curve must be considered for all practical purposes.

$$G = pQf(t) \tag{1}$$

The Laffer curve demonstrates that there is a particular tax rate at which the government can maximize its revenues. Once taxes are at that level, if rates are reduced, production will theoretically increase, because one of the costs, taxation, has been reduced. However, even if production does increase, it would not be enough to offset the loss in tax revenues due to the lowered tax rate. If taxes increased at this level, then production and tax revenue will both decrease, meaning that tax rates are inefficiently high. Given this inefficiency, anything past the Laffer curve's optimal tax rate is considered the prohibitive range for government by supply-side economists (Wanniski 1978).

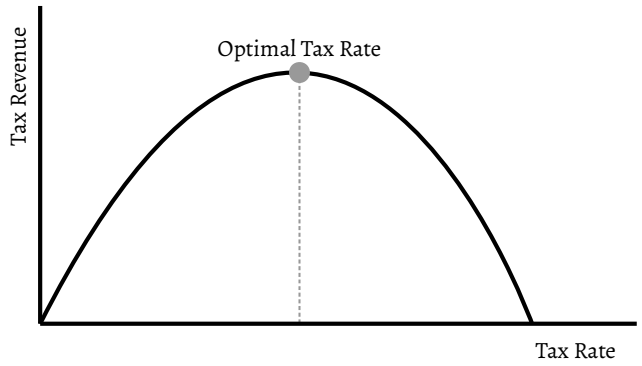


Figure 1: The Laffer curve, an economic model depicting the relationship between tax revenues and tax rates. Note the optimal tax level, which is at the maximum level of tax revenue collected by the government (Wanniski 1978).

From the function that describes the Laffer curve, we can find the government's optimal tax rate, where $\frac{dG}{dt} = 0$. Assuming the functional form provided by Blinder (1981), $\frac{dG}{dt}$ is given by (2). The first term, pQ, which represents total production, and would be a solid estimate of marginal tax yield, assuming no behavioral responses, is expected to have a positive effect. The second term, $tp\frac{dQ}{dt}$, which represents the change of production with respect to the change in tax rate, is expected to have a negative effect. The third and final term, $tQ\frac{dp}{dt}$, which represents the change in price with respect to the change in tax rate, is expected to have a positive effect (Blinder 1981).

$$\frac{dG}{dt} = pQ + tp\frac{dQ}{dt} + tQ\frac{dp}{dt} \tag{2}$$

However, there is a flaw in Blinder's (1981) model of the Laffer curve. He uses tpQ, which is a linear function, not quadratic. For the purposes of this project and its empirical analysis, Blinder's model will be modified slightly to make a quadratic representation of the curve, shown in (3), its derivative is given in (4). The signs on the three terms of (4) are expected to be the same as those in (2).

$$G = pQ(t^2 + t) \tag{3}$$

$$\frac{dG}{dt} = (2t + 1)pQ + (t^2 + t)p\frac{dQ}{dt} + (t^2 + t)Q\frac{dp}{dt} \tag{4}$$

Because there is an expectation that $(t^2 + t)p\frac{dQ}{dt}$ will have a negative sign, and because the government's optimal tax rate is $\frac{dG}{dt} = 0$, it is inferred that, in (4), the government's inefficiently high tax rate can be shown by (5). This function is the epitome of the Laffer curve, because it explains that when taxes are at a level that is inefficiently high, where the left side of (5) is less than the right side of (5), the change in production will not be significant enough to justify change in marginal tax revenue. In fact, when the tax rate is inefficiently high, there will be a decrease in total tax revenue, based on this theory.

$$(t^2 + t)p\frac{dQ}{dt} < (2t + 1)pQ + (t^2 + t)Q\frac{dp}{dt} \tag{5}$$

3.2 Government Spending and the Keynesian Model

One of the most passionate debates in the United States is over the size of government. In 2015, in Connecticut, Governor Malloy proposed a budget that was highly controversial, making cuts in departments which many residents consider to be vital to the state, from education to mental health. Meanwhile, state residents and businesses have been arguing that they pay too much in taxes, so it is the government's job to become more efficient, even if it means making sacrifices (Kauffman & Keating 2015). These contrasting views provide a glimpse into the commotion behind discussions on government spending.

If firms are not enticed to relocate by lowered tax rates in states outside of their home, then in response to the expected loss of corporate tax revenues, state governments are likely to make cuts to their budgets to create the required balanced budget. Government budgets are very complex, with many different aspects of the economy, from employment to economic growth, affecting their balance and composition. Plenty of theories have been developed to explain how governments should balance their budgets, in good times and bad. This project will be focused on how states have been attempting to balance their budgets, while dealing with, and sometimes engaging in, tax competition and the recovery from the Great Recession.

One particularly enticing and influential model of government spending is the one developed by John Maynard Keynes. This model is well-known for encouraging governments to increase their spending during recessions, providing either unemployment insurance or temporary work, because then the people will put that money back into the economy (Rosen 2002). This provides a contrasting view to the Laffer curve, by affecting the demand side of the economy, saying that when governments assist consumers, as opposed to producers, the economy will more readily correct itself. Further, there is an assumption in Keynesian theory that once the economy is stimulated, the private sector will start hiring once again, removing the need for the jobs the government created, and reducing the need for governments to provide substantial amounts of unemployment insurance.

As with any model that attempts to affect the behavior of government during poor economic times, Keynes's model has its criticisms. Of particular note is the concern that government bureaucracy and lawmaking can make stimulus programs take years to implement, much less be influential (Rosen 2002). To correct for this issue, the models used in this paper will lag the predictor variables in the firm entry models by two years, to account for the potential hurdles that are introduced by the political process.

An issue with Keynesian theory being applied to the state level is the problem of deficit spending. State governments have more difficulty than the federal government during recessions, because they cannot incur deficits in their budget. According to a report published by the National Conference of State Legislatures (2010), all but four states have a balanced budget requirement, which is enforced by either constitutional or statutory law. This means that states can only issue bonds, as a last resort, when their budgets cannot be balanced, a particularly pressing issue during economic downturns, especially if Keynesian theory holds. These bonds, also, generally cannot be used to fund a state's daily operations, such as its payroll and retirement funds; instead they are used for capital expenditures, such as roads and hospitals. Despite this,

however, during recessions, interest rates tend to fall, meaning that borrowing, from the government's perspective, is cheaper (Cecchetti & Schoenholtz 2011).

The Ricardian equivalence will play a role in the models, particularly those concerning government spending, used in this paper. This paper will assume, perhaps controversially, that, in the long run, state governments spend every dollar that they take in. In other words, during an economic expansion, the governments should take in more than they spend, and during a recession, governments will spend more than they take in, either from their savings or through debt (Seater 1993). This means, for the purposes of analysis, the effects of tax rates on government revenue, described in Section 3.1, should be the same as the effects of tax rates on government expenditures.

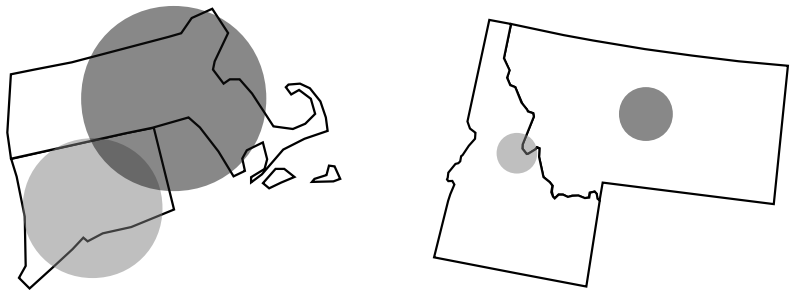
3.3 Location Theory and Firm Choice

As demonstrated by the literature review, corporate taxes have the potential to have an impact on firms' location choices, justifying tax competition. However, in addition to empirical research, location theory can demonstrate that the decision of where to locate, from the firm's perspective, has to do with much more than taxation. The Salop Model of Location Theory implies that when states are larger and further away from each other, then interstate tax competition becomes a less significant issue for them. This model also implies that when neighboring states do not have any largely populated areas near the border, tax competition has less of an impact (Salop 1979).

This means that, for example, Connecticut and Massachusetts are more likely to engage in tax competition than Montana and Idaho. Building on this example, it can be assumed that if a firm decides to move to Missoula, Montana from Boise, Idaho, almost 400 miles apart, the firm incurs a larger cost from the move than if it was moving from Hartford, Connecticut to Springfield, Massachusetts, 25 miles apart. These costs can be anything from finding new labor, because workers are not necessarily mobile and there is no guarantee that the new cities' workers will have the appropriate skills, to developing a new customer base, especially when the firm has established and loyal customers. This relationship between taxation, relocation costs, and the influence of a state is explained by (6) below, where v represents the highest tax rate a firm is willing to pay, p represents the current tax rate of a state, c represents relocation costs, which determine $\hat{x}$, the influence of the state (Salop 1979). This function will be incorporated into the tax competition variable used in the models of this project.

$$\hat{x} = \frac{v - p}{c} \tag{6}$$

What is learned from Salop's model, Figure 2, and (6) is that firms that are located closer to borders should be more susceptible to give in to tax competition, because the home state's circle of influence may enter that of a neighboring state. In Figure 2, it is shown that Massachusetts and Connecticut, being small states, have large circle of influence, with both states' circles entering the other, to encourage firms to move to their states. In Montana and Idaho, on the other hand, circles of influence of the same radius covers very small areas of those states, with Idaho's circle touching a very small portion of Montana. It can also be said that cities built on the border of another state can introduce tax competition. This can apply to situations like Pennsylvania and Delaware, where firms based in Philadelphia can easily incorporate in Wilmington,



(a) Connecticut and Massachusetts (b) Montana and Idaho

Figure 2: Salop's circle model implies that when two states are engaging in tax competition, they will have a certain circle of influence, determined by v, p, and c. Two circles of the same radius affect small states and large states differently.

only 30 miles away, to take advantage of Delaware's lower tax rates and its well-regarded corporate law (Roe 2009).

The literature reviewed does not consider the impacts of tax competition in this way. Chirinko and Wilson (2011) discuss the impacts of tax competition throughout the United States, and while they do account for the "relatedness" of states, they do not consider how tax competition may affect regions with smaller states, such as the northeast, compared to regions with larger states, such as the west. This is particularly interesting, because their results led to the conclusion of interstate tax competition in the United States acting more like a seesaw, where states are more likely to reduce taxes when their neighbor increases taxes, than a race to the bottom. This differs from the behavior of tax competition within the state of Ohio, where it was a race to the bottom (Cassell & Turner 2010).

Cassell and Turner mention that the intermunicipal tax competition in Ohio was designed to make the state as a whole more competitive, but they found that, between 1983 and 2004, only two percent of firms which received municipal tax abatements were from out of state. Could this be because firms in neighboring states, such as Pennsylvania and Indiana, did not have an incentive to move to Ohio? How did these states' tax policy differ from Ohio's over time? Using location theory, it could be said that the intermunicipal tax competition in Ohio existed and worked because of the small size of municipalities, compared to the relatively large size of states. Further, an argument could be made for the relatedness of municipalities within a state compared to the relatedness of states. There could be drastic differences between Cleveland and Erie, ranging from regulations to taxes at the state, county, and municipal level to changes in corporate law, but the differences between Cleveland and Toledo could be less substantial.

4 Models

Econometric modeling will be used in this paper, to measure the impact that tax competition has had on state governments. Three similar, but different, models will be used to measure the resultant changes in state government spending levels and the changes in the composition of state government revenue sources. The proposed models are represented by (7), (8), (9), and (10) below. The variables that will be studied in these models, and a summary of their expected impacts, are described in Table 1, with explanations of these effects in each model's respective section (4.1, 4.2, 4.3, and 4.4).

It is important to note that, while it is generally preferred to use standardized data, the variables *CORPREV* and *GOVEXP* are not standardized across the states, instead relying on raw data that has been corrected for inflation only. *CORPREV* and *GOVEXP* represent total corporate tax revenue and total government expenditures, respectively. Raw data is used for these variables to better estimate the Laffer curve, which does not predict a standardized revenue figure, but rather a raw revenue figure. A variable representing state population, *POP*, is included to correct for any variation caused by using raw data, as opposed to standardized data.

The statistical software package Stata will be used to perform the regressions required by (7), (8), (9), and (10). This software also has the ability to perform two-stage least squares regression, required to incorporate endogenous effects in the *ENTRY* term (two-stage least squares will be incorporated in models (7), (8), and (9)). This idea is formally introduced in Section 4.1 and in the *ENTRY* model's own section, 4.4.

Table 1: Definitions of variables in models to be used in this project, with expected impacts of predictor variables on response variables

Name	Variable	(7)	(8)	(9)
CORPREV	Total corporate tax revenue	•		
GOVEXP	Total government expenditures		•	
INCREV	Personal income tax revenue as percentage of total revenue			•
CORPTAX	Nominal corporate tax rate (linear term)	+	+	-
$CORPTAX^2$	Nominal corporate tax rate (quadratic term)	-	-	+
INCTAX	Nominal income tax rate (linear term)	+	+	+
$INCTAX^2$	Nominal income tax rate (quadratic term)	N/A	-	-
UNEMP	Unemployment rate	-	-	-
EDU	Percentage of state residents with at least a Bachelor's degree	+	N/A	+
POP	Population, in thousands	+	+	N/A
ENTRY	Percentage change in firm population (see Section 5.3)	+	+	-
FEDSUB	Federal subsidy received by state per capita	N/A	+	N/A
INT	Interest rate on US Treasury bonds	N/A	-	N/A

4.1 Model for Corporate Tax Revenue

The first model for this project, (7), will be used to determine how corporate tax rates affect corporate tax revenue, as a whole. Based on the Laffer curve, the sign of the linear term of the corporate tax rate, *CORPTAX* is expected to be positive, while the quadratic term of the curve, $CORPTAX^2$, is expected to be negative.

$$CORPREV = \alpha + \beta_1 CORPTAX + \beta_2 CORPTAX^2 + \beta_3 INCTAX + \beta_4 UNEMP + \beta_5 EDU + \beta_6 POP + \beta_7 ENTRY + \epsilon \tag{7}$$

The effects of the income tax rate, *INCTAX*, on corporate tax revenues are mostly due to possible changes in population. If the income tax rate goes down, it is expected that more individuals would be tempted to move to the state, meaning that there should be more productivity in the state, increasing corporate revenues, which means increased corporate tax revenue. This means that there is an expected positive relationship between *INCTAX* and *CORPREV*.

In terms of unemployment, which is represented by *UNEMP*, it is safe to assume that with more employed residents, there will be more productivity in the state. As a result, there is an expected negative relationship between *CORPREV* and *UNEMP*. Another factor that should be considered is the education level of residents in a state. More educated workers tend to be more productive, providing more to firms, hence why they are paid more than less educated workers. Therefore, it will be expected that there is a positive relationship between *EDU*, the percentage of state residents with at least a Bachelor's degree and *CORPREV*.

Because total corporate revenue is being measured by this model, it is imperative that the model for *CORPREV* incorporates state population, to account for the reasonable assumption that with more people, a state should have more firms, or at least more business establishments. As a result, it is easy to conclude that there exists a positive relationship between *POP* and *CORPREV*.

Entry and exit rates are key to this project. One of the reasons that lawmakers lower corporate tax rates is to entice new firms to come to their states. For the purposes of this project, the net entry rates, i.e. the percentage change of the current year's firm population compared to that of one year prior, will be analyzed for each state. When entry rates increase, there is an expectation that there is more production, and therefore more to be taxed. Further, with more entry, there will be more labor demand, and therefore, there will be more taxable personal income. As a result, there should be a positive relationship between corporate tax revenue, as well as personal income tax revenue, and *ENTRY*.

An important note must be made for the *ENTRY* term. The reader should consider that *ENTRY* is represented in the models, (7), (8), and (9) as a function of multiple variables. A two-stage least squares regression will be performed in this project, because this will provide information regarding the factors that bring new firms to the state. Firm entry is affected by several variables, one of the most significant being the perceived "business-friendliness" of the state. These variables will be detailed in Section 4.4. To properly account for these endogenous effects, a two-stage least squares regression is imperative to this analysis.

4.2 Model for Government Expenditures

This model, (8), will determine how government expenditures are affected by changes in the corporate tax rate. By applying the Ricardian equivalence to the Laffer curve, the direct effects of the corporate tax rate's linear and quadratic terms, *CORPTAX* and $CORPTAX^2$, on government expenditures should be the same as those in (7). The same will be said about *INCTAX*, $INCTAX^2$, and their signs, because individuals should exhibit similar behavior as businesses, as far as the Laffer curve is concerned.

$$GOVEXP = \alpha + \beta_1 CORPTAX + \beta_2 CORPTAX^2 + \beta_3 INCTAX + \beta_4 INCTAX^2 + \beta_5 UNEMP + \beta_6 FEDSUB + \beta_7 INT + \beta_8 POP + \beta_9 ENTRY + \epsilon \tag{8}$$

As unemployment decreases, the government can count on increasing tax revenue, from individual and corporate sources, so it can spend more money to improve government services, whether it is fixing bridges or providing grants to students. As a result, it is expected that there is a negative relationship between *UNEMP* and *GOVEXP*.

An interesting feature of state government budgets is the federal government subsidy. This subsidy allows the federal government to assist states in their attempts to provide all their services. If this subsidy is reduced, then state governments will have to make cuts to their budget, especially if they have a large dependence on the subsidy. To clarify this, consider that, in 2008, Illinois and Louisiana both received about $14 billion in federal subsidies, but Illinois has almost three times the population (United States Census Bureau 2015). Because states are reliant on the federal subsidy, there will be an expected positive relationship between *FEDSUB*, which represents the size of the subsidy per capita, and government expenditures.

While state governments are not allowed to have a deficit in their budgets, the interest rate could affect state government expenditures. A high interest rate discourages anybody from borrowing, so if it is high, governments at all levels are less likely to invest in long-term projects, the one time when governments are, more or less, allowed to borrow, by issuing bonds. As a result, the relationship between *INT*, the interest rate on 10-year U.S. Treasury bonds, and government expenditures is expected to be negative.

Because this model is designed to measure total government expenditures, changes in population must be incorporated into the model. It is obvious that with a higher population, a state will need to spend more on its services, meaning that there should be a positive relationship between *POP* and *GOVEXP*.

Firm entry and exit are fundamental to determining government expenditures in this analysis. There is an expectation that when more firms enter a state, the state will receive more tax revenue, and therefore, based on the Ricardian equivalence described in Section 3.2, will be inclined to spend that additional revenue. This leads to an expected positive relationship between *ENTRY* and *GOVEXP*.

4.3 Model for the Balanced Budget

Fundamental to this analysis is the measurement of how the state's government can balance its budget. For this project, the composition of state revenue sources will be considered. In other words, *INCREV* represents the percentage of total state government revenue that comes from personal income taxes. (9) will be used to estimate the percentage of the state budget that is made up of income tax revenues. This measure was chosen to determine whether individuals paid the price of increased taxes or reduced government expenditures when their state is engaging in tax competition.

$$INCREV = \alpha + \beta_1 CORPTAX + \beta_2 CORPTAX^2 + \beta_3 INCTAX + \beta_4 INCTAX^2 + \beta_5 UNEMP + \beta_6 EDU + \beta_7 ENTRY + \epsilon \tag{9}$$

The first two variables, *CORPTAX* and $CORPTAX^2$, from the Laffer curve's analysis of corporate tax revenues, are expected to affect this model in the opposite way that they affected (7), because when corporate tax rates increase, individuals are likely to pay the costs of lost corporate tax revenue. In other words, income tax revenue should make up a larger share of government revenue as corporate tax revenue decreases. Individual income tax rates are assumed to have the Laffer curve effect, as well, and *INCTAX* and $INCTAX^2$ are expected to behave the same way in (9) as *CORPTAX* and $CORPTAX^2$ behave in (7). In other words, *INCTAX* should have a positive impact on *INCREV*, while $INCTAX^2$ should have a negative impact on *INCREV*.

With more employment comes more productivity in a state. As more residents of a state are working, there is an expectation that there will be a larger contribution to the state government's tax revenues. As a result, there is an expected negative relationship between *UNEMP* and *INCREV*. In addition, the education level of individuals in a state, *EDU*, can have a positive impact on *INCREV* because, generally speaking, more educated workers are considered more productive, and tend to be compensated for it.

Last is the relationship between *ENTRY* and *INCREV*. A key assumption of this project is that when there are more firms in a state, then corporate tax revenues will make up a larger share of total revenues in the state budget. This means that the government will not be as dependent on non-corporate sources for funding itself, so there is an expected negative relationship between *ENTRY* and *INCREV*.

4.4 Model for Firm Entry

As discussed in Sections 4 and 4.1, a two-stage least squares regression is required to perform this analysis. The nested models, (7), (8), and (9), will require an entry model, which is described below, with variable descriptions and expected signs listed in Table 2. It is worth noting that many of these variables are lagged by two years, the rationale for this was discussed in Section 3.2.

$$\begin{aligned} ENTRY = \alpha &+ \beta_1 CORPTAX_2 + \beta_2 CORPTAXCOMP_2 + \beta_3 MINWAGE_2 + \beta_4 MINWAGECOMP_2 \\ &+ \beta_5 SALESTAX_2 + \beta_6 SALESTAXCOMP_2 + \beta_7 HWYEXP_2 + \beta_8 RANNEY_2 + \beta_9 EDU + \epsilon \end{aligned} \tag{10}$$

Economists are well aware that the primary incentive for going into business is to make money, which is achieved by lowering costs and maximizing profits. As described in the introduction, taxation can be a large deciding factor for businesses to move to a particular location. As a result, there is an expected negative relationship between $CORPTAX_2$ and *ENTRY*, because firms would like to reduce their costs as much as possible. Similarly, there is an expected positive relationship between $CORPTAXCOMP_2$ and *ENTRY*, because firms may consider leaving a state if its tax rate increases, leaving for their home state's nearest neighbor. The methodology for selecting a state's neighbor is described in Section 5.4 and the methodology for calculating competition between states is discussed in Section 3.3. The information presented in that section applies to calculations of $MINWAGECOMP_2$ and $SALESTAXCOMP_2$.

Another interesting debate that has been taking place in the United States has been over the minimum wage, which many believe is simply not high enough to provide a decent living. However, business owners tend to oppose the minimum wage hike, as there are fears that the increased wage cost may result in job loss

Table 2: Definitions of variables in (10), with expected impacts of predictor variables on *ENTRY*

Name	Variable	(10)
ENTRY	Percentage change in firm population (see Section 5.3)	•
$CORPTAX_2$	Corporate tax rate, lagged two years	-
$CORPTAXCOMP_2$	Corporate tax competition (see Section 3.3), lagged two years	+
$MINWAGE_2$	Minimum wage, lagged two years	-
$MINWAGECOMP_2$	Minimum wage competition, lagged two years	+
$SALESTAX_2$	Sales tax, lagged two years	-
$SALESTAXCOMP_2$	Sales tax competition, lagged two years	+
$HWYEXP_2$	Highway expenditures per capita, lagged two years	+
$RANNEY_2$	Ranney index, lagged two years	-
DIST	Distance between home state and neighbor	+
EDU	Percentage of state residents with at least a Bachelor's degree	+

(Tokars 2015). Because of these fears, there will be an expected negative relationship between $MINWAGE_2$ and *ENTRY*, as the minimum wage for an individual state increases, firms should be less inclined to move there or may even decide to leave the state. The opposite effect should take place with the neighbor's minimum wage and minimum wage competition. As the costs of doing business in the neighboring state increase, again, a firm may consider moving to the state which has not increased its minimum wage. This means that there is an expected positive relationship between $MINWAGECOMP_2$ and *ENTRY*.

The sales tax may prove to be another driving factor in firm entry. As the sales tax increases for a state, consumers in the state should have less money in their pocket at the end of transactions, *ceteris paribus*, because they have to spend more money when they go shopping. This implies that consumers in a state with a higher sales tax should spend less than consumers in a state with a lower sales tax. Firms would like for consumers to spend money with their business, so firms would likely desire to locate in states with lower sales taxes, meaning that there should exist a negative relationship between $SALESTAX_2$ and *ENTRY*. Consistent with the behavior of $CORPTAXCOMP_2$ and $MINWAGECOMP_2$, there is an expected positive relationship between $SALESTAXCOMP_2$ and *ENTRY*, because firms may consider leaving a state that has a high sales tax, in favor of a state with a lower sales tax.

Further, a factor businesses may consider when moving to another state may be related to infrastructure spending. This potentially driving factor will be measured using highway expenditures. This is of particular interest to organizations that travel frequently, since they would need to spend more on maintenance to their vehicles if the highways are not well-maintained. As a result, there is an expected positive relationship between $HWYEXP_2$ and *ENTRY*.

It is rather clear, based on the information provided earlier in this paper, that the issue being tested has a very political background to it. For this study, the Ranney index is the variable of choice, with its coding described in detail in Section 5.8. The Ranney index attempts to measure a state's political structure on a scale from 0 to 1, with a score of "0" indicating complete Republican control and a score of "1" indicating complete Democratic control (Ranney as cited in Holbrook & Van Dunk 1993). Because businesses seem to

flock to states under Republican control, and because states under complete Republican control receive a Ranney index score of "0," there is an expected negative relationship between $RANNEY_2$ and *ENTRY*.

The education level is another issue that may come into consideration for business owners when choosing a place to locate. Genschel (2002) notes, "Companies want low taxes. But they also want good public infrastructure, a well-educated labor force, easy access to markets, clustering economies with other relevant firms, and so forth." This statement makes it clear that firms would most like to locate in a state with a highly educated workforce, meaning that there is a positive relationship between *EDU* and *ENTRY*.

4.5 Expected Results

One of the key predictions of this project is that small states, as well as states that have cities on their borders, will be more susceptible to tax competition than others. In other words, states which have a circle of influence, as described in Section 3.3, that enters another state, have a greater potential impact from tax competition.

It is more difficult to predict the main result of this project, determining how states balance their budgets in response to tax competition, particularly when this competition fails to attract businesses. As discussed in Section 2.1, increasing taxes, i.e. shifting the responsibility of lowered tax revenues to non-corporate tax sources, is certainly a politically unpopular move. Further, it is fairly well known that a cut in government services can be politically unpopular, even if it is done in the name of making government more efficient.

Regardless, lawmakers would likely have an easier time justifying cuts in spending, as opposed to increasing taxes, because they can do it in the name of efficiency. For this project, the researcher expects that state governments will be more likely to cut spending on government programs, than to increase taxes, to make up for the loss in revenue from tax competition.

This can introduce several problems, however. As shown in Section 3.2, everybody wants their program to be fully funded. Students want more funding for their universities, the impoverished want more funding for Medicaid, commuters want more funding for highway and public transit improvements; the list goes on, demonstrating the political issues related to adjusting a state government's budget. Another issue arises from Section 3.2, if tax competition is an issue during economic downturns, how do these governments fund programs that help the unemployed? If the state wants to fix bridges, a program that could put thousands of people to work, how will it pay for the program? While states can issue bonds to pay for the project, they would have to allocate funds to pay back the interest over time, an imperative consideration for states when they are trying to cut spending.

5 Data

The data for this project was compiled from the federal government and its subsidiaries, the Council of State Governments, Harvard University, and the Washington State Department of Revenue. Data collection was performed during the summer and fall of 2015, with statistics dating from 1980 to 2012, and excludes Alaska and Hawaii, as they are unlikely to be affected by tax competition, because they do not border any other states. Any data that was available on a monthly basis uses April and data that is decennial is rounded down to the nearest decade (for example, data for 1986 will use 1980), this is done in response to the availability. For example, if this data was going to 2016, then 2020 would not be available. Full citations for data sources may be found in Section 8.2.

5.1 State Government Finances

In order to perform the analysis for this project, data on state government finances need to be obtained. The United States Census Bureau has data on state governments going back to 1951, with breakdowns of state government revenue sources, state government expenditures, the amount of federal subsidies that each state received, and direct expenditures on highway infrastructure. The Census Bureau provides the data on its website going back to 1992, a request was sent to the organization for additional data, which was fulfilled. The raw data was not adjusted for inflation, so the data (and further data included in this project) was adjusted using consumer price index (CPI) data from the Bureau of Labor Statistics, which uses 1982-1984 as its base period.

In order to gather data on population for models (7), (8), and (10), data was gathered primarily from the state government finances dataset. For data from 1980 to 2008, the estimated populations were included in the database provided by the Census Bureau. However, for populations from 2009 to 2012, data was collected directly from the Census Bureau's Population Division. Data on per capita highway expenditures, used in (10), was converted from raw inflation-adjusted highway expenditures using these population statistics.

5.2 Tax Rates

Imperative to this project is the collection of each state's corporate and personal income tax rates for years from 1980 to 2013. The corporate tax rates were provided by filing a request to the Washington State Department of Revenue. Their dataset included the maximum corporate tax rate for each state dating back to 1980. The maximum corporate tax rate is appropriate for this analysis because political arguments against raising corporate taxes will always be directed at the highest tax rate being charged within a state. The same spreadsheet also contained each state's sales tax rate, from 1980 to 2013, except 2003. The only state whose sales tax rate was excluded from the spreadsheet was Delaware. However, Delaware is well-known for its lack of sales tax, famously touting itself as the "home of tax-free shopping."

Personal income tax rates were obtained from the National Bureau of Economic Research, which had these rates dating from 1977 to 2012. In the table on their website, the "State Rate, Wages" column was chosen for the dataset, as one of the foci of this analysis is on whether state governments make up their losses from tax competition by raising rates on personal income taxes. In order to cover the lower- and middle-class, the groups that would be most affected by this change, properly, the data will strictly focus on

tax rates on people's incomes. The maximum rate for personal income taxes was chosen for the analysis because of data availability, and because the highest tax rate charged by a state can provide insight into the overall tax structure of the state, particularly since politicians have no political incentive to offer anything but a flat or progressive income tax.

5.3 Firm Entry and Exit

Data on firm population for each state was provided by the Census Bureau's Center for Economic Studies, under its Business Dynamics Statistics division. The website for the Business Dynamics division includes Firm Characteristics Data Tables. The statistic of interest is the number of firms in each state. Firm entry was calculated by $ENTRY = \frac{(f_n - f_{n-1})}{f_{n-1}} * 100$, where f_n represents the firm population for year n. The dataset from the Census Bureau provides data from 1977 to 2012.

5.4 Competitive Influence

The calculation of the competitive influence variables, *CORPTAXCOMP*, *MINWAGECOMP*, and *SALESTAXCOMP*, used in (10), required the corresponding variable of the home state, of the state's nearest neighbor, and the reciprocal of the distance between the home state and its nearest neighbor. This is a variation of the formula presented by the Salop Model of Location Theory, described in Section 3.3.

A state's nearest neighbor is defined by which state's center of population is geographically closest to the home state's center of population. The center of population is determined by the United States Census Bureau and is calculated on a decennial basis. The Census Bureau describes its calculation as follows,

> "The concept of the center of population as used by the U.S. Census Bureau is that of a balance point. The center of population is the point at which an imaginary, weightless, rigid, and flat (no elevation effects) surface representation of the 50 states [...] would balance if weights of identical size were placed on it so that each weight represented the location of one person." (United States Census Bureau, "Historical State Centers")

The Census Bureau's spreadsheet which provides this information includes a series of coordinate points, which were converted into decimal form. The formula for the "Great Circle Route," which is the shortest spherical route between two locations, was applied to develop a matrix for each ten year period of each state's distance relative to the other states. A series of *VLOOKUP* functions were developed, which matched states with their neighbors. Similar methodology allowed for states to be matched with their nearest neighbor's tax rate, allowing for the calculation of each state's influence.

5.5 Macroeconomic Statistics

Macroeconomic statistics for each state were obtained from the federal government. The unemployment rate for each state was obtained from the Bureau of Labor Statistics, under their Local Area Unemployment Statistics, which can generate tables on the unemployment rate for each region. This data was seasonally adjusted, and is included for all years from 1980 to 2013.

Each state's gross state product (GSP) was obtained from the Bureau of Economic Analysis (BEA). The BEA only had statistics for per capita and real GSP dating back to 1987, but nominal GSP was available

going back to 1963. Using similar methodology to that described in Section 5.1, real GSP per capita was calculated. For data from 1980 to 1997, the Standard Industrial Classification (SIC) GSP is used, and for data from 1998 to 2012, the North American Industry Classification System (NAICS) measure of GSP is used, due to data availability from the BEA. When NAICS was introduced, the BEA ceased the use of SIC in its GSP calculations, which creates a statistical discrepancy between 1997 and 1998, because of differences in how the NAICS and SIC estimate gross state product (Bureau of Economic Analysis, "Why").

The issue with the NAICS/SIC discrepancy was of particular concern when collecting data on the makeup of gross state product. The three major goods-producing industries were analyzed, manufacturing, mining, and construction, and data on what percentage of the GSP was made up of each sector was collected and developed from the same dataset. This discrepancy was not an issue for the industries just described, however the services sector was also considered for this analysis, but with the change in coding caused by the NAICS, the services sector was dropped from the analysis.

5.6 Minimum Wage

Minimum wages for each state were collected from the *Book of the States*, published by the Council of State Governments, for the years 1979 to 1998. Minimum wages from 2000 to 2013 were collected from the United States Department of Labor. Data for 1999 was unavailable. The state minimum wages were compared against the federal minimum wage. If any state's minimum wage was lower than the federal government's, then the federal minimum wage prevailed. For example, if Minnesota's minimum wage is $6.15, and the federal government's minimum wage is $7.25, then Minnesota's minimum wage is recorded at $7.25. This data has been adjusted for inflation, as well, using the procedure described in Section 5.1.

5.7 Education

Education statistics for each state were compiled from the United States Census Bureau's Educational Attainment statistics program. Their "Half-Century of Learning" page provides datasets containing decennial education data by state for attainment of high school diplomas and Bachelor's degrees, from 1940 to 2000. Educational attainment data for 2010 was selected from the American Community Survey, which provides one-year estimates for Bachelor's degree attainment for each state. Bachelor's degrees were chosen because a high percentage of the population has historically had high school diplomas, at least in the past forty years, whereas Bachelor's degrees are much less popular, though they do promise a higher salary and a more educated workforce for a particular state.

5.8 Ranney Index

As discussed in Section 4.4, the variable chosen for the political variable of this project is the Ranney index, which scores states under complete Republican control with a "0" and states under complete Democratic control with a "1." The data was gathered from a database at Harvard University, with data going as far back as 1936. As discussed by Holbrook and Van Dunk (1993), the Ranney index considers "the proportion of seats won in the state House and Senate elections, the Democratic percentage in the gubernatorial election, and the percentage of the time the governorship and state legislature were controlled by the Democratic party."

6 Results

The regressions for the models described in Section 4 were performed in Stata/SE 8.2. Four regressions were run for each model: (1) for ordinary least squares with random effects, (2) for ordinary least squares with fixed effects, (3) for generalized least squares with random effects, and (4) for generalized least squares with fixed effects. The generalized least squares method was used to correct for errors in the data related to heteroskedasticity, where standard errors in the dataset appear to be inconsistent across states, and autocorrelation, where variables may be correlated with their own previous values. Heteroskedasticity and autocorrelation are described in more detail in Section 6.1. This section will provide a description of the results and any corrections that were made to the data involved.

It is important to note that some states were dropped from the dataset, primarily due to those that had nonsensical data. For example, New Hampshire's income tax rate is zero percent. However, the state still was reporting income tax revenue, approximately three percent of its total tax revenue. Four states, New Hampshire, South Dakota, Tennessee, and Texas, were dropped from the dataset for this reason, along with Connecticut's data prior to 1991. California was dropped from the dataset because it proved to be an outlier in the regressions, adversely affecting the results. This may be due to California's very large population. Given the nature of this paper, and the measure used to estimate competition between states, described in Section 3.3, Alaska and Hawaii are necessarily dropped from consideration, leaving forty-three states in the dataset for analysis.

6.1 Robustness Testing

It is necessary to test the models used in this project for robustness. Even if the R^2 values indicate that the models are doing a relatively good job of predicting their response variables, robustness issues, particularly heteroskedasticity and autocorrelation, can adversely affect the results. Following the method provided by Wiggins and Poi (2013), the models were tested for heteroskedasticity and autocorrelation using Stata/SE 8.2. Summaries of the tests are provided in Tables 3 and 4.

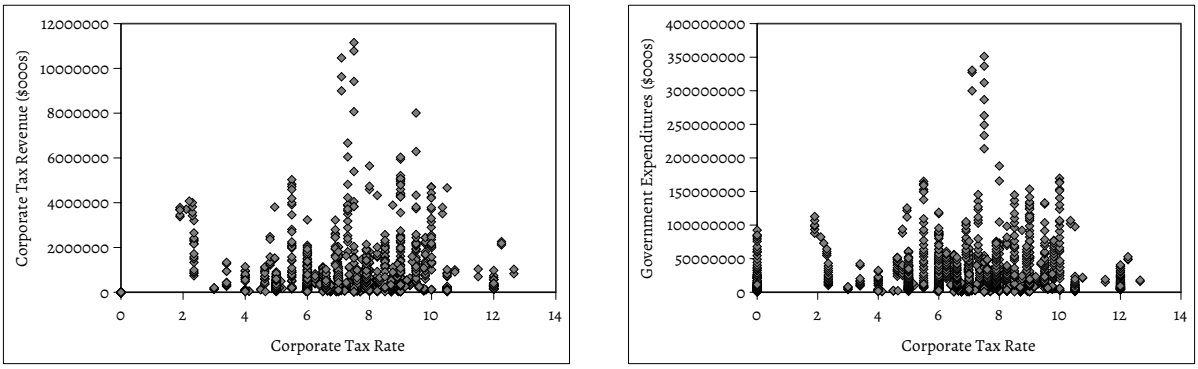
Before running the robustness tests, by looking at Figure 3, it is very clear that the corporate tax revenue and government expenditure models suffer from heteroskedasticity. This is particularly concerning considering that both graphs show a Laffer-esque effect, but that may be partially due to this heteroskedasticity.

Table 3: Test results of models for heteroskedasticity.

Model	Likelihood Ratio χ^2	*df*	*p*-value
CORPREV	2439.25	42	0.0000
GOVEXP	2140.87	42	0.0000
*INCREV**	1326.89	42	0.0000
ENTRY	353.76	40	0.0000
H_0: The model is homoskedastic			

* Iterated GLS for *INCREV* would not converge, 3,000 iterations were performed

It is certainly clear that, based on the results presented in Table 3, the null hypothesis, that the models are homoskedastic, should be rejected. This is shown by the *p*-value that is virtually zero across the models,



(a) Corporate Tax Revenue

(b) Government Expenditures

Figure 3: Heteroskedasticity clearly exists in both the model for corporate tax revenue and the model for government expenditures.

meaning that all of the models developed for this project suffer from heteroskedasticity. In other words, these models exhibit inconsistent standard errors across states. This justifies the use of generalized least squares regressions, which correct for heteroskedasticity across the states.

The existence of heteroskedasticity in the models is likely best explained by economic growth as a whole in the United States. Population growth also is likely playing a role in the *CORPREV* and *GOVEXP* models, because their response variables are total corporate tax revenue and total government expenditures, which both would increase with a higher population.

It is significant to note that performing the test for heteroskedasticity suggested by Wiggins and Poi (2013) requires the use of iterated generalized least squares regression, which should converge to a value. The iterated GLS for *INCREV* would not converge, so that regression was stopped after approximately 3,000 iterations. For comparison, the other models converged after less than 200 iterations.

Table 4: Test results of models for autocorrelation

Model	F	num. df	denom. df	p-value
CORPREV	71.686	1	42	0.0000
GOVEXP	304.195	1	42	0.0000
INCREV	88.333	1	42	0.0000
ENTRY	0.690	1	40	0.4110
H_0: There is no first-order autocorrelation in the model				

Likewise, for all models, except for *ENTRY*, it is clear, based on the results presented in Table 4, the null hypothesis, that the models do not have first-order autocorrelation, should be rejected. The p-value for this test in *CORPREV*, *GOVEXP*, and *INCREV* is virtually zero, meaning that these three models suffer from autocorrelation across the states. This, essentially, means that variables considered in the *CORPREV*, *GOVEXP*, and *INCREV* models are correlating with their own past and future values. This, again, justifies the use of generalized least squares regressions, which correct for autocorrelation across the states.

The autocorrelation in the *CORPREV* and *GOVEXP* models may be caused by a lack of significant variation in corporate tax rates and other variables in the model, meaning that economic and population growth, over time, may be the largest contributors to variation in corporate tax revenue and government expenditures. An issue that may affect the aforementioned models and the *INCREV* model is the development of state government budgets. Any drastic change in tax rates or government spending can be highly controversial and politically unpopular, meaning that only gradual changes are usually possible. Ultimately, this only leaves the possibility that drastic change will come with time.

6.2 Model for Corporate Tax Revenue

Table 5: Empirical results for estimation of corporate tax revenue (model (7) from Section 4.1)

CORPREV	(1)	(2)	(3)	(4)
CORPTAX	57940.24	178997.4	50764.53	51845.84
	(54159.58)	(79078.17)**	(24462.51)**	(30190.33)*
$CORPTAX^2$	-4247.856	-11578.57	-2247.746	-2547.124
	(3848.665)	(5284.14)**	(1705.912)	(2086.904)
INCTAX	49413.75	44620.74	-1082.104	-8229.073
	(14980.7)***	(16618.65)***	(4922.435)	(4848.654)*
UNEMP	-45422.46	-45107.15	-26346.26	-28157.93
	(8958.71)***	(8870.876)***	(2803.171)***	(2784.08)***
EDU	84909.23	72723.8	16151.61	7615.426
	(4594.369)***	(5534.331)***	(2160.884)***	(2422.459)***
POP	255.8976	409.1798	192.9376	565.0585
	(14.08872)***	(30.95714)***	(10.46949)***	(32.97448)***
ENTRY	-8877.767	-735.9002	92.74185	938.4862
	(7896.751)	(7846.315)	(1135.63)	(1137.096)
constant	-2297548	-3196362	-536910.5	-2063236
	(210469.7)***	(300060.4)***	(102760.8)***	(201945.5)***
n	1398	1398	1398	1398
R^2	0.6294	0.6218	§	§
Method	OLS	OLS	GLS	GLS
Fixed effects	No	Yes	No	Yes

* $p \leq 0.1$, ** $p \leq 0.05$, *** $p \leq 0.01$

§ R^2 is not calculated for GLS regressions

The primary purpose of the corporate tax revenue model is to estimate the Laffer curve, described in Section 3.1. The model for corporate tax revenue was defined in Section 4.1, its results are shown in Table 5. It is worth mentioning that both regressions (1) and (2) have an R^2 value of approximately 0.62, meaning that the model is able to explain about 62 percent of the variation in *CORPREV*. Regressions (3) and (4) do not have R^2 values, as R^2 is not calculated for generalized least squares. To interpret the results of these regressions, the values in this table correspond to the change in corporate tax revenue that a one point increase in the variable will cause. For example, in regression (1), a one percentage point increase in the corporate tax rate, *CORPTAX*, will correspond to an increase in corporate tax revenue of about $57,940,240, on average, with a standard deviation of approximately $54,159,580, with the other variables held constant.

In two of the four regressions, it is clear that the Laffer curve is evident in predictions of corporate tax revenue, with *CORPTAX* exhibiting a positive sign, and $CORPTAX^2$ exhibiting a negative sign. This effect is most prominent in regression (2), using ordinary least squares with fixed effects, because both signs are significant at $\alpha = 0.05$. Further, in regressions (1) and (2), the expected positive sign for *INCTAX* is shown, significant at $\alpha = 0.01$. In regressions (3) and (4), which correct for heteroskedasticity and autocorrelation, the regression estimates a negative sign for this variable, however the results are not statistically significant. For *UNEMP*, the expected negative sign is consistently shown to be significant at $\alpha = 0.01$. *EDU* and *POP* both exhibit their expected positive signs, consistent through the four regressions, at $\alpha = 0.01$.

ENTRY, unlike the other variables measured in this model, does not exhibit any significant result. This may be caused by the tax incentives offered by some states, which may promise to offer new firms significant tax breaks. These tax breaks may even be tax exemptions, meaning that new firms may not even bring in any tax revenue, causing the ambiguous results for *ENTRY*'s estimated impact on *CORPREV*. In order to correct for the errors that may be introduced by tax incentives offered to businesses, the *ENTRY* variable was lagged by three through five years. However, these attempts did not result in any statistically significant findings. This applies to the government expenditures model and its results, as well.

6.3 Model for Government Expenditures

The model for government expenditures was designed to estimate the Laffer curve effect for the corporate tax rate and the income tax rate, based on the assumptions made in Section 3.2. This model was defined in Section 4.2 and its results shown in Table 6. Before continuing, it is also important to note that the ordinary least squares regressions report an R^2 of approximately 0.75 and 0.62 for the random and fixed effects regressions, respectively. This means that when using random effects, in regression (1), the model is able to explain about 75 percent of the variation in *GOVEXP* and when using fixed effects, in regression (2), the model is able to explain about 62 percent of the variation in *GOVEXP*. To interpret the results of these regressions, the values in this table correspond to the change in government expenditures that a one point increase in the variable will cause. For example, in regression (1), a one percentage point increase in the corporate tax rate, *CORPTAX*, will correspond to a decrease in government expenditures of about $492,397,500, on average, with a standard deviation of approximately $1,333,419,000, with the other variables held constant.

In regressions (2), (3), and (4), the expected positive sign for *CORPTAX* and the expected negative sign for $CORPTAX^2$ were estimated, with statistically significant effects in the regressions employing fixed effects, (2) and (4). With respect to *INCTAX* and $INCTAX^2$, the regressions using fixed effects estimate the expected positive sign for *INCTAX* and negative sign for $INCTAX^2$. However, the only significant effects are shown in the ordinary least squares fixed effects regression, (2), and the significance of the sign for $INCTAX^2$ is very weak, at $\alpha = 0.1$.

The expected negative sign for *UNEMP* was not estimated in the ordinary least squares regressions, (1) and (2), though the effect is not significant. In the generalized least squares regressions, however, the expected negative sign was estimated, showing strong significance, at $\alpha = 0.01$. In the estimations of *FEDSUB*'s effect on *GOVEXP*, the expected positive sign was estimated across all four regressions, with effects statistically significant at $\alpha = 0.01$. Similarly, the expected negative sign for *INT* was estimated

Table 6: Empirical results for estimation of government expenditures (model (8) from Section 4.2)

GOVEXP	(1)	(2)	(3)	(4)
CORPTAX	-492397.5	1.03E7	415986.7	1218717
	(1333419)	(2274614)***	(450641.6)	(504189.2)**
$CORPTAX^2$	-64130.76	-771900.7	-26141.46	-75841.21
	(93885.61)	(151536.4)***	(30938.99)	(34493.49)**
INCTAX	1841226	4568697	88336.17	447773.5
	(1204172)	(1909592)**	(356117.7)	(343437.6)
$INCTAX^2$	10900.28	-2257722.1	4088.643	-22095.53
	(86643.52)	(123621.5)*	(22160.85)	(20298.32)
UNEMP	147264.5	9466.858	-292662.3	-203801.8
	(281647.4)	(241499.3)	(57309.89)***	(49042.85)***
FEDSUB	16532.41	17454.91	7580.9	5617.207
	(1524.237)***	(1529.112)***	(444.7517)***	(395.2265)***
INT	-2570020	-469659.3	-660976.3	-440480.6
	(305192.5)***	(337652.4)	(59681.41)***	(51625.14)***
POP	7920.567	20481.96	8404.892	24394.37
	(256.2367)***	(891.2315)***	(324.8629)***	(673.4044)***
ENTRY	-758661.4	-207928.1	-132020	99208.19
	(241043.2)***	(226312.7)	(28017.13)***	(23377.46)***
constant	-1.03E7	-1.27E8	-9420711	-8.67E7
	(5332396)*	(1.27E7)	(2235908)***	(3713363)***
n	1398	1398	1398	1398
R^2	0.7467	0.6191	§	§
Method	OLS	OLS	GLS	GLS
Fixed effects	No	Yes	No	Yes

* $p \leq 0.1$, ** $p \leq 0.05$, *** $p \leq 0.01$
§ R^2 is not calculated for GLS regressions

across all models, significant at $\alpha = 0.01$, except in regression (2), where the effect was not statistically significant.

The expected positive sign for *POP* was exhibited across the models, significant at $\alpha = 0.01$, which certainly was a strong expectation, considering that the response variable in question is total government expenditures.

ENTRY's effect on *GOVEXP* is inconsistent and unclear, as it was when estimating *ENTRY*'s effect on *CORPREV*. As discussed in Section 6.2, it is likely that new firms in a state are receiving large tax incentives, which may mean that they will not have an impact on government expenditures for several years. This assumption is based on the Ricardian equivalence assumption made in Section 3.2, which hypothesizes that, in the long run, governments will spend as much as they take in.

6.4 Model for the Balanced Budget

The model for the balanced budget uses the share of total government revenue that is made up by income tax revenue as its response variable. This model attempts to measure the Laffer curve effect for the income tax rate and the opposite of the Laffer curve effect for the corporate tax rate. In other words, there should be

Table 7: Empirical results for estimation of the balanced budget (model (9) from Section 4.3)

INCREV	(1)	(2)	(3)	(4)
CORPTAX	1.034178	0.6887958	1.214309	0.2335775
	(0.0394826)***	(0.4082519)*	(0.2919125)***	(0.3084535)
$CORPTAX^2$	-0.0657949	-0.0436701	0.0820271	-0.0131397
	(0.0264793)**	(0.0272574)	(0.0205915)***	(0.0208102)
INCTAX	2.950215	2.617207	4.297441	3.364038
	(0.3273889)***	(0.3367595)***	(0.30248)***	(0.3100602)***
$INCTAX^2$	-0.1003656	-0.0805971	-0.2377648	-0.1708634
	(0.0212529)***	(0.0217334)***	(0.0205092)***	(0.0209553)***
UNEMP	-0.510091	-0.520018	-0.1010566	-0.157847
	(0.0470455)***	(0.0468655)***	(0.031841)***	(0.0254038)***
EDU	0.4321813	0.4404742	0.2577906	0.3515751
	(0.0243633)***	(0.0244626)***	(0.0303335)***	(0.0207972)***
ENTRY	-0.0508099	-0.0498014	-0.0103479	-0.0270145
	(0.0405039)	(0.0413045)	(0.0129374)	(0.0095803)***
constant	10.30008	12.42369	8.845681	15.30012
	(2.088583)***	(1.715219)***	(1.381504)***	(1.351392)***
n	1396	1396	1396	1396
R^2	0.5974	0.5849	§	§
Method	OLS	OLS	GLS	GLS
Fixed effects	No	Yes	No	Yes

* $p \leq 0.1$, ** $p \leq 0.05$, *** $p \leq 0.01$
§ R^2 is not calculated for GLS regressions

a negative sign for *CORPTAX* and a positive sign for $CORPTAX^2$. This model was defined in Section 4.3, its results are shown in Table 7. The ordinary least squares regressions both have an R^2 of approximately 0.59. This means that, for both regressions, the model can explain about 59 percent of the variation in *INCREV*. To interpret the results of these regressions, the values in this table correspond to the change in income tax revenue's share of total tax revenue that a one point increase in the variable will cause. For example, in regression (1), a one percentage point increase in the corporate tax rate, *CORPTAX*, will correspond to an increase in income tax revenue's share in total tax revenue of about 1.034 percentage points, on average, with a standard deviation of approximately 0.04 percentage points, with the other variables held constant.

The estimation of the positive sign for *CORPTAX* is consistent through the four regressions, and it is a statistically significant predictor of *INCREV* in the random effects regressions, (1) and (3). However, these regressions do not account for effects that may affect only a particular state, so they may not be as reliable. Concerning $CORPTAX^2$, in all regressions except for (3), there is an estimated negative sign. In (3), there is an estimated positive sign. Like *CORPTAX*, only the random effects regressions have statistically significant predictions. As expected, *INCTAX* and $INCTAX^2$ exhibit the Laffer curve effect, consistent across the four regressions, with a positive sign for *INCTAX* and a negative sign for $INCTAX^2$. The results are significant at $\alpha = 0.01$.

The expected negative sign for *UNEMP* is exhibited across the four regressions, with statistically significant effects at $\alpha = 0.01$. In addition, the expected positive sign for *EDU* is estimated across the four regressions, and is statistically significant, at $\alpha = 0.01$, for all regressions.

In this model, while the effects are only significant in regression (4), which corrects for heteroskedasticity and autocorrelation and employs fixed effects, *ENTRY* is consistently a negative predictor of *INCREV*, which meets the expectations set in Section 4.3. The results estimated by regression (4) were significant at $\alpha = 0.01$.

6.5 Model for Firm Entry

Table 8: Empirical results for estimation of firm entry at the state level (model (10) from Section 4.4)

ENTRY	(1)	(2)	(3)	(4)
$CORPTAX_2$	-0.1111466	-0.0330119	-0.0981916	-0.012837
	(0.037748)***	(0.0613007)	(0.0280138)***	(0.0286395)
$CORPTAXCOMP_2$	-1.335156	0.4288669	-2.471029	0.6464471
	(4.04034)	(4.013889)	(2.37582)	(1.664357)
$MINWAGE_2$	-0.2878053	-0.1634645	-0.2299254	-0.0587024
	(0.0384063)***	(0.1052614)	(0.0353042)***	(0.065496)
$MINWAGECOMP_2$	-8.161805	-2.534795	-2.074791	-3.569932
	(10.33464)	(9.641139)	(9.006674)	(5.502157)
$SALESTAX_2$	-0.0446476	-0.1304747	-0.0779542	-0.0780811
	(0.069426)	(0.1152891)	(0.05836)	(0.0729607)
$SALESTAXCOMP_2$	0.7687545	6.454203	0.9608175	3.166688
	(4.378144)	(6.929535)	(3.108175)	(3.174218)
$HWYEXP_2$	1.57E-6	0.0000125	-2.63E-6	8.12E-6
	(4.04E-6)	(4.55E-6)***	(3.73E-6)	(3.14E-6)***
$RANNEY_2$	0.2090196	0.621052	0.7723944	0.6558913
	(0.5078332)	(0.6683063)	(0.4611754)*	(0.4028653)
EDU	0.0369072	-0.1487511	0.0598324	-0.089762
	(0.0228096)	(0.0622467)**	(0.017668)***	(0.0419471)**
constant	3.243539	5.735615	2.093812	1.161482
	(0.5970893)***	(1.696851)***	(0.5243144)***	(1.297262)
n	1163	1163	1163	1163
R^2	0.1943	0.2751	§	§
Method	OLS	OLS	GLS	GLS
Fixed effects	No	Yes	No	Yes

* $p \leq 0.1$, ** $p \leq 0.05$, *** $p \leq 0.01$

§ R^2 is not calculated for GLS regressions

The model for firm entry is based on the percentage change of a state's firm population from the prior year. The primary purpose of this model is to determine if the corporate tax rate, the state's nearest neighbor's tax rate, and the distance between the home state and its nearest neighbor have an impact on the firm entry rate. This model will also be used for two-stage least squares regressions, initially discussed in Section 4.1 and performed in Section 6.6. This model was defined in Section 4.4, with its results shown in Table 8.

Before continuing, it is significant to note that minimum wage data for 1978 and 1999 and sales tax data for 2003 were missing from the data sources, meaning they were not included in the regressions. Addi-

tionally, Ranney index data was not available for Nebraska, so that state was dropped from the regressions. Further, this model incorporates region by year fixed effects, in addition to state fixed effects meaning that each region, as defined by the federal government (United States Census Bureau, "Census Regions"), and year has a dummy variable, to correct for potential regional differences in firm behavior over time.

To interpret the results of these regressions, the values in this table correspond to the change in a state's firm population growth rate, *ENTRY*, that a one point increase in the variable will cause. For example, in regression (1), a one percentage point increase in the corporate tax rate, *CORPTAX*, will correspond to a decrease in the firm population growth rate by about 0.11115 percentage points, on average, with a standard deviation of approximately 0.03775 percentage points, with the other variables held constant.

The R^2 values of the two ordinary least squares regressions are 0.1943 and 0.2751 for the random effects and fixed effects regressions, respectively. In other words, when using random effects, the model is able to explain about 19 percent of the variation in *ENTRY* and when using fixed effects, the model is able to explain about 28 percent of the variation in *ENTRY*.

The expected negative sign for $CORPTAX_2$ is exhibited across the regressions, with significant effects in regressions (1) and (3), at $\alpha = 0.01$, except for (2) and (4), which incorporate fixed effects. Introducing corporate tax competition, the expected positive sign is shown in regressions (2) and (4), however, the regressions yield no significant results. This means that, based on the model developed in Section 4.4, there is no significant evidence to prove that $CORPTAXCOMP_2$ affects *ENTRY*.

The minimum wage debate seems to play a significant role in the *ENTRY* model, with significant results at $\alpha = 0.01$ in regressions (1) and (3). The regressions consistently show the expected negative sign, as well. This indicates that increased minimum wages do negatively affect the firm entry rate of a state. However, the results with minimum wage competition between states are similar to those for corporate tax competition. In addition to the estimated signs differing from those predicted in Section 4.4, the results are not significant. This indicates that, based on the *ENTRY* model developed in this paper, there is no significant evidence to prove that $MINWAGECOMP_2$ affects *ENTRY*. Unlike the corporate tax rate and the minimum wage, the sales tax does not seem to significantly impact a state's firm entry rate, although the estimated signs do match those predicted. Sales tax competition also does not seem to be a significant factor, either.

The variable chosen to measure infrastructure's ability to affect firm entry rates in a state was highway expenditures. Each regression estimated the predicted positive sign, except for (3). Significant results were found in regressions (2) and (4) at $\alpha = 0.01$, meaning that highway expenditures, and likely other infrastructure investments, are a significant predictor of firm entry.

Given that the issue at hand, corporate tax competition, is a politically driven issue, a political variable was necessary for the completion of this project. However, oddly, it seems that there is an estimated positive, significant relationship between $RANNEY_2$ and *ENTRY*. In other words, it seems that, at first sight, firms favor Democratic governors, even though the Republican party tends to tout itself as being more business-friendly than the Democratic party. These estimations have no statistical significance, however, except for in regression (3), where there is a weak significance, at $\alpha = 0.1$. *EDU* exhibits a negative sign and significant results, except for regression (1), at $\alpha = 0.05$ in regressions (2) and (4). This may be due to a lower cost of labor from less educated workers. However, regression (3) has the expected positive sign, at $\alpha = 0.01$.

6.6 Two Stage Least Squares Regressions

In this section, the previously discussed two stage least squares regressions will be performed, to capture the effects of *ENTRY* as a function of variables defined in Section 4.4. This section will also include a brief discussion of the results of the individual models. The organization of the four regressions changes in this section changes from that of Sections 6.2 through 6.5. Regressions (1) and (2) are not robust to heteroskedasticity and regressions (3) and (4) are robust to heteroskedasticity. Similar to the previous sections, regressions (1) and (3) use random effects and regressions (2) and (4) incorporate fixed effects. It is also important to note that when performing two-stage least squares regression, R^2 "really has no statistical meaning," so the R^2 values will not be interpreted for these regressions (Sribney, Wiggins, & Drukker 2015).

6.6.1 Two Stage Model for Corporate Tax Revenue

Table 9: Empirical results for estimation of corporate tax revenue, using two stage least squares regression

CORPREV	(1)	(2)	(3)	(4)
ENTRY	-75157.04	-1567.309	-59920.34	-1567.309
	(41293.38)*	(12740.53)	(50988.74)	(13488.24)
CORPTAX	-16968.05	131586.3	-152071.8	131586.3
	(58984.03)	(87975.92)	(83890.53)*	(109738.1)
$CORPTAX^2$	1175.393	-7094.344	13887.04	-7094.344
	(4127.878)	(5854.878)	(6761.775)**	(7224.89)
INCTAX	65298.16	60921.11	9032.006	60921.11
	(18800.93)***	(20712.72)***	(30899.13)	(28905.29)**
UNEMP	-57755.35	-44496.54	-96691.97	-44496.54
	(13978.42)***	(9539.287)***	(34234.38)***	(10632.09)***
EDU	71243.7	73609.74	13078.57	73609.74
	(9927.367)***	(6462.614)***	(16091.75)	(8280.914)***
POP	245.9479	417.3521	113.1958	417.3521
	(14.49193)***	(35.29615)***	(142.8921)	(34.78854)***
constant	-1681329	-3285137	19121.48	§
	(397154.7)***	(355885.2)***	(11753.85)	
n	1153	1153	1007	1153
R^2	0.6331	0.6228	-0.2937	0.4426
Robust	No	No	Yes	Yes
Fixed effects	No	Yes	No	Yes

* $p \leq 0.1$, ** $p \leq 0.05$, *** $p \leq 0.01$

§ Constant is not calculated for regression (4)

The two stage model for corporate tax revenue estimates its response variable in a way that also considers firm entry as a function of the variables described in Section 4.4. The regressions consistently estimate a negative relationship between *ENTRY* and *CORPREV*, with significant effects predicted in regression (1), at $\alpha = 0.1$. This is certainly an odd prediction, because with more firms, states should receive tax revenue from the new firms, however it is not strongly significant in any regression. Interpretation of the results in this section is similar to that of the previous sections. The values in this table correspond to the change in corporate tax revenue that a one point increase in the variable will cause. For example, in regression (1), a one

percentage point increase in the corporate tax rate, *CORPTAX*, will correspond to an decrease in corporate tax revenue of about $16,968,050, on average, with a standard deviation of approximately $58,984,030, with the other variables held constant.

The relationship between *CORPTAX* and *CORPREV* is inconsistent, with an estimated negative relationship in regressions (1) and (3) and an estimated positive relationship in regressions (2) and (4), the regressions using fixed effects. The only significant results are estimated in regression (3), merely at $\alpha = 0.1$. The opposite signs are estimated for the relationship between $CORPTAX^2$ and *CORPREV*, with an estimated positive relationship in regressions (1) and (3) and an estimated negative relationship in regressions (2) and (4), with the only significant results estimated in regression (3), at $\alpha = 0.05$. For both variables, *CORPTAX* and $CORPTAX^2$, only the regressions incorporating fixed effects, (2) and (4), estimated the predicted signs.

The expected positive sign for *INCTAX* is exhibited in all four regressions, significant at $\alpha = 0.01$ in the regressions which are not robust to heteroskedasticity, (1) and (2). The relationship is also significant, at $\alpha = 0.05$, in regression (4), which is robust to heteroskedasticity and incorporates fixed effects.

Unemployment's expected negative impact on *CORPREV* is exhibited in each of the regressions, significant at $\alpha = 0.01$. This makes it overwhelmingly clear that with less unemployment, there is more corporate tax revenue earned by state governments. This clearly is a reasonable estimation, as with less unemployment, there should be more productivity in a state, leading to more corporate revenue and, therefore, more corporate tax revenue.

Similarly, the expected positive relationship between *EDU* and *CORPREV* is consistently exhibited in the regressions, significant in regressions (1), (2), and (4), at $\alpha = 0.01$. The expected positive relationship between *POP* and *CORPREV* was also consistently estimated across the regressions, significant at $\alpha = 0.01$ in regressions (1), (2), and (4), as well.

6.6.2 Two Stage Model for Government Expenditures

The two stage model for government expenditures is designed to estimate the impacts of its predictor variables in a way that also captures *ENTRY* as a function of corporate tax rates and other issues that may impact a state's perceived "business-friendliness."

The expected positive relationship between firm entry and government expenditures is not shown in any of the two-stage regressions. There was a statistically significant negative relationship between *ENTRY* and *GOVEXP* in regressions (1) and (3), the regressions which do not incorporate fixed effects, at $\alpha = 0.1$ and $\alpha = 0.01$, respectively. As discussed previously, in the context of the two-stage corporate tax revenue model, described in Section 6.6.1. this may be due to governments offering tax incentives to new businesses entering their states. In Section 6.3, there was a discussion of how the Ricardian equivalence may play a role in how these tax incentives affecting government expenditures. That idea may also apply to these results.

In regressions (2) and (4), which incorporate fixed effects, the expected positive relationship between *CORPTAX* and *GOVEXP* is exhibited, with significant effects at $\alpha = 0.01$ in both regressions. Regressions (1) and (3) predict a negative relationship, with regression (1) showing a significant result at $\alpha = 0.05$. Likewise, regressions (2) and (4) exhibit the expected negative relationship between $CORPTAX^2$ and *GOVEXP*, which was significant at $\alpha = 0.01$, as well. Regressions (1) and (3) predicted a positive relationship, but those results

Table 10: Empirical results for estimation of government expenditures, using two stage least squares regression.

GOVEXP	(1)	(2)	(3)	(4)
ENTRY	-1.46E7	-399795.9	-2056531	-399795.9
	(8786718)*	(377208.6)	(557526.5)***	(413814.8)
CORPTAX	-3738746	1.10E7	-1672097	1.10E7
	(1692823)**	(2508456)***	(1917410)	(2386141)***
$CORPTAX^2$	77486.64	-781928.9	151917.7	-781928.9
	(161759.8)	(166873.6)***	(119660.1)	(175855.5)***
INCTAX	-477423.5	5998146	-857897.3	5998146
	(3100896)	(2512429)**	(1139747)	(2243167)***
$INCTAX^2$	271623.8	-333357.7	117750.2	-333357.7
	(295541.9)	(171842.7)*	(84906.58)	(167565.5)**
UNEMP	-3617177	294615.8	-1037385	294615.8
	(2749347)	(307459.9)	(359053.9)***	(322867.3)
FEDSUB	5146.332	16219.92	-1945.094	16219.92
	(6323.567)	(1662.861)***	(2026.058)	(2286.53)***
INT	-47486.17	-688221.8	-17933.97	-688221.8
	(2185861)	(410885.3)*	(209785.3)	(455591.5)
POP	7243.968	20999.13	11237.89	20999.13
	(299.9246)***	(1004.699)***	(3337.594)***	(1192.789)***
constant	4.34E7	-1.39E8	1300122	§
	(2.92E7)	(1.47E7)***	(234853.2)***	
n	1153	1153	1007	1153
R^2	0.5236	0.6117	-1.3972	0.6587
Robust	No	No	Yes	Yes
Fixed effects	No	Yes	No	Yes

* $p \leq 0.1$, ** $p \leq 0.05$, *** $p \leq 0.01$

§ Constant is not calculated for regression (4)

were not statistically significant. These results are indicative of a Laffer-esque relationship between the corporate tax rate and government expenditures.

The Laffer curve effect was also exhibited in the regressions for the relationship between the income tax and government expenditures, specifically in the regressions incorporating fixed effects, (2) and (4). Results were significant for *INCTAX* at $\alpha = 0.05$ and $\alpha = 0.01$ and for $INCTAX^2$ at $\alpha = 0.1$ and $\alpha = 0.05$ in regressions (2) and (4), respectively.

The expected negative relationship between *UNEMP* and *GOVEXP* is estimated in each of the regressions, with a significant result, at $\alpha = 0.01$, in regression (3), which is robust to heteroskedasticity, but does not incorporate fixed effects.

Regressions (2) and (4) estimated a significant positive relationship between *FEDSUB* and *GOVEXP*, which was predicted. These results were significant at $\alpha = 0.01$, meaning that state governments are willing to spend more when the federal government grants them a larger subsidy. Regression (3) predicted a negative relationship, but its results were not significant.

Across the regressions was an estimated negative relationship between the interest rate and government expenditures, as predicted. The result was significant at $\alpha = 0.1$ in regression (2). The lack of significant results may be caused by the balanced budget requirement imposed by nearly every state, which restricts states' abilities to borrow money to only large capital projects.

The predicted positive relationship between *POP* and *GOVEXP* was exhibited across the regressions, with significant results at $\alpha = 0.01$. These results clearly should be estimated, as the relationship between population and government expenditures should be obvious.

6.6.3 Two Stage Model for the Balanced Budget

Table 11: Empirical results for estimation of the balanced budget, using two stage least squares regression

INCREV	(1)	(2)	(3)	(4)
ENTRY	-0.5703683	-0.3482626	-0.2032528	-0.3482626
	(0.2256172)**	(0.0601519)***	(0.1768059)	(0.065393)***
CORPTAX	-0.001182	-0.2621993	-0.9834699	-0.2621993
	(0.4314927)	(0.4217895)	(0.6920846)	(0.553414)
$CORPTAX^2$	-0.0199729	-0.001918	0.0611583	-0.001918
	(0.0284944)	(0.028073)	(0.0496625)	(0.0397825)
INCTAX	4.526093	4.202966	2.715614	4.202966
	(0.4286584)***	(0.4199185)***	(1.392334)*	(0.9045972)***
$INCTAX^2$	-0.2185587	-0.2016276	-0.1448556	-0.2016276
	(0.0302037)***	(0.028673)***	(0.0833518)*	(0.0597916)***
UNEMP	-0.5784837	-0.5309198	-0.2144679	-0.5309198
	(0.0756482)***	(0.0475905)***	(0.1153988)*	(0.057577)***
EDU	0.2407217	0.298219	0.1273745	0.298219
	(0.0558796)***	(0.0275353)***	(0.0620427)*	(0.032432)***
constant	15.69013	15.86913	0.1710808	§
	(3.230311)***	(1.965948)***	(0.0651253)***	
n	1151	1151	1004	1151
R^2	0.5935	0.6016	-0.0062	0.4051
Robust	No	No	Yes	Yes
Fixed effects	No	Yes	No	Yes

* $p \leq 0.1$, ** $p \leq 0.05$, *** $p \leq 0.01$

§ Constant is not calculated for regression (4)

The two stage model for the balanced budget, like the aforementioned two stage models, measures its response variable, the percentage of total tax revenue that is made up of personal income tax revenue, while considering firm entry as a function of factors that may encourage business owners to incorporate in a particular state.

The expected negative relationship between *ENTRY* and *INCREV* is exhibited across the regressions. These results are significant at $\alpha = 0.01$ in regressions (2) and (4) and $\alpha = 0.05$ in regression (1). These results indicate that with more firms entering a state, the percentage of state tax revenue that comes from personal income taxes shrinks. This could mean that state governments start to rely more on corporate tax revenue, rather than income tax revenue, when new firms are entering.

The regressions estimate relationships between *CORPTAX* and *INCREV* and $CORPTAX^2$ and *INCREV* that are inconsistent, but also relationships that are not statistically significant. These results may indicate that the composition of state government tax revenue may not be significantly impacted by corporate tax rates. On the other hand, a clear significant relationship is exhibited between *INCTAX* and *INCREV* and $INCTAX^2$ and *INCREV*, with statistically significant results shown in across the regressions, meeting the expectations laid out in Section 4.3. These results are significant at $\alpha = 0.01$ in all regressions except for regression (3), where the results are significant at $\alpha = 0.1$.

The expected negative relationship between *UNEMP* and *INCREV* is exhibited in all four regressions, with significant effects at $\alpha = 0.01$, except in regression (3), where the result was significant at $\alpha = 0.1$. These results are certainly reasonable, as lower unemployment should yield more personal income and, therefore, more personal income tax revenue for state governments.

The expected positive relationship between *EDU* and *INCREV* is also exhibited in each of the regressions, with significant effects at $\alpha = 0.01$, except regression (3), which predicts significance at $\alpha = 0.1$, indicating that a more educated workforce brings in more income to a state, meaning state governments should receive more personal income tax revenue.

7 Discussion

As discussed in Section 2.4, the purpose of this paper is to determine how state governments react to ineffective tax competition, in addition to determining factors which may make states more attractive to businesses looking to either start in or move to another state. This section will discuss the findings and limitations of the empirical models, described in the previous section, and their implications for state governments, businesses, and lawmakers. There will also be a discussion of potential future research on interstate tax competition and its impact on state government budgets.

7.1 Modeling the Laffer Curve

The first theoretical model presented in this paper, in Section 3.1, was the Laffer curve, a quadratic function that shows the relationship between tax rates and tax revenue. When attempting to model the Laffer curve, there should be a positive sign for the linear term of the tax rate, t, and a negative sign for the quadratic term of the tax rate, t^2.

For this paper, the Laffer curve was to be modeled for the relationship between corporate tax rates and corporate tax revenue. Results from the modeling were described in Sections 6.2 and 6.6.1. In most of the eight regressions performed, the results were not statistically significant. However, in regression (2) of the non-two-stage model, in Section 6.2, which incorporated fixed effects, but did not correct for heteroskedasticity and autocorrelation, the correct signs were exhibited, significant at $\alpha = 0.05$. In regression (3) of the two-stage model, in Section 6.6.1, the opposite signs from those expected were estimated, however the sign for *CORPTAX* was significant at only $\alpha = 0.1$. It is also worth mentioning that this regression, while robust to heteroskedasticity, does not account for differences in individual states, which may be affecting the results.

7.2 Government Response to Tax Competition

In Section 2.4, the question was posed, "which part of the budget balance is affected more by tax competition, do state governments try to gain back the lost revenue from other sources or do they opt to cut back on government spending?"

In order to test the other sources hypothesis, the composition of government tax revenue was analyzed, particularly the percentage of total tax revenue that was made up of personal income tax revenue, described as *INCREV* in the models. The results from Sections 6.4 and 6.6.3 indicate that there exists a relationship between *INCTAX*, the personal income tax rate, and *INCREV*, that is consistent with the Laffer curve. The relationship between *CORPTAX*, the corporate tax rate, and *INCREV*, however, is not significant in regressions that incorporate fixed effects, which account for differences in individual states or in regressions that use two-stage least squares, accounting for *ENTRY* being a function of multiple variables. These results indicate that state governments likely are not manipulating their revenue sources in response to corporate tax competition.

To test the spending hypothesis, the states' government expenditures were analyzed, described as *GOVEXP* in the models. The results from Sections 6.3 and 6.6.2 indicate a relationship between *CORPTAX* and *GOVEXP* that models the Laffer curve and consistently has significant results, at $\alpha = 0.01$, in fixed effects

regressions, except regression (4) in the two-stage least squares models, where the results are significant at $\alpha = 0.05$. This is indicative of states' behavior in response to corporate tax competition, showing that states' government expenditures are determined by the Laffer curve, with respect to corporate tax rates. Specifically, the results show that state governments respond to corporate tax competition, which leads to changes in the corporate tax rates, by affecting their spending habits, instead of changing their tax revenue source composition. This conclusion is consistent with the expectations presented in Section 4.5.

7.3 The Making of a Business Friendly State

Tax competition may not be the only issue at play when a firm decides where to locate, as evidenced by the *ENTRY* model, which found no significant relationship between $CORPTAXCOMP_2$, corporate tax competition, lagged by two years, and *ENTRY*. Corporate taxation, lagged by two years, does have an effect that is negative and statistically significant in regressions that did not incorporate fixed effects. However, regressions that do not incorporate fixed effects fail to consider potential differences between states.

The cost of labor also seems to be a significant predictor of firm entry. There is a significant, negative relationship between $MINWAGE_2$, minimum wage, lagged by two years, and *ENTRY*, in regressions that did not incorporate fixed effects, meaning that labor costs are also a consideration of firm owners.

The only other factor that the *ENTRY* model deemed statistically significant was *HWYEXP*, highway expenditures, lagged by two years. The intention of this variable was to determine whether the infrastructure of a state can impact its attractiveness. In the two fixed effects regressions, accounting for differences in states and regions, highway expenditures proved to be a significant predictor of firm entry, at $\alpha = 0.01$. This result implies that states which pour money into their infrastructure should see more business.

Clearly, the issue at hand, competitive behavior between states, has been seen throughout the country, particularly when very large firms with a widespread presence look for headquarters. In January 2016, when General Electric, one of the most recognized companies in the world, reported that it would be moving its headquarters from Fairfield, Connecticut to Boston, Massachusetts, Republican politicians in Connecticut blamed the tax structure of their home state. J.R. Romano, chairman of the Connecticut Republicans told the *Hartford Courant*,

> "Massachusetts and other states aren't just drawing away Connecticut businesses because their taxes are lower, they are eating our lunch because fiscal instability and anti-business sentiment from the Democrat majority make Connecticut unappealing and unwelcoming." (as cited in Singer 2016)

However, when studying this move from an outside perspective, taxes may not have played a significant role in the GE move. The *Wall Street Journal* reported that the company was looking for a location that would bring the company closer to a workforce that was more technologically-oriented, typically found in urban areas, rather than suburban Connecticut. Further, the City of Boston and the Commonwealth of Massachusetts offered GE approximately $145 million in incentives and promised infrastructure spending, which may have made for a very convincing deal for the company (Mann and Kamp 2016).

7.4 Future Research

Given the relevance of this research, related to state corporate taxation and state budget balances, the opportunities for future research are plentiful. In particular, this paper should open future research opportunities related to how states can repair the damages caused by engaging in corporate tax competition.

The research in this paper may also introduce opportunities for future research in understanding the factors that make states attractive to businesses. This is of particular importance, because it appears that state government officials are under the impression that offering tax incentives and cutting their tax rates are the most effective ways to expand their tax base and bring in new firms.

A possible topic for future research may be how tax competition affects which services state governments ultimately decide to cut. If states cut spending on infrastructure, for example, then they may be negatively impacting their tax base, specifically their firm population, since according to this paper, highway spending is a significant, positive predictor of firm entry.

7.5 Final Thoughts

The research in this paper has determined that, based on trends from 1980 to 2012, across the contiguous United States, state governments respond to ineffective tax competition by cutting their spending levels, instead of changing the composition of state government revenue sources, specifically personal income tax revenue. This may be for a variety of reasons, one being that when lawmakers are presented with the option of either cutting spending or raising taxes, they may see the cuts as the less unpopular move.

This project also intended to determine which factors can make a state attractive for businesses. The results showed that, from 1980 to 2012, across the contiguous United States, corporate tax rates, minimum wages, and infrastructure investment all play a significant role in firm location decisions. However, using Salop's Circle Model as the method for determining competition between states described in Section 3.3, assuming states are competing on corporate tax rates, minimum wages, and sales taxes, proved not to be a significant determinant of firm entry. The *ENTRY* regressions were not particularly strong, though, with R^2 less than 0.3, when calculated.

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