Revenue Strategies of US States under Conditions of Economic and Political Stress: Revenues Diversification 1980 to 2011

by

Seeun Ryu

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved July 2013 by the
Graduate Supervisory Committee:

Gerald Miller, Chair
Daniel Smith
Spencer Brien
George Pettit

ARIZONA STATE UNIVERSITY

August 2013

ABSTRACT

This dissertation assesses the impact of revenue diversification on state revenue growth and volatility and then, the economic, political and institutional factors that predict diversification. Previous studies, taking advice from modern portfolio theory, argue that diversifying a revenue portfolio can stabilize volatility and even lead to faster rates of growth over time. However, levels of diversification are not assigned exogenously. Rather, differences among states in diversification might be a consequence of differences in states such as electoral cycles and the presence and strictness of tax limitations. Thus, the research question is: Whether or to what extent has diversification increased revenue growth and decreased volatility when the endogeneity of diversification is considered?

Using two-stage least squares and fixed-effects regression models with the data of the 50 states from 1980 to 2011, I examined the impact of diversification, reflecting a state's own political and institutional characteristics (i.e., endogeneity), on growth and volatility.

I found diversification was positively related to growth, but a diversified portfolio does not smooth volatility. Furthermore, I found that the level of revenue diversification increased in each year of legislators' terms and decreased in every year of governors' terms. These findings imply that legislators and governors have different preferences for diversification, perhaps due to different opportunities to enhance their reelection prospects.

I then investigated the relationship between political leaders' year of the terms and changes in specific revenue sources, the biggest set of reelection opportunities. Selective

sales and income taxes were negatively related to every year of legislators' terms. General sales taxes, corporate income taxes, and charges are positively related to every year of governors' terms. The results suggest that legislators focus on their districts or specific interest groups, closely associated with selective sales taxes. In contrast, governors' constituency-driven preferences lead them to be responsible for broader issues such as balancing the state budget, thereby using general sales taxes and charges as methods to do so. As a consequence of these political factors, levels of diversification will change, thereby influencing revenue growth and volatility.

DEDICATION

To my best teachers: Dr. Miller and Dr. Yoon

ACKNOWLEDGMENTS

I would first like to thank Jesus who offered support throughout my whole life.

I am grateful to my father and mother, my brother, Sejun and sisters, Serin and Sebin. I am also grateful to various teachers I have had along the way, my professors at the Arizona State University and at the Korea University I met, Dr. Svara, Dr. Lan, Dr. McCabe, Dr. Catlaw, and Dr. Yusim Kim, Dr. Jongbum Lee, Dr. Hungsuk Choi, Dr. Jun Koo, Dr. Sunhyuk Kim, and especially to Dr. Smith, Dr. Brien, and Prof. Pettit who later became my advisors and gave me help and valuable feedback.

I am particularly grateful for the unceasing help and patience of my advisor, Dr. Miller, who has been mentor, advisor, colleague, parent, bully and friend. I would also like to thank Dr. Sungsig Yoon for encouragement, support, and advice. Without them, I could not make anything.

I have been befriended by and spoken to many friends at ASU about my work and even my life. I'd especially like to thank my cohort, George Flores, Jennifer Auer, DJ Jung, Mohsin Bashir, Jeff Callen, Laura Hand, Brandon Ching, Jake Heller, Jenny Holsman, Andrea Mayo, and Marga Warnicke for listening and helping me.

I'd also like to thank my church members, Pastor Jo, Samonim Jo, Pastor Yoo, Samonim Yoo, Yunsil Kim, Mihye Shin, Jihye Shin, James Chang, Sue Chang, Dayun Nam, Peter Yu, Jaehun Yu, Grace Chang, Grace's husband, Hyunjoo Yoo, Hyesun Jo, Donovan Muller, Hyerin Cheon, Rachel Cheon, and Jean Yoo for always praying for me and giving advice on what the next step of the process was throughout my time at ASU. I'd also like to thank Sangeun Lee, Jusil Lee, Jieun Lee, Youngjae Kim, Jungeun Kim,

Hyunjung Ji, Sunmin Lee, Yewon Yoon, Chulhyun Park, Jeongju An, Woosung Jung, Jiseul Kim, Chika Kubo, Rashmi, and Kandyce Fernandez for hanging in there with me.

Finally, I am grateful to the program of Unlimited Challenges produced by Taeho Kim, Jaesuk Yoo, Hyungdon Jung, Haha, Hongchil Noh, Gill, Junha Jung, and Myungsu Park. The program has made me smile and overcome hardships I have experienced.

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INTRODUCTION

State government leaders want to structure revenues to grow in a predictable and stable manner over years, especially in the upcoming fiscal year. However, the leaders have not been able to realize this goal because the levels of revenues are sensitive to economic changes. Revenue structure diversification has been viewed as a means to smooth volatility and even lead to faster rates of revenue growth over business cycles. According to previous studies, a state's fiscal volatility will decrease and its growth rate will increase if the state relies on a diversified revenue structure (Carroll, 2005; Schunk & Porca, 2005). In diversified and balanced portfolios composed of elastic and less elastic revenue sources, less elastic revenue sources will compensate for the decrease of elastic revenue sources caused by recessions.

My dissertation casts doubt on officials' unlimited choices in diversifying revenues. Levels of revenue diversification are not assigned randomly or exogenously; rather, states choose their own levels of revenue diversification within the limits they face. My study assumes that differences among states in revenue diversification might be a consequence of differences in states, such as electoral cycles and the presence and strictness of tax and revenue limitations. This dissertation reexamines the impact of revenue diversification on state revenue growth and volatility.

My dissertation is divided into seven chapters, including this introduction. The second chapter explores the practical and theoretical questions related to the function of revenue diversification on revenue growth and volatility.

The third chapter begins with a review of the literature related to the four general principles of sound revenue policy—namely, ease of administration/compliance, economic efficiency, fairness, and adequacy—in order to examine the meaning of revenue diversification from a broad perspective. I then look deeply into revenue adequacy in terms of revenue growth and volatility. After reviewing the definition and measures of revenue diversification, I explore how revenue diversification plays a role in increasing revenue growth while decreasing volatility. Finally, the section explores the potential endogeneity of revenue diversification based on past research.

The fourth chapter discusses what we know and do not know about relationships among revenue diversification, revenue growth and volatility, and other explanatory variables, based on previous literature, and provides several hypotheses related to the areas that are lacking in terms of revenue diversification in the public budgeting and finance area.

The fifth chapter covers the methodology, discussing the research design, data sources, variables, and empirical models. My dissertation uses a panel data set of 50 U.S. state data from 1980 to 2011, gathered mainly from the Census Bureau, Bureau of Economic Analysis, and Council of State Governments. This chapter also discusses the measures of dependent and independent variables and specifies empirical models. The dependent variables considered are revenue growth and volatility; the main independent variable is revenue diversification.

The sixth chapter reports the statistical findings while the seventh chapter summarizes the findings and discusses implications of the findings, limitations, contributions, and future research directions.

Chapter 2

STATEMENT OF PROBLEMS

This chapter elaborates upon the theoretical and practical research questions and problems. My dissertation begins with the question of whether a diversified revenue portfolio increases state revenue growth and smoothes volatility. This question is important to both researchers and practitioners as it will broaden the theoretical discussion on the function of revenue diversification and help practitioners make informed decisions about adjusting revenue portfolio in response to economic changes.

In contrast to existing literature, the second big question in my study is whether the effect of revenue diversification on revenue growth and volatility depends on the differences in three state conditions: electoral cycles, the strictness of tax and revenue limits, and economic conditions. Specific research problems are related to this second significant question are.

First, levels of revenue structure diversification would be affected by a state's electoral cycles. If state political leaders decrease the rates of particular visible revenue sources and narrow bases of the revenue sources before and during an election year in order to enhance their reelection prospects, the levels of revenue diversification will change, thereby affecting revenue growth and volatility.

Second, the strictness of tax and revenue limits would affect revenue structure diversification. States that require stricter legislative items, such as super-majorities or popular referenda, to enact tax increases are more likely to prompt legislatures to consider alternative revenue sources, such as charges and fees for services. The levels of revenue diversification will change, thereby influencing revenue growth and volatility.

Third, economic changes prompt governors and legislators to manage their revenue portfolios in order to compensate for revenue shortfalls during recessions and moderate the accumulations of surplus during expansions. States would adjust their revenue rates and bases to lessen the impact of economic changes and, in turn, levels of revenue diversification will change, thereby influencing revenue growth and volatility.

In sum, the level of revenue diversification reflecting the three identified conditions could lead to changes in states' revenue growth and volatility levels. By assuming the potential endogeneity of revenue diversification, my dissertation investigates how and to what extent a state's revenue diversification, estimated by these three conditions, affects revenue growth and volatility over time. It then examines specifically how and to what extent political leaders' electoral cycles, the presence and strictness of tax and revenue limits, and economic changes affect levels of revenue diversification. The 50-state panel data for the period from 1980 to 2011 are used in my study.

Chapter 3

LITERATURE REVIEW

To review the existing literature, this chapter begins with four general principles of sound revenue policies—namely, ease of administration/compliance, economic efficiency, fairness and adequacy. It then goes into detail regarding revenue adequacy in terms of revenue growth and volatility. This chapter also explores the effect of revenue diversification on revenue growth and volatility along with the definition and measures of revenue diversification. Finally, it investigates the economic, institutional, and political determinants of revenue diversification.

Principles of Sound Revenue Policies

Most of the revenue that state governments collect is derived from such sources as taxes in addition to charges and fees for services. Such revenues are based on personal income as well as the sales of services, and property. The collected revenues fund public services or programs. Revenue policy determines "how the collective cost of government services will be distributed among [individuals]" (Mikesell, 2007, p. 291).

Given the vague nature of the term *sound*, a "sound" revenue policy is not easy to define. To some people, a sound revenue policy depends on who bears the revenue burdens. Others evaluate the policy in terms of the revenue policy's impact on economic growth. Many researchers and observers have tried to set standards for sound revenue systems by taking multiple principles into account. Adam Smith was the first to provide guidelines for revenue collection in a market-based economy. He proposed the following four basic maxims in his prominent book, *The Wealth of Nations* (1776):

> I. The subjects of every state ought to contribute towards the support of the government, as nearly as possible, in proportion to their respective abilities; that is, in proportion to the revenue which they respectively enjoy under the protection of state.
>
> II. The tax which each individual is bound to pay ought to be certain and not arbitrary. The time of payment, the manner of payment, the quantity to be paid, ought all to be clear and plain to the contributor, and to every other person.
>
> III. Every tax ought to be levied at the time or in the manner, in which it is most likely to be convenient for the contributor to pay it.
>
> IV. Every tax ought to be so contrived as both to take out and to keep out of the pockets of the people as little as possible, over and above what it brings into the public treasury of the state. (Smith, 1776, pp. 777-779)

The principles implied in these maxims remain important issues today.

Researchers and practitioners have repeated these principles for many years, although their terminology has changed over time (Blough, 1955; Break & Pechman, 1975; Brunori, 1997, 1998, 2011; Institute on Taxation and Economic Policy [ITEP], 2011; Mikesell, 2007; Reese, 1980; Shoup, 1937).

As such, several commonly cited principles of sound revenue policy have emerged. Some scholars have identified four broad principles: adequacy, fairness, collectability/simplicity, and economic efficiency (Mikesell, 2007). Brunori's (1997, 1998) early studies also suggested four principles: adequacy, fairness, ease of administration/compliance, and accountability; his most recent study (2011) added

neutrality to the list. Other scholars have delineated five principles: fairness, adequacy, simplicity, exportability, and neutrality (ITEP, 2011).

My dissertation uses four broad principles: ease of administration/compliance, economic efficiency, fairness, and adequacy. I chose several common criteria from previous studies, including fairness and adequacy; meanwhile, criteria such as accountability and exportability are not discussed here. In addition, I selected an easier criterion to understand (i.e., ease of administration/compliance) and a flexible criterion considering reality (i.e., economic efficiency) from criteria with similar meaning.

The principles of ease of administration/compliance and simplicity pursue the similar purpose of minimizing compliance costs for revenue payers and collection costs for governments. However, since the phrase, ease of administration/compliance, is immediately easier to understand than simplicity, my dissertation uses ease of administration/compliance as a criterion.

Meanwhile, the criterion of economic efficiency (Mikesell, 2007) is a more flexible criterion than neutrality (Brunri, 2011; ITEP, 2011). According to the objective of economic efficiency, revenue payers should bear the revenue burden to the extent that necessary revenues are raised while economic distortion (the excess burden) must be maintained as low as possible (Mikesell, 2007). Based on the neutrality objective, business decisions should be dictated not by the tax code, but by market conditions and the cost/benefit rule (Brunori, 2011). In reality, it is not possible to ensure economic decisions without any economic distortion. Thus, economic efficiency is a more reasonable criterion considering reality.

The following subsections provide a more detailed explanation of these four principles.

Ease of administration and compliance. Revenues must be collected easily. Collection and compliance costs do not provide any net benefit to society (Mikesell, 2007). An easy and simple revenue system should avoid "complex provisions and regulations; multiple filing and reporting requirements; and numerous deductions, exclusions, and exemptions" (Brunori, 1997, p. 53). Complicated revenue systems confuse citizens, and governments face difficulties in monitoring and enforcing revenue collections. Moreover, some groups can take advantage of a revenue system full of loopholes. For example, lawmakers use inherent complexity in revenue policy to enact or conceal targeted breaks that benefit particular groups (ITEP, 2011). Therefore, a revenue system must be designed to keep total collection and compliance costs as low as possible.

Economic efficiency. The revenue principle of economic efficiency indicates that undesirable excess burdens should be minimized. It is highly possible that tax codes affect individual or business decisions related to their investments or purchases more than their preferences do. In other words, revenue collection by its very nature creates a burden on payers.

However, according to the principle of economic efficiency, governments should minimize excess revenue burdens on revenue payers. Excess burdens or deadweight losses refer to the amount of social benefit sacrificed due to the presence of revenue collection. For example, if revenues are levied on income from labor, the increase in the revenues leads some people to work fewer hours and increase their leisure hours (i.e., substitution effect), whereas other people work more to cover the amount of revenues

(i.e., income effect). The sum of the substitution effect and income effect represents the revenue payer's behavior in responding to increases in revenues while their reduced utility becomes the deadweight loss.

Excess burden or undesirable distortions result in “a waste of productive resources, lower rates of economic growth, and lower national living standards” (Mikesell, 2007, p. 317). Therefore, the revenue policy seeks to generate the necessary revenue (i.e., the revenue burden), while keeping economic distortion (i.e., the excess burden) as low as possible (Mikesell, 2007).

Fairness. The revenue burden should be distributed fairly. When people discuss revenue “equity,” they are talking about fairness. Yet, the true meaning of fairness is elusive, as individuals perceive fairness differently. What is an unfair revenue system to one person might seem quite fair to others (Brunori, 1998; Gruber, 2005; Young, 1994). Evaluating a revenue system’s fairness requires examining both particular concepts of equity and a means to measure the system’s distribution (Gruber, 2005; Musgrave, 1959). The most commonly cited approaches to fundamental revenue fairness are: (a) the benefit principle, (b) the ability-to-pay principle, and (c) the revenue incidence analysis.

The first approach, the benefit principle, means that the cost of the benefit received from the government should be distributed to revenue payers according to the extent of benefit received. Fairness in the context of the benefit principle relates the revenue payers’ exchange of public services with governments (Gerbing, 1988). Measuring the principle requires knowing how much the benefits are and who receives those benefits from the government. However, these populations are very difficult to identify. Moreover, it is doubtful that the benefit principle can properly or actually

mitigate inequality. Richard A. Musgrave and Peggy B. Musgrave (1980) commented that "the benefit approach, ideally, will allocate that part of the tax bill which defrays the cost of public services, but it cannot handle taxes needed to finance transfer payments and serve redistributional objectives" (p. 238).

The second approach to fairness in revenue collection, the ability-to-pay principle, means that the cost of government should be distributed according to a taxpayer's ability to pay. Those with a greater ability must pay more than those with a lesser ability do. The ability-to-pay principle is connected to the concepts of horizontal and vertical equity. Revenue payers with an equal or similar ability should pay the same amount of revenues, while those with a different ability should pay a different amount of revenues.

More specifically, the principle of horizontal equity lies in treating equals equally. In other words, individuals with similar resources, including income, wealth, or profits, should be treated in the same way by the revenue system regardless of the different economic or lifestyle choices they make. If one person pays much higher revenues than another person with similar circumstances, it violates the concept of horizontal equity. Yet it is difficult to define "similar or identical circumstances" in order to measure horizontal equity or inequity in the real world (Gruber, 2005). From a practical standpoint, determining whether revenue payers have similar circumstances depends on the conditions of income, family structures, and age (ITEP, 2011). Nevertheless, because it is ambiguous to examine horizontal equity except in extreme cases, the issue is continuously raised in debates and is "often distorted to fit the views of the proponents or opponents of a particular [revenue] proposal" (Gruber, 2005, p. 496).

The principle of vertical equity refers to the idea that people with more resources, including higher income, greater wealth, or higher profits, should pay higher revenues. However, no scientific guideline exists to determine how much revenue people with different resources should pay (Mikesell, 2007). Rather, vertical equity is evaluated by "how a [revenue] affects different families from the bottom of the income spectrum to the top from poor to rich" (ITEP, 2011, p. 1). Three standard measures are used to measure vertical equity: regressive, proportional, and progressive revenue structures.

A revenue structure is regressive if low- and middle-income families pay a higher share of their income in revenues than do upper-income families. A revenue structure is proportional if all families pay the same share of income. A revenue system is progressive if upper-income families pay a higher share of their incomes than low- and middle-income families.

Vertical equity generally defends the progressive revenue system; those with higher income must pay a higher rate of revenue because of their own greater ability to pay (Gerbing, 1988). Given the definition that effective average revenue rates are the ratio of personal revenue payments to total income, "effective average rates must rise [faster] with income, so that the rich pay a higher share of their income in [revenues] than do the poor" (Gruber, 2005, p. 496).

However, because most states have revenue portfolios with regressive, proportional, and progressive revenues, it is difficult to distinguish the regressivity/progressivity/proportionality of their structure in a simple way. When viewed from a portfolio perspective, the progressivity in one revenue can offset the regressivity

in another revenue to some degree. Therefore, the overall level of progressivity or regressivity of a revenue system might be evaluated by:

> (1) The degree of progressivity or regressivity of each revenue within the system and,
>
> (2) How heavily a state relies on each revenue within the system. Thus, a state that relies on regressive sales, excise and property taxes more heavily than a progressive income tax will end up with a very regressive revenue system overall. (ITEP, 2011, p. 1)

Adequacy. Adequacy is defined as how well a government can collect enough revenues to sustain the level of public services its citizens and policy makers demand (Blom & Guajardo, 2001; ITEP, 2011). It is important to collect sufficient revenues to fund public services in the upcoming fiscal year as well as over the long term. Thus, it is desirable for revenues to change at the same or a very similar rate as the state expenditures. Several researchers concur that adequacy is the primary goal of revenue policies (Ladd, 1988; Reschovsky, 1998), because it serves as a criterion for distinguishing a successful revenue system from an unsuccessful system (ITEP, 2011).

However, the concept of adequacy sounds complex in that the accounting discussion is different from the economic discussion (Laffer, 2004). Although revenue increases at a higher revenue rate from the accounting concept, economic discussion recognizes the negative impact of a higher revenue rate on work, output, and employment. Indeed, when facing higher revenue rates, revenue payers are likely to change their behavior to avoid higher payments. The increasing revenue rate can become an excess burden on revenue payers beyond the revenue burden. Revenues will increase to a given

level of revenue rate, but they might actually shrink beyond the particular revenue rate as revenue payers change their behavior (Laffer, 2004).

In addition to changes in the revenue rate, the elasticity of a particular revenue source to economic fluctuation is a main factor of adequacy (ITEP, 2011; Mikesell, 2007). Elasticity refers to the change in the yield of a particular revenue source given economic growth. In general, some revenue sources (e.g., taxes on corporate profits) are more sensitive to change in economic activity and conditions than others, including property taxes. John Mikesell (2007) noted, "A revenue source with good cyclical adequacy remains reasonably stable during periods of declining economic activity" (p. 312). Thus, when a government's revenue system cannot adapt to changing economic conditions, large deficits or surpluses emerge (Blom & Guajardo, 2001). The National Conference State Legislature (NCSL) (1999) recommended that a government use a diversified revenue portfolio.[1] Revenue resources relatively inelastic to changing economic conditions can offset the lost portion by relying on sources that are quite elastic to economic fluctuations.

Summary and implication of sound revenue policy. The four criteria of a sound revenue policy have been discussed in the first section of this chapter. Ease of administration/compliance focuses on providing a simple and easy revenue system to improve revenue payers' and revenue collectors' understanding. Economic efficiency requires governments to minimize the excess revenue burden on revenue payers. Fairness involves governments imposing more revenue on those with a greater ability to pay

[1] Retrieved from NCSL: http://www.ncsl.org/magazine/sl-mag-the-history-of-us.aspx

whereas adequacy requires governments to collect sufficient revenues to maintain public services.

However, these criteria—namely, ease of administration/compliance, economic efficiency, fairness, and adequacy—might not be simultaneously achieved in reality because of the conflict among them. For example, economists have highlighted the economic efficiency criterion while paying less attention to other criteria, such as fairness. Others see growth competing with distribution. The priority among criteria might depend on the situations in which governments are placed.

Particularly in fiscal crises, most governments tend to pay more attention to revenue adequacy (Lowery, 1984; Reschovsky, 1998). The protracted downturn decreases a revenue growth rate while uncertainty in the economic condition increases volatility in the revenue collection. An adequate revenue system makes it possible to collect sufficient tax revenues to provide public services to the public.

The next section examines the ways in which to attain an adequate revenue system in terms of revenue growth and volatility in detail.

Revenue Adequacy: Growth and volatility

Revenue adequacy is widely accepted as an important revenue policy principle (Brunori, 1997, 1998; ITEP, 2011; Zodrow, 1998). One version of the principles defines adequacy as "whether the [revenue] system raises enough money, in the short run and the long run, to finance public services" (ITEP, 2011, p. 5). A government should raise sufficient funds to maintain the level of public services demanded by citizens (ITEP, 2011). In the short term, state governments must ensure that they have enough money to sustain public services in the upcoming fiscal year. In addition, governments should

balance their budgets not only in the immediate future, but also over the next five to ten years (ITEP, 2011) to fund public programs.

Adequacy should have some requirements. For example, most previous studies point out that the revenue system should ensure stability and growth (Bruce et al., 2006; Dye & McGuire, 1991; Groves & Kahn, 1952; Mallick & Harmon, 1994; Sobel & Holcombe, 1996; White, 1983). Stability requires revenues to be relatively constant over time. Stable revenues are not likely to fluctuate unpredictably with changes in the economy. Many studies use instability, variability, and volatility instead of stability. In general, the term *volatility*, or *stability*, refers to the potential variability in state revenues from the expected level of revenues at various points over the years (White, 1983). In addition, growth means generating enough revenue yields to maintain public spending over the years.

Many researchers begin by arguing that revenue growth should match spending growth. However, in their research, discussions, and conclusions, the balance between revenues and public spending is not the main point; rather, they seem to focus on growth responding to economic growth. Some studies have pointed out that, at best, a particular revenue can account for a considerable part of total revenues, thereby satisfying the sufficiency criterion. For example, Zodrow's (1998) definition of growth is limited to economic growth, as follows:

> [R]evenues should grow at approximately the same rate as the state economy, so that periodic rate increases are unnecessary. Note, however, that such growth implies that revenues would increase at a rate equal to the sum of the inflation rate and the real rate of growth in the economy (p. 15).

Any examination and assessment of revenue growth needs to consider the growth side of both public spending and economic growth. However, many studies have not analyzed the balance aspect between revenue growth and spending growth. They neglect might be due to the fact that the amount of state spending has remained relatively stable over time.

However, state governments have been asked to manage and pay for various public services, including welfare, and Medicaid. Thus, recent health care cost inflation affects state spending growth (Fox, 2004). In addition, education spending such as K—12 spending must grow faster than economic inflation in order to maintain or improve the current quality of education (Fox, 2004). Therefore, revenue growth should be discussed in future research in order to take into account new decisions on public spending along with the increased or decreased costs of existing public services due to economic inflation (Fox, 2004). My dissertation does not deal with the expenditure side, because it focuses on the revenue side and the issue of sufficiency is beyond my research.

Previous studies of adequacy have assumed that the cost of public programs grows at the same rate as economic change without considering explicit changes in decisions related to public programs. More discussion on this is warranted in another research. The current dissertation follows this same assumption and defines growth as the long-term trend of a state's revenues over years (White, 1983).[2]

[2] Relevant studies have not precisely defined the period of “long-term.” Rather, a "long-term" period seems to equal a research period. For example, Bruan and Otsuka (1998) used 11 years of the research period from 1981 to 1991, and Carroll (2005) used 11 years from 1990 to 2000. In addition, White (1983) used data from the period from 1970 to 1981. Previous studies have not specifically defined the terminology of “long-term,”; rather, they have applied different periods of “long-term” to their studies.

Returning to the issue of revenue adequacy, the next section examines the measures of revenue growth and volatility as well as the relationship between them based on previous studies.

Measures of growth and volatility. Several studies, including Mallick and Harmon (1994) and White (1983), examined growth and volatility in terms of a revenue portfolio rather than individual revenue sources. The portfolio approach makes it easy to assess overall growth and volatility. Thus, growth is represented by the long-run or trending rate of growth in a state's revenue structure, which includes several taxes as well as charges and fees over time. Meanwhile, volatility is measured by variability from the growth trend line in the short term (Mallick & Harmon, 1994; Misiolek & Perdue, 1987; White, 1983; Yan, 2008).

Other studies have used long-term and short-term income elasticity to represent revenue growth and volatility, respectively (Bruce et al., 2006; Fox & Campbell, 1984; Holcombe & Sobel, 1997). The two measures—trend rate of growth and income elasticity—generate different information and answer different questions (Dye & McGuire, 1991). Income elasticity measures the relationship between revenues and economic activity whereas the trend rate of growth simply measures revenue growth over time (Dye & McGuire, 1991). The trend rate measure has an advantage in exploring revenue growth and volatility over years from both economic and non-economic (i.e., political) perspectives.

Relationship between growth and volatility. Previous studies have identified a positive relationship between growth and volatility (Braun & Otsuka, 1998; White,

1983). As the overall growth rate of a revenue portfolio increases, revenue volatility also increases (Braun & Otsuka, 1998; White, 1983).

However, the relationship between growth and volatility is not always positive. For example, in their research, Mallick and Harmon (1994) demonstrated that growth does not have a clear positive relationship with volatility through tax portfolio analysis used in New York State in FY 1987—1988 (see Table 1). As the results in Table 1 indicate, although revenue structures B and C have the same growth rate, 7.7, revenue structures B and C have different degrees of volatility, 5.83 and 14.57, respectively. Thus, we do not know whether there is a positive or no relationship between revenue structure growth and volatility.

Table 1

Various Frontier Portfolios for New York State in FY 1987-1988—The Revenue Portfolio Growth-Volatility Frontier (mix of tax shares providing greatest stability for any particular revenue growth rate)

Revenue Sources	Portfolios on the Efficient Frontier					
	A	B	C	D	E	F
Personal Income Tax	33	40	50	45	47	44
Sales Tax	37	34	23	32	23	5
Transport Tax	15	8	3	3	0	0
Sin Tax	0	0	3	0	0	0
Energy Tax	12	15	5	17	22	34
Corporate Tax	0	0	10	0	0	0
Transfer Tax	3	3	6	4	8	18
Total	100	100	100	100	100	100
Portfolio Growth Rate	7.0	7.7	7.7	8.0	8.5	9.0
Portfolio Volatility	0.90	5.83	14.57	10.90	19.35	42.09

Note: The following taxes are included in each group: Except personal income and sales taxes, others are described. (1) transport—highway use, motor fuel, and motor vehicles; (b) sin—alcohol-beverage, alcohol-beverage license, cigarette, and pari-mutuel; (c) energy—public utility and petroleum business; (d) corporate—bank, corporate franchise, and insurance; and (e) transfer—estate and gift, real estate gains, and real estate transfer (p. 436). Adapted from "Portfolio Analysis and Vertical Equity: a New York Application," by R. Mallick and O. R. Harmon, 1994, *Public Finance Review*, *22*, p. 430.

Relationship among growth, volatility, and economic changes. Economic changes affect revenue structure growth and volatility. States usually face revenue changes over every business cycle. Almost every state experiences a drop in revenues during a recession and an increase after the recession (Sobel & Wagner, 2003). A state revenue portfolio, which is composed of elastic and less elastic sources, is affected by economic changes; accordingly, collected revenues fluctuate over business cycles (Braun & Otsuka, 1998; Holcombe & Sobel, 1997; Sobel & Wagner, 2003; Wilford, 1965). Furthermore, when a fiscal crisis emerges, the level of total revenues drops and the growth rate of total revenues also decrease as long as the crisis continues.

Summary and implications of revenue adequacy. Revenue adequacy refers to having sufficient revenues to maintain public services and programs as demanded by the public. Revenue should grow by at least the same rate as public expenditures in the long run. Revenue adequacy has been academically discussed in terms of short-run volatility and long-run growth. In my dissertation, growth is the long-term trend of a state's revenues over years; volatility refers to the potential variability in state revenues from the expected level of revenues at various points over the years (White, 1983). In order to raise revenues, the states should consider both long-term growth and short-term volatility.

When it comes to the relationship between volatility and growth, Mallick and Harmon's (1994) study provided the results of an inconsistent relationship between two concepts using revenue portfolio analysis even though they used only one case from New York state. In addition, economic changes affect states' revenue growth and volatility.

Revenue Diversification for Stable, Growing Revenues

This section investigates the positive effect of revenue diversification on state revenue growth and volatility. Revenue diversification has been considered a guarantor for stable, growing revenues at the state level. This section discusses the modern portfolio theory on which the discussion of revenue diversification has been based; it first examines the definition and measures of revenue diversification and then the impact of revenue diversification on growth and volatility.

The modern portfolio theory of revenue diversification. Meaningful diversification requires a state to avoid relying on any particular revenue source at the cost of other revenue sources (Carroll, 2005; Carroll et al., 2003; Cline & Shannon, 1983; Suyderhoud, 1994). A diversified revenue portfolio includes taxes and other types of revenues such as user charges and fees (Carroll et al., 2003).

Although the concept of revenue diversification in public portfolios seems straightforward, its origin is in the private sector that deals with investments. The modern portfolio theory (MPT) was introduced by Harry Markowitz in a 1952 *Journal of Finance* article entitled "Portfolio selection." Portfolios are referred to as the groups of objects of choice (Francis & Kim, 2013). According to Markowitz (1952), a well-diversified investment portfolio is likely to yield an overall, higher expected return and lower variance (risk or uncertainty) in the market. In other words, a diversified portfolio yields the same expected return with less risk compared to a portfolio that is not diversified.

MPT assumes that an investor does (or should) maximize the potential returns (benefits) and minimize risk (uncertainty) in an efficient market (Markowitz, 1952). Investors are assumed to be rational. Here, rationality means being satisfied with

constructing a less risky portfolio as long as the expected return is the same. As a normative theory, MPT assumes that investors are supposed to be coherent and consistent in their investment choices unless they are willing to increase risk without financial compensation (McCue, 2000). Furthermore, investors are expected to adjust quickly to any changes affecting the market or a return on investment (McCue, 2000).

MPT remains meaningful in the public budgeting and finance field both theoretically and practically. The management of risk and return in revenue collection might increase the capacity of political leaders to gather and manage revenues effectively (McCue, 2000). Diversifying revenue sources can be an effective and efficient strategy. Some researchers in the field have argued that diversification might encourage a broadening of the revenue base, generating less volatility and more flexibility in financial management (Bartle et al., 2003; Yan 2008). The reduction of volatility, according to modern portfolio theorists, is achieved by developing multiple revenue sources that are not perfectly correlated (Francis & Kim, 2013; Markowitz, 1952).

Measures of revenue diversification. The measurement of revenue diversification is complex. Until Suyderhoud (1994) used the modified Hirschman-Herfindahl Index in the 1990s, a state was treated as having revenue diversification if a share of the major revenue sources fell into a specific range of ratios (Cline & Shannon, 1983; Ladd & Weist, 1987; Shannon, 1987).

Early prescriptions (i.e., 1960—1975) urged that the individual income tax, the general sales tax, and the local property tax should each contribute 20 to 25 percent of all state-local tax revenues (Suyderhoud, 1994). In the early 1980s, this threshold was modified somewhat as researchers recognized the importance of user fees and severance

taxes. However, a balanced tax system still required the personal income tax to account for 20 to 35 percent of all state—local tax revenues while the general sales and local property taxes accounted for 20 to 30 percent each (Suyderhoud, 1994). Shannon (1987) defined a tax system as being "strongly balanced" if each of the big three (property, general sales, personal income) taxes accounted for 25 to 43 percent of the sum of these revenues; meanwhile, a tax system is "fairly well balanced" if each of the big three contributed 20 to 48 percent of the sum of these revenues.

However, Suyderhoud (1994) criticized these previous criteria of diversification for ignoring the role of other resources, such as corporate income taxes, user charges, and selective sales taxes. Suyderhood used four rather than three categories: property taxes, personal and corporate income taxes, general sales taxes, and all other revenues, including non-tax revenues. In addition, Suyderhoud (1994) developed a quantifiable measure of diversification, based on the Hirschman-Herfindahl Index (HHI) (Herfindahl, 1950; Hirschman, 1945). The measure indicates "the extent to which a revenue structure is diversified relative to a theoretical maximum" (Suyderhoud, 1994, p. 173).[3]

As Suyderhoud (1994) noted, his revised HHI diversification index offers several advantages over the previous approach. First, HHI is a well-established and well-accepted measure developed in the industrial organization concentration research to measure industry diversification that reduces risk (Suyderoud, 1994; Yan, 2008). Second, it is a continuous measure rather than a categorical measure, and it measures the relative position of a revenue structure to its maximal diversification.

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[33] "A diversification index of 1.00 indicates maximum balance among revenue categories, whereas an index value of 0 indicates total reliance on only one category" (Suyderhoud, 1994, p. 173).

Effect of revenue diversification on revenue growth and volatility. The topic of revenue diversification became important for state governments especially in the 1960s and 1970s, in response to the fiscal crises and tax revolts they experienced (Carroll, 2005). In particular, the main target of tax revolts has been to impose restraints on the local governments' authority to increase the local property tax. However, the restraints have also limited the size of revenue increases in state governments (Carroll, 2005). Fiscal crises and these limitations have urged state governments to find creative ways to maintain or increase revenues, and the issue of revenue structure diversification has attracted states' attention (Carroll, 2005).

A state with a well-diversified revenue portfolio can smooth volatility and protect growth rates from sharp decreases during recessions (Braun & Otsuka, 1998;Carroll, 2005). Carroll (2005) indicated that the 25 most diversified states experienced an average decline in tax revenue of only 2.7 percent, while the 25 least diversified states went through an average decline of 4.8 percent in the fiscal crisis between 2001 and 2002.

Determinants of Revenue Diversification

Previous relevant studies have identified determinants of revenue diversification. Revenue diversification levels could reflect such institutional conditions as the presence of tax and revenue limits as well as economic conditions, and these conditions could lead to changes in state revenue growth or volatility levels.

This section discusses the relationships between economic conditions and revenue diversification, and between an institutional factor (i.e., the presence of tax and revenue limits) and revenue diversification. The section further explores the possible association between another institutional factor (i.e., legislative super majorities or popular referenda

on tax increases) and revenue diversification. Neither of these has been discussed in previous literature on diversification. The discussion of the possibilities is based on previous research on the connection between strict tax and revenue limitations and heavier reliance on charges and fees for services not restrained by limitations. In addition, the section investigates the potential relationship between electoral cycles as political factors and revenue diversification, which also has not been directly investigated in previous research. The discussion of possibilities is based on prior work that examined the association between electoral cycles and the change of revenue source rates and bases.

Economic factors. Economic changes influence a state's flexibility to diversify its revenue sources. For example, severe fiscal crises might force state leaders to change their revenue portfolio. On the revenue side, a state in recession tends to rely more on relatively inelastic revenue sources than on elastic revenue sources to lessen the impact of recession (Clemens & Miran, 2012; Matsusaka, 2005). The adjustment of the state's portfolio influences levels of diversification (Carroll, 2005).

Institutional condition 1:Tax and revenue limits. Tax and revenue limitations influence a state's ability to diversify its revenue sources. Carroll (2005) found a negative relationship between revenue diversification and the imposition of tax and revenue limitations for revenue policy changes in states. Thus, her research suggested that tax and revenue limitations restrain political leaders' ability to increase levels of diversification.

Institutional Condition 2: Strict tax and revenue limits. The effect of strict tax and revenue limits on revenue diversification has not been directly discussed. However, strict restrictions on taxing might also influence political leaders' ability to increase levels of diversification in a different manner.

For instance, Mullins and Joyce (1996) indicated that tax and revenue limitations result in attempts to increase alternative sources of revenues, not usually constrained by the limitation, particularly in terms of user charges and fees for services. Thus, most state governments tend to increase a proportion of charges and fees for services to total revenues when states need to increase revenues (Mullins & Joyce, 1996; NCSL, 1999).

Moreover, arguing without data, NCSL (1999) wrote that states requiring legislative super-majorities or popular referenda to enact tax increases are more likely to consider charge and fee increases than states not requiring them when states need to increase revenues. Therefore, it is plausible that stricter tax and revenue limitations would lead states to increased charges and fees for services. Levels of revenue diversification will increase as a result.

However, due to the lack of empirical studies, we do not know whether the strictness of tax and revenue limitations influence (or vary with) levels of revenue diversification.

Political conditions. Given the incentives for reelection, what and when can political leaders do anything about revenue diversification? Despite what public budgeting and finance researchers argue, the politics of the diversification decision makes it unclear whether political leaders will act efficiently on the resource side of budgeting. Although previous studies have not directly analyzed the relationship between elections and levels of revenue diversification, there are some reasons to suspect the link between them. First, revenue policies are critical political issues in states. Previous studies have argued that a state's governor and legislature have incentives to adjust revenue policies during electoral cycles (Blais & Naneau, 1992; Rogoff, 1990).

Public choice theory helps understand why political leaders would or would not choose to diversify their states' revenue portfolios. Public choice assumes that rational individuals, including elected political leaders, act out of their own self-interest. The assumption of self-interest means that individuals have their own preferences that influence the decisions they make (Ostrom & Ostrom, 1971). According to public choice theory, as decision makers, political leaders seek advantages within the strategic opportunities they find. Only incidentally will leaders be evaluated by whether decision outcomes are consistent with efficiency standards (Ostrom & Ostrom, 1971). Leaders are assumed to choose maximizing strategies under uncertainty, which will provide the highest net personal benefit as weighted by their own preferences (Ostrom & Ostrom, 1971).

Political leaders, including legislators and governors, have few incentives to deviate from their constituents' interest (Bender & Lott, 1996). Because reelection, and not efficiency, has the highest payoff for them, leaders make decisions that benefit their constituents (Bender & Lott, 1996; Tollison, 1988).

Does revenue portfolio diversification—efficiency—benefit leaders and their constituents? As a matter of fact, we do not know. Reducing volatility in revenue collection is viewed as one of the important criteria for evaluating financial performance (ITEP, 2011). Stable collected revenues make stable funding for services and programs that benefit constituents more likely. Thus, rational political leaders would seem likely to select a diversified revenue portfolio, according to MPT principles.

However, political leaders might not select a diversified revenue portfolio. For example, rebalancing a portfolio can require a rate increase in a particular revenue base

that negatively affects constituents' interests. Thus, legislators' self-interest might not lead them to choose a diversified revenue portfolio.

Second, a limited number of empirical studies have supported the electoral cycle theory for a revenue policy at the state level (Mikesell, 1978; Nelson, 2000). Mikesell (1978) and Nelson (2000) identified changes in tax rates and new tax adoptions for state governments over electoral cycles. According to Mikesell (1978) and Nelson (2000), tax rate increases and adoptions distinctively occurred in the first year of a governor's and legislator's terms for a state with a 4-year election cycle for a governor and a 2-year election cycle for the legislature (see Table 2 and Table 3).[4] [5] In election years for both the governor and legislature, tax rate increases and adoptions were rarely implemented according to Mikesell (1978) and Nelson (2000) (see Table 2 and Table 3).

[4] Mikesell (1978) included individual income, corporate income, cigarette, gasoline, and distilled spirits taxes and treated them as broad-based taxes in his analysis. In contrast to broad-based taxes, the selective excise taxes—gasoline, distilled spirits, and cigarette taxes—did not show a pattern significantly different from the general revenue policy of tax increases and new source adoptions (Mikesell, 1978).

[5] According to Mikesell (1978), tax increases and adoption are substantially less likely to occur in an election year than in the first year of a governor's term. In addition, considering legislators who are in either an election year or the year before an election year, the probability of tax adoption or rate increase in each of the years might be ordered: first year of a governor's term > third year of a governor's term > second year of a governor's term > gubernatorial election year (Mikesell, 1978).

Table 2

Comparison of the Results regarding State Tax Increases and Adoptions by Year of Gubernatorial Election Cycle between Mikesell (1978) and Nelson (2000)

Tax	Mikesell (1978), 1960-1977					Nelson (2000), 1946-1986, 1990-1993				
	Years Before Next Election for Governor				Number of Increase/ Adoption	Years Before Next Election for Governor				Number of Increase /Adoption
	3	2	1	0		3	2	1	0	
Personal Income	27 (%)	24	41	8	37	52 (%)	11	29	9	91
Corporate Income	34	19	40	7	90	45	10	33	12	118
Sales	47	16	30	8	64	40	16	29	15	120
Gasoline	47	13	38	2	53	39	12	39	10	197
Cigarettes	61	11	29	0	38	41	13	38	8	152
Distilled Spirits	55	13	30	2	47					
Alcohol						45	14	32	9	203

Note: Percentage of rate increases by tax. Adapted from "Election Periods and State Tax Policy Cycles," by J. L. Mikesell, 1978, Public Choice, 33(3), p. 102-103 and "Electoral Cycles and the Politics of State Tax Policy," by M. A. Nelson, 2000, Public Finance Review, 28(6), p. 545.

Table 3

Comparison of the Results regarding State Tax Adoptions by Year of Gubernatorial Election Cycle between Mikesell (1978) and Nelson (2000)

Tax	Mikesell (1978), 1960-1977					Nelson (2000), 1946-1986, 1990-1993				
	Years Before Next Election for Governor				Number of Adoption	Years Before Next Election for Governor				Number of Adoption
	3	2	1	0		3	2	1	0	
Individual Income	71 (%)		29		7	70 (%)		30		10
Corporate Income	83	17			6	67		33		9
Sales	63		25	13	8	62		39		13
Gasoline										
Cigarettes	25	25	50		4	39	8	39	8	13
Distilled Spirits										
Alcohol						100				1

Note: Percentage of total adoptions by tax. Adapted from "Election Periods and State Tax Policy Cycles," by J. L. Mikesell, 1978, Public Choice, 33(3), p. 102-103 and "Electoral Cycles and the Politics of State Tax Policy," by M. A. Nelson, 2000, Public Finance Review, 28(6), p. 545.

Furthermore, the number of tax rate decreases from 1960 to 1977 was limited (see Table 4). Similarly, Mikesell (1978) and Nelson (2000) found that tax rate decreases in states relatively rarely occurred, considering the number of states and the length of time period between 1946 and 1993 (see Table 4). Nelson (2000) concluded, "These data provide only weak evidence in support of the view that state politicians deliberately reduce taxes before election periods" (p. 544).[6]

[6] Mikesell (1978) analyzed the 36 states from 1960 to 1974; Nelson (2000) did not provide the specific number of states examined. However, both studies were restricted to states with a 4-year election cycle for governor and a 2-year legislature cycle. The study period of Nelson's (2000) study began in 1946 and ended in 1993. Because states' tax changes immediately followed the Tax Reform Act of 1986, the years 1987–1989 were excluded in Nelson's (2000).

[6] Nelson (2000) included individual income, corporate income, sales, cigarette, alcohol, and motor fuel in the analysis. Alcohol excise tax is a group of taxes composed of beer, wine and distilled spirits.

Table 4

Comparison of the Results regarding State Tax Decreases by Year of Gubernatorial Election Cycle between Mikesell (1978) and Nelson (2000)

Tax	Mikesell (1978), 1960-1977					Nelson (2000), 1946-1993				
	Years Before Next Election for Governor				Number of	Years Before Next Election for Governor				Number of
	3	2	1	0	Decrease	3	2	1	0	Decrease
Individual Income			57	43	7	23	18	32	27	44
Corporate Income	60		40		6	32	18	32	18	22
Sales		67	33		3	46		27	27	11
Gasoline				100	1	100				2
Cigarettes	67			33	3	100				4
Distilled Spirits										
Alcohol						44		2	33	9

Note: Percentage of rate decreases by tax. Adapted from "Election Periods and State Tax Policy Cycles," by J. L. Mikesell, 1978, Public Choice, 33(3), p. 103 and "Electoral Cycles and the Politics of State Tax Policy," by M. A. Nelson, 2000, Public Finance Review, 28(6), p. 544.

Given the finding that the timing of tax rate increases and new adoptions is associated with electoral cycles, when political leaders show a pattern of strategically using a particular revenue source during electoral cycles, the level of revenue diversification decreases and its impact on growth and volatility changes as a result.

Mikesell (1978) and Nelson (2000) provided different empirical results regarding whether the pattern of tax increases across the election cycle differs among the tax categories analyzed. Mikesell's (1978) empirical study demonstrated that tax rate increases and adoptions were clearly linked with electoral cycles in cases of individual income and corporate income taxes and the sales and use taxes in the cases of distilled spirits, cigarettes, and gasoline. However, Nelson (2000) provided a different finding: "No discernible differences in the patterns of increases among the various tax categories could be detected" (p. 545).

Based on Mikesell's (1978) study, the degree of revenue diversification is expected to change in the first year of a governor's and/or a legislator's terms. However, Nelson's (2000) results found nothing distinctive about specific years. Rather, the results demonstrated that all years are likely to have similar changes in a state portfolio.

Summary and implication of revenue diversification. This section explored the modern portfolio theory and measures of revenue diversification, the positive role as a guarantor for stable, growing revenues at a state level, and the determinants of revenue diversification. Furthermore, this section examined the relationships among the economic, institutional, and political conditions and revenue diversification based on previous studies. The specific relationships are detailed in the next chapter.

Chapter 4

HYPOTHESES

This chapter discusses what we do and do not know related to the relationships among revenue diversification, revenue growth and volatility, and other explanatory variables based on the existing literature. The discussion of what we know summarizes the previous studies' findings related to the relationships between state revenue growth and revenue diversification as well as between state revenue volatility and revenue diversification, the determinants of revenue diversification including the presence of tax and revenue limits and economic changes, and the association between electoral cycles and changes in revenue policies. The discussion of what we do not know involves the inconsistent association between revenue growth and volatility, and the plausible determinants of revenue diversification, including strict tax and revenue limits and political leaders' electoral cycles. This chapter then presents four hypotheses along with the remaining questions related to what we do not know.

What We Know

Despite the limited number of studies, previous research has found that a state's revenue diversification increases growth and reduces volatility (Carroll, 2005; Schunk & Porca, 2005; Suyderhoud, 1994).

Revenue structure growth is referred to as the long-term trend of a state's revenues over the years; volatility is referred to as the variability in state revenues from the expected level of revenues at various points over the years. The rate of growth generally increases during an economic expansion for a given revenue portfolio while the rate

declines in a recession. In addition, the rate of revenue volatility for a given revenue portfolio within a state increases or decreases in response to economic changes.

Tax and revenue limitations and economic changes would affect levels of revenue diversification. First, tax and revenue limitations reduce levels of revenue diversification by restricting a state's ability and flexibility to rebalance revenue sources. Second, economic changes lead state political leaders to adjust revenue rates, bases, and portfolios, thereby influencing the state's revenue diversification.

Meanwhile, state political leaders adjust revenue policies during electoral cycles. The electoral cycle theory demonstrates that state political leaders implement increases in tax rates and new revenue adoptions if they are in the first year of their terms. In contrast, state political leaders rarely increase tax rates or adopt new revenues in the last year of their tenures (Mikesell, 1978; Nelson, 2000). The changes in revenue rates and adoptions over electoral cycles are associated with the state's revenue portfolio.

In sum, the relevant studies produce the following findings.

Finding 1. Revenue diversification increases revenue growth and reduces revenue volatility.

Finding 2. Economic changes affect a state's revenue portfolio growth and volatility.

Finding 3. Tax and revenue limitations reduce levels of revenue diversification.

Finding 4. Economic changes affect a state's flexibility to diversify its revenue sources.

Finding 5. State political leaders are most likely to increase tax rates and adopt new resources in the first year of their terms whereas they are least likely to enact these strategies in the last year of their terms.

Figure 1 presents a diagram for the relationships among economic changes, revenue diversification, electoral cycles, tax and revenue limitations, and revenue growth and volatility at the state level, based on what we know.

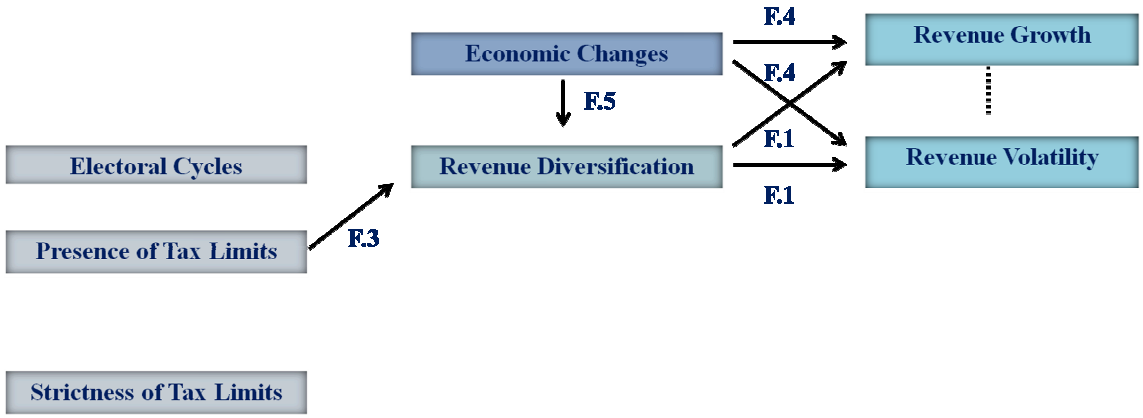

Figure 1. A model of relationships among revenue diversification, tax and revenue limits, revenue growth and volatility, economic changes, and electoral cycles.

Note: A solid line presents the relationship that we know. F.# abbreviates the finding number.

What We Do Not Know

Several questions remain in the state revenue diversification, growth, and volatility research. First, we do not know whether and to what extent political leaders' portfolio restructuring during their electoral cycles influences revenue diversification. The previous studies explained only one revenue policy adjustment during electoral cycles and did not identify the impact of the adjustment on revenue diversification. In addition, the previous studies of Mikesell (1978) and Nelson (2000) showed different statistical results with respect to whether political leaders prefer to raise revenues with the relatively elastic or relatively inelastic taxes in order to raise revenues. Thus, although we can infer that a revenue portfolio changes during electoral cycles, we do not know specifically whether and how revenue diversification changes during electoral cycles.

Second, we do not know whether and to what extent strict legislative super-majorities or referenda requirements influence levels of revenue diversification. NCSL (1999) argued that strict legislative supermajorities or referenda limits might lead state governments to increase alternative sources of revenues that are not usually constrained by the limits, such as user charges and fees for services, yet it provided no data to support this argument. Furthermore, we do not know the exact impact of stricter tax and revenue limitations on revenue diversification levels.

Third, we do not know how and to what extent levels of revenue diversification affect revenue growth and volatility when it is assumed that revenue diversification reflects such factors of electoral cycles, strict legislative supermajorities or popular referenda on tax increases, and economic changes. Without considering the endogeneity of revenue diversification, some previous studies have found that the movement toward a

well-diversified revenue structure increases growth and reduces volatility. However, the dynamics underlying revenue diversification in states would affect levels of diversification and, in turn, generate different results regarding the effect of diversification on growth and volatility. Thus, questions still remain.

Finally, when it comes to the relationship between revenue growth and volatility, other studies have found a positive relationship between revenue growth and volatility. In contrast, more recent studies have cast doubt about whether a consistent positive relationship always exists between revenue growth and volatility. Thus, we do not know whether revenue growth has a consistent relationship with revenue volatility or not.

Hypotheses

Given what we do not know, my dissertation suggests four relevant hypotheses in light of what we have not known yet determined:

Hypothesis 1. Revenue diversification levels change during electoral cycles.

Hypothesis 2. States that require strict super-majorities or popular referenda to enact tax increases would generate a different level of revenue diversification compared to states that do not require strict conditions.

Hypothesis 3. The effect of diversification on revenue portfolio growth and volatility changes in the model considering dynamics among electoral cycles, strict super-majorities or popular referenda, and economic changes in revenue diversification (i.e., endogeneity), compared to a model not including the dynamics (i.e., endogeneity).

Hypothesis 4. Revenue growth rate has no consistent relationship with revenue portfolio volatility.

My research aims to explore these four hypotheses empirically.

Figure 2 depicts a diagram of the relationships among economic changes, revenue diversification, electoral cycles, tax and revenue limitations, and revenue structure growth and volatility in the states, based on what we know and what we do not know.

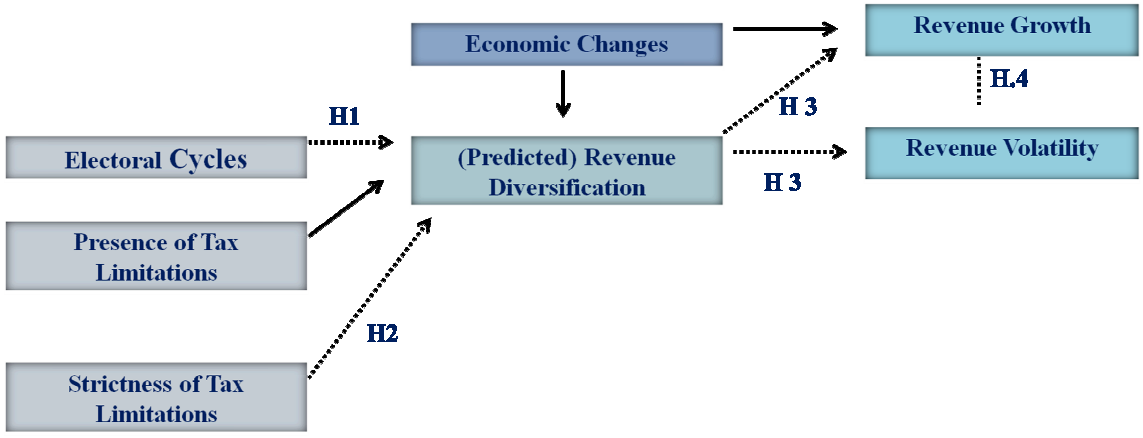

Figure 2. A model of relationships among revenue diversification, tax and revenue limits, revenue growth and volatility, economic changes, and electoral cycles.

Note: A solid line presents the relationship that we know. A dotted line presents the relationship that we do not know. H.# indicates the hypothesis number.

Chapter 5

METHODOLOGY

My research looks at the 50 American states as a panel and analyzes these state revenue structures from 1980 to 2011. The data were collected primarily from the Bureau of Economic Analysis, Census Bureau, and Council of State Governments.

This chapter begins with a description about dependent, independent, and control variables, describing the measures of variables. It then explains the panel data set that I chose and the research design. Finally, I discuss the endogeneity of revenue diversification and the measures of potential instrumental variables, and specify the model that my research uses.

The Variables

The empirical analysis begins with the estimation of growth, G_{it}, and volatility, V_{it}, of revenue flow. In my study, the measures of revenue growth and volatility are the portfolio growth developed by White (1983) and the portfolio variance measure for volatility developed by White (1983) and Misiolek and Perdue (1987). Growth is measured using a deterministic trend model. Volatility is referred to as the extent to which actual revenue deviates from the predicted revenue—that is, the deterministic growth trend line (Yan, 2008). Thus, revenue volatility is measured according to the variance from the growth trend line here. The formulas of revenue growth and volatility are detailed in the following sections.

Dependent variable. The dependent variables are revenue portfolio growth and volatility.

***Revenue growth*.** Two steps are used to calculate revenue growth.

Step 1: Projected revenue growth for individual revenue source. The expected revenue growth for each revenue source can be estimated using the following equation.

$$G_{it} = b_i$$

where β_i is estimated by the following equation:

$$(1) \quad \log(R_{it}) = a + b_i(\text{year } t) + e_{it}$$

where G_{it} is the projected annual growth for the *ith* revenue source,

R_{it} is the revenue from the *ith* revenue source in period *t*,

year t is the time variable indicating year, and

b_i is the regression coefficient.

My research uses an autoregressive integrated moving average (ARIMA) model, together with diagnostic tests for stationarity and white nose. The annual growth rate represents coefficient *b* in Equation 1, multiplied by 100 to convert it to a percentage (%) (White, 1983).

Step 2: Projected revenue growth for a revenue portfolio. The overall growth for a particular revenue portfolio is measured by a weighted average of growth rates for each individual revenue source (White, 1983). This formula is expressed as follows (White, 1983, p. 106):

$$(2) \quad G_T = \sum_{i=1}^{6} \frac{G_i}{R_T} R_i$$

where G_T is the estimated annual growth rate for the total revenue portfolio,

G_i is the estimated annual growth rate for the *ith* revenue source,

R_T is total revenue (total general fund state-own source revenues) from all revenue sources, and

R_i is revenue from revenue source *i*.

In order to calculate the overall growth rate (G_T), the growth rate for the *ith* revenue source (G_i) is weighted by $\frac{R_i}{R_T}$—that is, the proportion of total revenue produced by the *ith* revenue source. When the revenue structure includes six revenue sources, the overall growth rate is measured by a weighted average of the growth rates of the individual revenue sources (White, 1983).

***Revenue volatility*.** Two steps are used to calculate revenue volatility for a revenue portfolio.

Step 1: Unit standard deviation. Revenue volatility for an individual revenue source is measured by the unit standard deviation—that is, deviation from the predicted level of revenues ($\widehat{R}_{it}$). It is calculated as follows (White, 1983):

$$(3) \quad \sigma_i = \sqrt{\frac{\sum_{t=1}^{m}\left[\frac{R_{it}-\widehat{R}_{it}}{R_{i\cdot}}\right]^2}{m-1}}$$

where σ_i is the standard deviation of the *ith* revenue source,

R_{it} is the revenue from the *ith* revenue source in period *t*,

$\widehat{R}_{it}$ is expected revenue from the *ith* revenue source in period *t*, obtained from Equation 2,

$R_{i\cdot}$ is mean revenue of the *ith* revenue source for period *1* through *m*, and

m is the number of time periods included in the analysis.

In order to calculate the unit standard deviation, it is necessary to estimate $\widehat{R}_{it}$.

Step 2: The revenue volatility for a revenue portfolio. To measure the volatility associated with a particular revenue portfolio, we need to calculate the variance of individual revenue source and the covariance (σ_{ij}) between revenue sources (White, 1983,

p. 106). The measure of covariance can be calculated as $\sigma_{ij} = \rho_{ij}\sigma_i\sigma_j$ whereas the overall measure of volatility for a revenue portfolio at a point in time is expressed as follows (White, 1983, p. 106; Misiolek & Perdue, 1987, p. 111):

$$(4) \quad \sigma_T^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} R_i R_j \rho_{ij} \sigma_i \sigma_j$$

where $\sigma_{i,}$ and σ_j are the standard deviations of revenue source *ith* and *jth*, respectively, ρ_{ij} is the correlation coefficient between the two revenue sources *ith* and *jth* when $i \neq j$ and the variance for the *ith* and *jth* revenue sources when $i = j$, and

R_i and R_j are the levels of each revenue source *i* and *j*, respectively, for the period under study.

The revenue portfolio volatility is estimated in millions of squared dollars (Yan, 2008).

Independent variables. The main independent variables are economic condition and revenue diversification.

Economic condition. My research measures economic condition using annual per capita real gross domestic product (GDP) by state. According to the Bureau Economic Analysis, GDP by state is "the state counterpart of the Nation's gross domestic product (GDP), the Bureau's featured and comprehensive measure of U.S. economic activity." (Bureau Economic Analysis, 2012).[7] Economic conditions could be positively correlated with revenue growth and volatility.

Revenue diversification. In the public finance literature, revenue diversification is usually measured using Suyderhoud's modified HHI. Revenue diversification for state *n* at date *t* is measured as follows:

[7] Retrieved from the Bureau of Economic Analysis: http://www.bea.gov/newsreleases/regional/gdp_state/gsp_newsrelease

$$(6) \quad RD_{n,t} = \frac{1-\sum_{i=1}^{6} R_{i,n,t}^2}{0.833}$$

where $R_{i,n,t}$ is the share of total general fund state-own source revenues generated by source *i* for state *n* at date *t*.

My study calculates the index for every state and every year using six sources of total general fund state-own source revenues: individual income and corporate income taxes, general sales taxes, motor fuel taxes, property taxes, and charges and fees for services, and all other revenues. If all of the six revenue source shares are identical at 0.1666, then the numerator will be .8333 and the index will equal 1. On the other hand, if revenue is generated by only one source, that source's fraction will equal 1, the numerator will equal 0, and thus, the index will equal 0. However, this does not mean that perfectly balanced revenue shares among the six sources are an optimal portfolio. Rather, this index can be a useful measure for comparing relative revenue diversity across states (Schunk & Porca, 2005).

Control variables. The model employs additional control variables to isolate the effects of revenue diversification from other factors influencing the dependent variables. Thus, this model controls for revenue capacity. First, to control the effect of a state's varying revenue capacity on its revenue growth and volatility, the log of per capita personal income of the state is used as a proxy for revenue capacity (Yan, 2008). As volatility and growth are sensitive to income change, income would have positive correlations with revenue volatility and growth respectively (Hendrick, 2002; Holcombe & Sobel, 1997).

Second, to control the effect of a state's size on its revenue growth and volatility, the log of annual state population is included in the model. The size of a jurisdiction has a

positive impact on revenue stability (Yan, 2008); thus, a negative relationship between a state's annual population and revenue volatility is expected. As there is no prior literature on the relationship between revenue growth and population, population could be negatively or positively correlated with revenue growth.

Finally, political factors, such as the annual state proportion of House seats held by the Democratic Party and Democratic governor might influence revenue growth and volatility, being particularly salient during the process of revenue adjustment in states facing unexpected deficits. If the leadership in the house is Democrats and/or the governor is a Democrat, the pro-spending proclivity of Democrats will lead to increases in revenues (Kioko & Martell, 2012). In my research, the political control factors are captured by a dichotomous variable, with Democratic House and Democratic governor being equal to one and zero otherwise. The expected sign of the variable is positive.

Panel Data Set

The research uses a panel data set of 50 American states from 1980 to 2011. The data were gathered mainly from the Bureau of Economic Analysis, Census Bureau, and Council of State Governments.

This 32-year period includes four recessions. According to the National Bureau of Economics (2010), the first recession of this period began in July 1981 and ended in November 1982, the second recession began in July 1990 and ended in March 1991, the third recession started in March 2001 and ended in November 2001, and the fourth recession began in December 2007 and ended in June 2009.[8]

[8] Retrieved from the National Bureau of Economic Research: http:/www.nber.org/cycles/cyclesmain.html

Panel data—that is, the mixed data concerning inter-individual differences and intra-individual dynamics—have several advantages compared to either purely cross-sectional or purely time-series data (Hsiao, 2005). First, panel data can include rich information concerning both time and cross-sectional aspects of a phenomenon. Second, a panel data analysis can reduce the omitted variable bias. Third, panel data have more degrees of freedom, more variability, and less multicollinearity among variables than purely time-series data. Fourth, panel data analysis helps us construct and test hypotheses that are more complicated such as when assuming the effect of the implementation of a tax policy, as compared to purely cross-sectional or time-series analyses. Fifth, the panel data enable a comparison of the states for variations because of fixed differences at one point in time. The data also enable us to evaluate states' responses to temporal factors causing variations in their behavior.

There are several basic characteristics of panel data. Before going deeper, this section explains the characteristics of panel data, referring to the book by Cameron and Trivedi (2010) entitled *Microeconometrics using stata*.

First, panel data are generally collected at regular time intervals, as are most time series data. For example, panel data related to tax revenues can be collected annually or quarterly.

Second, a panel dataset can be balanced or unbalanced. In a balanced dataset, subjects in samples are observed during all time periods whereas in an unbalanced dataset, the subjects in the samples from one period are not observed the same as those from another (Cameron & Trivedi, 2010; Eom et al., 2008). In a balanced dataset for Table 5, each subject has the same number of observations (Frees, 2004). If, in Table 5,

the data on states' personal income in 2007 are omitted in the data collection process, it will create an unbalanced dataset as shown in Table 6.

Table 5

An Example of a Balanced Panel Dataset

Observations	Year	Personal Income ($ thousands)	Total Sales & Gross Receipt Tax($ thousands)	Population
Alabama	2000	107,151	3,228,445	4,447
...	...	...	...	...
Alabama	2006	144,437	4,233,895	4,598
Alabama	2007	152,136	4,390,386	4,638
Alabama	2008	157,422	4,433,108	4,677
Alaska	2000	19,158	137,735	627
...	...	...	...	...
Alaska	2006	26,307	208,898	677
Alaska	2007	28,030	235,797	682
Alaska	2008	30,224	279,569	688
...	...	...	...	...
Wyoming	2000	14,463	476,596	494
...	...	...	...	...
Wyoming	2006	22,912	747,610	513
Wyoming	2007	24,457	825,964	523
Wyoming	2008	25,892	825,964	533

Note: U.S. Census of Bureau, Statistical Abstract of the United States, 2000 to 2008.

Table 6

An Example of an Unbalanced Panel Dataset

Observations	Year	Personal Income ($ thousands)	Total Sales & Gross Receipt Tax($ thousands)	Population
Alabama	2000	107,151	3,228,445	4,447
...	...	...	...	...
Alabama	2006	144,437	4,233,895	4,598
Alabama	2007	Omitted	4,390,386	4,638
Alabama	2008	157,422	4,433,108	4,677
Alaska	2000	19,158	137,735	627
...	...	...	...	...
Alaska	2006	26,307	208,898	677
Alaska	2007	Omitted	235,797	682
Alaska	2008	30,224	279,569	688
...	...	...	...	...
Wyoming	2000	14,463	476,596	494
...	...	...	...	...
Wyoming	2006	22,912	747,610	513
Wyoming	2007	Omitted	825,964	523
Wyoming	2008	25,892	825,964	533

Note: U.S. Census of Bureau, Statistical Abstract of the United States, 2000 to 2008

An unbalanced panel dataset might lead to a biased estimation of results in practice, but panel data analysis has a statistical remedy—namely, including a fixed-effects model for missing values (Eom et al., 2008).

Third, observations can be collected over several periods of time from many individuals (a short panel), over many time periods from a few individuals (a long panel), or both in several time periods and from many individuals (Cameron & Trivedi, 2010). Typically, in a short panel, the number of time periods is fewer than 10 (Binder et al., 2005). An example of a short panel is the panel dataset for the Panel Study of Income Dynamics (PSID) on the dynamic relationship between wages and hours worked for 898 American males covering the years 1977 to 1981. A long panel tends to include approximately 20 to 50 years of data (Frees, 2004).

An example of a long panel is the dataset of the U.S. state-year panel from Baltagi, Griffin, and Xiong (2000) on annual cigarette consumption and price for 46 states from 1963 to 1992. In Baltagi et al.'s (2000) study, if T = 30 is large relative to N = 46, it would be necessary to specify a panel data model for serial correlation in the error (Cameron & Trivedi, 2010). Moreover, if N is small, it is possible to relax the assumption that the error term is independent over subjects (Cameron & Trivedi, 2010). The different datasets result in different inferences and estimations of results (Cameron & Trivedi, 2010).

Fourth, in panel data models, model errors tend to be correlated. Correlations (or clustering) occur over time for a given individual with independence over individual units (Cameron & Trivedi, 2010; Frees, 2004). Correlations also exist across different individual units. The former refers to serial correlation whereas the latter refers to cross-

sectional correlation[9]. For example, if the total tax revenues in 50 state governments are observed annually over time from 2000 to 2012, the error in tax revenues of the previous year for a given state such as Arizona, $\varepsilon_{\text{Arizona,t}-1}$, is correlated with the error in tax revenue of the following year, $\varepsilon_{\text{Arizona,t}}$. This is serial correlation. In addition, the tax revenues of one state (e.g., Arizona) are correlated with those of other states; these correlations are cross-sectional correlations. Coefficients in the model with serial correlations are estimated using differencing data or unit-root tests. Coefficients in the model with cross-sectional correlations are estimated using feasible generalized least-squares procedures (FGLS) [10] (Frees, 2004).

[9] "Cross-sectional correlations are particularly important in studies of governmental units, such as states or nations. In some fields, such as political science, when *T* is large relative to *N*, the data are referred to as time-series cross-section data. This nomenclature distinguishes this setup from the panel context, where *N* is large relative to *T*. For example, ... time-series cross-section data would typically range from 10 to 100 subjects with each subject observed over a long period, perhaps 20 to 50 years; many cross-national studies have ratios of *N* to *T* that are close to 1. Such studies involve economic, social, or political comparisons of countries or states; because of the linkages among governmental units, the interest is in models that permit substantial contemporaneous correlation." (Frees, 2004, p. 286)

[10] "Regardless of the assumptions made, some correction to default ordinary least-squares (OLS) standard errors is usually necessary and efficiency gains using generalized least squares (GLS) may be possible" (Cameron & Trivedi, 2010, p. 236).

"Generalized least-square estimation in a regression context has drawbacks that are well documented. GLS estimators are more efficient than OLS estimators when the variance parameters are known. However, because variance parameters are rarely known, one must use instead feasible GLS estimators. Asymptotically, feasible GLS estimators may be more or less efficient than OLS estimators, depending on the regression design and distribution of disturbances. ... Having many variance parameters means that feasible GLS estimators are inefficient in regression designs that are typically of interest in political science application. ...Thus, ... using OLS estimators of regression coefficients [is recommended.] To account for the cross-sectional correlations, ... using standard errors [is] robust to the presence of cross-sectional correlations, [known as] panel-corrected standard errors." (Frees, 2004, p. 287)

Fifth, regression variables have different characteristics depending on regressor type. Examples include time-constant-[11] and time-varying variables. A time-constant variable is one that does not change over time whereas a time-varying variable is not constant in time. An example of a time-constant variable is gender in a study of the gender effects on a taxpayer's tax liability because gender can be assumed not to change for a taxpayer over time (Frees, 2004). Another example of a time-constant variable is a variable that classifies subjects into groups, such as a treatment group and a control group (Frees, 2004). By using a group variable, we are able to compare the treatment effects, such as new tax policy implementation within different groups: a treatment group and a control group (Frees, 2004). Meanwhile, an example of a time-varying variable is inflation, which varies over time (Cameron & Trivedi, 2010). In general, inflation tends to move upward over a period of time, except during 2011 and 2012.

Finally, two distinct panel data models exist: the fixed- effects model and random- effects model. By observing subjects over time, we can find that subjects are not like one another; rather, they are heterogeneous (Frees, 2004). A panel data analysis incorporates subjects' uniqueness (or heterogeneity among subjects), denoted bya_i, into the model: $y_{it} = a_i + x_{it}\beta$ (Frees, 2004). Models with the heterogeneity term are referred to as heterogeneous models whereas models without such terms are referred to as homogeneous models (Frees, 2004).

[11] "We saw that time-constant variables are perfectly collinear with subject-specific intercepts and hence are inestimable. In contrast, coefficients associated with time-constant variables are estimable in a random-effects model. Hence, if a time-constant variable such as gender or treatment group is the primary variable of interest, one should design the longitudinal study so that a random-effects model can be used." (Frees, 2004, p. 78)

According to Frees (2004), heterogeneity might be interpreted as "observations from the same subject tend[ing] to be similar compared to observations from different subjects" (p. 8). Accordingly, heterogeneity can be modeled by "examining the sources of correlation among repeated observations from a subject" (p. 8). For many data sets, researchers expect to identify positive correlations among the observations when examining $\{y_{i,1}, y_{i,2}, \cdots, y_{i,T_i}\}$ (Frees, 2004). One possible source is the dynamic pattern among repeated observations (Frees, 2004). The other possible source is that the dependent variable shares "a common, yet unobserved, subject-specific parameter" leading to a positive correlation" (Frees, 2004, p. 8).

Research Design 1: Fixed effects model.

My dissertation basically employs the fixed effects model because it uses data on the population of the 50 states rather than the sample data drawn from the population of states. A fixed effects model has the ability to control for a possibly correlated, time-constant variable without observation, denoted by a_i. The a_i is referred to as a fixed effect—a_i is fixed over time (Wooldridge, 2009). A model including a fixed effect is called an unobserved effects or a fixed effects model (Wooldridge, 2009).

Several panel data models exist. One of the criteria for distinguishing among these models is their way of treating heterogeneity. Examples of panel data models include the fixed effects model and random effects model.

The general regression model of panel data can be represented as follows (Eom et al., 2008, p. 579):

$$y_{it}=\beta_0 + \beta_1 x_{it,1} + \cdots + \beta_k x_{it,k} + v_{it}, i = 1, \ldots, N; t = 1, \ldots, T; k = 1, \ldots, K.$$

where *i* is the unit of observation, *t* is the period of time, *k* indicates the *kth* explanatory variable, β_0 is the intercept, β_k is the coefficient of each explanatory variable, and v_{it} is the error term (Eom, et al., 2008, p. 579).

In general, a basic panel data model decomposes an error term v_{it} into two error components: an individual-specific error term a_i and an idiosyncratic error term u_{it}. The benefits of decomposing the error term v_{it} into a_i and u_{it} include the possibility of minimizing concerns of omitted variable bias. The individual-specific error term a_i is also known as the unobserved effect, unobserved heterogeneity, or the fixed effect (Eom et al., 2008). In the basic panel model, the idiosyncratic error term u_{it} is uncorrelated with regressors x_{it} (Cameron & Trivedi, 2010).

The fixed effects and random effects models employ different assumptions in regard to the error term. A fixed-effects (FE) model assumes that a_i is correlated with the regressors x_{it} while x_{it} is uncorrelated with the idiosyncratic error u_{it}. The FE model removes the time-constant variable a_i, such as differencing panel data across time periods: consequently, we cannot estimate a_i. In contrast, the random-effects (RE) model assumes that the a_i is purely random and is uncorrelated with the regressors. Advantages of the random-effects model are that it provides estimates of all coefficients, even those of time-constant regressors (Cameron & Trivedi, 2010). However, the model's major disadvantage is that these estimates are inconsistent in some cases, for which the FE model is more appropriate (Cameron & Trivedi, 2010). A fixed effects model is widely viewed as a more convincing tool for estimating the explanatory variables, all other relevant factors being equal (Wooldridge, 2009).

Based on previous research, my dissertation assumes that revenue portfolio growth and volatility are a function of the economic condition, its revenue diversification, and random fluctuations. The growth and volatility of a revenue flow might then be expressed as $G_{it} = f(E_{it}, RD_{it}, C_{it}, \varepsilon_{it})$ and $V_{it} = f(E_{it}, RD_{it}, C_{it}, u_{it})$, where G_{it} represents the growth rate in state *i* at time *t* and V_{it} is the volatility rate of state *i*'s revenue flow at time *t*. E_{it} represents a state *i*'s economic variable and RD_{it} is the state *i*'s revenue diversification at time *t*. C_{it} is a matrix of control variables in state *i* at time *t*. Variables ε_{it} and u_{it} represent random fluctuations.

Endogeneity of Revenue Diversification

My study further assumes that electoral cycles and the presence of tax and revenue limits as well as strict tax and revenue limits on tax increases affect growth and volatility only indirectly through revenue diversification. These factors constrain states' decisions on budget activity in terms of whether state governments raise revenues or which revenue source they will use, rather than directly influence growth and volatility.

To date, no research has examined the direct impacts of electoral cycles and strict tax and revenue limits on revenue diversification. However, previous studies have reported that the presence of tax and revenue limitations would influence revenue diversification (Carroll, 2005). Carroll (2005) found that tax and revenue limitations for the tax policy would decrease the level of revenue diversification.

Potential instrumental variables. To solve the endogeneity problem of revenue diversification, this study uses potential instrumental variables: the presence of tax and expenditure limitations (TELs) as the measure of the presence of tax and revenue limits and strict legislative super-majorities or popular referenda on tax increases as the measure

of the strictness of tax and revenue limits as well as gubernatorial and legislative electoral cycles. These variables are expected to be correlated with revenue diversification (i.e., "instrument relevance") but uncorrelated with other unobserved variables affecting revenue growth and volatility (i.e., "instrument exogeneity") (Wooldridge, 2006). My research uses the Durbin-Wu-Hausman test of endogeneity to determine instrumental variables. The result is reported in Chapter 6. Detailed explanations regarding how to measure the electoral cycle and other political factors are provided in the following subsections.

Tax and revenue limitations. To control the tax and revenue limitation factor that limits a state's ability to collect revenues, the model includes two dichotomous variables of the presence of tax and revenue limitations and the strictness of tax and revenue limitation as proxies for regulation.[12]

First, this study distinguishes between states with and without TELs using a dichotomous variable. Second, this study distinguishes between states with and without legislative super-majorities or popular referenda to enact tax increases, regardless of any form of TELs or other tax and revenue limitations that states use, using a dichotomous variable. The weak tax limitation does not require legislative super-majorities or popular referenda to enact tax increases, but constrains annual tax increases to a fixed fraction of previous taxes or contemporaneous income growth. Meanwhile, the strict tax limitation

[12] The idea of using an ordinal variable for measuring both the presence and strictness of tax and revenue limits is a very good idea for the future research. However, here, the presence of tax and revenue limits is captured by the presence of TELs in a state while the strictness of tax and revenue limits is measured by the presence of requirement on legislative super-majorities or popular referenda on tax increases in a state's laws.

requires legislative super-majorities or popular referenda to enact tax increases (Poterba, 1994).

As Carroll (2005) reported only a negative relationship between revenue diversification and the presence of tax and revenue limitations in states and there is no prior literature on the relationship between strict tax and revenue limitations and revenue diversification, the correlations should be explored.

Electoral cycle. Mikesell (1978) and Nelson (2000) considered only 2-year legislative terms and 4-year gubernatorial terms; however, my study includes all states with 2- and 4-year legislative terms as well as 2- and 4-year gubernatorial terms. In other words, my research tries to capture all years of legislators' terms (legislators' election year and first, second, and third years of their terms). The legislative term is measured by two dichotomous variables, coded as a 1 if a state is in the legislative election and 0 otherwise; a 1 if a state is in the first year of legislative term and 0 otherwise; a 1 if a state is in the second year of legislative term and 0 otherwise; a 1 if a state is in the third year of legislative term and 0 otherwise. For example, if a state is in the election year, the coding is (1, 0, 0, 0) whereas if a state is in the first year of term, the coding is (0, 1, 0, 0). Thus, there is no problem of perfect collinearity.

The governor's term is also measured by two dichotomy variables, coded as a 1 if a state is in the gubernatorial election and 0 otherwise; a 1 if a state is in the first year of governor's term and 0 otherwise; a 1 if a state is in the second year of governor's term and 0; a 1 if a state is in the third year of governor's term and 0. For example, if a state is in the election year, the coding is (1, 0, 0, 0); if a state is in the first year of the governor's term, the coding is (0, 1, 0, 0). Thus, there is no problem of perfect collinearity. As there

is no prior literature on the relationship between electoral cycles and revenue diversification, the correlations should be explored.

Research Design 2: Two-stage least-squares model

If all proposed instruments are valid (i.e., instruments are uncorrelated with errors in the dependent variable), the coefficients of the endogenous variable of revenue diversification can be estimated using a two-stage least squares (2SLS) regression. The first stage begins with an ordinary least squares (OLS) regression that includes the endogenous variable (revenue diversification) and the set of potential instrumental variables—governor's and legislators' electoral cycles and the presence of TELs and strict legislative supermajorities or popular referenda to enact tax increases—along with other exogenous variables including economic variables and other control variables—namely, income, population, and Democratic governor, and a Democratic House. That is:

$$(7)\quad RD_{it} = \delta_i + \varphi_t + \gamma_1 GEC_{it} + \gamma_2 LEC_{it} + \gamma_3 PTL_{it} + \gamma_4 STL_{it} + \gamma_5 E_{it} + \gamma_6 C_{it} + v_{it}$$

where $\delta_i$is a state dummy variable; φ_t is a time dummy variable; GEC_{it} is two dummy variables for governor's electoral cycle in state *i* at time *t*; LEC_{it} is two dummy variables for legislator's electoral cycle in state *i* at time *t*; PTL_{it} is a dummy variable for the presence of TELs in state *i* at time *t*; STL_{it} is a dummy variable for strict legislative supermajorities or popular referenda to enact tax increases variable in state *i* at time *t*; E_{it} economic variable in a state *i* at time *t*; C_{it} is a matrix of other control variables; and v_{it} is a classical disturbance term.

The second stage of 2SLS is to regress a growth rate, G_{it}, or degree of volatility, V_{it}, on a economic condition, E_{it},and revenue diversification, RD_{it}, along with other

exogenous control variables—namely, income, population, Democratic governor and Democratic House. The predicted value of revenue diversification from the first-stage is used in the second stage of 2SLS. The state- and time-fixed effects are also included—α_i and s_t in Equation 8 and θ_i and n_t in Equation 9.

The following empirical fixed-effect models are used:

(8) $G_{it} = \alpha_i + s_t + \beta_1 E_{it} + \beta_2 RD_{it} + \beta_3 C_{it} + \varepsilon_{it}$

(9) $V_{it} = \theta_i + n_t + \beta_1 E_{it} + \beta_2 RD_{it} + \beta_3 C_{it} + u_{it}$

where $\alpha_i$and θ_i are state dummy variables; s_t and n_t are time dummy variables; E_{it} is the economic variable in a state *i* at time *t*; RD_{it} is the revenue diversification variable in a state *i* at time *t*; C is a matrix of control variables thought to affect growth and volatility in a state *i* at time *t*; and ε_{it} and u_{it} are classical disturbance terms.

Table 7 provides the summarized description of variables and data sources.

Table 7

Variable Information for Revenue Growth and Stability Estimation

Variable	Description	Data Source
Dependent Variables		
Growth	Revenue growth measured by portfolio trend growth line in %	Bureau of Economic Analysis
Volatility	Revenue volatility measured by portfolio variance in millions squared dollars	Bureau of Economic Analysis
Independent Variables		
Economic Condition (Exogenous variable)	Economic condition, measured by per capita real gross domestic product (GDP) by state	Bureau of Economic Analysis
Revenue Diversification (Endogenous Variable)	Revenue diversification, measured by Hirschman-Herfindahl Index (HHI) modified to include six revenue categories; calculated as one minus the sum of the proportions of total revenue generated by each category squared and then divided by 0.833; transposed to a scale from 0 to 1, with increasing values indicating greater diversification	Census of Governments: Government Finances
Potential Instrumental Variables		
Electoral Cycle	Electoral cycle, measured by dichotomous variables; coded as 1 if a state is in a gubernatorial election year and 0 otherwise; 1 if a state is in the first year of a governor's term and 0 otherwise; 1 if a state is in the second year of a governor's term and 0 otherwise; 1 if a state is in the third year of a governor's term; and 0 otherwise; 1 if a state is in a legislative election year and 0 otherwise; 1 if a state is in the first year of a legislator's term and 0 otherwise; 1 if a state is in the second year of a legislator's term and 0 otherwise; and 1 if a state is in the third year of a legislator's term and 0 otherwise.	*The Book of States* published by The Council of State Governments
Presence of Tax Limitation	A dichotomous variable indicating whether a state has a TELs measure, coded as 1 if the state has TELs and 0 otherwise.	National Conference of State Legislatures (NCSL) Kioko (2011)
Strict Tax and Revenue Limits	A dichotomous variable indicating whether a state has a strict tax and revenue limitation measure; coded as 1 if the state has a strict limitation that require legislative super-majorities or popular referendum to enact tax increases, and 0 otherwise.	National Conference of State Legislatures (NCSL) Kioko (2011)
Control Variables		
Income	Log of per capita real personal income	Bureau of Economic Analysis
Population	Log of annual state population	Census of Governments: Population Estimates
Democratic House	Annual state proportion of House seats held by the Democratic party	*The Book of States*, The Council of State Governments
Democratic Governor	Dichotomous variable indicating the political party of the state governor; coded as 1 if the governor is a Democrat and 0 otherwise.	*The Book of States*, The Council of State Governments

Chapter 6

FINDINGS

This chapter presents the descriptive statistics and regression results related to relationships among revenue diversification, revenue portfolio growth and volatility, and other explanatory factors.

Table 8 summarizes the descriptive statistics for all variables included in the analyses. According to Table 8, the mean score for the level of state revenue diversification is 0.858, indicating that the states have fairly diversified revenue structures during the research period.

The mean score for the level of growth is 0.899 % with a 0.411 standard deviation. On average, growth rates are less than 1% over the years across states. The relatively small standard deviation of growth rates indicates that most states might have a similar growth rate. The mean score for the degree of volatility is 7.522 with a standard deviation of 20.104. With the relatively large standard deviation, state volatility differs widely.

Figures 3 and 4 describe levels of state revenue growth and volatility from 1980 to 2011 as a scatter plot. According to Figures 3 and 4, a growth rate in most states ranges between 0% and 2 % and volatility degree in most states is between 0 and 50 million squared dollars in general. [13]

[13] The revenue portfolio volatility is estimated by multiplying covariance between two revenue sources by each revenue sources' total amount. The calculation is explained in detail on page 41 in Chapter 4. As a result of the calculation, the volatility is estimated in millions of squared dollars. Revenue growth is measured by the trend-line slope of each revenue category and the average of all revenue's slopes and estimated in %.

Table 8

Descriptive Statistics

Variable	*Mean*	*SD*	*Min*	*Max*
Growth	.8988159	.4118665	-.119091	3.59732
Volatility	7.521622	20.10351	.0045029	257.8028
Revenue Diversification	.8582169	.097569	.206	.959
Political Variables				
Legislative election	.47875	.4997044	0	1
First year of legislator's term	.48	.499756	0	1
Second year of legislator's term	.0212633	.1443059	0	1
Third year of legislator's term	.020625	.1421698	0	1
Gubernatorial election	.266875	.4424648	0	1
First year of governor's term	.2625	.4401305	0	1
Second year of governor's term	.238125	.4260692	0	1
Third year of governor's term	.23625	.4249103	0	1
Democratic House	.55511	.1705482	.1285714	.9619048
Democratic Governor	.5137117	.4972517	0	1
Institutional Variables				
Presence of TELs	.443125	.49691	0	1
Strict tax & revenue Limits	.22	.4143758	0	1
Financial Capacity				
Log of per capita personal income	4.524909	.0875431	4.269258	4.782471
Economic Variable				
Log of per capita GSP	4.590139	.0851768	4.400721	4.973684
Demographic Variable				
Log of population	6.516097	.4398049	5.604065	7.576156

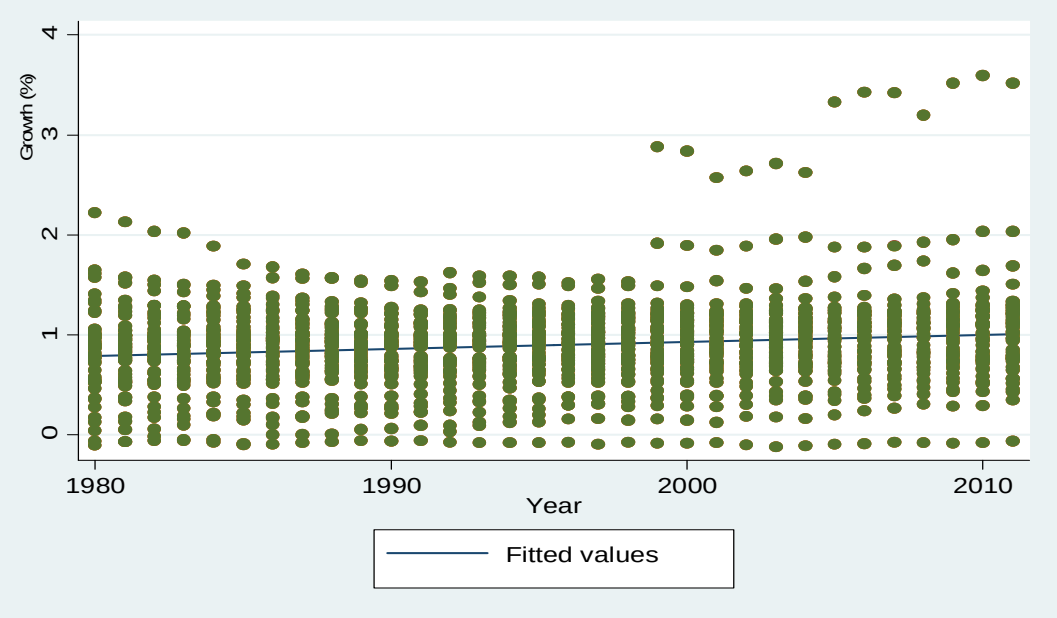

Figure 3. Levels of state revenue growth, 1980–2011.

Note: The line of fitted values presents the estimated linear trend line.

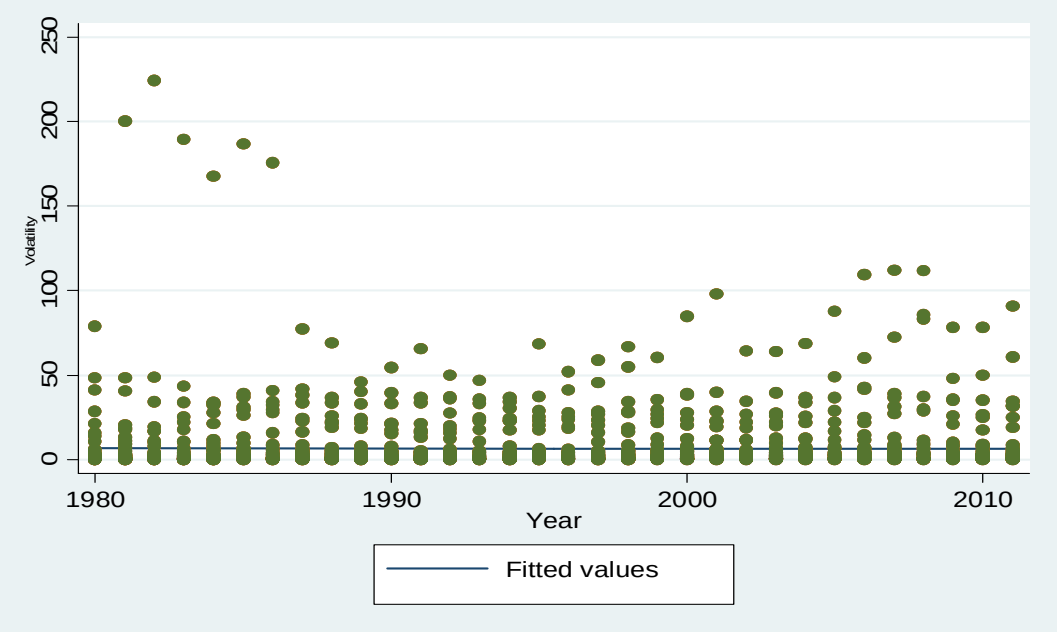

Figure 4. Levels of state revenue volatility, 1980–2011.

Note: The line of fitted values presents the estimated linear trend line.

Estimating the Relationship between Growth and Volatility

Table 9 provides the correlation estimates for the relationship between state revenue growth and volatility. As seen in Table 9, long-term growth and short-term volatility are positively correlated across the states. The positive sign of the correlation estimate might suggest that a trade-off exists between growth and stability in state revenues. Thus, if a state wishes to lower the volatility of its revenues, it must also suffer decreased long-term growth potential (Holcombe & Sobel, 1997).

However, the magnitude of the correlation estimate is not large, being close to zero. Thus, the weak trade-off leaves open the question of why political leaders cannot manage such a minor trade-off.

Table 9

Correlation Estimates on Growth and Volatility

Measures	Growth	Volatility
Growth	—	
Volatility	.1490***	—

Note: Coefficients significant at: ***$p < .01$.

Estimating the Effect of Revenue Diversification on Growth and Volatility

This section presents the statistical results describing the relationships among revenue diversification, growth, and volatility. However, before going on with the findings, I want to discuss an endogeneity problem I encountered. In the earlier stages of my research, the dependent variables were revenue growth and volatility while the independent variables were revenue diversification along with economic, political, and institutional variables that are expected to explain revenue diversification. In addition, during the literature review, as I analyzed the data, I had doubts about the possibility of endogeneity in the revenue diversification variable and assumed that the potential variables might be political leaders' electoral cycles as political variables and the presences of TELs and strict legislative supermajorities or popular referenda on tax increases in a state.

To identify appropriate instrumental variables, I performed a simple regression, Durbin-Wu-Hausman test of endogeneity and a Stock-Yogo test for weak instruments. These simple regression estimates for growth and volatility using potential instrumental variables as independent variables are shown in Appendices A and B.[14] To reach a conclusion, the appropriate instrumental variables in the revenue growth model (Table 10) are contemporaneous and once-lagged governor's electoral cycle while those in the revenue volatility model (Table 12) are the strict legislative supermajorities or popular referenda on tax increases as well as, the interactions between governors' electoral cycle dummies and dummies of the strict legislative supermajorities or popular referenda on tax

[14] At the conference of Public Management Research Association held from June 20 to 22 in Madison, WI, I was asked questions about whether instrumental variables are directly related to the dependent variables, growth and volatility. Thus, I provided the regression results in Appendices A and B.

increases. Therefore, I considered the effect of revenue diversification on revenue growth and volatility treated both endogenously and exogenously. This section describes these results.

Table 10 reports the regression estimates for revenue growth. Revenue diversification, treated exogenously, produced the estimates that appear in column 1 and the estimates, considering the endogeneity of revenue diversification, are reported in column 2.

According to the results in column 1, revenue diversification levels are positively related to revenue growth levels whereas, as column 2 shows, (predicted) revenue diversification levels are positively related to state revenue growth. The results in columns 1 and 2 confirm the existence of a positive relationship. The effect of revenue diversification in column 2 is associated with an increase in the growth rate by approximately 7.4 % on average.

Table 10

Revenue Growth Model Regression Results in (%)

Variable	(1) Growth (Revenue Diversification Treated Exogenously)	(2) Growth (Revenue Diversification Treated Endogenously)
Revenue Diversification	0.687647**	7.42491***
	(0.283570)	(2.283994)
Log Per capita Personal Income	0.408812	1.886422
	(0.333547)	(2.175593)
Log Per capita GSP	-0.277251	-0.759113
	(0.238823)	(1.44547)
Democratic House	0.003893	0.220658
	(0.031818)	(0.256920)
Democratic Governor	-0.001926	-0.016187
	(0.003050)	(0.042240)
Log of Population	0.005695	0.367088
	(0.055461)	(0.449534)
Constant	-1.135943	-13.72593**
	(0.889405)	(5.99709)
Durbin-Wu-Hausman test of endogeneity (*p*-value)		2.97923 (0.0605)
P-value: Joint significance	< 0.001	< 0.001
Stock-Yogo weak ID test (*p*-value)		11.134, 10% IV bias 10.22
R-squared	.9634	.5411
Endogenous variables		Revenue diversification, Once-lagged revenue diversification
Instrumental variables		Governor's electoral cycle, and once-lagged governor's electoral cycle

Notes: Coefficients significant at: *** $p < .01$, ** $p < .05$, * $p < .10$. The lagged dependent variable is used in column 1. Cluster-corrected standard errors are included in parentheses. All specifications include state and time fixed effects. *F*-statistics have been adjusted for 48 clusters in state.

Table 11 reports the estimates of revenue volatility without instruments in column 1 and estimates with instrumental variables in column 2.[15]

According to the results in column 1, revenue diversification levels are negatively related to revenue volatility. In contrast, the level of (predicted) revenue diversification in column 2 is positively related to volatility. In other words, (predicted) revenue diversification in column 2 is associated with an increase in volatility. Nonetheless, the revenue diversification coefficient is not statistically significant and is approximately four times larger than the panel corrected standard errors regression estimate in column 1 in Table 11. The standard error also increases vis-à-vis column 2, implying that the asymptotic standard errors reported in column 2 are exaggeratedly low (Levitt, 1997). The imprecise estimates would preclude any strong conclusion (Levitt, 1997).

[15] To compare the results of 2SLS with the results without endogeneity, a panel corrected standard errors (PCSE) regression model is used in column1. The revenue diversification estimate is not statistically significant in the fixed effect model with lagged dependent variable and cluster-corrected errors clustered by states.

Table 11

Revenue Volatility Model Regression Results (in million squared dollars)

Variable	(1) Volatility (Revenue Diversification Treated Exogenously)	(2) Volatility (Revenue Diversification Treated Endogenously)
Revenue Diversification	-49.84083***	182.5272
	(8.34263)	(249.8051)
Log Per capita Personal Income	3.719959	-25.8805
	(11.19298)	(41.18139)
Log Per capita GSP	9.307082	42.32214
	(8.036236)	(44.65696)
Democratic House	0.052129	4.48087
	(2.137529)	(10.62658)
Democratic Governor	0.167028	0.364579
	(0.334161)	(1.21367)
Log of Population	7.500533	9.126113
	(6.05595)	(14.76829)
Constant	-60.80118	-306.2611
	(69.1347)	(432.2523)
Durbin-Wu-Hausman test of endogeneity (*p*-value)		3.31 (.0693)
P-value: Joint significance	< 0.001	< 0.001
Stock-Yogo weak ID test (*p*-value)		20.031, 5% IV bias 18.37
R-squared	.5829	.7779
Endogenous variables		Revenue diversification &
Instrumental variables		Strictness of tax limits, Governor's electoral cycles*Strictness of tax limits

Notes: Coefficients significant at: *** $p < .01$, ** $p < .05$, * $p < .10$. Panel corrected standard errors in column 1 and cluster-corrected standard errors are included in parentheses in column 2. All specifications include state and time fixed effects. *F*-statistics have been adjusted for 48 clusters in state in column 2.

In sum, when it comes to the relationship between revenue diversification and state revenue growth, there are similar results regardless of whether or not the endogeneity of revenue diversification is considered. In contrast, the relationship between revenue diversification and state revenue volatility is different depending on the consideration of revenue diversification endogeneity. I concluded that revenue diversification predicted by the instrumental variables will be associated with an increase in volatility. These results led to a subsequent question: What might influence efforts to diversify revenue portfolios? The next section will report the findings that answer this question.

Determinants of Revenue Diversification

This section goes into detail regarding determinants of revenue diversification. The statistical results present which and to what extent explanatory variables are associated with revenue diversification.

Table 12 presents regression estimates for revenue diversification.[16] In Table 12, per capita real personal income, per capita real GSP, population, and the House seats held by Democrats within a state are the most influential factors in a state's level of revenue diversification on average. To show the relationships clearly, the level of revenue diversification is transformed into a percentage by multiplying the level by 100. Here, the estimates of economic, institutional, and political variables are described as follows.

Estimates of economic variable. My findings showed a negative relationship between per capita real GSP and levels of revenue diversification in Table 12. Given the assumption that an increase or decrease in per capita real GSP mirrors economic change,

[16] Table 14 reports the result estimates for revenue diversification using the fixed-effects model with a lagged dependent variable and cluster-robust standard errors clustered by states.

a decrease in per capita real GSP (i.e., economic downturn) leads states to rely on a more diversified revenue portfolio. However, the result was not statistically significant. Similarly, assuming that per capita real personal income reflects a state's fiscal capacity, per capita real personal income was negatively related to revenue diversification levels and the estimate was not statistically significant, as shown in Table 12.

Thus, I reexamined the sign of the coefficients for both correlations between per capita real GSP and revenue diversification levels and between per capital real personal income and diversification. Table 13 reports the correlation estimates for them. As seen in Table 13, both per capita GSP and per capita personal income are negatively correlated with revenue diversification levels. Although we do not know to what extent changes in diversification are predicted by changes in per capita GSP or per capita personal income, we can confirm that these economic and fiscal variables are related to revenue diversification in a negative linear sense.

In terms of the value of *r*-squared, the per capita real GSP accounts for approximately 33% of the total variation in revenue diversification. The other 67% of the total variation in revenue diversification remains unexplained. The political and institutional variables might explain the other 67%.

Estimates of institutional variables. Here, three instrumental variables are applied: the presence of TELs, legislative super-majorities, and popular referenda (i.e., the letters I labeled strict tax and revenue limits). According to the findings, the presence of TELs is positively related to the level of revenue diversification. Strict tax and revenue limits within a state are associated with a .09% decrease in the level of state revenue diversification. However, the result estimate is not statistically significant; thus, it precludes the conclusion that the strict legislative super-majorities or popular referenda on tax increases will prompt states to find alternative revenue sources that are not restricted by the limits.

Estimates of political variables. In my research, four political variables are used. These variables are the House seats held by Democrats, a Democrat governor, legislators' electoral cycles, and governors' electoral cycles.

As seen in Table 12, there is a positive coefficient estimate for the House seats held by Democrats. The positive sign implies that the more House seats that are held by Democrats within a state, the more diversified the revenue portfolio will be. However, the estimate is not statistically significant.

Each point in state legislators' electoral cycles is associated with an increase in levels of revenue diversification. In contrast, each year in the gubernatorial electoral cycle within a state is associated with a decrease in levels of revenue diversification. These estimates do not support the argument that the change in levels of revenue diversification would show a different pattern in the year before and the year after political leaders are elected (Hypothesis 1). Moreover, the estimates indicate that legislators' and governor's preferences for revenue diversification would be different.

Table 12

Revenue Diversification Model Regression Results (in %)

	Coefficient	Robust Standard Error	*t*	*P* > |*t*|
Legislative election	0.33822	0.210478	1.61	0.115
First year of legislator's term	0.362968*	0.189347	1.92	0.061
Second year of legislator's term	0.186340	0.237681	0.78	0.437
Third year of legislator's term	0.262305**	0.100509	2.61	0.012
Gubernatorial election	-0.344488**	0.141423	-2.44	0.019
First year of governor's term	-0.31348*	0.166713	-1.88	0.066
Second year of governor's term	-0.352092**	0.14706	-2.39	0.021
Third year of governor's term	-0.372611*	0.187374	-1.99	0.053
Presence of TELs	0.135320	0.104198	1.30	0.200
Strictness of Tax Limits	-0.085229	0.16832	-0.51	0.615
Log Per Capita Personal Income	-3.172378	4.537805	-0.70	0.488
Log Per Capita GSP	-4.597507	3.04885	-1.51	0.138
Democratic Governor	0.000550	0.11613	-1.48	0.138
Democratic House	0.759131	0.130522	0.00	0.997
Log of Population	2.285213	1.393671	1.64	0.108
Constant	39.31052	24.40182	1.61	0.114
rho = .54253007				
R-squared = .9336				

Note: Coefficients significant at: **p <.05, * p <.10. The lagged dependent variable is included in the fixed effect model. Cluster-corrected standard errors are included in parentheses. All specifications include state and time fixed effects.

Table 13

Correlation Estimates among Revenue Diversification, Per Capita Real GSP, and Per Capita Real Personal Income

Measure	HHI	Per capita GSP	Per capita Personal Income
HHI	—		
Per capita GSP	-.5758***	—	
Per capita Personal Income	-.1889***	.6573***	—

Note: Coefficients significant at: *** $p < .01$.

Political Leaders' Preferences for Revenue Sources

In the previous section, I found that legislators' and governor's preferences for revenue diversification would be different. Given these results, I asked why. My initial expectation was that legislators and governors might adjust a state's revenue base and rate, acting out of different preferences, to enhance their reelection chances. Because of the inherent difficulties in measuring revenue bases, I examined political leaders' preference for revenue sources that compose a revenue portfolio as an alternative way. This section will report the findings that answer this question.

Table 14 summarizes descriptive statistics regarding each revenue source. General sales and income taxes account for 23% and 26% of total revenues, respectively. Selective sales taxes and charges and fees for services constitute 13% and 14% of total revenues, respectively.

Table 14

Descriptive Statistics

Variable	*Mean*	*SD*	*Min*	*Max*
General sales tax	.232	.112	0	.51
Selective sales tax	.129	.049	.01	.42
Motor fuel tax	.052	.020	0	.12
Property tax	.016	.033	0	.27
Income Taxes	.258	.129	0	.53
Personal income tax	.212	.122	0	.48
Corporate income tax	.045	.028	0	.21
Current charges	.139	.048	.02	32
Other revenues	.304	.133	.12	.91

Table 15 provides the coefficient estimates for the ratio of revenue source totals to total general fund revenues from state-own sources (in %) (i.e., total revenues) over governors' and legislators' electoral cycles. [17]

Table 15 demonstrates that selective sales taxes that include motor fuel, alcoholic beverages, tobacco products, and public utilities, as a proportion of total revenues are negatively related to each point in the legislator's electoral cycles. Moreover, the share of income taxes, including personal and corporate income taxes, is associated with a decrease in any year of legislators' terms whereas the share is associated with an increase in all years of governors' terms. In addition, the share of general sales taxes, the proportion of corporate income taxes, and the ratio of charges are associated with an increase in each point of governors' terms. In other words, on average, selective sales and income taxes are roughly 0.72% and 0.61% lower, respectively, in all years of legislators' terms. Meanwhile, on average, general sales taxes, corporate income taxes, and charges are approximately 0.33%, 0.47%, and 0.33% higher, respectively, in any year of governors' terms. Thus, these estimates might indicate that political leaders have different preferences for each revenue source.

[17] I conducted the fixed-effects model with a lagged dependent variable and cluster-robust standard errors clustered by states.

Table 15

Regression Estimates for Each Revenue Source as a Ratio of State Total Revenues (in %) over Governor's and Legislator's Terms

	General sales	Selective sales	Motor fuel	Property	Income	Personal income	Corpor-ate income	Charge
Legislative election year	.072 (.002)	-.764*** (.002)	.240 (.002)	-.047 (.001)	-.505 (.003)	-.387* (.002)	-.005 (.002)	.007 (.002)
First year of legislator's term	.157 (.002)	-.728*** (.002)	.213 (.002)	-.007 (.001)	-.66*** (.002)	-.356 (.002)	-.115 (.002)	.180 (.002)
Second year of legislator's term	-.255 (.002)	-.863*** (.002)	.161 (.003)	-.072 (.001)	-.73** (.003)	-.70** (.003)	.174 (.002)	-.094 (.002)
Third year of legislator's term	.147 (.002)	-.543*** (.002)	.19** (.001)	.144* (.001)	-.54*** (.002)	-.61*** (.002)	-.089 (.001)	-.179 (.002)
Gubernatorial election year	.266 (.002)	.151 (.001)	.23** (.001)	-.43** (.002)	.211 (.002)	-.182 (.002)	.39*** (.001)	.219 (.003)
First year of governor's term	.315* (.002)	-.166 (.001)	.119 (.001)	-.43** (.002)	.109 (.002)	-.330* (.002)	.49*** (.001)	.406 (.003)
Second year of governor's term	.388* (.002)	-.065 (.001)	.158 (.001)	-.45** (.002)	.066 (.001)	-.338** (.002)	.43*** (.001)	.424 (.003)
Third year of governor's term	.356* (.002)	-.073 (.001)	.107 (.001)	-.49** (.002)	.112 (.002)	-.392* (.002)	.57*** (.002)	.277 (.003)

Note: State total revenues present a state's general fund revenue from state-won sources. Data source is the Bureau of Census. Coefficients significant at: *** $p < .01$, ** $p < .05$, * $p < .10$. Cluster-corrected standard errors are included in parentheses. All specifications include state and time fixed effects.

Figures 5, 6, 7, 8, 9, and 10 roughly depict the changes in major revenue sources in a portfolio as a proportion of total revenues over years and across states. With the mean score of each source in Table 14 and the regression coefficient of each source in Table 15, changes in each source from its mean at each point of legislators' and governors' terms are shown in Figures 5, 6, 7, 8, 9, and 10. I believe that a heavier reliance on general sales taxes in each year of a governors' term might lead to a less diversified portfolio. The lower reliance on income taxes including personal and corporate income taxes in each year of a legislators' term might result in a more diversified portfolio.

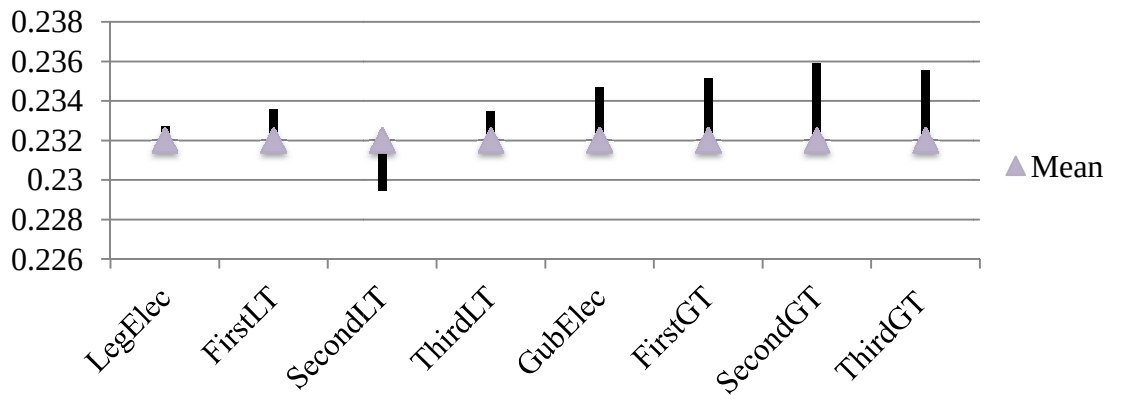

Figure 5. General sales tax changes over political leaders' terms.

Note: LegElec stands for a legislative election year; FirstLT stands for the first year of legislators' term; SecondLT stands for the second year of legislators' term; ThirdLT stands for the third year of legislators' term; GubElec stands for the gubernatorial election year; FirstGT stands for the first year of governors' term; SecondGT stands for the second year of governors' term; and ThirdGT stands for the third year of governors' term.

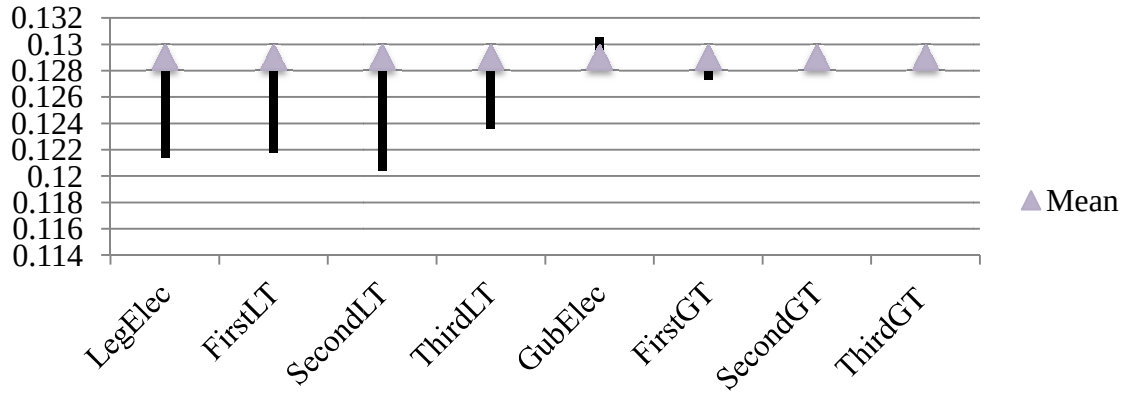

Figure 6. Selective sales tax changes over political leaders' terms.

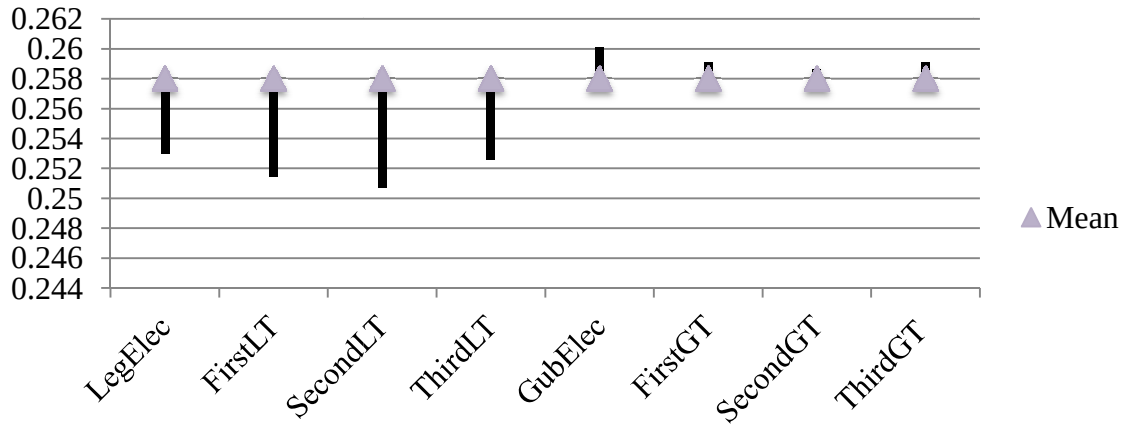

Figure 7. Total personal and corporate income tax changes over political leaders' terms.

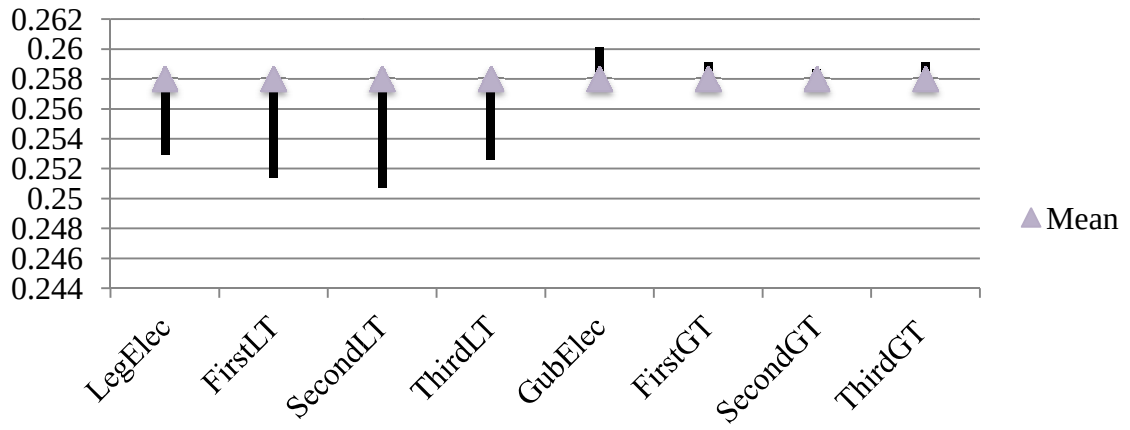

Figure 8. Personal income tax changes over political leaders' terms.

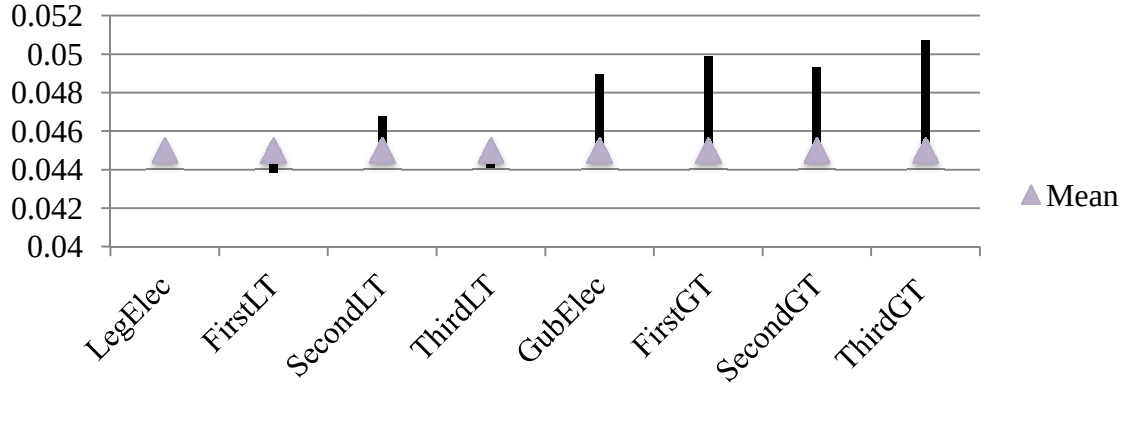

Figure 9. Corporate income tax changes over political leaders' terms.

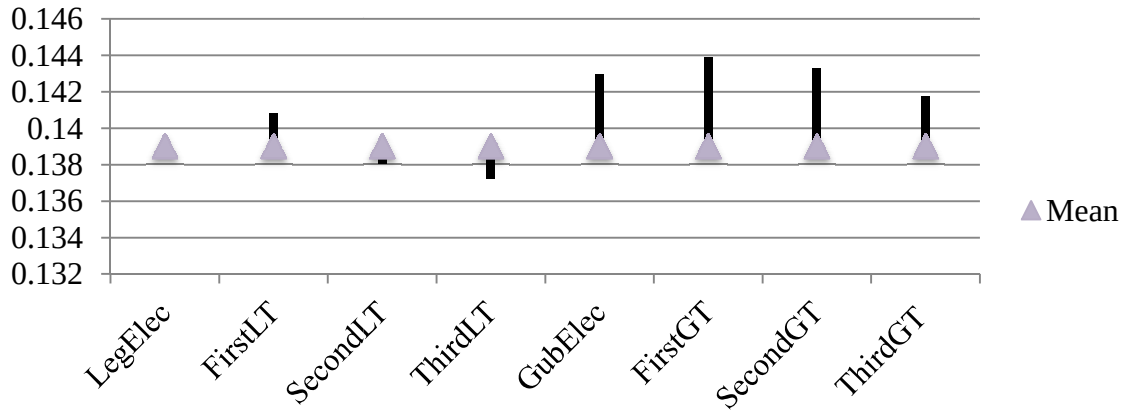

Figure 10. Charges and fees for services over political leaders' terms.

Different Effects of Different Revenue Portfolios

During the analysis, I discovered a third problem: measuring a portfolio in order to measure revenue diversification, HHI. Previous studies, including Carroll (2005), have used a revenue portfolio composed of five revenue sources: general sales taxes, property taxes, motor fuel taxes, individual and corporate income taxes, and a category of "other." In fact, it is possible to vary the number of revenue portfolios in a portfolio. For example, we can create a revenue portfolio composed of 10 revenue sources, including general sales, property, motor fuel, alcoholic beverage, tobacco products, public utilities, individual and corporate income, motor vehicle license, current charges and fees for services, and others, following the classification of the Census Bureau. This section reports my analysis using revenue portfolio composed of five revenue sources—namely, general sales taxes, property taxes, motor fuel taxes, individual and corporate income taxes, and others—to reinvestigate the effect of revenue diversification on revenue growth and volatility.

Furthermore, I reexamined and assessed the effect of revenue diversification on growth and volatility. I went through the same process to identify appropriate instrumental variables as I did before. Tables 16 and 17 summarize the statistical regression estimates for the relationships between revenue diversification and state revenue growth as well as between revenue diversification and state revenue volatility, respectively. Tables 16 and 17 describe the effect of revenue diversification on growth and volatility.

Table 16 reports the result estimates for growth without endogeneity of revenue diversification in column 1 and the estimate with endogeneity in column 2.[18] [19]

Estimates for revenue diversification in both columns1 and 2 are positively related to state revenue growth. These results reconfirm the existence of a positive relationship again compared to the result from the revenue portfolio composed of six categories in Table 11. In particular, the effect of revenue diversification, predicted by instrumental variables within a state at its mean, is associated with an increase in the growth rate by approximately 4.25% on average.

[18] I used the fixed effects model with lagged dependent variable and cluster-corrected standard errors clustered by states in column 1.

[19] Table 18 shows the Durbin-Wu-Hausman test of endogeneity and it leads to rejection of the null hypothesis that the variables of contemporaneous and once-lagged governor's electoral cycle are exogenous at the .01 level (Cameron & Trivedi, 2010). Thus, we can conclude that it is endogenous.

Table 16

Revenue Growth Model Regression Results for the Base Portfolio (in %)

Variable	(1) Growth (Revenue Diversification Treated Exogenously)	(2) Growth (Revenue Diversification Treated Endogenously)
Revenue Diversification	0.76926**	4.25249***
	(0.332773)	(0.809305)
Log Per capita Personal Income	0.312970	0.564361
	(0.290140)	(1.919205)
Log Per capita GSP	-0.294332	-0.830396
	(0.244490)	(1.37110)
Democratic House	0.02046	0.23106
	(0.027438)	(0.233696)
Democratic Governor	-0.00093	-0.009626
	(0.003175)	(0.038609)
Log of Population	-0.041237	0.325514
	(0.044428)	(0.429519)
Constant	-0.357556	-5.00667
	(0.728220)	(5.89494)
Durbin-Wu-Hausman test of endogeneity (*p*-value)		15.31 (0.0001)
Test of joint significance (*p*-value)	*Prob* > *F*(31,47)= 4616.11=0.0000	*Prob* > *F*(8,47) = 26.92 (0.0000)
Stock-Yogo weak ID test (*p*-value)		7.851, 10% IV bias 10.22
R-squared	.9460	.8600
Endogenous variables		Revenue diversification, Once-lagged revenue diversification
Instrumental variables		Governor's electoral cycle, and once-lagged governor's electoral cycle

Notes: Coefficients significant at: *** $p < .01$, ** $p < .05$, * $p < .10$. Cluster-corrected standard errors are included in parentheses. All specifications include state and time fixed effects. *F*-statistics have been adjusted for 48 clusters in state.

Table 17 reports the estimates of revenue diversification, treated exogenously, in column 1 and estimates with endogeneity in column 2.

According to the result estimates in column 1, revenue diversification has a negative relationship with revenue volatility. Interestingly, the results in column 2 confirm the existence of a negative relationship. This result differs from the estimates from the relationship between volatility and predicted revenue diversification in the revenue portfolio composed of the six revenue categories shown in Table 12.[20]

The results in Table 17 imply that the decision about the number of revenue categories composing a revenue portfolio can generate a different story about the effect of revenue diversification on growth and volatility.

[20] To compare the results of 2SLS with the results without endogeneity, a panel corrected standard errors (PCSE) regression model was applied in column 1. The revenue diversification estimate was not statistically significant in the fixed effect model, with a lagged dependent variable and cluster-corrected errors clustered by states.

Table 17

Revenue Volatility Model Regression Results for the Base Portfolio (in million squared dollars)

Variable	(1) Volatility (Revenue Diversification Treated Exogenously)	(2) Volatility (Revenue Diversification Treated Endogenously)
Revenue Diversification	-34.12837***	-6.303148
	(5.334556)	(46.85796)
Log Per capita Personal Income	15.19639	-27.14907
	(12.74749)	(32.39353)
Log Per capita GSP	10.96484	19.48202
	(9.080117)	(25.22613)
Democratic House	1.104983	5.639841
	(2.569568)	(12.18164)
Democratic Governor	0.390869	-0.1476266
	(0.391314)	(0.985351)
Log of Population	33.52185***	26.9725
	(9.854465)	(19.31165)
Constant	-308.286***	-134.5527
	(85.59572)	(125.0901)
Durbin-Wu-Hausman test of endogeneity (*p*-value)		3.95 (0.0471)
Test of joint significance (*p*-value)	<0.001	$F(5,47) = 18.32$ (0.000)
Stock-Yogo weak ID test (*p*-value)		18.32, 10% IV bias 10.83
R-squared	.5966	.9036
Endogenous variables		Revenue diversification
Instrumental variables		Strictness of tax limits, Governor's electoral cycles*Strictness of tax limits

Notes: Coefficients significant at: *** $p < .01$, ** $p < .05$, * $p < .10$. Panel corrected standard errors in column 1 and cluster-corrected standard errors are included in parentheses in column 2. All specifications include state and time fixed effects. *F*-statistics have been adjusted for 48 clusters in state in column 2.

Furthermore, Appendix C reports levels of revenue diversification by state in 2010 using a modified Hirschman-Herfindahl Index (HHI).[21] The first column uses the portfolio composed of five resources, including general sales, property, motor fuel, corporate and individual income taxes, and others. The second column uses the portfolio composed of six resources by adding a category of charges and fees for services to the portfolio in column 1. The third column uses the portfolio composed of 10 resources by adding four more categories (i.e., alcoholic beverage, tobacco products, public utilities, and motor vehicle license taxes) to the portfolio in column 2. The classification of revenue sources is adopted from the Census Bureau. Because of data availability, Appendix C reports the level of revenue diversification in 2010.

The mean score of the portfolio in column 1 is 0.7679 while the mean scores in column 2 and 3 are similar, 0.86838 and 0.861252, respectively. The standard deviation of the portfolio in column 1 is 0.121405 whereas standard deviations in column 2 and 3 are also similar, 0.091732 and 0.080325, respectively.

In sum, this chapter reported the findings from the analysis of the collected data. In the next chapter, I will discuss the implications of these findings. This finding chapter identified three problems that emerged. The first is endogeneity. Solving the problem led me to change my literature and research design. The second problem was the one of portfolio analysis versus specific revenue sources analysis. Judgment let me include both findings in this chapter. The third problem was the measurement of a portfolio. In other words, the problem was how many revenue sources should be included in a portfolio. This was the biggest problem I encountered and will require additional research.

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[21] The formula is explained on page 51.

Chapter 7

DISCUSSION AND IMPLICATIONS

The purpose of this chapter is to discuss the findings and is done in the first section. The second section provides the policy implications of the research. Finally, this chapter discusses future directions this research can take.

Summary, Findings, and Discussion

Based on the literature review, we know economic change affects a state's revenue portfolio growth and volatility. In particular, economic contractions—decreases in state per capita real GDP and state per capita real personal income—are likely to decrease revenue growth and increase volatility in revenue collection. However, it is unclear what to do about this problem. The literature suggests that efforts to increase revenue growth increase volatility and vice versa. If true, political leaders end up trading off growth and stability.

Public budgeting and finance experts have suggested diversifying a state's revenue portfolio to deal with the tradeoff. Taking advice from modern portfolio theory, they argue that diversifying a revenue portfolio can increase revenue growth and reduce revenue volatility over time.

A continuing question is why state portfolios have such a range of diversification levels: from 0.21 to 0.96 (see Table 8) (levels vary from zero to one, with one representing a fully diversified portfolio). The mean score of revenue diversification among states is about 0.86. The literature has little to say about what factors seem conducive to revenue diversification or lead to such a wide range of levels.

This research is an effort to answer the question of what factors correlate with revenue diversification. I used fixed-effects and two-stage least squares models.

My findings provide several insights. When it comes to the relationship between growth and volatility, the correlation coefficient is approximately 0.14. The positive sign indicates that there is a trade-off between revenue growth and stability. However, because the magnitude is relatively low, there might be room for reducing volatility without sacrificing revenue growth. Restructuring a state's revenue portfolio might be a solution for increasing growth and stability at the same time.

In addition, economic, institutional, and political changes are related to revenue diversification in my findings. These associations are described in the following subsections.

Economic changes. Economic changes are negatively related to revenue diversification levels. I measured economic variables with the log of per capita real GDP by state and the log of per capita real personal income over the 50 states from 1980 to 2011. In the fixed-effects model, per capita real GDP by state is negatively related to the level of revenue diversification. However, the relationship is not statistically significant. State per capita real personal income is also negatively related to diversification levels, and this relationship is not statistically significant either.

Looking at these relationships another way, I wondered why economic variables are not perfectly correlated with revenue diversification. One possible reason why they are not perfectly correlated might be that other explanatory variables account for the other proportion of the total variance in revenue diversification. My reading of the

previous literature revealed other variables, which I categorized as institutional and political variables.

Institutional changes. Two institutional factors came from the research conducted by Carroll (2005), who used the presence of tax and revenue limitations in her research. I measured the presence of tax and revenue limits using a dichotomous variable indicating the presence of TELs. Feeling that strength is important, I added additional dummy variables, legislative super-majorities required for tax increases and popular referenda on tax increases, to my research.

The presence of TELs is positively related to revenue diversification. The estimate differs from Carroll's estimation (2005). The different result might be due to the different measure of the presence of tax and revenue limits. However, as the estimate is not statistically significant, we still do not know the relationship between revenue diversification and the presence of TELs.

However, legislative supermajorities and popular referenda are negatively associated with revenue diversification. In any case, none of these relationships are statistically significant (Table 14).

Political changes. Common sense leaves no doubt that revenue diversification is a political issue. The literature leaves no doubt either. To investigate the politics more deeply, I relied on advice from research conducted by Mikesell (1978) and Nelson (2000), among others. They argued that political leaders adjust revenue rates and bases over their electoral cycle to enhance their re-election prospects.

It was very clear to me that Mikesell (1978) and Nelson (2000) based their research on public choice theory. According to public choice, elected political leaders as

rational individuals are assumed to act out of their own self-interest, which in this case is reelection. As the most important political factor, the electoral cycle seemed apt as a metaphor. Given the separation of powers and the nature of state electoral systems, the legislative electoral cycle had to be separated from the gubernatorial electoral cycle. This is the way that both Mikesell (1978) and Nelson (2000) handled the variables.

After repeated efforts, I found that looking at a year before and after election alone—Mikesell's approach and findings— is not enough to determine the impact of electoral cycles on revenue diversification. More precisely, I wondered when over their 4-year terms the governors would propose change and legislators would create new revenues, abolish existing ones or change revenue rates and bases. Conceivably, these actions can take place in any year of legislators' or governors' terms. Therefore, I modeled an electoral cycle as any year of legislators' and governors' terms and correlated them with changes in revenue diversification.

I found that legislative electoral cycles are positively related to revenue diversification. Although any year of a legislator's term is likely to be associated with an increase in revenue diversification levels, the election year and the first year of legislators' term had the strongest relationship, just as Mikesell (1978) found.

On the other hand, each of the four years of a gubernatorial was negatively associated with revenue diversification. Any year of a governor's term was associated with a decrease in revenue diversification. As far as the strength of these relationships, each year of a governor's term had a similar magnitude of coefficients.

Revenue diversification occurs as a result of political leaders' specific actions on specific revenue sources—namely, creating a new one, abolishing an old one or changing

the rate or base of an existing one. Therefore, I investigated the relationship between legislators' and governors' year of the term and changes in specific revenue sources. Any year of legislators' terms was negatively related to changes in the proportion of selective sales and income taxes in a state's revenue portfolio. Meanwhile, any year of governors' terms was positively related to changes in general sales taxes, corporate income taxes, and charges and fees for services as a proportion of state portfolios.

To summarize the findings still further, economic changes predict changes in revenue diversification most strongly. There are still important relationships between revenue diversification and institutional factors as well as between revenue diversification and political factors. Although these estimates are not statistically significant, the presence of TELs is positively associated with revenue diversification. Requirements for a legislative super-majority or a popular referendum to raise taxes (i.e., the strict tax and revenue limits) are negatively related to diversification. As for political factors, any year of legislators' terms is positively associated with any change in diversification whereas any year of governors' term is negatively related to a change in diversification.

Implications

Intuitively, we expect economic changes to be negatively related to revenue diversification. Economic expansions tend to imbalance a state's revenue portfolio. For example, a portfolio that relies heavily on elastic sources would have faster revenue growth than the other sources, making the portfolio less diversified. In contrast, economic recessions are likely to balance a state's portfolio for the same reasons. My statistical findings confirmed this expectation.

Intuitively again, we expect to find a positive relationship between tax and revenue limits and revenue diversification. The TELs affect the most unpopular income taxes or largest sales taxes, respectively, in most states. Limiting these large sources allows normal growth in other sources to balance the portfolio.

The data analysis did not confirm this expectation. That is, as long as strict tax and revenue limits appear in a state, revenue diversification levels decline. However, the negative relationship should not lead to confusion. Tax and revenue limits might prompt states to find alternative revenue sources, thereby increasing diversification.

The likelihood that political leaders will act to change a revenue portfolio to increase their chances of reelection is assumed to vary from year to year in their electoral cycle, with most efforts being concentrated in the last year of a term (the year of the election). The first year of a term might also be a hotbed of revenue portfolio activity as political leaders follow through on election promises and mandates. The data supported this assumption.

The findings about political changes imply that legislators and governors have different preferences for revenue diversification. In detail, every year of legislators' terms is negatively related to selective sales and personal income taxes. That is, the proportion of the portfolios held by selective sales tax revenues is likely to fall in any year of a legislator's term. The same goes for personal income taxes.

In contrast, every year of a governors' term is positively associated with general sales taxes, corporate income taxes and charges and fees for services. Thus, governors are likely to do what it takes to increase their revenue portfolios’ reliance on these revenue sources.

Implications are difficult to draw from these political factor findings. Perhaps, these results can be linked with governors' and legislators' differing behaviors to enhance reelection prospects. Relevant previous studies point out that legislators represent narrower interests than do governors (Crain, 1999, p.678; Dometrius & Wright, 2010). Legislators focus on their districts or specific interest groups. Selective sales taxes, including taxes on alcoholic beverages and motor fuels, might—in many if not most states—have saliency for narrowly focused clientele groups' interests. Thus, an increase or decrease in the tax base's breadth and tax rates are very sensitive issues to legislators.

On the other hand, governors might tend to be more interested in broader state issues such as balancing the budget. Previous studies have found that governors' constituency-driven preferences lead them to be responsible for these broader issues (Crain & Miller, 1990; Dometrius & Wright, 2010; Hansen, 1999; Niemi, Stanley, & Vogel, 1995; Partin, 1995). General sales taxes, very often the largest state revenue source—as well as charges and fees have been frequent solutions to the resource side of budget balancing problems of reversing shortfalls. Sales tax rate changes can produce what it takes to balance the state budget quickly; thus, sales taxes are productive in a budget balancing sense. Charge and fee changes can help balance the budget unobtrusively.

Future Directions for Research

My dissertation brings up the question of revenue diversification measurement. I used a six-source portfolio to measure diversification. Although the number of revenue sources in the portfolio did not seem to matter in previous studies, I varied the number. I found that portfolios with and without the separate category of charges and fees for

services yielded different statistical results. Revenue diversification and institutional and electoral cycle variables had a positive relationship with volatility when the category of charges and fees is included in a portfolio. Revenue diversification predicted by institutional or electoral cycle variables produced the opposite result when the category of charges and fees is not separately categorized in a portfolio. This finding implies that many of the variables in this analysis are very sensitive to changes in the number and type of categories used in the portfolio to measure diversification.

Second, the last recession revealed two characteristic ways to deal with revenue shortfalls. Some states increased their income tax rates while others increased their sales tax rates. Both of these actions have a considerable impact on tax fairness. It will be interesting to delve into how and to what extent changes in a revenue portfolio influence revenue fairness. Fairness is also a critical criterion for a sound revenue system. Previous studies, as well as my research, have focused on growth and volatility—that is, many if not all of the facets of what we think of as revenue adequacy. If diversifying a revenue portfolio spreads out the revenue burden over income classes, revenue fairness will improve. Because a diversified revenue portfolio is expected to increase growth and decrease volatility, it can improve fairness while simulataenously more nearly achieving the goal of a sound revenue system. It would be interesting to determine whether these goals have ever been achieved in the U. S. states.

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APPENDIX A

OLS REGRESSION ESTIMATES FOR STATE REVENUE GROWTH (IN %)

	Coefficient	*p*-value
Legislative election	-.0242256 (0.0370695)	.514
First year of legislator's term	-.0189991 (0.0344392)	.581
Second year of legislator's term	-.0078843 (0.0515136)	.878
Third year of legislator's term	-.0088056 (0.0264833)	.740
Gubernatorial election	-.0593198 (0.0454056)	.192
First year of governor's term	-.0514375 (0.0484169)	.288
Second year of governor's term	-.0498296 (0.0469588)	.289
Third year of governor's term	-.0585376 (0.0473497)	.217
Presence of TELs	-.0676462 (0.0166561)	.000
Strictness of tax and revenue Limits	-.0275781 (0.0158674)	.082
Constant	1.042891 (0.0744537)	.000
Year indicators?	Yes	
State fixed effects?	Yes	
R-squared	.8054	

Note: Robust standard errors are included in parentheses.

APPENDIX B

OLS REGRESSION ESTIMATES FOR STATE REVENUE VOLATILITY (IN MILLION SQUARED DOLLARS)

	Model 1		Model 2	
	Coefficient	*p*-value	Coefficient	*p*-value
Legislative election	-0.997(1.50)	.507	-1.006(1.22)	.412
First year of legislator's term	-0.807(1.40)	.563	-0.812(.99)	.411
Second year of legislator's term	-0.687(2.24)	.760	-1.600(1.92)	.404
Third year of legislator's term	-1.145(1.42)	.421	-1.434(1.57)	.362
Gubernatorial election	0.426(0.79)	.587	0.364(0.87)	.674
First year of governor's term	0.390(0.78)	.619	0.173(0.92)	.851
Second year of governor's term	0.427(0.65)	.511	0.440(0.90)	.625
Third year of governor's term	0.480(0.87)	.580	0.450(1.01)	.656
Presence of TELs	0.599(1.47)	.684	0.605(1.48)	.682
Strictness of tax and revenue limits	-0.011(0.68)	.987	0.240(3.94)	.952
Legislative election*Strictness of tax and revenue limits			-1.014(3.34)	.826
1st year of legislator's term*Strictness of tax and revenue limits			-0.760(3.46)	.761
2nd year of legislator's term*Strictness of tax and revenue limits			1.416(3.97)	.721
3rd year of legislator's term*Strictness of tax and revenue limits			0	omitted
Gubernatorial election*Strictness of tax and revenue limits			0.674(1.95)	.730
1st year of governor's term*Strictness of tax and revenue limits			1.221(2.14)	.568
2nd year of governor's term*Strictness of tax and revenue limits			0.174(1.46)	.905
3rd year of governor's term*Strictness of tax and revenue limits			0.434(2.08)	.835
Year indicators?	Yes		Yes	
State fixed effects?	Yes		Yes	
R-squared	.6401		.6403	

Note: Robust standard errors are included in parentheses.

APPENDIX C

STATE REVENUE DIVERSIFICATION OUTLOOK USING DIFFERENT REVENUE PORTFOLIOS

State	Year 2010 HHI with 5 revenue categories	Year 2010 HHI with 6 revenue categories	Year 2010 HHI with 10 revenue categories
Alabama	.758	.92	.904112
Alaska	.224	.354	.39394
Arizona	.899	.939	.898842
Arkansas	.907	.959	.91029
California	.85	.863	.814721
Colorado	.801	.904	.878864
Connecticut	.829	.87	.852903
Delaware	.43	.712	.747845
Florida	.719	.834	.847085
Georgia	.856	.889	.83827
Hawaii	.818	.896	.869552
Idaho	.868	.916	.874786
Illinois	.816	.891	.919871
Indiana	.84	.912	.889461
Iowa	.815	.92	.894005
Kansas	.852	.916	.866607
Kentucky	.854	.943	.915112
Louisiana	.678	.863	.915518
Maine	.849	.919	.898132
Maryland	.856	.913	.891045
Massachusetts	.8	.859	.826876
Michigan	.857	.942	.912157
Minnesota	.869	.91	.903953
Mississippi	.836	.912	.886379
Missouri	.842	.916	.88318
Montana	.656	.82	.878372
Nebraska	.853	.919	.878522
Nevada	.711	.786	.893337
New Hampshire	.566	.819	.924493
New Jersey	.821	.889	.864363
New Mexico	.715	.872	.862188
New York	.77	.813	.81199
North Carolina	.852	.898	.86545
North Dakota	.61	.802	.822188
Ohio	.794	.92	.910954
Oklahoma	.737	.891	.892438
Oregon	.662	.802	.785755
Pennsylvania	.802	.912	.92127
Rhode Island	.772	.895	.908035
South Carolina	.769	.911	.868495
South Dakota	.666	.8	.840872
Tennessee	.77	.843	.827007

(continued)

Texas	.638	.808	.871069
Utah	.792	.91	.86558
Vermont	.87	.946	.935796
Virginia	.777	.89	.851418
Washington	.769	.852	.836368
West Virginia	.772	.899	.903875
Wisconsin	.84	.913	.913
Wyoming State	.688	.737	.718593
Mean	.7679	.86838	.861252
SD	0.121405	0.091732	0.080325

Note: Data is collected from the Census Bureau.