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# CROSS-BORDER SHOPPING: IMPLICATIONS FOR STATE FISCAL COMPETITION IN MULTIPLE TAX INSTRUMENTS

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ABSTRACT OF DISSERTATION

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The Graduate School  
University of Kentucky

2011

CROSS-BORDER SHOPPING: IMPLICATIONS FOR STATE FISCAL  
COMPETITION IN MULTIPLE TAX INSTRUMENTS

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ABSTRACT OF DISSERTATION

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A dissertation submitted in partial fulfillment of the  
requirements for the degree of Doctor of Philosophy in the  
College of Business and Economics  
at the University of Kentucky

By  
Kusum Singh

Lexington, Kentucky

Director: Dr. William H. Hoyt, Professor of Economics

Lexington, Kentucky

2011

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## ABSTRACT OF DISSERTATION

### CROSS-BORDER SHOPPING: IMPLICATIONS FOR STATE FISCAL COMPETITION IN MULTIPLE TAX INSTRUMENTS

This dissertation investigates whether consumers' cross-border shopping due to interstate commodity tax differentials influence counties' economic activity and states' strategic competition in multiple tax policies.

First, I examine how own and the nearest neighboring states' commodity tax rates affect counties' retail activity. Particularly, in contrast to many previous studies, I examine whether the distance to the state border influences the responsiveness of counties' retail activity to sales and excise taxes of own and the nearest neighboring states. Since the costs of avoiding state commodity taxes are presumably lower along borders, the impacts of state commodity taxes on retail activity may be different for counties closer and further away from the state border. Considering retail establishments and employment of industries that are most likely to be affected by consumers' cross-border shopping activity, I find that the impacts of domestic and the nearest neighboring states' sales and excise tax rates on counties' retail establishments and employment depend on the distance to the state border. However, contrary to what would be expected, the impacts tend not to be very robust.

Second, I investigate whether consumers' cross-border shopping to low commodity taxed states influence state governments to engage in strategic competition in multiple tax policies. Previous works on fiscal competition document that state governments engage in commodity tax competition to gain cross-border shoppers. Specifically, the empirical research find that changes in neighboring states' one commodity tax rate influence changes in a home state's same commodity tax rates. However, these studies do not address whether changes in neighboring states' one commodity tax rate also induce the home state to adjust other taxes, either other commodity taxes or possible income taxes. Using a panel of the United States' state-level data for the period 1977–2002, I estimate the reaction functions not for a single tax rate but multiple rates. In this framework, I find that states react to neighbors' lower tax rates on one tax base by changing rates on either the same tax base or/and other tax bases, thereby suggesting that states engage in strategic competition in multiple tax rates to meet their revenue goals.

KEYWORDS: Cross-border Shopping, Tax Competition, Excise Tax, Sales Tax,  
Income Tax

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CROSS-BORDER SHOPPING: IMPLICATIONS FOR STATE FISCAL  
COMPETITION IN MULTIPLE TAX INSTRUMENTS

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DISSERTATION

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## **Chapter 1**

### **Introduction**

In the United States, there are wide variations in commodity tax rates among states. Hence, we can expect at least some consumers to take advantages of lower after-tax retail prices by purchasing goods in low commodity taxed neighboring states. This phenomenon of cross-border shopping, however, if widespread, can place significant negative impacts on retail activities of high-taxed regions, such as retail sales, retail employment and retail establishments of goods subject to commodity tax rates. Moreover, it can place limits on states' ability to increase their commodity tax rates to raise revenues, which in turn can lead states to engage in tax competition in several tax bases to meet their state revenue goals. Therefore, this dissertation consists of two chapters (chapter 2 and chapter 3) that separately examine each of these issues that arise from cross-border shopping for goods subject to state commodity tax rates.

The second chapter, "Distance to the Border: The Impact of Own and Neighboring States' Sales and Excise Tax Rates on County Retail Activity", examines whether sales and excise tax rates of own and nearest neighboring states have more influences on retail activity of counties closer to the state border than of counties further away from the state border. This study extends previous research that look at the impacts of interstate commodity tax differentials on retail activity of jurisdictions in two ways. First, unlike many previous studies that investigate the impacts of state commodity tax or price differences on retail activity aggregated to state level, this study investigates how sales or excise tax rates of own and the nearest neighboring states affect retail activity aggregated to county level. As the time and transportation costs to travel for cross-border shopping activities are potentially lower in counties closer to the state border than in counties further away from the state border, one can expect the distance to the state border to impact the responsiveness of counties' retail activities to sales and excise tax rates of own state and the nearest neighboring state.



Second, in contrast to many previous studies that focuses on the impacts of states' sales or excise tax differentials on retail sales of a jurisdiction, this chapter looks at the effects of own and the nearest neighboring states' sales and excise tax rates on counties' establishments and employment of five retail industries that are most likely to be affected by consumers' cross-border shopping activities. These retail industries include grocery stores, gasoline stations, furniture stores, clothing stores and alcohol stores. The intuition here is that if interstate tax differentials encourage consumers to engage in cross-border shopping, thereby reducing retail sales of counties of high-taxed states, then this decreased in retail sales can also induce fewer numbers of retail establishments and employment of counties of high-taxed states. Using a county-level panel data of the forty-eight contiguous states over the period 1998 to 2007, I find that domestic and the nearest neighboring states' sales and excise tax rates, in many cases, have significant impacts on counties' retail establishments and employment. I also find that the distance to the state border influences the impacts of own state's and the nearest neighboring state's sales and excise tax rates on counties' retail establishments and employment, however, the influence does not appear to be very robust.

The third chapter, "The Battle of Taxes: Strategic Interaction in Multiple Tax Policies among States," investigates whether state governments engage in tax competition in multiple tax instruments to maintain a balanced budget. Previous studies have addressed how state governments engage in excise tax competition to gain cross-border shoppers. For example, Kanbur and Keen (1993) present a simple theoretical model suggesting that competition in excise taxes will be more prevalent among states that have a greater share of their population on the border. Devereux et al. (2007), examining U.S. state excise taxes on cigarettes, provide evidence supporting the conjectures of Kanbur and Keen (1993). Specifically, they find that state cigarette tax rates respond positively to neighboring states' cigarette tax rates, and cigarette taxes are lower among states in which the greater share of consumers is on borders. However, these studies do not address whether changes in neighboring states' cigarette tax rates also induce a home state to adjust other taxes, either other commodity taxes or possible income taxes, to maintain its revenue requirements. For instance, it is possible that if a

“race to the bottom” occurs in cigarette tax rates among state governments to preserve or gain cigarette tax base, the home state may respond to neighboring states’ lower cigarette tax rates by not only decreasing its cigarette tax rates but also changing rates on other tax bases such as individual income taxes to maintain its state revenue goals.

Thus, this third chapter extends the previous studies on tax competition by expanding the focus from a tax on specific base, usually an excise tax, to a much broader construction of the tax base to include other taxes including individual income and general sales taxes. Specifically, using a panel of the United States’ state-level data for the period 1977-2002, I estimate the reaction functions not for a single tax rate but multiple rates. In this framework, I examine whether state rates on one tax base respond to changes in neighboring states’ rates on the same tax base or/and another tax base. The results from this analysis show that strategic competition among state governments may occur within the same tax base or across different tax bases. For example, a home state cigarette tax rates not only show a positive response to changes in neighboring states’ cigarette tax rates, but also show a negative response to changes in neighboring states’ sales tax rates. Similarly, while the home state gas tax rates are positively influenced by changes in neighboring states’ gas tax rates and sales tax rates, they are negatively affected by neighboring states’ cigarette tax rates and individual income tax rates. The sales and income tax rates of the home state are not affected by neighboring states’ sales and income tax rates, respectively. However, the home state responds to lower income tax rates of neighboring states by increasing its sales tax rates. In the same way, the home state reacts to lower gas tax rates of neighboring states by increasing its income tax rates, thereby confirming my prediction that if strategic competition among states in one tax rate, such as in gas tax rates, leads to a “race to the bottom”, home state would respond to neighboring states’ lower gas tax rates by not only decreasing its gas tax rates but also increasing its rates on less mobile tax bases such as an individual income tax base to meet its state revenue goals. Furthermore, my results in general show that if we ignore strategic competition in multiple tax rates, we would be underestimating the overall degree of strategic interaction in tax rates among state governments.

## Chapter 2

### **Distance to the Border: The Impact of Own and Neighboring States' Sales and Excise Tax Rates on County Retail Activity**

#### **2.1 Introduction**

On March 1, 2009, Arkansas increased its cigarette tax rates from fifty-nine cents to \$1.15 per twenty-pack. However, rather than enforcing a statewide increase in cigarette tax rates by \$1.15 per twenty-pack, they introduced a lower tax rate for areas that near a state border. In particular, for towns that bordered Arkansas's neighboring states with low cigarette tax rates, they imposed cigarette tax rates equal to that of the low cigarette taxed neighboring state plus three cents (Robyn, 2009). Arkansas' tax policy is one of the first to address the potential cross-border shopping problems that may arise with different commodity tax rates in neighboring states.

Most previous studies, with some exceptions, have found that cross-border shopping caused by interstate sales or excise tax differentials have negative effects on economic activity of high-taxed states. However, they have not addressed whether sales or excise tax rates of own and neighboring states have more impacts on economic activity of counties closer to the state border than on economic activity of counties further away from the state border for all the forty-eight contiguous states of the US. As the time and transportation costs of engaging in border shopping are presumably lower in counties along the border of high taxed states than in counties further away from the border of high taxed states, the adverse impacts of cross-border shopping due to interstate sales and excise tax differentials on economic activity can be expected to be more apparent in counties near the border of high taxed states than in counties far away from the border of high taxed states.

In addition, most previous studies have usually looked at the impacts of interstate sales or excise tax differentials on states' economic activities such as retail sales of goods. However, it is equally possible that interstate sales or excise tax differentials also have impacts on other economic activities such as the establishments and employment of

retail industries of states. For example, in the spring of 2002, when Kansas increased its cigarette tax rates, cigarette sales from Kansas migrated to low cigarette taxed states, causing some tobacco merchants in Kansas to either shut or relocate their stores to another state (Wagner, 2005). Similarly, the Price Waterhouse report, prepared for the conservative American Legislative Exchange Council, determined that during 1987 to 1991, when Connecticut had New England's highest combined sales and excise tax rates on cigarettes, it lost 2,261 jobs as residents crossed borders into Massachusetts and Rhode Island to avoid paying higher cigarette tax per-pack<sup>1</sup>. Hence, cross-border shopping due to differentials in sales and excise tax rates of states can be expected to have adverse effects on retail establishments and employment of high-taxed states, particularly counties near the border of high-taxed states.

Thus, the purpose of this chapter is to investigate whether the distance to the state border influences the impacts of own and the nearest neighboring states' sales and excise tax rates on a county's total number of establishments and employment for five retail industries: liquor stores, clothing stores, furniture stores, gasoline stations, and grocery stores. These five retail industries are among those most likely to be affected by cross-border shopping behaviors of consumers. For example, goods sold by clothing stores and furniture stores are expensive goods, and as the potential savings by border shopping to low tax states may be large for these goods, we expect the number of establishments and employment of clothing stores and furniture stores to be negatively affected by counties' own state sales tax rates and positively affected by the nearest neighboring state's sales tax rates. In addition, we also expect the number of establishments and employment of gasoline stations, liquor stores, and grocery stores to be negatively (positively) affected by counties' own state's (nearest neighboring state's) sales and excise tax rates. Most consumers spend more money in grocery stores, gasoline stations and liquor stores and shop them more often than any other type of stores. If consumers bear less costs to purchase grocery, gasoline and alcohol in nearby low sales or excise taxed states, then this would create negative impacts on the total number of establishments and

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<sup>1</sup> "Report: State policy taxes Maine economy" *Sun Journal*, August 6, 1992.

employment of grocery stores, gasoline stations and liquor stores of high taxed states' areas.

Using a county-level panel data of the forty-eight contiguous states over the period 1998 to 2007, I estimate how responsive counties' retail establishments and employment are to domestic and the nearest neighboring states' sales and excise tax rates, and relate the responsiveness to the county's distance to the state border. In particular, first, I estimate how retail establishments and employment of counties respond to sales and excise tax rates of own and the nearest neighboring states. Second, I estimate how the impacts of sales and excise tax rates of own and the nearest neighboring states on counties' retail establishments and employment vary linearly to the distance to the state border. Third, I estimate whether the effects of sales and excise tax rates of own and the nearest neighboring states on a county's retail establishments and employment vary discontinuously to the distance to the state border.

The results from these estimations suggest that sales tax rates and excise tax rates of own and the nearest neighboring states, in many cases, have significant influences on counties' retail establishments and employment. While considering how the distance to the state border influences the impacts of own and the nearest neighboring states' sales and excise tax rates on a county's retail establishments and employment, I find that sales or excise tax rates of own and the nearest neighboring states have more expected effects on retail establishments and employment of counties closer to the state border than of counties further away from the state border, however, the effects are not robust across all specifications. In this way, the results of this chapter are inconclusive regarding whether the impacts of own and the nearest neighboring states' sales and excise tax rates on retail establishments and employment of counties vary with the distance to the state border.

In the next section, I provide a brief review of the literature on the economic impacts of jurisdictions' commodity tax or price differences with emphasis on studies that have incorporated US data to examine the impacts of jurisdictions' commodity tax or price differences on retail sales, establishment or employment. Section 2.3 describes data,

Section 2.4 consists of empirical specifications, Section 2.5 presents the estimation results, and Section 2.6 concludes.

## **2.2 Literature Review**

Most previous studies have examined the effects of sales or excise tax differentials on economic activity aggregated to the state level. Coats (1995), Fleenor (1998), Saba et al. (1995) and Yurekli and Zhang (2000) estimated the impact of cigarette tax differentials on states' cigarette sales. Beard et al. (1997) and Fleenor (1999) looked at the effects of alcohol tax differentials on states' alcohol sales. The majority of these studies find that sales or excise tax differentials have negative impacts on high commodity taxed states' sales of goods. However, these studies do not show whether the effects of interstate sales or excise tax rate differentials on retail activities such as sales, establishment or employment differ between counties closer and further away from the border of states.

There are few studies that have examined the impacts of interstate commodity tax differentials on retail activity aggregated to a county level. Mikesell (1971) compared sales for various classes of goods in border and interior counties of Illinois. He found that total sales were lower in border counties than in interior counties of Illinois and suggested that sales tax differentials between Illinois and its adjacent states were the reasons for such findings. Fox (1986) focused on counties along the Tennessee state border and found evidence that the sales tax differentials had significant negative impacts on retail sales and employment. Walsh and Jones (1988) and Tosun and Skidmore (2007) focused on West Virginia's counties and found evidence that state sales tax differentials had significant effects on sales of food in border counties but not on sales of food in interior counties. However, these studies have not examined how the impact of neighboring states' sales and excise tax rates on retail establishments and employment may vary with distance from the border, the focus of my work.

There are also studies that have used consumer-level data to examine the relationship between border shopping and commodity price differences of US states.

Using micro-data on cigarette consumption in the US over the period 1992–2002, for example, Lovenheim (2008) developed and estimated a demand model that incorporated an individual's decision to purchase cigarettes across a lower-price border. He found evidence that consumers nearby lower-price states engaged in extensive cross-border shopping for cigarettes, estimating that between thirteen and twenty-five percent of consumers purchased cigarettes in lower-price states. Furthermore, using micro-data on cigarette consumption of U.S. smokers for February, June, and November 2003, Chiou and Muehlegger (2008) estimated that an individual would be willing to travel 2.7 miles to save one dollar on a pack of cigarettes. Yet, these studies do not estimate the impacts of commodity tax differences on counties' retail establishments and employment.

A small number of studies have looked at whether border-area retail industries respond to tax or price differences between jurisdictions by changing the number of retail establishments or/and employment. Campbell and Lephram (2004) examined whether price differentials caused by changes in real exchange rates between the US's and Canada's currencies affected the number of establishments and their average employment of four retail industries of the US. Using a county-level panel data of ten contiguous states of the US that border Canada over the period 1977 to 1996, they found evidence that when the price of goods in the US were lower to those in Canada due to a real exchange rate depreciation, the number of retail establishments of gasoline stations, food stores, and eating places increased in border counties but not in interior counties of the US. Similarly, the average employment of drinking places increased in only border counties of the US when price of goods fell lower to those in Canada due to the real exchange rate depreciation. In this way, this study indicates that exchange rate-driven price differentials between US and Canada have more impacts on retail establishments and employment of border counties relative to interior counties of the US. Nevertheless, it has not looked at if tax-driven price differentials between US states have more effects on retail establishments and employment of border counties relative to interior counties of the forty-eight contiguous states of the US.

Manuszak and Moul (2009) examined whether gasoline and cigarette tax differences in adjacent regions affected the concentration of retail gasoline capacity of northern Illinois and Indiana. Using cross-sectional data from 2001, they found that the concentration of retail gasoline capacity varied with respect to the tax border, lower in the border of a high taxed region and higher in the border of a low taxed region. Moreover, they estimate that Chicago, the jurisdiction with the highest taxes, would miss approximately forty percent of the capacity that would exist were taxes equalized. However, this study does not investigate how adjacent regions' gasoline and cigarette tax differences affect regions' employment on gasoline stations. Moreover, it does not look at whether adjacent regions' sales tax differences influence the number of establishment and employment of regions' other retail industries such as grocery stores and liquor stores.

In this way, previous studies have used state-level data of all forty-eight contiguous states or county-level data of one or few states to examine the impact of tax or price differences between jurisdictions on either retail sales, retail establishment, or retail employment of a jurisdiction. Yet, none of the studies have used county-level panel data of the forty-eight contiguous states to analyze whether sales and excise tax rates of own state and the nearest neighboring state have more impacts on the total number of retail establishments and employment of counties closer to the state border than of counties further away from the state border<sup>2</sup>.

### **2.3 Data**

To perform this analysis, I use a county-level panel data of the forty-eight contiguous states over the period 1998 to 2007<sup>3</sup>. These data include the total number of establishments and employees of liquor stores, clothing stores, furniture stores, gasoline stations, and grocery stores were taken from the U.S. Census Bureau, County Business Patterns (CBP). In the CBP, liquor stores were comprised of the beer, wine and liquor

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<sup>2</sup> Studies that consider European countries to study the effects of commodity tax or price differences between jurisdictions on economic activity include: Banfi et al. (2005), Asplund et al. (2007), and Leal et al. (2009). The results obtained from these studies, in general, confirm that commodity tax or price differences between jurisdictions have negative impacts on sales of goods in high-taxed jurisdictions.

<sup>3</sup> Definition of counties is referred from the Bureau of Economic Analysis.



stores. Clothing stores represented not only men, women, and children clothing stores, but also clothing accessories stores that sold products such as hats, jewelry, gloves, handbags, and shoes. The furniture stores represented furniture and home furnishing stores such as floor covering stores and window treatment stores. The gasoline stations consisted of gasoline stations with and without convenience stores. The grocery stores referred to supermarkets and convenience stores.

Data on effective tax rates rather than statutory tax rates were considered in this analysis as it was difficult to get statutory tax and standardize rates for taxes on alcohol and income. For instance, in the case of alcohol taxes, although all states levied excise taxes on beer, some states levied ad valorem mark up and/or excise taxes for distilled spirits and wine. It was unclear as how to compare ad valorem mark up on distilled spirits (or wine) in some states with excise taxes in other remaining states. In the case of income tax rates, since several states imposed different range of income tax rates for various individual income brackets, it was difficult to find a common comparable measure of statutory income tax rates among states. Therefore, for all taxes, state effective tax rates were determined by dividing state total tax collections in a tax category by personal income. State total tax collections data were obtained from the U.S. Census Bureau, while state total income data were obtained from the Bureau of Economic Analysis (BEA).

Data on whether the state has sales tax holidays were drawn from the Tax Policy Center – Urban Institute and Brookings Institution. Data on food tax exemptions were also collected from the Tax Policy Center – Urban Institute and Brookings Institution. However, there were missing data on state food tax exemptions for certain period in this data source. The missing data were then obtained from the various editions of the American Bar Association Sales and Use Tax Deskbook.

The distance from a county to the state border affects retail sales was obtained from the website of Thomas J. Holmes, where distance is calculated from the centroid of the county (Holmes, 2008). Using these data, I determined a county's distance to its nearest neighboring state (or nearest state border). County per capita income and total

population data were collected from the BEA. The percentage of elderly population, the percentage of young population, the percentage of black population, the percentage of other race population, and the percentage of male population between ages twenty and sixty-four years of counties were obtained from the U.S. Census Bureau.

Table 2.1 provides the summary statistics of the entire sample. During the period 1998 to 2007, of all five retail industries, gasoline stations had the highest average number of establishments per 1,000 county residents. Over the same period, however, grocery stores had the largest average number of employees per 1,000 county residents. The average effective tax rates on own state are 2.12 percent for sales taxes, 0.11 percent for tobacco taxes, 0.44 percent for fuel taxes, and 0.05 percent for alcohol taxes during the years 1998 to 2007.

*Table 2.1—Descriptive Statistics, 1998–2007*

<b>Variables</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev.</b>
<i>Establishment per 1,000 County Residents</i>			
Grocery Stores	30770	0.421	0.275
Gasoline Stations	30770	0.702	0.373
Clothing Stores	30770	0.344	0.378
Furniture Stores	30770	0.190	0.145
Alcohol Stores	30770	0.110	0.128
<i>Employment per 1,000 County Residents</i>			
Grocery Stores	17128	8.965	3.467
Gasoline Stations	28185	5.482	3.816
Clothing Stores	22943	2.920	3.377
Furniture Stores	20695	1.326	1.240
Alcohol Stores	16147	0.394	0.700
<i>Own State Tax Rates (% of Personal Income)</i>			
Sales Tax	30770	2.121	0.721
Tobacco Tax	30770	0.106	0.062
Fuel Tax	30770	0.439	0.129
Alcohol Tax	30770	0.053	0.030
Income Tax	30770	2.028	1.087
Property Tax	30770	0.126	0.290

Table 2.1 continued

<b>Variables</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev.</b>
<i>Nearest Neighboring State's Tax Rates (% of Personal Income)</i>			
Sales Tax	30770	2.126	0.753
Tobacco Tax	30770	0.106	0.061
Fuel Tax	30770	0.443	0.120
Alcohol Tax	30770	0.051	0.031
Income Tax	30770	2.073	0.998
Property Tax	30770	0.131	0.306
<i>Own Other Tax Dummies</i>			
Local Tax (=1 if a county's state has local sales tax; 0 = other)	30770	0.810	0.392
Food Tax Exempt (=1 if county's food items are tax exempt; 0 = other)	30770	0.638	0.481
Sales Tax Holidays (=1 if county has sales tax holidays; 0 = other)	30770	0.258	0.437
<i>Nearest Neighboring State's Other Tax Dummies</i>			
Local Tax (=1 if the nearest neighboring state has local sales tax; 0 = other)	30770	0.806	0.396
Food Tax Exempt (=1 if the nearest neighboring state allows food tax exemption; 0 = other)	30770	0.552	0.497
Sales Tax Holidays (=1 if the nearest neighboring state has sales tax holidays; 0 = other)	30770	0.206	0.404
<i>Other Variables</i>			
Distance to the state border (miles)	30770	48.897	51.546
Per capita Income (thousand dollars)	30770	25.163	6.869
Male (Percentage of male population between 20 to 64 years old)	30770	29.116	2.816
Black (Percentage of Black population)	30770	8.948	14.466
Other Race (Percentage of Other race population)	30770	2.573	6.436
Elderly (Percentage of population over 64 years)	30770	15	4.125
Young (Percentage of population 5-19 years old)	30770	21.139	2.552

Table 2.2 compares the means for five retail industries' establishments and employment per 1,000 county residents for (i) border counties, (ii) interior counties, (iii) high-sales taxed border counties, and (iv) low- sales taxed border counties of the forty-eight contiguous states during the period 1998 to 2007. It illustrates that in the case of retail establishment, the average numbers of grocery stores per 1,000 residents are slightly higher in border counties than in interior counties. Low sales-taxed border

counties have slightly greater average number of establishments of grocery stores per 1,000 residents than high sales-taxed border counties. The average numbers of gasoline stations or liquor stores per 1,000 residents are higher in border counties relative to interior counties, however, there are no differences in average numbers of gasoline stations or liquor stores between high sales-taxed border counties and low-sales taxed border counties. There are no differences in average number of furniture stores and clothing stores per 1,000 residents between interior and border counties. On the contrary, low-sales taxed border counties have slightly higher average number of furniture stores and clothing stores per 1,000 residents than high-sales taxed border counties.

Table 2.2 also shows that in the case of retail employment, the average number of employment of grocery stores per 1,000 residents is slightly higher in border counties than in interior counties. Besides, low sales-taxed border counties have little higher grocery stores' employment per 1,000 residents than high sales-taxed border counties. The average number of employment of gasoline stations or liquor stores per 1,000 residents are higher in border counties than in interior counties, however, gasoline stations and liquor stores of high-sales taxed border counties have slightly unexpected higher average number of employment per 1,000 residents than those of low-sales taxed border counties. The average number of employment per 1,000 residents in furniture stores is higher in interior counties than in border counties, but high-sales taxed border counties have a lower average number of employees in furniture stores than low-sales taxed border counties. The clothing stores have larger average number of employment per 1,000 residents in interior counties than in border counties. In addition, they also have slightly greater average number of employment per 1,000 residents in low-sales taxed border counties than in high-sales taxed border counties.

*Table 2.2—Comparison of Means of Retail Establishments and Employment per 1,000 County Residents*

	Interior counties	Border counties	High Sales-taxed Border counties	Low Sales-taxed Border counties
<i>Establishments per 1,000 Residents</i>				
Grocery Stores	0.42	0.43	0.41	0.44
Gasoline Stations	0.69	0.72	0.72	0.72
Furniture Stores	0.19	0.19	0.19	0.20
Clothing Stores	0.34	0.34	0.34	0.35
Liquor Stores	0.11	0.12	0.12	0.12
<i>Employment per 1,000 Residents</i>				
Grocery Stores	8.95	8.99	8.88	9.09
Gasoline Stations	5.35	5.70	5.73	5.68
Furniture Stores	1.35	1.28	1.25	1.31
Clothing Stores	2.96	2.86	2.79	2.93
Liquor Stores	0.36	0.46	0.46	0.45

## 2.4 Econometric Specification

I begin my estimation by considering four specifications. First, I analyze how the total number of establishments and employees of five retail industries of counties are correlated to the tax rates of their own state and their nearest neighboring state. Second, I estimate a specification in which I measure the interaction effects not only between tax rates of a home county's state and distance of the home county to the nearest state border, but also between tax rates of the home county's nearest neighboring state and distance of the home county to this nearest neighboring state. Third, I perform a dynamic analysis of the second estimation by including the lagged value of a dependent variable as one of the regressors. Fourth, to control for possible spillover effects among counties' retail establishments, I analyze a spatial analysis of the second specification by including the spatial lag variable. This fourth estimation is not performed for the number of employees of five retail industries. There are missing data on employment for some counties' retail industries<sup>4</sup>, and hence, it is not possible to obtain full values for the spatial lag variable of

<sup>4</sup> The CBP data source withholds employment data for any county-industry observation where the data might reveal confidential information about an individual producer.

employment (or the weighted average of neighboring counties' total number of employees).

#### 2.4.1 Impact of State Tax Rates

I estimate a fixed-effect model to examine the impacts of sales and excise tax rates of a home county's state and nearest neighboring state on the total number of establishments and employment per 1,000 residents of five retail industries of the home county. The equation to be estimated is as follows:

$$E_{ijk,t,r} = \alpha_0 + \alpha_1 ST_{ij,t-1} + \alpha_2 NST_{ij,t-1} + \alpha_3 LT_{ij,t-1} + \alpha_4 NLT_{ij,t-1} + MT_{ijk,t-1}\gamma + NMT_{ijk,t-1}\delta + OT_{ij,t-1}\chi + Z_{ijk,t-1}\phi + X_{ijt}\beta + \mu_i + \lambda_t + \varepsilon_{ijk,t,r} \quad (2.1)$$

where the  $i$  subscript refers to the local county. The  $j$  subscript refers to the state and the  $k$  subscript refers to the type of retail industry such that  $k$  equals grocery stores, gasoline stations, furniture stores, clothing stores, and liquor stores. The  $t$  subscript refers to the time. The  $r$  subscript refers to either retail establishments or employees. The outcome variable,  $E_{ijk,t,r}$ , means the total number of establishments (or employees) per 1,000 residents of  $k$  retail industry of county  $i$  of state  $j$  at period  $t$ . The terms  $ST$  and  $NST$  represent sales tax rates of a county's own state and nearest adjacent state, respectively.

Some states have variation in sales tax rates across counties and/or within counties. For instance, there were thirty-three states that allowed their counties or cities to charge a local sales tax during 1998 to 2002. Similarly, the number of states that permitted additional local sales tax rates in their counties and cities were thirty-four during periods 2003 to 2007. However, data on actual rates on county-level local sales tax are not readily available for 3077 counties over a ten year period from 1998 to 2007. Thus, to control for the local sales tax rates of counties in equation (2.1), I create two dummy variables: the first dummy variable, referred as  $LT$ , indicates one if a county's own state allows local sales tax rates, and zero otherwise; and the second dummy variable,  $NLT$ , indicates one if the county's nearest neighboring state allows local sales tax rates, and zero otherwise.

The terms *MT* and *NMT* represent excise tax rates of the county's own state and nearest neighboring state. These excise taxes influence only specific retail industries such as liquor stores, gasoline stations and grocery stores. In particular, for liquor stores, *MT* and *NMT* refer to alcohol tax rates of a county's own state and nearest adjacent state, respectively. For gasoline stations, while *MT* refers to fuel tax rates and tobacco tax rates of a home county's state, *NMT* refers to a home county's nearest adjacent state's fuel tax rates and tobacco tax rates. For grocery stores, *MT* and *NMT* denote tobacco tax rates of home county's state and the nearest adjacent state of home county, respectively.

It is expected that the number of establishments and employees of a county's five retail industries are inversely related to home county's state's sales and excise taxes and positively related to its nearest neighboring state's sales and excise taxes. The higher the sales or excise taxes of a home county's state, the higher the possibility of border shopping from the home county to the nearest low sales or excise taxed neighboring state. Thus, this cross-border shopping to low commodity taxed state is expected to have negative impacts on the total number of retail establishments and employment per *1,000* residents of the home county. Correspondingly, the higher the commodity tax rates of a home county's nearest neighboring state, the higher the possibility of border shopping to home county from the nearest neighboring state, and thus, this is expected to have positive effects on the total number of retail stores and employees of the home county.

Meanwhile, other taxes such as individual income taxes and property taxes may also influence the number of retail establishments and retail employees of a county. For example, in counties that have higher income tax rates, retailers would need to offer higher wages to persuade employees to work for them. Similarly, in counties that have higher property tax rates, retailers may have to pay higher rent price for land and buildings. Since higher wages and rents increase the cost of doing retail business, the higher income tax rates and property tax rates of counties can generate negative incentives for retailers to establish their stores as well as demand more employees to work in retail stores. Thus, the term *OT* in equation (2.1) controls for individual income tax rates and property tax rates of own and nearest neighboring states.

The term  $Z$  consists of additional dummy variables that influence specific retail industries. In particular, for grocery stores, the term  $Z$  includes two dummy variables: the first dummy variable is equal to one if a home county allows food tax exemptions, and zero otherwise; and the second dummy variable equals one if the home county's nearest neighboring state has food tax exemptions, and zero otherwise. The impacts of counties' own food tax exemptions on their total number of grocery stores and employees are expected to be positive. Food tax exemptions lower the final price of groceries to consumers, and this is expected to increase consumers' demand for grocery. Higher grocery demand may then induce positive impacts on the total number of establishments and employees of grocery stores per 1,000 residents of counties.

For clothing stores, the term  $Z$  includes two dummy variables: the first dummy variable indicates one if a county's state has sales tax holidays, and zero otherwise; and the second dummy variable indicates one if a county's nearest neighboring state has sales tax holidays, and zero otherwise. During sales tax holidays, clothing items are exempted from sales tax rates<sup>5</sup>. Demand for clothing goods can increase in the absence of sales tax rates, which in turn may have some positive effects on the total number of establishments and employees of clothing stores per 1,000 residents of counties.

All tax terms in equation (2.1) are one year lagged. There are two reasons for lagging the tax terms. First, it is used to control for possible endogeneity of tax variables. For example, the total number of retail establishments (employment) and sales tax rates of either home county's state or nearest neighboring state may be jointly determined. If a lower number of retail establishments (employment) of counties encourages a state to change their tax rates in comparison to its neighboring state, then this means that the total number of retail establishments (employment) of counties affect the tax rates of home county's state and the nearest neighboring state. Second, since retail firms require time to relocate and change employment levels, they are likely to make their employment and location decisions based on previous period's taxes rather than current year taxes.

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<sup>5</sup> According to the Federation of Tax Administrators, most states typically exempt clothing items of priced \$100 from sales tax rates during sales tax holidays (FTA, 2010).



The term  $X$  includes economic and demographic characteristics of a county that influence the total number of establishments and employees of retail industry  $k$  per 1,000 residents, such as per capita income, the percentage of elderly population, the percentage of young population, the percentage of black population, the percentage of other race population, and the percentage of male population between ages twenty and sixty-four years. The county effects,  $\mu_i$ , control for all unobserved county characteristics that remain constant over time, such as transportation routes. The time effects,  $\lambda_t$ , account for all factors that affect all counties in a given year. The error term  $\varepsilon_{ijtk,r}$  is a mean zero, normally distributed random error.

#### 2.4.2 *Impact of State Tax Rates Interacted with Distance*

As discussed in the introduction section, the impacts of sales and excise tax rates of own and nearest adjacent states on a county's total number of establishments and employment of a retail industry may depend on the magnitude of the county's distance to another state. Therefore, to account for this issue, I include interaction terms between tax variables and distance of a county to the nearest state border in equation (2.1)<sup>6</sup>. The equation to be estimated is then specified as follows:

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<sup>6</sup> Another possible way to account for this factor is by interacting tax variables with a border dummy variable that equals one if a county lies on the border with another state, and zero otherwise. However, for this analysis, I consider distance of a county to the state border to be a better measure than a border dummy variable. Some counties may not lie on the border with another state, but their distance to another state may be small for consumers to engage in cross-border shopping. These counties can mostly be seen in states that belong to the eastern parts of the US, such as Virginia, Pennsylvania, and Kentucky. At the same time, some counties may lie on the border with another state, but the distance that consumers need to travel for cross-border shopping is so big that it discourages them to participate in cross-border shopping. These counties can mostly be found in states such as Arizona, Nevada, and Utah. Thus, it is the distance of the county to the state border, and not whether a county lies on the border, should mostly affect consumers' decisions to do cross-border shopping, which in turn then should reflect the number of retail establishments and employment of a county.

$$\begin{aligned}
E_{ijkt,r} = & \alpha_0 + \alpha_1 ST_{ij,t-1} + \alpha_2 (ST \times D)_{ij,t-1} + \alpha_3 NST_{ij,t-1} + \alpha_4 (NST \times D)_{ij,t-1} \\
& + \alpha_5 LT_{ij,t-1} + \alpha_6 NLT_{ij,t-1} + MT_{ijk,t-1} \gamma + (MT \times D)_{ijk,t-1} \rho + NMT_{ijk,t-1} \delta \\
& + (NMT \times D)_{ijk,t-1} \sigma + OT_{ij,t-1} \chi + (OT \times D)_{ij,t-1} \kappa + Z_{ijk,t-1} \phi + X_{ijt} \beta \\
& + \mu_i + \lambda_t + \varepsilon_{ijkt,r}
\end{aligned} \tag{2.2}$$

where the term  $D$  refers to the distance of a county to the state border, and the remaining variables are same as in equation (2.1). It is expected that the impacts of sales or excise tax rates of a county's own state and nearest neighboring state on the total number of retail establishments (employees) of the county to decrease in the distance of the county to the state border. That is, for all tax variables, I expect the coefficients on the home county's state sales or excise tax rates interacted with distance to be positive and the coefficients of the home county's nearest neighboring state sales or excise tax rates interacted with distance to be negative.

#### 2.4.3 Dynamic Analysis

The number of retail establishments (employment) of a county's previous year may affect its current period's number of retail establishments (employment). Hence, to allow the total number of retail establishments (employment) per 1,000 residents to dynamically adjust to past number of retail establishments (employment) per 1,000 residents, I include a lagged dependent variable in equation (2.2):

$$\begin{aligned}
E_{ijkt,r} = & \alpha_0 + \theta_r E_{ijkt-1,r} + \alpha_1 ST_{ij,t-1} + \alpha_2 (ST \times D)_{ij,t-1} + \alpha_3 NST_{ij,t-1} + \\
& \alpha_4 (NST \times D)_{ij,t-1} + \alpha_5 LT_{ij,t-1} + \alpha_6 NLT_{ij,t-1} + MT_{ijk,t-1} \gamma + \\
& (MT \times D)_{ijk,t-1} \rho + NMT_{ijk,t-1} \delta + (NMT \times DT)_{ijk,t-1} \sigma + OT_{ij,t-1} \chi + \\
& (OT \times D)_{ij,t-1} \kappa + Z_{ijk,t-1} \phi + X_{ijt} \beta + \mu_i + \lambda_t + \varepsilon_{ijkt,r}
\end{aligned} \tag{2.3}$$

where  $\theta$  is the coefficient on the lagged dependent variable that accounts for dynamics. The fixed-effect method will produce biased estimates as the lagged dependent variable and county fixed effects are probably correlated. To solve this issue, first I obtain the first-differenced of all variables except year-fixed variables in equation (2.3). The resulting equation becomes:

$$\begin{aligned}
E_{ijk,t,r} = & \theta_r \Delta E_{ijk,t-1,r} + \alpha_1 \Delta ST_{ij,t-1} + \alpha_2 \Delta (ST \times D)_{ij,t-1} + \alpha_3 \Delta NST_{ij,t-1} + \\
& \alpha_4 \Delta (NST \times D)_{ij,t-1} + \alpha_5 \Delta LT_{ij,t-1} + \alpha_6 \Delta NLT_{ij,t-1} + \Delta MT_{ijk,t-1} \gamma + \\
& \Delta (MT \times D)_{ijk,t-1} \rho + \Delta NMT_{ijk,t-1} \delta + \Delta (NMT \times D)_{ijk,t-1} \sigma + \Delta OT_{ij,t-1} \chi + \\
& \Delta (OT \times D)_{ij,t-1} \kappa + \Delta Z_{ijk,t-1} \phi + \Delta X_{ijt} \beta + \lambda_t + \Delta \varepsilon_{ijk,t,r}
\end{aligned} \tag{2.4}$$

The above equation is then estimated using the Arellano-Bond (1991) estimator, which is a General Method of Moments (GMM) estimator correcting for endogeneity by including the lags of dependent variable. That is, I instrument the lagged dependent variable by using the dynamic instruments ( $E_{ijk,t-2,r}, \dots, E_{ijk,0,r}$ ) suggested by Arellano and Bond (1991).

#### 2.4.4 Spatial Lag Analysis

There may be spillover effects between counties. For example, changes in the number of retail establishments in one county may affect the number of same retail establishments in another county. To account for this possible spatial relationship between counties, I include the spatial lag term in equation (2.2):

$$\begin{aligned}
E_{ijk,t,r} = & \alpha_0 + \psi_k \sum_{i \neq h} w_{ih} E_{hkt,r} + \alpha_1 ST_{ij,t-1} + \alpha_2 (ST \times D)_{ij,t-1} + \alpha_3 NST_{ij,t-1} + \\
& \alpha_4 (NST \times D)_{ij,t-1} + \alpha_5 LT_{ij,t-1} + \alpha_6 NLT_{ij,t-1} + MT_{ijk,t-1} \gamma + \\
& (MT \times D)_{ijk,t-1} \rho + NMT_{ijk,t-1} \delta + (NMT \times D)_{ijk,t-1} \sigma + OT_{ij,t-1} \chi + \\
& (OT \times D)_{ij,t-1} \kappa + Z_{ijk,t-1} \phi + X_{ijt} \beta + \mu_i + \lambda_t + \varepsilon_{ijk,t,r}
\end{aligned} \tag{2.5}$$

The term  $w_{ih}$  is the weight assigned to county  $h$  by county  $i$ . That means,  $w_{ih} = 1/n_i$  if county  $i$  and  $h$  are contiguous, and zero if they are not, where  $n_i$  represents the total number of contiguous counties. The spatial weight is row normalized so that  $\sum_{i \neq h} w_{ih} = 1$ .

Since the total number of establishments of retail industry  $k$  per 1,000 residents in neighboring counties is endogenous in the above equation, the equation is estimated by using the weighted average of neighboring counties' per capita income as an instrument for neighboring counties' total number of retail establishments per 1,000 residents. The

weight used for this instrument is the same as that used in the average neighboring counties' retail establishment.

## **2.5 Results**

### *2.5.1 Establishment Results*

Tables 2.3 to 2.7 report results for the total number of establishments per 1,000 county residents of each five retail industries I consider. In each table, the first column displays results from equation (2.1). The second and third columns present results from estimating equation (2.2) with and without county fixed effects. The fourth and fifth columns display results from estimating equations (2.4) and (2.5), respectively.

For most of the five retail industries, I find that the sales and excise tax rates of domestic and the nearest neighboring states have significant impacts on retail establishments of counties. While considering whether the impacts of domestic and the nearest neighboring states' sales and excise tax rates on counties' retail establishments depend on the distance of a county to the state border, I find that the significances of the coefficients of domestic and the nearest neighboring state sales (excise) tax rates and sales (excise) tax rates interacted with distance of a county to the state border are sensitive to an exclusion of fixed effects and inclusion of either the lagged dependent variable or the spatial lag variable. For instance, when fixed effects are excluded to estimate equation (2.2), the tax terms are highly significant and larger in magnitudes. Often times, I find that sales or excise tax terms that are insignificant in other specifications are significant when equation (2.2) is estimated without county fixed effects. This probably indicates that tax rates are stable over time in many states and thus, they are accounted for in county fixed effects. Nonetheless, since results from estimating equation (2.2) without county fixed effects are biased as they do not account for county unobserved heterogeneity, in the following result section by industry, the impact of sales and excise tax terms on establishments of a retail industry will be considered robust if the impacts of these taxes are significant in specifications that account for both county fixed effects and year fixed effects.

### *2.5.1.1 Grocery Stores' Establishment Results*

Table 2.3 presents results for the total number of establishments of grocery stores. The first column shows that sales tax rates of own state have expected negative effects on counties' total number of establishments of grocery stores per 1,000 residents. Similarly, the nearest neighboring state's tobacco tax rates also have expected positive impacts on counties' total number of establishments of grocery stores per 1,000 residents. In contrast, the nearest neighboring state's sales tax rates and own state's tobacco tax rates have no significant impacts on counties' total number of establishments of grocery stores per 1,000 residents.

The second column shows that the coefficients on own state's sales tax rates and own state's sales tax rates interacted with distance are jointly significant, thereby suggesting that sales tax rates of own state have more negative effects on the total number of grocery stores per 1,000 residents of counties that are closer to the state border. Similarly, the joint significance of the coefficients on tobacco tax rates of the nearest neighboring state and its interaction term indicates that the nearest neighboring state's tobacco tax rates have more positive effects on the total number of establishments of grocery stores per 1,000 residents of counties closer to the state border.

The third column reports that when fixed effects are not accounted in the model of the second column, the coefficients on own state tobacco tax rates and the nearest neighboring state sales tax rates, which are insignificant in the first and second columns, have significant effects on the total number of grocery stores per 1,000 residents of counties. Moreover, signs of some of the coefficients are changed in this column. For example, the coefficients on the nearest neighboring state's tobacco tax rates interacted with distance and own state's sales tax rates interacted with distance have opposite signs to those observed in the second column.

The fourth column reveals that when counties' past year's total number of establishments of grocery stores is accounted for in the model of the second column, the coefficients on own state's sales tax rates and its interaction term still have significant

negative effects on the total number of establishments of grocery stores per 1,000 residents of counties closer to the state border. In particular, a rise in own state sales tax rates by one percent is expected to decrease grocery store establishments by 0.04 units per 1,000 county residents in the short run and 0.11 units per 1,000 county residents in the long run. Besides, although the coefficients on own state's tobacco tax rates and its interaction term have same signs as in the second column, they are not jointly significant in the fourth column.

The fifth column indicates that when the average numbers of grocery stores' establishments in neighboring counties are accounted for in the model of the second column, only the coefficients on own state sales tax rates and its interaction term are statistically significant. Alike in the second column, the nearest neighboring state tobacco tax rates have more positive effects on the total numbers of establishments of grocery stores of counties closer to the state border, however, the effect is not statistically significant.

To sum up, I find that while sales tax rates of own state have negative effects on counties' total number of establishments of grocery stores per 1,000 county residents, the nearest neighboring states' tobacco tax rates have expected positive effects on counties' total number of establishments of grocery stores per 1,000 county residents. Considering how distance to the state border influences the impacts of own and the nearest neighboring states' sales or excise tax rates on the total number of establishments of grocery stores per 1,000 residents of a county, I find that sales tax rates of own state have robust negative effects on the total number of establishments of grocery stores per 1,000 residents of counties closer to the state border. The nearest neighboring state's tobacco tax rate has a positive effect on the total number of establishments of grocery stores of counties closer to the state border, however, the effect is not statistically significant across different specifications. Similarly, although the coefficient on local sales tax of own state has an expected negative sign, it is not statistically significant across different specifications. Food tax exemption has an expected positive effect on the total

establishments of grocery stores per 1,000 county residents, but it is never statistically significant.

*Table 2.3—Impacts of Sales and Excise Tax Rates on the Total Number of Establishments of Grocery Stores per 1,000 County Residents*

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
Grocery Stores <sub>t-1</sub>				0.642 (9.60)***	
Neighboring County Grocery Stores					0.013 (0.96)
Sales Tax	-0.029 (3.39)***	-0.037 (3.88)*** <sup>a</sup>	-0.025 (6.88)*** <sup>a</sup>	-0.039 (2.55)** <sup>a</sup>	-0.036 (3.74)*** <sup>a</sup>
Sales Tax × Distance		0.0001 (0.85) <sup>a</sup>	-0.0001 (1.62) <sup>a</sup>	0.00002 (0.08) <sup>a</sup>	0.0003 (1.29) <sup>a</sup>
Neighboring State Sales Tax	0.003 (0.51)	0.001 (0.10)	-0.016 (4.90)*** <sup>a</sup>	0.003 (0.18)	0.016 (0.89)
Neighboring State Sales Tax × Distance		0.00003 (0.33)	0.00008 (1.93) <sup>a</sup>	0.0002 (0.74)	-0.00004 (0.33)
Tobacco Tax	0.012 (0.44)	0.062 (1.81)*	-0.152 (3.61)*** <sup>a</sup>	-0.013 (0.25)	0.07 (1.70)*
Tobacco Tax × Distance		-0.001 (1.51)	0.001 (1.45) <sup>a</sup>	-0.001 (0.76)	-0.0002 (0.20)
Neighboring State Tobacco Tax	0.127 (5.33)***	0.146 (4.58)*** <sup>a</sup>	0.032 (0.89) <sup>a</sup>	0.045 (0.98)	0.108 (1.94)*
Neighboring State Tobacco Tax × Distance		-0.0004 (0.73) <sup>a</sup>	0.001 (1.18) <sup>a</sup>	-0.0004 (0.53)	-0.001 (0.85)
Local Sales Tax	-0.055 (6.79)***	-0.054 (6.66)***	-0.056 (14.43)***	-0.022 (1.22)	-0.034 (1.51)
Neighboring State Local Sales Tax	0.012 (1.58)	0.013 (1.70)*	-0.022 (7.25)***	-0.006 (0.48)	0.041 (1.34)
Food Tax Exemption	0.008 (0.97)	0.008 (1.06)	0.003 (0.96)	0.023 (1.52)	0.021 (1.40)
Neighboring State Food Tax Exemption	-0.008 (1.31)	-0.009 (1.35)	-0.014 (4.22)***	0.00002 (0)	0.002 (0.14)
County fixed effects	Y	Y	N	Y	Y
Year fixed effects	Y	Y	Y	Y	Y

*Notes:* Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels. Joint significance at a 5% significance level of a tax term and tax term interacted with a distance variable is indicated by the superscript letter “a”. Detailed estimates and additional explanatory variables are reported in Table A1 in Appendix.

### *2.5.1.2 Gasoline Stations' Establishment Results*

Table 2.4 provides results for the total number of establishments of gasoline stations per 1,000 residents of counties. The first column reports that the total numbers of establishments of gasoline stations per 1,000 residents of counties are negatively affected by own state's fuel tax rates, tobacco tax rates, and the nearest neighboring state's tobacco tax rates. It also shows that total numbers of establishments of gasoline stations per 1,000 residents of counties are positively affected by own state's sales tax rates.

The second column shows that the coefficients on own state fuel tax rates and own state fuel tax rates interacted with distance are jointly significant, thereby inferring that fuel tax rates of own state have lower unexpected negative effects on the total number of establishments of gasoline stations per 1,000 residents of counties closer to the state border. The coefficients on tobacco tax rates of the nearest neighboring state and its interaction term are also jointly significant, and they suggest that the nearest neighboring state's tobacco tax rates have lower negative influences on the total number of gasoline stations per 1,000 residents of counties closer to the state border. In contrast, the joint significance of the coefficients on sales tax rates of own state and its interaction term suggests that sales tax rates of own state have more expected negative impacts on the total number of establishments of gasoline stations per 1,000 residents of counties nearer to the state border. The third column shows that when unobserved county heterogeneity is not accounted in the model of the second column, the coefficients of sales or excise tax terms are highly significant.

The fourth column reveals that previous year's total number of gasoline stations of counties have positive impacts on current year's total number of gasoline stations of counties. However, none of the commodity tax terms and their interaction terms are jointly significant. These results, therefore, suggest that there are no major shocks in sales and excise tax rates of many states over the ten-year time period considered here.

The fifth column shows that when the spatial lag variable is included in the model of the second column, the coefficients of sales or excise tax terms that are jointly



significant in the second column are still jointly significant, and they also have same signs as those in the second column. These coefficients include own state's fuel tax variables, nearest neighboring state's tobacco tax variables and own state's sales tax variables. Moreover, unlike in the second column, it indicates that there is a joint significance of coefficients of own state's tobacco tax rates and its interaction term, thereby indicating that the total numbers of establishments of gasoline stations per 1,000 residents of counties closer to the state border are more negatively affected by own state's tobacco tax rates.

To sum up, I find that the total number of establishments of gasoline stations per 1,000 residents of counties are significantly affected by own state's fuel tax rates, tobacco tax rates, sales tax rates, and the nearest neighboring state's tobacco tax rates. Moreover, I also find that own state's fuel tax rates, sales tax rates and nearest neighboring state's tobacco tax rates have more effects on the total number of gasoline stations per 1,000 residents of counties closer to the state border. However, these impacts are found insignificant in the fourth column that accounts for the lagged dependent variable in the model of the second column. Thus, there is no robust evidence to indicate that the impacts of own state's fuel tax rates, sales tax rates and nearest neighboring state's tobacco tax rates on a county's total number of gasoline stations per 1,000 residents vary with the distance to the state border. Similarly, regarding local sales tax variables, although the coefficient on the local sales tax of domestic state is found positive, it is not found significant in all specifications.

Table 2.4—Impacts of Sales and Excise Tax Rates on the Total Number of Establishments of Gasoline Stations per 1,000 County Residents

Variable\Specification	(1)	(2)	(3)	(4)	(5)
Gasoline Stations <sub>t-1</sub>				0.527 (10.39)***	
Neighboring County Gasoline Stations					-0.004 (1.70)*
Fuel Tax	-0.113 (4.00)***	-0.078 (2.00)** <sup>a</sup>	0.259 (10.93)*** <sup>a</sup>	-0.122 (0.98)	-0.096 (2.30)** <sup>a</sup>
Fuel Tax × Distance		-0.001 (1.22) <sup>a</sup>	-0.001 (3.76)*** <sup>a</sup>	0.0004 (0.13)	-0.001 (1.42) <sup>a</sup>
Neighboring State Fuel Tax	0.008 (0.28)	0.022 (0.61)	0.16 (5.78)*** <sup>a</sup>	-0.072 (0.48)	0.02 (0.53)
Neighboring State Fuel Tax × Distance		-0.0003 (0.57)	0.003 (6.59)*** <sup>a</sup>	0.001 (0.39)	-0.0002 (0.33)
Tobacco Tax	-0.065 (1.94)*	-0.094 (1.99)**	-1.079 (21.57)*** <sup>a</sup>	1.622 (0.83)	-0.136 (2.65)*** <sup>a</sup>
Tobacco Tax × Distance		0.0005 (0.66)	0.008 (11.01)*** <sup>a</sup>	-0.02 (0.80)	0.001 (1.23) <sup>a</sup>
Neighboring State Tobacco Tax	-0.216 (6.42)***	-0.205 (4.63)*** <sup>a</sup>	-0.116 (2.27)** <sup>a</sup>	-1.115 (0.60)	-0.24 (4.97)*** <sup>a</sup>
Neighboring State Tobacco Tax × Distance		-0.0003 (0.45) <sup>a</sup>	-0.001 (0.86) <sup>a</sup>	0.003 (0.08)	-0.0003 (0.49) <sup>a</sup>
Sales Tax	0.025 (2.89)***	-0.009 (0.84) <sup>a</sup>	-0.001 (0.19) <sup>a</sup>	0.033 (0.83)	-0.006 (0.50) <sup>a</sup>
Sales Tax × Distance		0.001 (4.23)*** <sup>a</sup>	-0.0004 (6.50)*** <sup>a</sup>	-0.0002 (0.25)	0.001 (3.73)*** <sup>a</sup>
Neighboring State Sales Tax	0.008 (0.96)	0.003 (0.32)	-0.012 (2.24)** <sup>a</sup>	-0.025 (0.93)	0.006 (0.67)
Neighboring State Sales Tax × Distance		0.00005 (0.41)	-0.0003 (4.35)*** <sup>a</sup>	0.0004 (0.59)	0.00004 (0.31)
Local Sales Tax	0.04 (4.31)***	0.038 (4.03)***	0.041 (9.28)***	0.038 (1.25)	0.046 (3.73)***
Neighboring State Local Sales Tax	-0.011 (1.24)	-0.012 (1.32)	0.052 (12.82)***	0.021 (0.49)	-0.012 (1.08)
Observations	27693	27693	27693	24616	27693
County fixed	Y	Y	N	Y	Y
Year fixed	Y	Y	Y	Y	Y

Notes: See Table 2.3 for additional notes on significances on signs of coefficients. Detailed estimates and additional explanatory variables are reported in Table A2 in Appendix.

### *2.5.1.3 Furniture Stores' Establishment Results*

Table 2.5 presents results for the total number of establishments of furniture stores per 1,000 residents of counties. The first column shows that own state's sales tax rates have expected negative impacts on the total number of establishments of furniture stores per 1,000 residents of counties. The nearest neighboring state's sales tax rates also have expected positive effects on the total number of establishments of furniture stores per 1,000 residents of counties. However, both the coefficients on own state's sales tax rates and nearest neighboring state's sales tax rates are not statistically significant.

The second column shows that own state's sales tax rates have unexpected more positive effects on the total number of furniture stores per 1,000 residents of counties closer to the state border. The third column re-estimates the model as in the second column without fixed effects. Unlike in the second column, the coefficients on the nearest neighboring state sales tax rates and its interaction term are jointly significant in this column. The fourth column reports that with the addition of the lagged dependent variable to the model as in the second column, there is neither the joint significance of coefficients on own state's sales tax rates and its interaction term nor the joint significance of the nearest neighboring state's sales tax rates and its interaction term. The fifth column show results with the addition of the weighted average of neighboring counties' total number of furniture stores per 1,000 residents to the model as in the second column. The average establishments of neighboring counties' furniture stores have significant positive impacts on counties' own total number of furniture stores per 1,000 residents. However, alike in the fourth column, there is no joint significance of coefficients on either own state's sales tax rate variables or the nearest neighboring state's sales tax rate variables.

To sum up, although sales tax rates of own state and the nearest neighboring state, respectively, have expected negative and positive effects on the total number of establishments of furniture stores per 1,000 residents of counties, the effects of these tax rates are not statistically significant. In addition, there is no statistically significant evidence that sales tax rates of own state and the nearest neighboring state have more

impacts on the total number of establishments of furniture stores per 1,000 residents of counties closer to the state border. The coefficients on local sales tax of own state and the nearest neighboring state occasionally have negative signs, however, they are not statistically significant across different specifications.

*Table 2.5—Impacts of Sales Tax Rates on the Total Number of Establishments of Furniture Stores per 1,000 County Residents*

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
Furniture Stores <sub>t-1</sub>				0.512 (10.54)***	
Neighboring County Furniture Stores					0.012 (4.12)***
Sales Tax	-0.004 (1.49)	0.005 (1.22) <sup>a</sup>	0.005 (3.03)*** <sup>a</sup>	0.005 (0.81)	-0.001 (0.16)
Sales Tax × Distance		-0.0002 (3.71)*** <sup>a</sup>	0.000006 (0.28) <sup>a</sup>	-0.00003 (0.45)	0.0001 (1.09)
Neighboring State Sales Tax	0.001 (0.31)	0.002 (0.47)	0.013 (8.40)*** <sup>a</sup>	0.008 (1.01)	0.005 (1.43)
Neighboring State Sales Tax × Distance		0.000006 (0.21)	0.000004 (6.58)*** <sup>a</sup>	-0.00003 (0.58)	-0.00001 (0.35)
Local Sales Tax	-0.002 (0.55)	-0.001 (0.31)	0.013 (6.15)***	-0.005 (1.00)	0.0005 (0.10)
Neighboring State Local Sales Tax	-0.005 (1.72)*	-0.004 (1.48)	0.015 (6.94)***	-0.002 (0.47)	0.001 (0.31)
Observations	27693	27693	27693	24616	27693
County fixed	Y	Y	N	Y	Y
Year fixed	Y	Y	Y	Y	Y

*Notes:* See Table 2.3 for additional notes on significances on signs of coefficients. Detailed estimates and additional explanatory variables are reported in Table A3 in Appendix.

#### *2.5.1.4 Clothing Stores' Establishment Results*

Table 2.6 shows results for the total number of establishments of clothing stores per 1,000 residents of counties. The first column reports that own state's sales tax rates have unexpected positive effects on the total number of establishments of clothing stores per 1,000 residents of counties, however, the effect is not statistically significant. Similarly, although the coefficient on the nearest neighboring state's sales tax rates have

expected positive effects on the total number of establishments of clothing stores per 1,000 residents of counties, it is not statistically significant.

The second column shows that own state's sales tax rates have more unexpected positive impacts on the total number of establishments of clothing stores per 1,000 residents of counties closer to the state border. In contrast, the nearest neighboring state's sales tax rates have more expected positive effects on the total number of establishments of clothing stores closer to the state border. The third column reports that when fixed effects are excluded to the model as of the second column, the coefficients on own state's sales tax rates and interaction term are still statistically significant.

The fourth column shows that the lagged total number of establishments of clothing stores is positive and highly significant, but the coefficients of own state's sales tax rate variables and the nearest neighboring state's sales tax variables are statistically insignificant, thereby implying that sales tax rates in many states are stable over time during this period. The fifth column reports that when the average number of establishments of clothing stores per 1,000 residents of neighboring counties are accounted for in the model as of the second column, the coefficients on the nearest neighboring state's sales tax rates and its interaction term are still jointly significant. However, the coefficients on domestic state's sales tax rates and its interaction term are jointly insignificant.

To sum up, sales tax rates of the nearest neighboring state have a positive effect on the total number of establishments of clothing stores per 1,000 residents of counties, however, the effect is not statistically significant. Similarly, the nearest neighboring state's sales tax rates seem to have positive effects on the total number of establishments of clothing stores per 1,000 residents of counties closer to the state border, however, this effect is found insignificant when accounting for counties' past year's total number of establishments of clothing stores of counties. In addition, own state's sales tax rates do not have robust positive impacts on the total number of establishments of clothing stores per 1,000 residents of counties closer to the state border. Considering other taxes such as local sales tax and sales tax holidays, while the coefficients on local sales taxes of own

state as well as the nearest neighboring state are found positive and significant, the coefficients on sales tax holidays of own and the nearest neighboring states are found negative and insignificant.

*Table 2.6—Impacts of Sales Tax Rates on the Total Number of Establishments of Clothing Stores per 1,000 County Residents*

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
Clothing Stores <sub>t-1</sub>				0.538 (6.02)***	
Neighboring County Clothing Stores					0.005 (2.52)**
Sales Tax	0.005 (1.10)	0.013 (2.33)** <sup>a</sup>	0.017 (3.64)*** <sup>a</sup>	0.006 (0.50)	0.012 (1.88)*
Sales Tax × Distance		-0.0002 (2.19)** <sup>a</sup>	-0.0002 (2.70)*** <sup>a</sup>	0.00003 (0.23)	- 0.0000007 (0.01)
Neighboring State Sales Tax	0.007 (1.23)	0.019 (2.77)*** <sup>a</sup>	0.017 (4.37)*** <sup>a</sup>	0.003 (0.32)	0.023 (4.00)*** <sup>a</sup>
Neighboring State Sales Tax × Distance		-0.0002 (3.44)*** <sup>a</sup>	0.00004 (0.95) <sup>a</sup>	0.00006 (0.71)	-0.0002 (3.73)*** <sup>a</sup>
Local Sales Tax	0.015 (2.48)**	0.015 (2.56)**	0.013 (2.11)**	0.006 (0.52)	0.02 (2.80)***
Neighboring State Local Sales Tax	0.026 (6.28)***	0.027 (6.52)***	0.048 (8.17)***	0.001 (0.24)	0.029 (4.30)***
Sales Tax Holidays	-0.003 (1.65)*	-0.002 (1.36)	0.007 (1.24)	-0.003 (1.16)	-0.002 (1.03)
Neighboring State Sales Tax Holidays	-0.0004 (0.19)	-0.001 (0.31)	0.006 (1.01)	-0.002 (0.55)	-0.002 (0.91)
Observations	27693	27693	27693	24616	27693
County fixed	Y	Y	N	Y	Y
Year fixed	Y	Y	Y	Y	Y

*Notes:* See Table 2.3 for additional notes on significances on signs of coefficients. Detailed estimates and additional explanatory variables are reported in Table A4 in Appendix.

### 2.5.1.5 Liquor Stores' Establishment Results

Table 2.7 reports results for the total number of establishment of liquor stores per 1,000 residents of counties. The first column indicates that own state's alcohol tax rates have significant positive impacts on the total numbers of establishments of liquor stores per 1,000 residents of counties. In contrast, the nearest neighboring state's alcohol tax

rates have negative and insignificant effects on the total numbers of establishments of liquor stores per 1,000 residents of counties. The sales tax rates of own state have expected negative influences on the total numbers of establishments of liquor stores per 1,000 residents of counties, but the impact is not statistically significant. Similarly, although the nearest neighboring state's sales tax rates have expected positive effects on the total numbers of establishments of liquor stores per 1,000 residents of counties, the effect is not significant.

The second column reveals that alcohol tax rates and sales tax rates of own state and the nearest neighboring state do not have more significant impacts on the total numbers of establishments of liquor stores per 1,000 residents of counties closer to the state border. The third column shows that when fixed effects are not accounted for in the model of second column, the coefficients on the nearest neighboring state's alcohol tax variables, own state's sales tax variables and the nearest neighboring state's sales tax variables are statistically significant. However, the coefficients on some of these tax terms have unexpected signs. For instance, the coefficient on the neighboring state's alcohol tax has an unexpected negative sign, thereby suggesting that an increase in the nearest neighboring state's alcohol tax rates have negative effects on the total number of establishments of liquor stores per 1,000 residents of counties closer to the state border.

The fourth column shows that the coefficient on the lagged total number of establishments per 1,000 residents of liquor stores of counties is highly significant, thereby suggesting that there is a positive autocorrelation in total establishments of liquor stores per 1,000 residents of counties. However, none of the sales and excise tax variables is statistically significant. Similarly, the fifth column indicates that when the average numbers of liquor stores per 1,000 residents of neighboring counties are accounted for in the model of the second column, the coefficients on sales and excise tax variables are statistically insignificant.

To sum up, the total numbers of establishments of liquor stores per 1,000 county residents are positively affected by own state's alcohol tax rates and negatively affected by own state's sales tax rates. The nearest neighboring state's sales tax rates have

expected positive effects on the total number of establishments of liquor stores per 1,000 county residents, however, the effect is not statistically significant. Similarly, there is no significant evidence that alcohol tax rates and sales tax rates of own state as well as the nearest neighboring state have more noteworthy impacts on the total number of establishments of liquor stores per 1,000 residents of counties closer to the state border. Moreover, the coefficients on local sales taxes of own and the nearest neighboring states do not have significant impacts on the total number of establishments of liquor stores per 1,000 residents of counties.

*Table 2.7—Impacts of Sales and Excise Tax Rates on the Total Number of Establishments of Liquor Stores per 1,000 County Residents*

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
Alcohol Stores <sub>t-1</sub>				0.429 (6.07)***	
Neighboring County Alcohol Stores					-0.004 (1.42)
Alcohol Tax	0.122 (2.48)**	0.087 (1.13)	0.049 (1.15)	-0.104 (0.87)	0.165 (1.41)
Alcohol Tax × Distance		0.0004 (0.49)	-0.00003 (0.05)	-0.001 (0.69)	-0.001 (0.46)
Neighboring State Alcohol Tax	-0.105 (1.63)	-0.041 (0.44)	-0.278 (7.04)*** <sup>a</sup>	-0.004 (0.03)	-0.039 (0.39)
Neighboring State Alcohol Tax × Distance		-0.001 (0.63)	0.001 (1.51) <sup>a</sup>	-0.001 (0.71)	-0.001 (0.78)
Sales Tax	-0.005 (1.71)*	-0.001 (0.24)	0.009 (5.66)***	0.002 (0.39)	-0.001 (0.33)
Sales Tax × Distance		-0.00007 (1.26)	-0.0002 (9.51)***	-0.0001 (1.65)*	-0.0001 (1.19)
Neighboring State Sales Tax	0.004 (1.28)	0.005 (1.25)	-0.004 (2.93)***	0.005 (0.66)	0.006 (1.77)*
Neighboring State Sales Tax × Distance		-0.00002 (0.45)	0.00005 (3.11)***	-0.0001 (1.30)	-0.00002 (0.56)
Local Sales Tax	0.001 (0.41)	0.002 (0.64)	0.013 (7.07)***	0.006 (1.21)	0.0004 (0.08)



*Table 2.7 continued*

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
Neighboring State	-0.005	-0.005	0.012	0.006	-0.008
Local Sales Tax	(1.97)**	(2.05)**	(6.86)***	(1.10)	(1.77)*
Observations	27693	27693	27693	24616	27693
County fixed	Y	Y	N	Y	Y
Year fixed	Y	Y	Y	Y	Y

*Notes:* See Table 2.3 for additional notes on significances on signs of coefficients. Detailed estimates and additional explanatory variables are reported in Table A5 in Appendix.

### *2.5.1.6 Economic Impact of Tax Policy Changes*

Based on Tables 2.3 to 2.7, for most retail industries I consider, the distance to the state border has significant effects on the responsiveness of counties' retail establishments to sales and excise tax rates of domestic and neighboring states. However, contrary to what would be expected, the effect is not robust across different specifications for all retail industries. Only for grocery stores, is there consistent evidence that sales tax rates of domestic state have more negative effects on the total number of establishments of grocery stores of counties closer to the state border. This being the case, I consider, for grocery stores the impact of a one percent increase in the domestic state's sales tax rates on the total number of grocery store establishments per 1,000 county residents. The results are shown in Table 2.8 The table illustrates that an increase in own state's sales tax rates is estimated to decrease 0.04, 0.03 and 0.02 grocery store establishments per 1,000 residents at 10 miles, 40 miles and 100 miles from the state border, respectively, results consistent with my expectations.

*Table 2.8—Estimated Effect on the Total Number of Grocery Store Establishments per 1,000 County Residents, Following a One Percent Increase In Domestic State Sales Tax*

<b>Distance</b>	<b>1% increase in Domestic State Sales Tax Rates</b>
10 miles	-0.036
40 miles	-0.033
100 miles	-0.027

### 2.5.2 *Employment Results*

Tables 2.9 to 2.12 present results for several specifications of the total number of employees per 1,000 residents of counties for each of the five retail industries. In each table: the first column reports results from estimating specification (2.1); the second column shows results from estimating specification (2.2); the third column reports results from re-estimating specification (2.2) without county fixed effects; and the last column presents results from estimating specification (2.4).

As in the results for establishments, for all five retail industries' total number of employees per 1,000 county residents, I find that the joint significances of coefficients on sales (or excise) tax rates and their interaction terms are sensitive to an exclusion of fixed effects and an inclusion of a lagged dependent variable. Without fixed effects, the coefficients on these tax terms are often large and statistically significant. In contrast, with an inclusion of a lagged dependent variable, the coefficients on these tax terms turn insignificant for most retail industries' employment per 1,000 residents, thereby implying that there are less variation in sales and excise tax rates in many states over a ten-year time period considered in this analysis. Again, only in the case of grocery store industry, there is robust evidence across different specifications that the distance to the state border has significant effects on the responsiveness of counties' grocery store employment to own state tobacco tax rates.

#### 2.5.2.1 *Grocery Stores' Employment Results*

Table 2.9 demonstrates results for the total number of employees of grocery stores per 1,000 residents of counties. The first column reports that the total numbers of employees of grocery stores per 1,000 residents of counties are not significantly influenced by sales tax rates of own state and the nearest neighboring state. In contrast, the total numbers of employees of grocery stores per 1,000 residents are negatively influenced by own state's tobacco tax rates.

The second column shows that the coefficients on own state's tobacco tax rates and its interaction term are jointly significant, thereby suggesting that own state's tobacco

tax rates have more unexpected positive impacts on the total numbers of employees of grocery stores per 1,000 residents of counties closer to the state border.

The third column shows that when county fixed effects are not accounted to the model of the second column, the coefficients on own state's tobacco tax rates and its interaction term that are jointly significant in the second column are insignificant. In addition, some of the tax terms that are insignificant in the second column have significant effects on the total number of employees per 1,000 residents of grocery stores of counties. For instance, the coefficients on the nearest neighboring state's sales tax rates and its interaction term are found to be jointly significant, thereby suggesting that an increase in the nearest neighboring state's sales tax rates have more expected positive effects on the total number of employees of grocery stores per 1,000 residents of counties closer to the state border.

The fourth column shows that when previous year's total number of employees of grocery stores is accounted for in the model of the second column, the coefficients on own state's tobacco tax rates and its interaction term are still jointly significant. In particular, at mean value of distance to the state border, an increase in own state tobacco tax rates is estimated to decrease around one grocery store employee per 1,000 county residents in the short run and around two grocery store employees per 1,000 county residents in the long run. Moreover, unlike in the second column, it also reports that the sales tax rates of own state and nearest neighboring state have more significant impacts on the total number of employees of grocery stores per 1,000 residents of counties closer to the state border.

To sum up, tobacco tax rates of own state has negative effects on the total number of employees of grocery stores per 1,000 residents of counties. However, when examining how the distance to the state border impacts the influence of own and the nearest neighboring state's sales and excise tax rates on the total number of employees of grocery stores per 1,000 residents of counties, tobacco tax rates of own state are found to have more unexpected positive impacts on the total number of employees of grocery stores per 1,000 residents of counties closer to the state border. At the same time, there is

no robust evidence across all specifications that sales tax rates, local sales tax, and food tax exemptions of own state and the nearest neighboring state have more significant effects on the total number of employees of grocery stores per 1,000 residents of counties closer to the state border.

*Table 2.9—Impacts of Sales and Excise Tax Rates on the Total Number of Employees of Grocery Stores per 1,000 County Residents*

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Grocery Store Employees <sub>t-1</sub>				0.464 (10.10)***
Sales Tax	0.028 (0.22)	0.139 (0.82)	-0.358 (6.40)*** <sup>a</sup>	0.259 (0.99) <sup>a</sup>
Sales Tax × Distance		-0.003 (1.30)	0.004 (5.73)*** <sup>a</sup>	-0.007 (2.60)*** <sup>a</sup>
Neighboring State Sales Tax	-0.09 (0.84)	0.058 (0.40)	0.124 (2.40)** <sup>a</sup>	0.336 (1.30) <sup>a</sup>
Neighboring State Sales Tax × Distance		-0.002 (1.34)	-0.005 (8.11)*** <sup>a</sup>	0.002 (0.96) <sup>a</sup>
Tobacco Tax	-0.851 (1.84)*	1.523 (2.30)** <sup>a</sup>	0.186 (0.27)	1.059 (1.16) <sup>a</sup>
Tobacco Tax × Distance		-0.053 (4.38)*** <sup>a</sup>	0.015 (1.38)	-0.045 (2.91)*** <sup>a</sup>
Neighboring State Tobacco Tax	-0.508 (1.15)	-0.387 (0.63)	2.517 (3.66)*** <sup>a</sup>	-0.195 (0.23)
Neighboring State Tobacco Tax × Distance		-0.003 (0.32)	-0.034 (3.05)*** <sup>a</sup>	0.003 (0.27)
Local Sales Tax	-0.056 (0.32)	0.014 (0.08)	-0.043 (0.64)	1.478 (4.14)***
Neighboring State Local Sales Tax	-0.553 (2.92)***	-0.498 (2.63)***	0.09 (1.41)	0.473 (2.11)**
Food Tax Exemption	-0.203 (1.32)	-0.205 (1.34)	0.753 (12.53)***	-0.051 (0.20)
Neighboring State Food Tax Exemption	0.119 (1.22)	0.026 (0.25)	0.372 (6.29)***	0.123 (0.77)
Observations	15440	15440	15440	9886
County fixed	Y	Y	N	Y
Year fixed	Y	Y	Y	Y

*Notes:* See Table 2.3 for additional notes on significances on signs of coefficients. Detailed estimates and additional explanatory variables are reported in Table A6 in Appendix.

### 2.5.2.2 Gasoline Stations' Employment Results

Table 2.10 reports results for the total number of employees of gasoline stations per 1,000 residents of counties. The first column shows that the total numbers of employees of gasoline stations per 1,000 residents of counties are negatively affected by tobacco tax rates of own state and the nearest neighboring state. The second column reveals that the total number of employees of gasoline stations per 1,000 residents of counties closer to the state border are less negatively affected by an increase in tobacco tax rates of own state and the nearest neighboring state. In contrast, the total numbers of employees of gasoline stations per 1,000 residents of counties closer to the state border are more negatively affected by an increase in sales tax rates of own state.

The third column shows that when county heterogeneity is not accounted to the model as in the second column, many tax terms have significant effects on the total number of employees of gasoline stations per 1,000 residents of counties. For example, unlike in the second column, fuel tax rates of own state and the nearest neighboring state have less positive effects on the total number of gasoline stations' employees per 1,000 residents of counties closer to the state border.

The fourth column illustrates that when previous year's gasoline stations' employees per 1,000 residents of counties are included in the model of the second column, the nearest neighboring state's fuel tax rates have more unexpected negative impacts on the total number of employees of gasoline stations per 1,000 residents of counties closer to the state border. Then for counties within fifteen miles from the state border, an increase in the nearest neighboring state fuel tax rates is expected to reduce a county's gasoline station employees by around eight people per 1,000 residents in the short run and by about nine people per 1,000 residents after the full lagged adjustment occurs. In contrast, the coefficients on own state's tobacco tax rates and its interaction term that are found to be jointly significant specification (2) are found insignificant here.

To sum up, tobacco tax rates of own state and the nearest neighboring state have negative effects on the total number of employees of gasoline stations per 1,000 county

residents. On the contrary, there is no consistent evidence that fuel tax rates, tobacco tax rates and sales tax rates of own state or the nearest neighboring state have more effects on the total number of employees of gasoline stations per 1,000 residents of counties closer to the state border. Besides, counties whose own state have local sales tax rates have higher unexpected total number of gasoline station employees per 1,000 residents than counties whose own and the nearest neighboring states do not have local sales tax rates.

*Table 2.10—Impacts of Sales and Excise Tax Rates on the Total Number of Employees of Gasoline Stations per 1,000 County Residents*

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Gasoline Station Employees <sub>t-1</sub>				0.133 (1.19)
Fuel Tax	0.182 (0.61)	0.255 (0.66)	2.695 (9.52) <sup>***a</sup>	-4.453 (1.03)
Fuel Tax × Distance		-0.005 (0.67)	0.003 (0.62) <sup>a</sup>	0.033 (0.33)
Neighboring State Fuel Tax	-0.183 (0.68)	-0.063 (0.18)	2.062 (6.85) <sup>***a</sup>	-9.62 (2.23) <sup>**a</sup>
Neighboring State Fuel Tax × Distance		-0.003 (0.47)	0.005 (0.94) <sup>a</sup>	0.1 (1.39) <sup>a</sup>
Tobacco Tax	-0.793 (2.64) <sup>***</sup>	-0.112 (0.27) <sup>a</sup>	-7.577 (12.87) <sup>***a</sup>	53.959 (1.02)
Tobacco Tax × Distance		-0.015 (2.68) <sup>***a</sup>	0.073 (8.38) <sup>***a</sup>	-1.476 (1.31)
Neighboring State Tobacco Tax	-1.26 (4.12) <sup>***</sup>	-0.83 (2.10) <sup>**a</sup>	0.171 (0.30)	103.148 (1.71) <sup>*</sup>
Neighboring State Tobacco Tax × Distance		-0.011 (1.75) <sup>*a</sup>	-0.016 (1.58)	-0.906 (1.09)
Sales Tax	-0.071 (0.78)	-0.313 (2.49) <sup>**a</sup>	-0.057 (0.95) <sup>a</sup>	-0.857 (1.02)
Sales Tax × Distance		0.005 (2.81) <sup>***a</sup>	-0.002 (2.25) <sup>**a</sup>	-0.002 (0.08)
Neighboring State Sales Tax	-0.022 (0.24)	-0.018 (0.16)	-0.008 (0.12) <sup>a</sup>	-0.602 (0.76)
Neighboring State Sales Tax × Distance		0.00002 (0.02)	-0.003 (3.05) <sup>***a</sup>	0.021 (0.82)
Local Sales Tax	0.578 (4.30) <sup>***</sup>	0.562 (4.16) <sup>***</sup>	0.109 (2.12) <sup>**</sup>	2.304 (1.83) <sup>*</sup>

*Table 2.10 continued*

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Neighboring State	-0.007	-0.003	0.281	1.871
Local Sales Tax	(0.07)	(0.03)	(6.43)***	(1.89)*
Observations	25357	25357	25357	21508
County fixed	Y	Y	N	Y
Year fixed	Y	Y	Y	Y

*Notes:* See Table 2.3 for additional notes on significances on signs of coefficients. Detailed estimates and additional explanatory variables are reported in Table A7 in Appendix.

### *2.5.2.3 Furniture Stores' Employment Results*

Table 2.11 displays results for the total number of furniture stores' employees per 1,000 residents of counties. The first column indicates that the total number of employees of furniture stores per 1,000 residents of counties respond negatively to the nearest neighboring state's sales tax rates. The second column shows that there is joint significance of coefficients on the nearest neighboring state's sales tax rates and its interaction term, thereby suggesting that the neighboring state's sales tax rates have unexpected more negative effects on the total number of employees of furniture stores per 1,000 residents of counties closer to the state border.

The third column shows that when fixed effects are not accounted to the model as in the second column, the coefficients on own state's sales tax rates and its interaction term, which are insignificant in the second column, are statistically significant, and they suggest that sales tax rates of own state have more expected negative effects on the total number of employees of furniture stores per 1,000 residents of counties closer to the state border. Furthermore, the coefficients on the nearest neighboring state's sales tax rate and its interaction term have different signs from those in the second column, and they indicate that sales tax rates of the nearest neighboring state have more expected positive effects on the total number of employees of furniture stores per 1,000 residents of counties closer to the state border. The fourth column reports that previous year's total numbers of employees of furniture stores of counties have positive and significant effects on current year's total numbers of employees of furniture stores of counties. However,

the coefficients on own state's sales tax rates and its interaction term as well as the nearest neighboring state's sales tax rates and its interaction term are found insignificant.

To sum up, the nearest neighboring states' sales tax rates have negative effects on the total number of employees of furniture stores per 1,000 county residents. In contrast, there is no robust evidence that sales tax rates of own state and the nearest neighboring state have more impacts on the total number of employees of furniture stores per 1,000 residents of counties closer to the state border. In addition, there is no clear evidence that local sales tax of own state or the nearest neighboring state have significant impacts on the total number of employees of furniture stores per 1,000 residents of counties.

*Table 2.11—Impacts of Sales Tax Rates on the Total Number of Employees of Furniture Stores per 1,000 County Residents*

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Furniture Store Employees <sub>t-1</sub>				0.526 (8.51)***
Sales Tax	0.02 (0.88)	0.05 (1.56)	-0.039 (2.54)** <sup>a</sup>	0.025 (0.50)
Sales Tax × Distance		-0.001 (1.48)	0.001 (4.68)*** <sup>a</sup>	0.00002 (0.03)
Neighboring State Sales Tax	-0.082 (3.46)***	-0.096 (2.77)*** <sup>a</sup>	0.079 (5.89)*** <sup>a</sup>	-0.034 (0.67)
Neighboring State Sales Tax × Distance		0.0002 (0.73) <sup>a</sup>	-0.001 (7.92)*** <sup>a</sup>	-0.0001 (0.35)
Local Sales Tax	0.082 (2.61)***	0.088 (2.76)***	0.099 (5.01)***	-0.012 (0.27)
Neighboring State Local Sales Tax	-0.048 (1.67)*	-0.041 (1.42)	0.08 (3.84)***	-0.118 (1.96)*
Observations	18589	18589	18589	13637
County fixed	Y	Y	N	Y
Year fixed	Y	Y	Y	Y

*Notes:* See Table 2.3 for additional notes on significances on signs of coefficients. Detailed estimates and additional explanatory variables are reported in Table A8 in Appendix.

#### 2.5.2.4 Clothing Stores' Employment Results

Table 2.12 presents results from estimating several specifications for the total number of employees of clothing stores per 1,000 residents of counties. The first column



reveals that the coefficient on the nearest neighboring state's sales tax rates have the expected positive impacts on the total number of employees of clothing stores per 1,000 residents of counties. The coefficient on own state's sales tax rates also have expected negative effects on the total number of employees of clothing stores per 1,000 residents of counties, however, the coefficient on own state's sales tax rates is not statistically significant.

The second column shows that there is a joint significance of the coefficients on the nearest neighboring state's sales tax rates and its interaction term, thereby indicating that an increase in the nearest neighboring state's sales tax rates have more expected positive effects on the total number of employees of clothing stores per 1,000 residents of counties closer to the state border.

The third column indicates that when county fixed effects are excluded to the model as in the second column, the coefficients on the nearest neighboring state's sales tax rates and its interaction term are still significant jointly. However, the sign on the coefficient of the interaction term has a positive sign, thereby suggesting that an increase in the nearest neighboring sales tax rates has less positive effects on the total number of employees of clothing stores per 1,000 residents of counties closer to the state border. Besides, the coefficients on own state's sales tax rates and its interaction term, which are insignificant in the second column, have more significant positive impacts on the total number of employees of clothing stores per 1,000 residents of counties closer to the state border. The fourth column indicates that when previous year's total number of employees of clothing stores per 1,000 residents of counties are accounted for in the model of the second column, the coefficients on the nearest neighboring state's sales tax rates and its interaction term are jointly insignificant.

To sum up, the nearest neighboring state's sales tax rates have expected positive effects on the total number of employees of clothing stores per 1,000 county residents. The nearest neighboring state's sales tax rates also have more positive effects on the total number of employees of clothing stores per 1,000 residents of counties closer to the state border, but the coefficients on the nearest neighboring state's sales tax rates and its

interaction term with distance to the state border are not jointly significant across all specifications. Moreover, there is robust evidence that counties that have sales tax holidays have fewer unexpected total numbers of clothing stores' employees per 1,000 residents than counties that do not have sales tax holidays in their own areas as well as the nearest neighboring state.

*Table 2.12—Impacts of Sales Tax Rates on the Total Number of Employees of Clothing Stores per 1,000 County Residents*

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Clothing Store Employees <sub>t-1</sub>				0.063 (0.86)
Sales Tax	-0.015 (0.37)	0.046 (0.72)	0.102 (2.33)** <sup>a</sup>	0.155 (1.76)*
Sales Tax × Distance		-0.001 (1.11)	-0.0003 (0.51) <sup>a</sup>	-0.003 (1.75)*
Neighboring State Sales Tax	0.121 (3.13)***	0.174 (2.94)*** <sup>a</sup>	0.12 (3.32)*** <sup>a</sup>	0.125 (1.80)*
Neighboring State Sales Tax × Distance		-0.001 (0.73) <sup>a</sup>	0.001 (1.49) <sup>a</sup>	-0.001 (0.59)
Local Sales Tax	-0.05 (0.59)	-0.049 (0.59)	-0.041 (0.78)	-0.05 (0.81)
Neighboring State Local Sales Tax	-0.035 (0.76)	-0.024 (0.52)	0.184 (3.43)***	-0.027 (0.18)
Sales Tax Holidays	-0.082 (4.02)***	-0.074 (3.53)***	0.275 (4.62)***	-0.063 (2.98)***
Neighboring State Sales Tax Holidays	-0.01 (0.48)	-0.011 (0.51)	0.192 (3.12)***	0.005 (0.24)
Observations	20518	20518	20518	15885
County fixed	Y	Y	N	Y
Year fixed	Y	Y	Y	Y

*Notes:* See Table 2.3 for additional notes on significances on signs of coefficients. Detailed estimates and additional explanatory variables are reported in Table A9 in Appendix.

### 2.5.2.5 Liquor Stores' Employment Results

Table 2.13 reports results for the total number of employees of liquor stores per 1,000 residents of counties. The first column reports that the total numbers of employees of liquor stores per 1,000 residents of counties are not significantly affected by alcohol

tax rates of own state and the nearest neighboring state. In contrast, the sales tax rates of own state have unexpected positive effects on the total number of employees of liquor stores per 1,000 residents of counties. The nearest neighboring state's sales tax rates have expected positive effects on the total number of employees of liquor stores per 1,000 residents of counties, however, the coefficient on the nearest neighboring state's sales tax rates is not statistically significant.

The second column shows that alcohol tax rates and sales tax rates of own state and the nearest neighboring state have more positive effects on the total number of employees of liquor stores per 1,000 residents of counties closer to the state border. However, the coefficients on alcohol tax rates of own state (or the nearest neighboring state) and its interaction term with distance to the state border are not jointly significant. Similarly, the coefficients on sales tax rates of own state (or the nearest neighboring state) and its interaction term with distance to the state border are jointly insignificant.

The third column shows that when unobserved county heterogeneity is not controlled in specification (2.2), the coefficients on sales and alcohol tax terms of own and the nearest neighboring states are statistically significant. This probably suggests that sales and alcohol tax rates are constant over time for many states and thus, they are accounted by county-fixed effects in the second column. The fourth column shows that when the lagged dependent variable is accounted for in specification (2.2), the coefficients on own state's alcohol tax rates and its interaction term are jointly significant, thereby implying that alcohol tax rates of own state have more expected negative effects on the total number of employees of liquor stores per 1,000 residents of counties closer to the state border. Then, at the distance of fifteen miles from the state border, an additional increase in own state alcohol tax rates decreases liquor store employees per 1,000 county residents by one in the short run and two in the long run.

To sum up, sales tax rates of domestic state have positive effects on the total number of employees of liquor stores per 1,000 county residents. However, there is no robust evidence across different specifications that the total number of employees of liquor stores per 1,000 residents of counties closer to the state border show more

responses to alcohol tax rates and sales tax rates of own state and the nearest neighboring state. Similarly, the coefficient on the local sales tax dummy variable of domestic state does not have significant positive effects on the total number of employees of liquor stores per 1,000 county residents across all specifications.

*Table 2.13—Impacts of Sales and Excise Tax Rates on the Total Number of Employees of Liquor Stores per 1,000 County Residents*

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Alcohol Store Employees <sub>t-1</sub>				0.22 (1.17)
Alcohol Tax	-0.134 (0.54)	0.404 (1.06)	-2.774 (9.98)*** <sup>a</sup>	-1.37 (2.39)** <sup>a</sup>
Alcohol Tax × Distance		-0.008 (1.58)	0.024 (6.37)*** <sup>a</sup>	0.008 (0.93) <sup>a</sup>
Neighboring State Alcohol Tax	0.073 (0.23)	0.155 (0.34)	-1.866 (7.24)*** <sup>a</sup>	-0.294 (0.32)
Neighboring State Alcohol Tax × Distance		-0.0002 (0.05)	0.004 (0.85) <sup>a</sup>	-0.017 (1.54)
Sales Tax	0.02 (1.82)*	0.033 (1.77)*	0.062 (4.76)*** <sup>a</sup>	0.025 (1.00)
Sales Tax × Distance		-0.0003 (0.94)	-0.0004 (2.96)*** <sup>a</sup>	-0.0003 (0.52)
Neighboring State Sales Tax	0.008 (0.52)	0.009 (0.38)	0.042 (3.79)*** <sup>a</sup>	-0.041 (1.08)
Neighboring State Sales Tax × Distance		-0.00003 (0.16)	-0.0003 (2.67)*** <sup>a</sup>	0.00001 (0.05)
Local Sales Tax	0.017 (1.55)	0.022 (1.88)*	0.032 (2.39)**	0.078 (2.19)**
Neighboring State Local Sales Tax	-0.006 (0.78)	-0.005 (0.54)	0.065 (5.13)***	0.019 (0.71)
Observations	14560	14560	14560	10174
County fixed	Y	Y	N	Y
Year fixed	Y	Y	Y	Y

*Notes:* See Table 2.3 for additional notes on significances on signs of coefficients. Detailed estimates and additional explanatory variables are reported in Table A10 in Appendix.

#### 2.5.2.6 Estimated Impact of Tax Increases

Based on Tables 2.9 to 2.13, although sales and excise tax rates of domestic and the nearest neighboring state have significant influences on counties' employment of most retail industries, there is no robust evidence across different specifications that

distance to the state border has significant effects on the impacts of sales and excise tax rates of domestic and neighboring states on counties' employment for most retail industries I consider. Only for grocery stores, there is consistent evidence across equations (2.2) and (2.4) that tobacco tax rates of domestic state have unexpected more positive effects on the total number of grocery store employees of counties closer to the state border. Therefore, in this section, I perform the quantitative analysis to show how the impact of domestic state's tobacco tax rates on the total number of grocery store employment per 1,000 county residents vary with the distance to the state border. In particular, Table 2.14 illustrates the effect of a hypothetical one percent increase in a county's own state tobacco tax rates. The table shows that an increase in own state's tobacco tax rates is estimated to increase one grocery store employee per 1,000 county residents at ten miles from the state border, but the effect gradually diminishes and become negative as one moves further from the border. In this way, as distance to the state border increases, domestic state tobacco tax rates have more unexpected negative influences on the total number of grocery store employment per 1,000 county residents.

*Table 2.14—Estimated Effect on the Total Number of Grocery Store Employment per 1,000 County Residents, Following a One Percent Increase In Domestic State Tobacco Tax*

<b>Distance</b>	<b>1% increase in Domestic State Tobacco Tax Rates</b>
10 miles	0.993
40 miles	-0.597
100 miles	-3.777

### 2.5.3 *Alternative specifications*

In this section I consider an alternative measure of a distance variable. In the above analysis, the impacts of sales or excise tax rates of own state and the nearest neighboring state on a county's total numbers of retail establishment and employment per 1,000 residents are considered to vary linearly to the county's distance to the state border. However, in this section, I examine whether the impacts of own state's and the nearest neighboring state's sales or/and excise tax rates on the total numbers of retail establishment and employment per 1,000 residents of a county are influenced by the

discontinuous function of the county's distance to the state border. In particular, the equations to be estimated are identical to equations (2.2), (2.4) and (2.5) except the distance variable ( $D$ ) is replaced with a dummy variable  $D10$  that indicates one for counties within ten miles of the state border<sup>7</sup>. Therefore, the equations to be estimated are then specified as follows:

$$\begin{aligned}
E_{ijkt,r} = & \alpha_0 + \alpha_1 ST_{ij,t-1} + \alpha_2 (ST \times D10)_{ij,t-1} + \alpha_3 NST_{ij,t-1} + \\
& \alpha_4 (NST \times D10)_{ij,t-1} + \alpha_5 LT_{ij,t-1} + \alpha_6 NLT_{ij,t-1} + MT_{ijk,t-1} \gamma + \\
& (MT \times D10)_{ijk,t-1} \rho + NMT_{ijk,t-1} \delta + (NMT \times D10)_{ijk,t-1} \sigma + \\
& OT_{ij,t-1} \chi + (OT \times D10)_{ij,t-1} \kappa + Z_{ijk,t-1} \phi + X_{ijt} \beta + \mu_i + \lambda_t + \varepsilon_{ijkt,r}
\end{aligned} \tag{2.2a}$$

$$\begin{aligned}
E_{ijkt,r} = & \theta_r \Delta E_{ijk,t-1,r} + \alpha_1 \Delta ST_{ij,t-1} + \alpha_2 \Delta (ST \times D10)_{ij,t-1} + \alpha_3 \Delta NST_{ij,t-1} + \\
& \alpha_4 \Delta (NST \times D10)_{ij,t-1} + \alpha_5 \Delta LT_{ij,t-1} + \alpha_6 \Delta NLT_{ij,t-1} + \Delta MT_{ijk,t-1} \gamma + \\
& \Delta (MT \times D10)_{ijk,t-1} \rho + \Delta NMT_{ijk,t-1} \delta + \Delta (NMT \times D10)_{ijk,t-1} \sigma + \\
& \Delta OT_{ij,t-1} \chi + \Delta (OT \times D10)_{ij,t-1} \kappa + \Delta Z_{ijk,t-1} \phi + \Delta X_{ijt} \beta + \lambda_t + \Delta \varepsilon_{ijkt,r}
\end{aligned} \tag{2.4a}$$

$$\begin{aligned}
E_{ijkt,r} = & \alpha_0 + \psi_k \sum_{i \neq h} w_{ih} E_{hkt,r} + \alpha_1 ST_{ij,t-1} + \alpha_2 (ST \times D10)_{ij,t-1} + \alpha_3 NST_{ij,t-1} + \\
& \alpha_4 (NST \times D10)_{ij,t-1} + \alpha_5 LT_{ij,t-1} + \alpha_6 NLT_{ij,t-1} + MT_{ijk,t-1} \gamma + \\
& (MT \times D10)_{ijk,t-1} \rho + NMT_{ijk,t-1} \delta + (NMT \times D10)_{ijk,t-1} \sigma + OT_{ij,t-1} \chi + \\
& (OT \times D10)_{ij,t-1} \kappa + Z_{ijk,t-1} \phi + X_{ijt} \beta + \mu_i + \lambda_t + \varepsilon_{ijkt,r}
\end{aligned} \tag{2.5a}$$

### 2.5.3.1 Retail Establishment Results

Tables 2.15 to 2.17 report estimated signs and significances on coefficients from estimating equations (2.2a), (2.4a) and (2.5a) for the total number of establishments of

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<sup>7</sup> Ten mile distance to the state border is an arbitrary boundary in which cross-border shopping due to sales and excise tax differentials is expected to have noteworthy impacts on retail establishment and employment of counties. Considering different dummy variables such as D25 that equals one for counties within twenty-five miles of the state border did not particularly produce different results from those obtained by using dummy variable D10.

five retail industries. Each column represents the total number of establishments of each retail industry per 1,000 residents of counties.

Table 2.15 demonstrates estimated signs of coefficients and indicates their significances for equation (2.2a). The coefficient on own state's sales tax rates interacted with *D10* is statistically significant only for counties' total number of establishments of gasoline stations, clothing stores and liquor stores per 1,000 residents, thereby suggesting that an increase in own state's sales tax rates have different impacts on the total number of establishments of gasoline stations, clothing stores and liquor stores per 1,000 residents for counties within and above ten miles from the state border. The coefficient on the nearest neighboring state's sales tax rates interacted with *D10* is statistically significant only for counties' total number of establishments of grocery stores, furniture stores, and liquor stores per 1,000 residents. Holding all else same, on average, an increase in sales tax rates of the nearest neighboring state is expected to induce fewer total numbers of establishments of grocery stores and liquor stores per 1,000 residents in counties within ten miles from the state border than in counties above ten miles from the state border. On the contrary, an increase in the nearest neighboring state's sales tax rates is expected, on average, to induce greater total number of establishments of furniture stores per 1,000 residents for counties within ten miles from the state border than for counties beyond ten miles from the state border. The coefficient on the nearest neighboring state's fuel tax rates interacted with *D10* is positive and significant in the case of gasoline stations, thus suggesting that one percent increase in fuel tax rates of the nearest neighboring state affects counties within ten miles from the state border to have more gasoline stations per 1,000 residents than counties beyond ten miles from the state border. Similarly, the coefficient on the nearest neighboring state's alcohol tax rates interacted with *D10* is positive and statistically significant in the case of liquor stores, thereby implying that changes in the total numbers of establishments of liquor stores per 1,000 residents for each additional percent of the nearest neighboring state's alcohol tax rates is different for counties within and above ten miles from the state border.

Table 2.15—Alternative Distance Static Specification: Establishments per 1,000 County Residents

	Dependent Variables				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Sales Tax	-0.029 (3.01)***	0.033 (3.57)***	-0.005 (1.65)*	0.007 (1.62)	-0.007 (2.58)***
Sales Tax × D10	-0.011 (0.52)	-0.065 (3.00)***	0.007 (0.87)	-0.02 (1.95)*	0.016 (2.13)**
Neighboring State Sales Tax	0.007 (0.95)	0.009 (1.02)	-0.0002 (0.07)	0.006 (0.98)	0.008 (2.46)**
Neighboring State Sales Tax × D10	-0.038 (2.53)**	-0.011 (0.50)	0.013 (1.67)*	0.006 (0.44)	-0.038 (4.83)***
Tobacco Tax	0.009 (0.29)	-0.071 (1.94)*			
Tobacco Tax × D10	0.012 (0.22)	0.042 (0.56)			
Neighboring State Tobacco Tax	0.134 (5.07)***	-0.231 (6.27)***			
Neighboring State Tobacco Tax × D10	-0.032 (0.62)	0.064 (0.83)			
Fuel Tax		-0.113 (3.72)***			
Fuel Tax × D10		-0.005 (0.08)			
Neighboring State Fuel Tax		-0.013 (0.39)			
Neighboring State Fuel Tax × D10		0.14 (2.04)**			
Alcohol Tax					0.141 (2.84)***
Alcohol Tax × D10					-0.192 (1.02)
Neighboring State Alcohol Tax					-0.171 (2.38)**
Neighboring State Alcohol Tax × D10					0.361 (2.48)**
Local Sales Tax	-0.054 (6.72)***	0.041 (4.38)***	-0.002 (0.61)	0.015 (2.47)**	0.001 (0.54)
Neighboring State Local Sales Tax	0.012 (1.57)	-0.011 (1.28)	-0.005 (1.66)*	0.026 (6.28)***	-0.005 (2.00)**



Table 2.15 continued

	Dependent Variables				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Food Tax Exemption	0.008 (1.03)				
Neighboring State Food Tax Exemption	-0.008 (1.26)				
Sales Tax Holidays				-0.003 (1.74)*	
Neighboring State Sales Tax Holidays				-0.003 (0.18)	

Notes: Observations: 27693 counties. The regressions include county fixed effects and year fixed effects. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels. Detailed estimates and additional explanatory variables are reported in Table A11 in Appendix.

Table 2.16 reports results from estimating equation (2.4a). The coefficient on the nearest neighboring state's sales tax rates interacted with *D10* is still negative and significant for total number of establishments of grocery stores per 1,000 county residents. However, most of the tax interaction terms that are significant in Table 2.15 are either insignificant or/and have different signs in this table. For example, while the coefficient on own state's sales tax rates interacted with *D10* has positive and insignificant effects on the total number of establishments of gasoline stations per 1,000 county residents, the coefficients on own state's sales tax rates interacted with *D10* have insignificant negative and positive impacts on the total number of establishments of clothing and liquor stores per 1,000 county residents, respectively. Similarly, for gasoline stations, although the coefficient on the nearest neighboring state's fuel tax rates interacted with *D10* is still positive as in Table 2.15, it is statistically insignificant. Moreover, some of the tax interaction terms that are insignificant in Table 2.15 are significant in this table. For example, the coefficient on the nearest neighboring state's tobacco tax rates interacted with *D10* has positive and significant effects on the total number of establishments of gasoline stations per 1,000 county residents, thereby implying that an increase in the nearest neighboring state's tobacco tax rates would lead

to higher number of gasoline stations in counties within ten miles from the state border than in counties above ten miles from the state border.

*Table 2.16—Alternative Distance Dynamic Specification: Establishments per 1,000 County Residents*

	<b>Dependent variables</b>				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Grocery Stores <sub>t-1</sub>	0.643 (9.58)***				
Gasoline Stations <sub>t-1</sub>		0.523 (11.99)***			
Furniture Stores <sub>t-1</sub>			0.512 (10.56)***		
Clothing Stores <sub>t-1</sub>				0.537 (6.03)***	
Alcohol Stores <sub>t-1</sub>					0.429 (6.07)***
Sales Tax	-0.039 (2.93)***	0.019 (1.53)	0.007 (1.47)	0.01 (0.82)	-0.007 (1.53)
Sales Tax × D10	0.005 (0.17)	0.061 (1.15)	-0.022 (1.54)	-0.014 (1.06)	0.019 (1.48)
Neighboring State Sales Tax	0.019 (1.38)	0.008 (0.69)	0.007 (1.06)	0.009 (1.02)	0.0004 (0.07)
Neighboring State Sales Tax × D10	-0.055 (1.93)*	-0.054 (1.69)*	-0.01 (0.84)	-0.025 (1.77)*	-0.014 (1.31)
Tobacco Tax	-0.042 (1.14)	-0.02 (0.49)			
Tobacco Tax × D10	-0.054 (0.68)	-0.05 (0.70)			
Neighboring State Tobacco Tax	0.036 (0.92)	-0.076 (1.81)*			
Neighboring State Tobacco Tax × D10	-0.092 (1.12)	0.087 (1.15)			
Fuel Tax		-0.07 (1.44)			
Fuel Tax × D10		-0.102 (1.16)			
Neighboring State Fuel Tax		-0.063 (1.39)			
Neighboring State Fuel Tax × D10		0.198 (1.57)			

Table 2.16 continued

	Dependent variables				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Neighboring State Sales Tax Holidays				-0.002 (0.52)	
Alcohol Tax					-0.201 (2.45)**
Alcohol Tax × D10					0.393 (1.34)
Neighboring State Alcohol Tax					-0.1 (0.91)
Neighboring State Alcohol Tax × D10					0.248 (1.03)
Local Sales Tax	-0.022 (1.26)	0.05 (3.16)***	-0.005 (1.01)	0.006 (0.54)	0.006 (1.18)
Neighboring State Local Sales Tax	-0.006 (0.50)	0.008 (0.56)	-0.003 (0.50)	0.002 (0.25)	0.006 (1.09)
Food Tax Exemption	0.022 (1.51)				
Neighboring State Food Tax Exemption	0.0004 (0.04)				
Sales Tax Holidays				-0.003 (1.17)	
Neighboring State Sales Tax Holidays				-0.002 (0.52)	

Notes: Observations: 24616 counties. The regressions include county fixed effects and year fixed effects. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels. Detailed estimates and additional explanatory variables are reported in Table A12 in Appendix.

Table 2.17 reports results from estimating equation (2.5a). The coefficient on the nearest neighboring state's sales tax rates interacted with *D10* is still negative and significant for the total number of establishments of grocery stores per 1,000 county residents. Similarly, the coefficients on most of the interaction terms of sales and excise taxes that were significant in Table 2.15 are still significant and have same signs in this table. For example, while the coefficients on own state's sales tax rates interacted with *D10* are still negative and significant for the total number of gasoline stations and clothing stores per 1,000 county residents, the coefficient on own state's sales tax rates

interacted with *D10* is positive and significant for the total number of liquor stores per 1,000 county residents. In the same way, while the coefficient on the nearest neighboring state's fuel tax rates interacted with *D10* is positive and significant for the total number of gasoline stations per 1,000 county residents, the coefficient on the nearest neighboring state's alcohol tax rates interacted with *D10* is positive and significant for the total number of liquor stores per 1,000 county residents.

*Table 2.17—Alternative Distance Spatial Specification: Establishments per 1,000 County Residents*

	Dependent Variables				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Neighboring County Grocery Stores	0.013 (1.12)				
Neighboring County Gasoline Stations		-0.005 (1.81)*			
Neighboring County Furniture Stores			0.011 (4.13)***		
Neighboring County Clothing Stores				0.004 (2.55)**	
Neighboring County Alcohol Stores					-0.004 (1.50)
Sales Tax	-0.021 (2.08)**	0.033 (4.04)***	0.003 (0.82)	0.013 (2.50)**	-0.009 (2.73)***
Sales Tax × D10	-0.013 (0.65)	-0.06 (2.76)***	0.004 (0.52)	-0.022 (1.74)*	0.018 (2.25)**
Neighboring State Sales Tax	0.018 (1.52)	0.012 (1.62)	0.003 (1.07)	0.006 (1.56)	0.009 (3.27)***
Neighboring State Sales Tax × D10	-0.04 (1.97)**	-0.011 (0.48)	0.015 (1.64)	0.007 (0.54)	-0.039 (4.73)***
Tobacco Tax	0.073 (1.12)	-0.093 (2.55)**			
Tobacco Tax × D10	-0.085 (0.76)	-0.001 (0.01)			
Neighboring State Tobacco Tax	0.099 (2.25)**	-0.267 (6.70)***			
Neighboring State Tobacco Tax × D10	-0.057 (0.78)	0.056 (0.72)			
Fuel Tax		-0.138 (4.04)***			
Fuel Tax × D10		0.026 (0.34)			

Table 2.17 continued

	Dependent Variables				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Neighboring State Fuel Tax		-0.006 (0.19)			
Neighboring State Fuel Tax × D10		0.128 (1.77)*			
Alcohol Tax					0.151 (2.01)**
Alcohol Tax × D10					-0.215 (0.91)
Neighboring State Alcohol Tax					-0.175 (2.11)**
Neighboring State Alcohol Tax × D10					0.381 (1.97)**
Local Sales Tax	-0.032 (1.40)	0.049 (4.02)***	0.0004 (0.08)	0.02 (2.82)***	-0.0003 (0.08)
Neighboring State Local Sales Tax	0.041 (1.48)	-0.012 (1.04)	0.002 (0.47)	0.029 (4.31)***	-0.008 (1.80)*
Food Tax Exemption	0.019 (1.57)				
Neighboring State Food Tax Exemption	0.001 (0.05)				
Sales Tax Holidays				-0.002 (0.99)	
Neighboring State Sales Tax Holidays				-0.002 (1.02)	

Notes: Observations: 27693 counties. The regressions include county fixed effects and year fixed effects. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels. Detailed estimates and additional explanatory variables are reported in Table A13 in Appendix.

To summarize, Tables 2.15 to 2.17 show that the nearest neighboring state's sales tax rates have negative effects on the total number of establishments of grocery stores per 1,000 residents for counties within ten miles from the state border. However, for the total number of establishments per 1,000 county residents of other four retail industries, the coefficients on interaction terms of sales tax rates, fuel tax rates, tobacco tax rates or alcohol tax rates of own state and the nearest neighboring state are not consistently significant across different specifications. Therefore, except in the case of grocery stores,

there is no clear evidence to suggest that the sales or excise tax rates of own state and the nearest neighboring state have different effects on the total number of establishments per 1,000 residents of four retail industries for counties within and beyond ten miles from the state border.

### 2.5.3.2 Retail Employment Results

Tables 2.18 to 2.19 show estimated signs and significances on coefficients from estimating equations (2.2a) and (2.4a) for the total number of employees of five retail industries. Each column of this table represents the total number of employees of each retail industry per 1,000 residents of counties.

Table 2.18 reports estimated signs on coefficients and indicate their significances from estimating equation (2.2a) for each retail industry's total number of employees per 1,000 residents of counties. The coefficient on own state's sales tax rates interacted with *D10* is negative and insignificant for all five retail industries' total number of employees per 1,000 residents, thus suggesting that changes in any five retail industry's employment per 1,000 residents for each additional sales tax rates of own state is not different for counties within and above ten miles from the state border. The coefficient on the nearest neighboring state's sales tax rates interacted with *D10* is significant for the total number of employees per 1,000 residents of grocery stores and liquor stores of counties. In particular, an increase in the nearest neighboring state's sales tax rates induces higher number of employees of grocery stores per 1,000 residents in counties within ten miles from the state border than in counties beyond ten miles from the state border. In contrast, an increase in the nearest neighboring state's sales tax rates induces fewer number of employees of liquor stores per 1,000 residents in counties within ten miles from the state border than in counties beyond ten miles from the state border.

The coefficient on tobacco tax rates of own state interacted with *D10* is statistically significant for the total number of employees of grocery stores, thereby indicating that if tobacco tax rates of own state increase by one percent, grocery stores in counties within ten miles from the state border will have on average more grocery stores'

employees per 1,000 residents than in counties beyond ten miles from the state border. Similarly, the negative sign on the coefficient of own state's fuel tax rates interacted with *D10* suggests that an increase in fuel tax rates of own state induces fewer numbers of employees of gasoline stations per 1,000 residents in counties within ten miles from the state border than in counties beyond ten miles from the state border. The alcohol tax rates of own and the nearest neighboring states do not have more impacts on the total number of employees per 1,000 residents of liquor stores in counties within ten miles from the state border than in counties beyond ten miles from the state border.

*Table 2.18—Alternative Distance Static Specification: Employment per 1,000 County Residents*

	<b>Dependent Variables</b>				
	Grocery Store	Gasoline Station	Furniture Store	Clothing Store	Liquor Store
Sales Tax	0.064 (0.47)	-0.047 (0.50)	0.031 (1.22)	0.008 (0.18)	0.024 (1.99)**
Sales Tax × D10	-0.244 (0.73)	-0.228 (0.83)	-0.097 (1.60)	-0.143 (1.22)	-0.044 (1.41)
Neighboring State Sales Tax	-0.162 (1.47)	-0.029 (0.30)	-0.077 (3.04)***	0.103 (2.57)**	0.019 (1.18)
Neighboring State Sales Tax × D10	0.756 (2.08)**	0.059 (0.25)	-0.08 (1.14)	0.151 (0.96)	-0.135 (2.16)**
Tobacco Tax	-1.242 (2.45)**	-0.719 (2.18)**			
Tobacco Tax × D10	2.317 (2.14)**	-0.176 (0.26)			
Neighboring State Tobacco Tax	-0.424 (0.92)	-1.254 (3.77)***			
Neighboring State Tobacco Tax × D10	-0.743 (0.66)	-0.078 (0.12)			
Fuel Tax		0.409 (1.27)			
Fuel Tax × D10		-1.685 (2.65)***			
Neighboring State Fuel Tax		-0.304 (1.04)			
Neighboring State Fuel Tax × D10		0.652 (0.94)			
Alcohol Tax					-0.041 (0.16)

Table 2.18 continued

	Dependent Variables				
	Grocery Store	Gasoline Station	Furniture Store	Clothing Store	Liquor Store
Alcohol Tax × D10					-0.946 (1.11)
Neighboring State Alcohol Tax					-0.014 (0.04)
Neighboring State Alcohol Tax × D10					0.018 (0.02)
Local Sales Tax	-0.069 (0.40)	0.573 (4.25)***	0.084 (2.68)***	-0.054 (0.65)	0.019 (1.68)*
Neighboring State Local Sales Tax	-0.553 (2.91)***	-0.009 (0.10)	-0.046 (1.59)	-0.035 (0.76)	-0.007 (0.79)
Food Tax Exemption	-0.207 (1.35)				
Neighboring State Food Tax Exemption	0.116 (1.20)				
Sales Tax Holidays				-0.084 (4.13)***	
Neighboring State Sales Tax Holidays				-0.01 (0.47)	

Notes: The regressions include county fixed effects and year fixed effects. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels. Detailed estimates and additional explanatory variables are reported in Table A14 in Appendix.

Table 2.19 reports estimated signs and significances on coefficients from estimating equation (2.4a) for the total number of employees of each of five retail industries per 1,000 county residents. Unlike in Table 2.18, it shows that only in the case of gasoline station employees, the coefficient on the nearest neighboring state's tobacco tax rates interacted with *D10* is statistically significant, thus implying that an increase in tobacco tax rates of the nearest neighboring state induces higher number of employees of gasoline stations per 1,000 residents in counties within ten miles from the state border than in counties beyond ten miles from the state border. In addition, the coefficients on own state's and the nearest neighboring state's sales (or excise) tax rates interacted with *D10* are insignificant for all other retail industries. Thus, there is no robust evidence that the impacts of sales or excise tax rates of own state and the nearest neighboring state on



the total number of employees of four retail industries are different for counties within and above ten miles from the state border.

*Table 2.19—Alternative Distance Dynamic Specification: Employment per 1,000 County Residents*

	Dependent Variables				
	Grocery Store	Gasoline Station	Furniture Store	Clothing Store	Liquor Store
Grocery Store Employees <sub>t-1</sub>	0.464 (10.04)***				
Gasoline Station Employees <sub>t-1</sub>		0.217 (2.28)**			
Furniture Store Employees <sub>t-1</sub>			0.527 (8.55)***		
Clothing Store Employees <sub>t-1</sub>				0.065 (0.93)	
Alcohol Store Employees <sub>t-1</sub>					0.219 (1.14)
Sales Tax	-0.105 (0.50)	-0.0004 (0)	0.009 (0.23)	-0.02 (0.30)	0.023 (1.44)
Sales Tax × D10	0.187 (0.34)	-0.629 (1.69)*	0.126 (1.20)	0.127 (0.98)	-0.113 (1.48)
Neighboring State Sales Tax	0.378 (1.92)*	0.138 (1.13)	-0.041 (0.86)	0.068 (1.31)	-0.019 (0.68)
Neighboring State Sales Tax × D10	0.275 (0.41)	-0.261 (1.04)	0.012 (0.13)	-0.016 (0.13)	-0.209 (1.30)
Tobacco Tax	-0.664 (0.93)	0.494 (1.33)			
Tobacco Tax × D10	0.059 (0.04)	-1.079 (1.76)*			
Neighboring State Tobacco Tax	-0.098 (0.16)	-0.597 (1.57)			
Neighboring State Tobacco Tax × D10	-0.646 (0.39)	1.212 (2.01)**			
Fuel Tax		0.458 (0.92)			
Fuel Tax × D10		-1.009 (1.36)			
Neighboring State Fuel Tax		-1.056 (1.97)**			
Neighboring State Fuel Tax × D10		1.039 (1.23)			
Alcohol Tax					-1.179 (2.32)**

Table 2.19 continued

	Dependent Variables				
	Grocery Store	Gasoline Station	Furniture Store	Clothing Store	Liquor Store
Alcohol Tax × D10					1.636 (1.03)
Neighboring State Alcohol Tax					-0.755 (1.10)
Neighboring State Alcohol Tax × D10					-2.927 (1.42)
Local Sales Tax	1.475 (4.12)***	-0.469 (1.35)	-0.012 (0.28)	-0.049 (0.81)	0.08 (2.26)**
Neighboring State Local Sales Tax	0.487 (2.18)**	0.199 (1.05)	-0.118 (1.94)*	-0.024 (0.16)	0.018 (0.68)
Food Tax Exemption	-0.035 (0.14)				
Neighboring State Food Tax Exemption	0.143 (0.90)				
Sales Tax Holidays				-0.071 (3.61)***	
Neighboring State Sales Tax Holidays				0.005 (0.21)	

Notes: The regressions include county fixed effects and year fixed effects. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels. Detailed estimates and additional explanatory variables are reported in Table A15 in Appendix.

To summarize, although Tables 2.18 and 2.19 show that sales tax rates and excise tax rates of own state and the nearest neighboring states have different impacts on some retail industries' employment for counties within and above ten miles from the state border, the finding is not robust across different specifications. Therefore, there is no consistent evidence to suggest that sales and excise tax rates of own state and the nearest neighboring state have different impacts on the total number of employees per 1,000 residents of retail industries for counties within and beyond ten miles from the state border.

#### 2.5.4 Limitation of Econometric Analysis

This analysis fails to take into account for actual rates on counties' own sales taxes. These rates are not taken into account because data needed to do so are not readily

available. As a result, in this analysis, although I have attempted to account for counties' own or the nearest neighboring states' sales tax rates by including local sales tax dummy variables that controls for whether a county's own state or nearest neighboring state allow local sales tax rates, it is possible that local sales tax dummy variables may not have completely controlled for actual local sales tax rates of counties. For instance, a state may allow counties to have local sales tax rates, yet it is possible that a county may not have imposed any additional local sales tax rates. In such case, the omission of actual values of county sales tax rates may bias the results against counties that have no additional sales tax rates on purchases of goods.

## **2.6 Conclusion**

Whether, and to what extent, sales and excise tax rates of own and the nearest neighboring states influence economic activity of counties closer to the state border merit serious considerations. Today, as state governments are introducing new tax policies to combat the potential adverse impacts of interstate sales and excise tax differentials on economic activity of areas closer to the state border, it is important to determine how the impacts of sales and excise tax rates of domestic and neighboring states on economic activity vary with the distance of a county to the state border. The current literature that focuses on the United States largely utilizes a state level data of the forty-eight contiguous states or a county level data of one or few states to analyze the impacts of interstate sales and excise tax differentials on economic activity such as retail sales of goods. However, in this chapter, I use a county-level panel data of all forty-eight contiguous states to examine whether retail industries of counties closer to the state border relative to retail industries of counties further away from the state border show more responses to the impacts of sales and excise tax rates of domestic and the nearest neighboring states by changing the number of retail establishments and employment. These retail industries include grocery stores, gasoline stations, furniture stores, clothing stores and liquor stores that are most likely to be affected by consumers' cross-border shopping activity due to different sales and excise tax rates in adjacent states.

I start my analysis by estimating how sales and excise tax rates of domestic and the nearest neighboring states affect retail establishments and employment of counties. The results from these estimations indicate that sales and excise tax rates of own and nearest neighboring states, in most cases, have significant influences on retail establishments and employment of counties. Next, I estimate how the distance to the state border influences the responsiveness of a county's retail establishments and employment to sales and excise tax rates of domestic and neighboring states. The results from these estimations find that the impacts of sales and excise tax rates of domestic and the nearest neighboring states on counties' retail establishments and employment depend on the distance to the state border, however, the impacts tend not to be robust across different specifications.

In this way, although this chapter suggests policy makers that own and the nearest neighboring states' sales and excise tax rates influence counties' establishments and employment of most retail industries, it is inconclusive regarding whether the distance to the state border plays a significant role on the responsiveness of counties' retail establishments and employment to own and the nearest neighboring states' sales and excise tax rates. One possible reason for failing to obtain robust results may be because there are fewer variations in states' sales and excise tax rates over the period 1998 to 2007. For instance, during this ten-year period, states on average changed their sales tax rates around one time, while gas tax rates and tobacco tax rates around two times. Since the average frequency in which states have changed their sales and excise tax rates is relatively small over the period 1998 to 2007, the time period used in this analysis possibly does not have enough number of changes in state sales and excise tax rates to realize the robust effects of the distance to the state border on the responsiveness of counties' retail establishments and employment to sales and excise tax rates of own and the nearest neighboring states. Therefore, one possible extension of this chapter might be to examine the same issue again by using a county-level panel data with different time periods, particularly a time period that captures higher frequency of changes in states' sales and excise tax rates.

Another possible extension to this chapter might be to examine whether the finding of this study also holds for retail sales of counties. Since the cost of avoiding higher sales and excise tax rates are presumably easier and less costly for consumers than retailers, sales and excise tax rates of own and the nearest neighboring states have probably more marked and prompter effects on border counties' retail sales than retail establishments and employment. Thus, if county-level panel data is available on retail sales for forty-eight contiguous states' counties, the future study can investigate whether the impacts on counties' retail sales from sales and excise tax rates of own and the nearest neighboring states vary with the distance to the state border.

## Chapter 3

### The Battle of Taxes: Strategic Interaction in Multiple Tax Policies among States

#### 3.1 Introduction

In the United States, excise taxes rates on cigarettes and gas vary significantly among the states. In 2002, for example, cigarette taxes ranged from a low of three cents per pack to a high of one dollar and fifty cents per pack. In the same year, gas taxes ranged from a low of four cents per gallon to a high of twenty-eight cents per gallon. Furthermore, states with low excise taxes often share a border with high excise tax states. Kentucky, which imposed a three cent tax on each pack of cigarettes, for instance, shares a border with Indiana which levied a similar tax of fifty-six cents in 2002. Similarly, Virginia, which taxed around eighteen cents per gallon of gas, shares a border with North Carolina that levied gas tax rates of twenty-four cents per gallon in 2002. As a result of these differences in excise tax rates among states, we expect responses from both consumers and state governments.

First, we expect such tax differentials among states to encourage cross-border shopping. Specifically, we predict consumers of a high excise taxed state to cross the border and shop in a low excise taxed state to take advantages of lower after-tax retail prices in the low tax state. For example, on January 1, 2007, when the cigarette tax rate in South Dakota increased from fifty-three cents a pack to \$1.53, making a carton cost at least \$11.70 more than a carton in Iowa, thousands of South Dakotans crossed the border into Larchwood, Iowa to purchase cigarettes (Efrati, 2007).

Second, we expect excise tax differentials among states to incite smuggling activities. Particularly, we expect individuals to purchase large quantities of goods such as cigarettes, which are light, compact and easily transportable, in low excise tax states and illegally transport them to resell in a high excise tax state. By doing so, individuals would try to make as much profits as possible from the excise tax differential that exists between two states on every smuggled good. For example, it is found that when an individual brings 120,000 cigarette packs in a semitrailer to Michigan, which is a high

cigarette taxed state, from North Carolina, which is a low cigarette taxed state, he is able to earn as much as \$100,000 in avoided cigarette excise taxes (Fleenor, 1998).

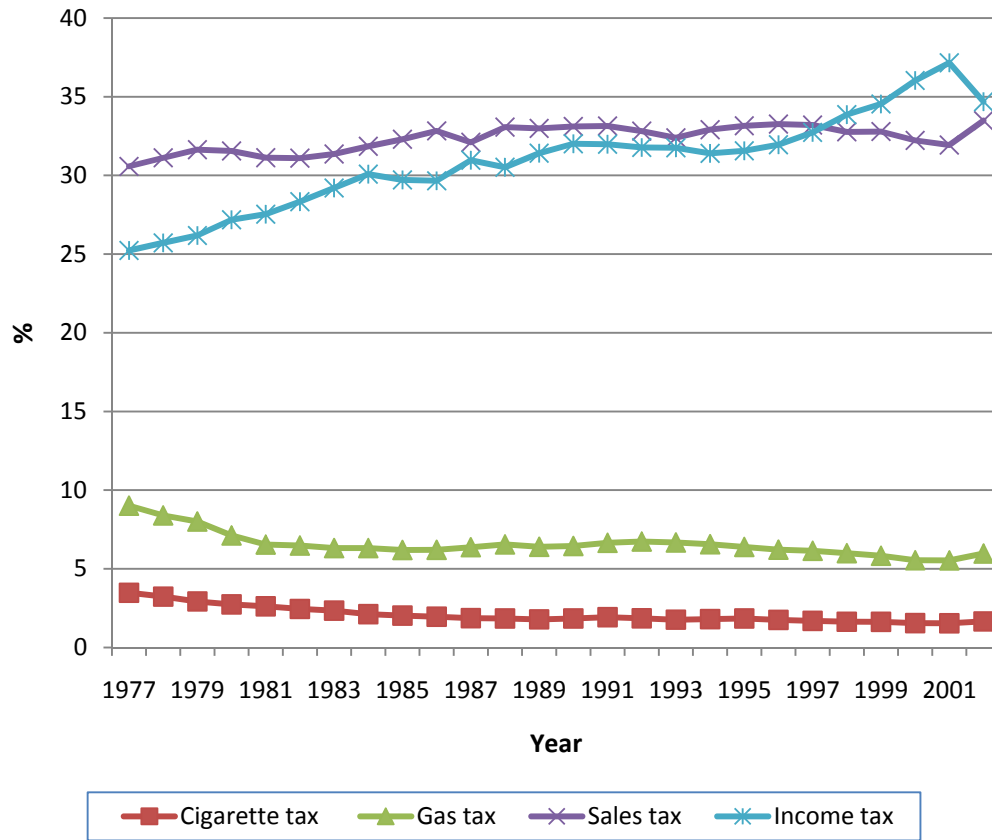
Third, we expect state governments to consider cross-border shoppers when setting tax rates. The theoretical literature on tax competition, in particular Kanbur and Keen (1993), suggests that states will compete against one another to set lower commodity tax rates to gain cross-border shoppers. Similarly, the empirical analyses on excise tax competition provide additional evidence that states mutually undercut each other's excise tax rates, and excise taxes are lower among states in which the greater share of population is on borders (Devereux et al., 2007).

Fourth, we expect state governments to consider and react to potential negative influences of excise tax competition on excise tax revenues. In particular, if a "race to the bottom" occurs in excise tax rates as state governments attempt to gain cross-border shoppers, excise tax revenues will decrease due to lower excise tax rates. As states' excise tax revenues decrease, we may expect the impact of this on the rest of the state's budget and would want to know how state governments maintain their balanced budgets. For instance, do state governments decrease their public expenditure levels to maintain a balanced budget? Or do they rely more on other taxes when faced with more competition in excise taxes to meet their revenue goals? This paper empirically investigates the answer to the latter question.

Besides cigarette and gas taxes, states use sales and individual income taxes to generate state revenues. In 2002, for instance, states on average collected about 33.48 percent of their revenues from general sales tax rates and 34.66 percent from individual income tax rates (U.S. Census Bureau). Furthermore, Figure 1 shows the share of tax revenues collected from cigarette tax rates, gas tax rates, sales tax rates, and individual income tax rates in the forty-eight contiguous states over the period 1977 to 2002. While the average share of revenues collected from cigarette tax rates and gas tax rates have decreased, the average share of revenues generated from sales tax rates and individual income tax rates have increased over this period. This observed trend possibly suggests that state governments are relying less on cigarette and gas tax rates and more on sales

and individual income tax rates to meet their revenue goals. A natural question to ask then is whether states use sales and income taxes as substitute taxes for cigarette and gas taxes to meet state revenue goals. Moreover, how is each tax rate related to other tax rates across states? Thus, this paper intends to understand the degree of relationship between these four taxes across states.

Figure 3.1: Share of State Tax Revenues, 1977–2002



In general, when a state has several taxes to meet its revenue goals, rates on one tax base may increase, decrease, or remain unchanged in response to an increase in rates on another tax base. For instance, if income tax rates and cigarette tax rates are considered as substitute taxes within the same state, a state may increase its income tax rates in order to compensate for its lower cigarette tax rates. Moreover, if there is strategic competition in tax rates among states, changes in rates one tax of neighboring states may induce a home state to change the rates on the same tax base or/and change the



rates on another tax base. For instance, Kentucky may respond to Ohio's lower cigarette tax rates by not only changing its cigarette tax rates but also changing its sales (income or gas) tax rates to maintain its revenue requirements. Most previous studies such as Rork (2003) and Devereux et al. (2007) have examined how changes in neighboring states' rates on one tax base impact the home state's rates on the same tax base. They have not addressed whether changes in neighboring states' one tax rate also affect changes in the home state's other tax rates. If neighboring states' rates on one tax base influence the home state's rates on the same tax base as well as other tax bases, then failing to account for such strategic interaction in multiple tax rates may cause misleading inferences about the degree or even the direction of responses to neighboring states' tax policies. Thus, this study adds to and extends the growing empirical literature on fiscal competition by expanding the focus from a tax on a specific base, usually an excise tax, to a much broader construction of the tax base to include other taxes including income and general sales taxes, while also helping policy makers to better gauge the impact of tax competition with neighboring states on state revenues.

Considering cigarette tax rates, gas tax rates, sales tax rates and individual income tax rates of the forty-eight contiguous states over the period 1977 to 2002, this paper estimates how rates on one tax base are influenced by neighboring states' rates on the same tax base as well as other tax bases. Specifically, I analyze four sets of tax reaction functions. The first set of tax reaction functions examines how neighboring states' tax rates affect the home state's tax rates on the same base. The second set of tax reaction functions investigates whether rates on one tax base react to neighboring states' rates on the same tax base even after controlling for rates on other tax bases of the home state. The third set of tax reaction functions examine whether one tax rate relates to neighboring states' identical and other tax rates. Finally, the fourth set of tax reaction functions includes rates on other tax bases of the home state to analyze how its rates on one tax base relates to neighboring states' rates on the same tax base and other tax bases.

My empirical results show that strategic competition among state governments occurs within the same tax base and across different tax bases. For example, consistent

with Rork (2003), I find that a home state's cigarette tax rates and gas tax rates respond positively to neighboring states' cigarette tax rates and gas tax rates, respectively. In terms of strategic interaction across different tax bases, I find that while the home state cigarette tax rates react negatively to neighboring states' sales tax rates, the home state sales and gas tax rates respond negatively to neighboring states' income tax rates. Furthermore, the home state income tax rates react negatively to neighboring states' gas tax rates, thereby confirming my prediction that if there is a race to the bottom in excise tax rates such as gas tax rates, states would counteract on lower gas tax rates of neighboring states by increasing their income tax rates. In this way, these results, in general, reveal that strategic competition among state governments is not confined to only identical tax rates.

The paper proceeds as follows: Section 3.2 provides background literature, Section 3.3 explains the theoretical framework, Section 3.4 outlines empirical specifications, Section 3.5 describes data and variables used in the study, Section 3.6 provides regression results, and Section 3.7 presents conclusions.

## **3.2 Literature Review**

Related previous studies fall into three broad categories: theoretical studies of tax competition; empirical studies of cross-border shopping; and empirical studies of fiscal competition.

### *3.2.1 Theoretical Literature on Tax Competition*

The theoretical literature on tax competition investigates the effect of tax competition among governments for mobile tax bases such as firms, capital, and shoppers. One of the earliest papers to discuss tax competition was by Zodrow and Mieszkowski (1986). They analyze the impact of tax competition among regions for mobile capital. The basic model of their paper considers that each region's supply of a public good is financed entirely by a tax on domestic capital ('source based'). Capital is nationally fixed but moves among regions in response to tax-differentials, while land is

an immobile factor. The main insight of the model is that if a region's government raises the tax rate on capital, then a capital outflow will be generated, and therefore, a positive externality is created. The region's government fails to account for such positive externality because it is concerned only with the welfare of its own residents. Therefore, the end result is that the region sets its capital tax rates and public goods level at an inefficiently low level (see also, Wilson, 1999).

Similarly, Mintz and Tulkens (1986) research the effect of commodity tax competition on regions' commodity tax rates. In commodity tax competition, each jurisdiction finances its public goods expenditures by an origin-based tax on private goods consumption. The use of origin-based taxes means that each jurisdiction collects a uniform tax on only the output of domestic firms, regardless of where this output is ultimately consumed. As a result, the jurisdiction's residents can escape the tax by incurring the transport costs necessary to do cross-border shopping in low tax jurisdictions. The primary result of the model is that tax competition leads to lower commodity taxes and under-provision of public goods. However, Mintz and Tulkens use a very general model, and hence, their analysis does not look at the effect of a region's size on commodity tax competition, an element likely to be important when explaining cross-border shopping between US states.

Kanbur and Keen (1993) formulate a commodity tax competition model that contains two regions of different population densities, with an open border between them. The governments in the two regions levy an origin-based tax on a single commodity to maximize their tax revenues. Consumers have an option to purchase the commodity either in their own region or across the border by incurring a certain transport cost per unit distance. Their model infers that in the non-cooperative outcome, the smaller region will set lower tax rates, which will increase its revenue collection (as a result of cross-border shopping) while decreasing that of a larger region. Thus, in Nash equilibrium, the larger region levies the higher tax, and the smaller region features the higher tax revenue per capita.

Ohsawa (1999) extends Kanbur and Keen's (1993) analysis by allowing commodity tax competition among more than two regions. His model suggests that geographical sizes and positions of regions create varying degrees of market power, which in turn produces differences in tax rates among regions in the Nash equilibrium. Moreover, his model also confirms the conjecture of Kanbur and Keen (1993) that the larger regions have higher tax rates than smaller regions in the Nash equilibrium.

Similarly, Nielsen (2001) modifies Kanbur and Keen's (1993) model by examining the effect of goods' transportation costs and border inspection on commodity tax competition between two different regions. His model also supports the results of Kanbur and Keen (1999). In addition, his model suggests that both transportation costs of goods and border inspection increase commodity taxes of regions.

In this way, all these studies predict the presence of tax competition between regions by assuming that regions have only single tax instrument such as commodity tax rates to generate revenues. However, in reality, regions have more than one tax instrument to generate revenues, and thus, these theoretical studies have not addressed how regions would engage in strategic competition in more than one tax instrument.

### *3.2.2 Empirical Studies of Cross-Border Shopping*

Empirical studies of cross-border shopping investigate whether tax differentials leads consumers to alter their decisions regarding where to purchase goods. Fox (1986), Walsh and Jones (1988), and Tosun and Skidmore (2007) focus on state sales tax differentials of the United States. In particular, Fox (1986) examines the impact of state sales tax differentials on sales in counties on both sides of state borders in three Tennessee urban areas. He finds that a one percent difference in sales tax rates results in decreased sales ranging from one percent to four percent in high tax jurisdictions. Walsh et al. (1988) and Tosun and Skidmore (2007) finds that high sales tax differentials have negative impacts on food sales in border counties of West Virginia. However, these studies do not explain why sales tax differentials exist among states.

Numerous studies have also examined the impacts of interstate cigarette tax differentials on cigarette sales. Coats (1995) investigates whether state cigarette tax differentials induce cross-border sales of cigarettes in the forty-eight contiguous states and the District of Columbia during 1964–1986. He finds that high state cigarette tax differentials lead to significant increases in cross-border sales. Specifically, he finds that eighty percent of cigarette sales elasticity is due to cross-border sales. Fleenor (1998) uses a similar methodology as Coat’s analysis to examine the effect of cross-border shopping on cigarette sales in the US for the period 1980–94. However, Fleenor’s analysis examines not only the impacts of state cigarette tax differentials on cross-border sales of cigarettes, but also the effects of state cigarette tax differentials on interstate smuggling. He finds that 7.8 percent of final cigarette sales in the US are due to smuggling, while 3.6 percent are due to cross-border shopping. Other studies that find significant effects of cigarette tax differentials on border shopping for cigarettes are Baltagi and Levin (1992), Yurekli and Zhang (2000), and Lovenheim (2008). Yet, all these studies do not explain whether cross-border shopping or smuggling behaviors of individuals influence states to engage in cigarette tax competition.

Few studies have analyzed the impact of fuel price differentials on jurisdictions’ fuel sales. For example, Rietveld et al. (2001) analyze the cross-border fuelling behavior of Dutch residents in the presence of fuel price differentials between the Netherlands and Germany in 1997. They find that a price difference of five Euro-cents per liter will lead about thirty percent of the Dutch car owners who are living at the border to fuel in Germany. Banfi et al. (2003), on the other hand, use panel data to examine the impact of gas price differentials on cross-border fuelling in Switzerland’s three regions that border Italy, Germany and France. They find that a ten percent decrease in the ratio of Swiss gas price to the price in the bordering country will increase gas demand of between 6.7 to 7.7 percent in the Swiss border regions. Meanwhile, Leal et al. (2009) investigate whether an increase in diesel prices in certain Autonomous communities of Spain, as a result of the application of the regional tranche of the Hydrocarbon Retail Sales Tax (HRST), has an effect on cross border fuelling in neighboring communities. Using monthly panels of diesel prices from January 2001 to March 2007, they find that diesel price differentials

have a significant influence upon cross-border purchases of automotive diesel in Autonomous communities of Spain. Nonetheless, these studies do not examine whether jurisdictions compete for lower gas taxes to gain cross-border fuel shoppers.

In this way, the above discussed articles confirm that tax (price) differentials among jurisdictions influence location of individuals' purchase (or cross-border sales) of goods. However, these studies do not explain whether jurisdictions keep their tax rates competitive with surrounding jurisdictions so as to attract much of the cross-border shoppers that lie along their common border.

### *3.2.3 Empirical Studies of Fiscal Competition*

Most empirical analyses of fiscal competition estimate spatial reaction functions to assess fiscal competition among governments. This spatial reaction function relates a region's fiscal policy to other regions' fiscal policies. When the reaction function has a non-zero slope, it indicates that fiscal decisions by one government are affected by fiscal decisions of others. One of the first authors to test fiscal competition among governments is Case, Rosen, and Hines (1993). They study strategic interaction in expenditure policies among state governments of the United States over the period 1970–1985. They find that states' spending decisions are positively influenced by their neighbors' spending decisions. However, their research does not address strategic interaction in states' tax policy decisions.

Meanwhile, there are numerous studies that look at strategic interaction in tax policies among regional governments. Some articles that analyze strategic interaction in capital tax rates are Brueckner and Saavedra (2001), Buettner (2001), and Hernández-Murrillo (2003). Brueckner and Saavedra (2001), which focus on property tax competition among cities in the Boston metropolitan area, Buettner (2001), which considers business tax competition among German municipalities, and Hernández-Murrillo (2003), which studies capital income tax competition among the US state governments, find that capital tax rates of neighboring regions have positive effects on a region's own capital tax rates. In addition, Esteller-Moré and Solé-Ollé (2001) and

Hayashi and Boadway (2001) investigate both horizontal and vertical capital tax competition among governments. Specifically, Esteller-Moré and Solé-Ollé (2001) focus on income tax rates of the US states and find that state income tax rates respond positively to federal income tax rates and neighboring states' income tax rates. Hayashi and Boadway (2001) consider business tax rates of Canadian provinces and find that provincial tax rates respond negatively to the federal tax rates and positively to an increase in the tax rates of other provinces. However, all these studies focus on strategic interaction in single capital tax rate among regions, and thus they are unable to suggest if strategic interaction among regions occur beyond single capital tax rate.

Empirical papers that look at strategic interaction in commodity tax rates include Rork (2003), Jacobs et al. (2007), and Devereux et al. (2007). Considering statutory tax rates of commodities in the US states, Rork (2003) finds that state taxes with mobile bases, such as motor fuel and tobacco respond positively to tax rates set in neighboring states, while state taxes with relatively immobile bases, such as sales tax, respond negatively to tax rates set in neighboring states. On the other hand, focusing on an average effective tax rate<sup>8</sup> for commodities such as beer, cigarettes, distilled spirits, wine, and gas, Jacobs et al. (2007) find that state commodity tax rates are positively affected by neighboring states' same commodity tax rates. Moreover, Devereux et al. (2007) analyze both the vertical and horizontal tax competitions for cigarettes and gas taxes in the US for the period 1977–1997. They find that the weighted average of neighboring states' cigarette tax rates has a positive effect on a state's cigarette tax rate, while the federal cigarette tax has no significant effect on a state's cigarette tax. In the case of gas tax rates, they find that the weighted average of neighboring states' gas tax rates has no significant effect on state gas tax; however, the federal gas tax has a small positive effect on state gas tax. In this way, all these studies test competition in single commodity tax rates between state governments, and thus the findings of these studies cannot be used to understand if state governments engage in strategic competition in multiple tax rates.

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<sup>8</sup> The authors define an average effective tax rate as the ratio of the sum of sales tax and excise tax revenues to total consumption expenditures.

Furthermore, some studies have taken a different route and tested for tax competition among governments by estimating tax base functions, which relate a jurisdiction's tax base to its own tax rates and neighbors' tax rates. Buettner (2003), for example, estimates tax base functions to test business tax competition among German municipalities. He finds that a municipality's business tax base depends on its own business tax rates and the tax rates of the neighboring municipalities. Similarly, considering fourteen western European countries over the period 1982–2004, Riedl and Rocha-Akis (2007) find that corporate income tax bases respond to foreign countries' corporate income tax rates. However, these studies again look at strategic interaction among jurisdictions in only one tax base, and thus they do not suggest whether one tax base of jurisdictions responds to neighbors' other tax bases.

There are three papers that have estimated spatial reaction functions to test if there is strategic interaction in multiple fiscal policies among jurisdictions. Fredriksson et al. (2004), for example, investigate whether strategic interactions occur among state governments for tax, expenditure, and environmental policies. In particular, they examine three reaction functions: in the domestic region, the optimal choice of tax, expenditure and environmental policies reacts to changes in each of these policies in the neighboring region, and vice versa. Based on the US state-level panel data over the period 1977 to 1994, they find that a state's policy responds to neighbors' policies for the same type as well as other types of policies, thereby confirming the presence of own and cross policy interactions among state governments. However, this article does not look at the presence of own and cross effects of various tax rates among state governments.

Van Parys and Verbeke (2007) investigate whether municipal governments interact strategically with each other across two tax policy instruments rather than only within one tax policy instrument. In particular, their analysis focuses on personal income and property tax rates and uses panel data from Belgian municipalities over the period 1991–2004. They find that a municipal's personal income (property) tax rates respond positively to not only personal income (property) tax rates of competing municipalities, but also to property (personal income) tax rates of competing municipalities. However,



this study does not assess strategic interactions within and across cigarette, gas, sales and income tax rate policies among state governments of the United States.

Devereux et al. (2008) develop a theoretical model that shows that multinational firms choose their capital stock in response to an effective marginal tax rate (EMTR), and simultaneously choose the location of their profit in response to differences in statutory tax rates. Based on this model, they analyze whether governments of 12 OECD countries engage in two-dimensional tax competition: over statutory tax rates for mobile profit and over effective marginal tax rates (EMTR) for capital. Their empirical estimations include two tax-reaction functions: statutory rates (or EMTRs) of the home country react to changes in both statutory rates and EMTRs of the foreign country. Using panel data over the period 1982–1999, they find that statutory tax rates of the home country depend on statutory tax rates of foreign countries, but do not depend on EMTRs of foreign countries. In contrast, depending on the type of weights used to define foreign rival country, they find that EMTR of the home country depends on foreign countries' statutory tax rates as well as EMTRs. In this way, although this study examines two-dimensional tax competition in capital tax rates of national-level governments, it has not analyzed four-dimensional tax competition in cigarette, gas, sales and income tax rates of state-level governments.

In summary, most previous studies have addressed strategic competition among jurisdictions by estimating how one fiscal policy responds to neighbors' same fiscal policy. In addition, a small number of recent studies have examined whether jurisdictions engage in strategic competition in multiple fiscal policies. However, none of these studies have looked at strategic competition in multiple tax policies among state governments of the US. Therefore, considering cigarette tax rates, gas tax rates, sales tax rates and income tax rates of the forty-eight contiguous states of the US over the period 1977–2002, this paper analyzes how states' tax rates on one tax base respond to the same tax base of neighboring states as well as other tax bases of neighboring states.

### 3.3 Theoretical Framework

Here I develop a simple framework to consider the expected cross-border effects of taxes when states have multiple tax instruments. As will be evident, it is difficult to make theoretical predictions about these cross state effects. In an even simpler framework focused on property tax competition among local jurisdictions, Brueckner and Saavedra (2003) show that even with a single tax instrument, the sign of the tax reaction functions are ambiguous—theoretically, increases in neighboring jurisdictions’ taxes could increase a jurisdiction’s tax. Then, given the ambiguity obtained when there is only a single instrument, multiple instruments make results even more ambiguous. Still, I believe that my simple model and subsequent comparative static analysis using the model provides insights into what might be the expected results and allows for some interpretation of the results.

With multiple tax instruments, inter-jurisdictional spillovers are possible among all tax bases. Then, as one might expect, without prior conditions on demand relationships, the impact of an increase in gas tax, for example, in one state on its neighbor’s gas or cigarette taxes are ambiguous. Here, then, I try to outline what factors affect the tax reactions and, in particular, highlight the *relative* impacts on the different bases. That is, how might an increase in the gas tax in one state affect the tax on income relative to the tax on gas in its neighboring state?

To make any statement about the tax reactions, I have to posit how the tax rates are determined. I assume that state governments choose taxes to maximize the utility of a representative resident, essentially following the optimal tax framework (Diamond and Mirrlees, 1971). To keep the analysis as simple as possible, I assume that there are two taxed goods, 1 and 2, and two states, a and b. Let the tax revenue used to finance a public service be  $g$ . Then the state’s problem can be expressed as

$$\begin{aligned}
 & \underset{\tau_1^j, \tau_2^j, g^j}{Max} \quad V^j(p_1(1 + \tau_1^j), p_2(1 + \tau_2^j), g^j), \quad j, k = a, b, j \neq k \\
 & s.t. \quad g^j = \tau_1^j X_1^{jj} + \tau_2^j X_2^{jj} + \tau_1^j X_1^{jk} + \tau_2^j X_2^{jk}
 \end{aligned} \tag{3.1}$$

where  $p_i, i=1,2$  is the net price of good  $i$ , assumed to be the same in both states and invariant to changes in the tax rate. The tax rate by state  $j$  on good  $i$  is  $\tau_i^j$ . Purchases of good  $i$  by residents of state  $j$  in state  $j$  are given by  $X_i^{jj}$  and purchases by residents of state  $k$  in state  $j, j \neq k$  is  $X_i^{jk}$ . The amount of purchases of both goods, both by state residents and residents of the other state, are assumed to be affected by taxes on either good in either state.

Then the objective of state  $j$  is to maximize utility of a resident of its state purchasing goods in that state subject to a budget that considers tax revenue from the domestic state residents and residents of the other state. Then the first order conditions can be stated as

$$\tau_1^j X_{1\tau_1^j}^j + \tau_2^j X_{2\tau_1^j}^j = \theta^j X_1^{jj} - X_1^{jk} \quad (3.2a)$$

$$\tau_1^j X_{1\tau_2^j}^j + \tau_2^j X_{2\tau_2^j}^j = \theta^j X_2^{jj} - X_2^{jk} \quad (3.2b)$$

where  $X_{i\tau_l^j}^j = \frac{\partial X_i^{jj}}{\partial \tau_l^j} + \frac{\partial X_i^{jk}}{\partial \tau_l^j}$ , the change in purchases of good  $i$  in state  $j$  by residents of

both states with respect to a tax on good  $l$  in state  $j$ . The term  $\theta^j = \frac{\frac{\partial V^j}{\partial y^j}}{\frac{\partial V^j}{\partial g^j}} - 1 < 0$ , where  $y^j$  is

the income of the representative resident of state  $j$ . Then solving for the tax rates gives

$$\tau_1^j = \left[ \left( \theta^j X_1^{jj} - X_1^{jk} \right) X_{2\tau_2^j}^j - \left( \theta^j X_2^{jj} - X_2^{jk} \right) X_{1\tau_1^j}^j \right] |H|^{-1} \quad (3.3a)$$

and

$$\tau_2^j = \left[ \left( \theta^j X_2^{jj} - X_2^{jk} \right) X_{1\tau_1^j}^j - \left( \theta^j X_1^{jj} - X_1^{jk} \right) X_{2\tau_2^j}^j \right] |H|^{-1} \quad (3.3b)$$

where  $|H| = X_{1\tau_1^j}^j X_{2\tau_2^j}^j - X_{1\tau_2^j}^j X_{2\tau_1^j}^j > 0$ .

In the absence of cross-border shopping, equations (3.3a) and (3.3b) would yield the solution for the standard two-good optimal tax problem as in Atkinson and Stiglitz (1980). However, cross-border shopping complicates the problem as the revenue collected from residents of the other state is considered, but the impact on their utility is not.

If one assume linear demand equations, that is, the slopes of the demands for  $X_1$  and  $X_2$  with respect to taxes  $\tau_1^j$  and  $\tau_2^j$  do not change with a change in  $\tau_1^k$ , and instead focus on the impacts of  $\tau_1^k$  on purchases in state  $j$  ( $X_1^{jj}$ ,  $X_1^{jk}$ ,  $X_2^{jj}$ ,  $X_2^{jk}$ ) and on the shadow price  $\theta$ , one can differentiate (3.2) to obtain:

$$\begin{bmatrix} X_{1\tau_1^j}^j - X_1^{jj} \frac{d\theta}{d\tau_1^j} & X_{2\tau_1^j}^j - X_1^{jj} \frac{d\theta}{d\tau_2^j} \\ X_{1\tau_2^j}^j - X_2^{jj} \frac{d\theta}{d\tau_1^j} & X_{2\tau_2^j}^j - X_2^{jj} \frac{d\theta}{d\tau_2^j} \end{bmatrix} \begin{bmatrix} \frac{d\tau_1^j}{d\tau_1^k} \\ \frac{d\tau_2^j}{d\tau_1^k} \end{bmatrix} = \begin{bmatrix} \theta X_{1\tau_1^k}^{jj} - X_{1\tau_1^k}^{jk} + X_1^{jj} \frac{d\theta}{d\tau_1^k} \\ \theta X_{2\tau_1^k}^{jj} - X_{2\tau_1^k}^{jk} + X_2^{jj} \frac{d\theta}{d\tau_1^k} \end{bmatrix} \quad (3.4)$$

Solving (3.4) gives

$$\frac{dt_i^j}{dt_1^k} = \begin{bmatrix} \left( \theta X_{1\tau_1^k}^{jj} - X_{1\tau_1^k}^{jk} + X_1^{jj} \frac{d\theta}{dt_1^k} \right) \left( X_{2\tau_2^j}^j - X_2^{jj} \frac{d\theta}{dt_2^j} \right) - \left( \theta X_{2\tau_1^k}^{jj} - X_{2\tau_1^k}^{jk} + X_2^{jj} \frac{d\theta}{dt_1^k} \right) \left( X_{1\tau_2^j}^j - X_1^{jj} \frac{d\theta}{dt_2^j} \right) \\ \left( X_{2\tau_1^j}^j - X_1^{jj} \frac{d\theta}{dt_2^j} \right) \end{bmatrix} \times |M|^{-1} \quad (3.5a)$$

and

$$\frac{dt_2^j}{dt_1^k} = \left[ \begin{array}{c} \left( \begin{array}{ccc} \theta X_{2t_1^k}^{jj} - X_{2t_1^k}^{jk} + X_2^{jj} \frac{d\theta}{dt_1^k} \\ (?) & ? & (+) \end{array} \right) \left( \begin{array}{c} X_{1t_1^j}^j - X_1^{jj} \frac{d\theta}{dt_1^j} \\ (-) & (-) & (-) \end{array} \right) - \left( \begin{array}{ccc} \theta X_{1t_1^k}^{jj} - X_{1t_1^k}^{jk} + X_1^{jj} \frac{d\theta}{dt_1^k} \\ (-) & - & (+) \end{array} \right) \\ \left( \begin{array}{ccc} X_{1t_2^j}^j - X_2^{jj} \frac{d\theta}{dt_1^j} \\ (?) & (?) & (-) \end{array} \right) \end{array} \right] \times |M|^{-1} \quad (3.5b)$$

$$\text{where } |M| = \left( X_{1t_1^j}^j - X_1^{jj} \frac{d\theta}{dt_1^j} \right) \left( X_{2t_2^j}^j - X_2^{jj} \frac{d\theta}{dt_2^j} \right) - \left( X_{2t_1^j}^j - X_1^{jj} \frac{d\theta}{dt_2^j} \right) \left( X_{1t_2^j}^j - X_2^{jj} \frac{d\theta}{dt_1^j} \right) > 0$$

I denote the expected signs of each of the terms in equations (3.5a) and (3.5b). As indicated, a number of terms are indeterminate. There are two primary reasons for this indeterminacy. As suggested by (3.3a), an increase in the tax base for good 1 in state  $j$  ( $X_1^j$ ) will tend to increase  $\tau_1^j$  given  $\theta$  as well as other parameters. However, the increase in revenue will increase the public service lowering  $\theta$  ( $\frac{d\theta^j}{d\tau_i^j} > 0, i=1,2$  and  $\frac{d\theta^j}{d\tau_i^k} > 0, i=1,2$ )

. In addition, while we expect an increase in  $\tau_1^k$  to increase purchases of good 1 in state  $j$  ( $X_{1\tau_1^k}^j > 0$ ), it is not clear what impact there will be on purchases of good 2 ( $X_{2\tau_1^k}^j$ ).

While ambiguous, the results are suggestive. If exogenous increases in tax bases are generally used by the state government to increase public services rather than reduce tax rates ( $\frac{d\theta^j}{d\tau_i^k} = 0, i=1,2$ ) and increases in  $\tau_1^k$  have little effect on the purchases of good 2 in

state  $j$ , then (5a) suggests  $\frac{d\tau_1^j}{d\tau_1^k} > 0$  with the impact of an increase in  $\tau_1^k$  on  $\tau_2^j$  depending on

whether goods 1 and 2 are complements or substitutes; if complements then  $\frac{d\tau_2^j}{d\tau_1^k} > 0$  and

if substitutes  $\frac{d\tau_2^j}{d\tau_1^k} < 0$ .

### 3.4 Empirical Specification

In this section, I examine how states engage in strategic interaction in four tax bases: cigarette, gas, sales, and income taxes. First, I start by estimating how a home state's rates on one tax base react to neighboring states' rates on the same tax base. Second, I account for the home state rates on other tax bases to analyze how home state rates on one tax base respond to neighboring states' rates on the same tax base. Third, I examine whether the home state rates on one tax base react to neighboring states' rates on the same tax base and other tax bases. Lastly, I control for home state's rates on other tax bases to estimate how home state's rates on one tax base respond to neighboring states' rates on the same and other tax bases.

#### 3.4.1 Strategic Interaction within One Tax Base

As discussed earlier, most previous studies have examined tax-reaction functions that relate a state's tax rates on a single base to other states' tax rates on the same base. Following this approach, in the first set of equations I estimate, I want to ascertain the impact of tax rates of other states on a state's own tax rates for the same tax base. The econometric specification of this tax-reaction function is as follows:

$$Y_{it,k} = \lambda_k \sum_{i \neq j} w_{ij} Y_{jt,k} + x'_{it} \beta + z'_{it,k} \phi + \mu_i + \alpha_t + v_{it,k} \quad (3.6)$$

where  $Y_{it,k}$  refers to tax rates of state  $i$  at period  $t$  for tax base  $k$ , and  $k = 1,2,3,4$  that represents cigarette, gas, sales and income tax rates respectively;  $\lambda_k$  is a parameter measuring within tax-base effects;  $w_{ij}$  is the weight assigned to state  $j$  by state  $i$ ; the term  $Y_{jt,k}$  refers to a tax rate of neighboring state  $j$  of state  $i$  at period  $t$  for tax base  $k$ . The term  $x'_{it}$  represents a vector of state  $i$ 's socio-economic, political characteristics that is identical for each tax base  $k$ . In contrast, the term  $z'_{it,k}$  refers to a vector of state  $i$ 's characteristics at period  $t$  that is specific for each tax base  $k$ . The state effects,  $\mu_i$ , control for all unobserved state characteristics that remain constant over time, while the time

effects,  $\alpha_t$ , account for all factors that affect all states in a given year. The error term  $v_{it,k}$  is a mean zero, normally distributed random error.

### 3.4.2 *Strategic Interaction within One Tax Base along with Interdependence among Tax Bases within the Same State*

In addition to strategic interaction in the same tax base, states' rates on one tax base may be related to their own rates on other tax bases. For instance, Agostini (2004) shows that sales tax rates are negatively affected by personal income and corporate tax rates within the same state. Thus, conditional on home states' rates on other taxes, a second set of equations examines how a home state's rates on one tax base respond to neighboring states' rates on the same tax base. The equation to be estimated is specified as follows:

$$Y_{it,k} = \lambda_k \sum_{i \neq j} w_{ij} Y_{jt,k} + \sum_{m \neq k}^4 Y_{it,m} \delta_m + x'_{it} \beta + z'_{it,k} \phi + \mu_i + \alpha_t + v_{it,k} \quad (3.7)$$

where the subscript  $m$  refers to cigarettes, gas, sales and income tax rates such that  $m = 1, 2, 3, 4$ . The term  $Y_{it,m}$  represents rates on tax base  $m$  of state  $i$  at period  $t$ ; and  $\delta_m$  is the parameter that measures the relationship between tax bases  $m$  and  $k$  within states. The remaining other variables are the same as in (3.6).

### 3.4.3 *Strategic Interaction across Multiple Tax Bases*

When setting tax rates on one base, do state governments consider neighboring states' rates on other tax bases in addition to rates on their identical tax base? That is, for instance, does Kentucky's government determine its cigarette tax rates by looking at neighboring states' not only cigarette tax rates, but also at rates on gas, sales and income taxes? In order to determine answer to this question, I estimate the third set of reaction functions, where I relate a state's tax rate to the neighboring states' tax rates on the same base as well as other bases.

$$Y_{it,k} = \lambda_k \sum_{i \neq j} w_{ij} Y_{jt,k} + \sum_{l \neq k} \lambda_l \left( \sum_{i \neq j} w_{ij} Y_{jt,l} \right) + x'_{it} \beta + z'_{it,k} \phi + \mu_i + \alpha_t + v_{it,k} \quad (3.8)$$

Here, the term  $Y_{jt,l}$  refers to a tax rate of neighboring state  $j$  of state  $i$  at period  $t$  for tax base  $l$ , where  $l$  represents cigarette, gas, sales and income tax rates, and  $l=1,2,3,4$ ; The term  $\lambda_l$  is a parameter measuring across tax base effects. The other variables are the same as in (3.6).

#### 3.4.4 Strategic Interaction across Multiple Tax Bases along with Interdependence among Tax Bases within the Same State

Based on equations (3.6) through (3.8), state rates on one tax base may be influenced by: (i) neighboring states' rates on an identical tax base; (ii) rates on a state's own other tax bases; or (iii) neighboring states' rates on other tax bases. To collectively measure the impact of all these three factors on state rates on one tax base, the following fourth set of equations is estimated:

$$Y_{it,k} = \lambda_k \sum_{i \neq j} w_{ij} Y_{jt,k} + \sum_{l \neq k} \lambda_l \left( \sum_{i \neq j} w_{ij} Y_{jt,l} \right) + \sum_{m \neq k} Y_{it,m} \delta_m + x'_{it} \beta + z'_{it,k} \phi + \mu_i + \alpha_t + v_{it,k} \quad (3.9)$$

where the variables are defined as before.

#### 3.4.5 Assigning Neighbor Weights

Before estimating equations (3.6) through (3.9), I need to define which states are neighbors. There are two basic approaches to defining neighbors. In the first approach, also referred to as contiguity weight, contiguous states are defined as neighbors. That is, in all the above four sets of equations, I define the spatial weight as follows:  $w_{ij}=1/n_i$  if state  $i$  and  $j$  are contiguous and zero if they are not, where  $n_i$  represents total number of adjacent states of state  $i$ . The matrix is row normalized so that  $\sum_{i \neq j} w_{ij} = 1$ . This approach treats neighboring states with lightly and heavily populated borders equally. However, the tax competition between neighboring states with lightly populated borders may not be the same as the tax competition between neighboring states with heavily populated



borders. The presence of a heavily populated border represents a large number of potential cross-border populations, and thus, state tax rates may show more response to lower tax rates of neighboring states with heavily populated borders than to the lower tax rates of neighboring states with lightly populated borders. Therefore, in order to place more weight on neighbors with heavily populated borders, I consider the second approach to define neighbors.

This second approach, also referred to as population contiguity weight, defines spatial weight in the following way:  $w_{ij} = \frac{P_{ij}}{\sum_{j \in J_i} P_{ij}}$  if states  $i$  and  $j$  are contiguous and zero otherwise –where  $P_{ij}$  refers to the population of states  $i$  and  $j$  that are 25 miles away from their common border, and  $J_i$  is the set of states bordering state  $i$  such that  $\sum_{j \in J_i} P_{ij}$  represents the total population that is 25 miles away from the common border between state  $i$  and its neighbors.

#### 3.4.6 *Econometric Issues*

There are a few econometric issues to be addressed when estimating equations (3.6)–(3.9). First, as all states determine their tax rates simultaneously, the tax rates of neighboring states are endogenous, implying that the ordinary least squares method will produce biased and inconsistent estimates. Second, there is the possible presence of spatial autocorrelation in the error term. That is, in equations (3.6)–(3.9), the error term  $v_{it,k}$  follows the relationship:

$$v_{it,k} = \theta M_i v_{t,k} + \varepsilon_{it,k}$$

where  $\varepsilon$  is the well-behaved normal error vector, and  $\theta$  is the spatial auto-regressive coefficient. Such spatial correlation can arise when unobserved variables affecting tax rates are themselves spatially dependent. One way to address both of these econometric issues is by using an instrumental variable (IV) approach (Kelejian and Prucha, 1998; Brueckner, 2003). This approach generates consistent estimates even in the presence of spatial error dependence. Some strategic interaction studies that have used this approach

are Rork (2003) and Devereux et al. (2007). Following these previous empirical papers, I use the weighted average of the neighbors' exogenous variables as instruments for neighbors' tax rates, where the weight used for instruments is the same as that used in the average neighbors' tax rates.

A third issue is that as rates on all tax bases are jointly determined within the same state, a state's rates on other tax bases are endogenous in equations (3.7) and (3.9). That is, for instance, when considering cigarette tax rates as a dependent variable in equation (3.7), any observed correlation between the state's cigarette and sales (or gas or income) tax rates may be due to reverse causation. One way to solve this simultaneity problem is by using instrumental variables, which is, however, a difficult task. In particular, I need at least one unique control variable for each tax base's tax rates so that I can use this control variable(s) as instrument(s) to identify the coefficients of the endogenous domestic state's tax rates in equations (3.7) and (3.9). Therefore, on the right hand side of equations (3.6)–(3.9), I add the term  $z'_{it,k}$  that includes control variable(s), which is expected to influence only specific tax rates. These control variables are used as instrumental variables to identify the effect of a state's taxes on one another. The variables that are in  $z'_{it,k}$  are explained in more detail in the Data section.

Similarly, a fourth issue is that as rates on all tax bases are determined at the same time across states, rates on other tax bases of neighboring states are endogenous in equations (3.8) and (3.9). This problem is solved by using an instrumental variable approach, where the weighted average of the neighboring states' control variable(s),  $z'_{it,k}$ , which are specific to each tax rate, are used as instruments to identify endogenous neighboring states' rates on other tax bases. The weight used for instruments is same as that used in the weighted average of neighboring states' tax rates.

## 3.5 Data

### 3.5.1 Variable Descriptions

In this study, I use data on the forty-eight contiguous states from 1977 to 2002<sup>9</sup>. For measures of tax rates, I use the statutory tax rates for cigarette tax rates, gas tax rates, and sales tax rates. Since states impose a range of tax rates for different individual income tax brackets, I consider top (statutory) marginal income tax rate as a proxy for states' income tax rates.

Independent variables that characterize the demographic, political, and economic characteristics of the state,  $x'_{it}$ , in equations (3.6)–(3.9) include total population, the percentage of population over the age of sixty-five, the percentage of population under the age of eighteen, income per capita, the current unemployment rate, per capita federal grants, per capita outstanding debt, per capita gross state product, a dummy variable indicated by a one if the governor of a state is Democrat and a zero otherwise, a dummy variable indicated by a one if it is an election year for the governor position in a state and a zero otherwise, and the percentage of Democrats in the House.

Also included are factors,  $z'_{it,k}$ , that are expected to influence only specific tax rates. For instance, when the cigarette tax rate is the dependent variable,  $z'_{it,k}$  includes states' tobacco production values. It is predicted that the tobacco production values of a state will have negative influences on state cigarette tax rates. Tobacco producers are expected to promote demand for tobacco so that they can continue producing it. One way to achieve this goal is by having lower cigarette tax rates in states. A lower cigarette tax rate of state reduces the cost of cigarettes to cigarette consumers, which may then increase or at least sustain the demand for cigarettes and tobacco in the state.

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<sup>9</sup> Since Alaska and Hawaii do not share borders with any other state, I do not include these states in my panel data.

Similarly, when the gas tax rate is the dependent variable,  $z'_{it,k}$  includes states' total number of motor vehicle registrations. It is expected that states' total number of motor vehicle registrations would have negative impacts on gas tax rates. When a state has a higher number of motor vehicle registrations, it is able to collect higher amount of revenues from motor vehicle registration fees. If more revenues are generated from motor vehicle registrations, the state requires less need to increase its gas tax rates to finance its transportation expenditures.

In the case of sales tax rates as the dependent variable,  $z'_{it,k}$  includes the percentage of gross state product from hotels and other lodging places. The percentage of gross state product from hotels and other lodging places is a proxy for the fraction of total consumption by people from other states. A state may want to export some of its sales tax burden to consumers from outside states, and thus, it is predicted that the state with the higher percentage of gross state product from hotels and other lodging places will have higher sales tax rates.

When the income tax rates is the dependent variable,  $z'_{it,k}$  includes adjustment for residence and a dummy variable indicating whether the state has a reciprocity agreement with another state. The adjustment for residence represents the net inflow of earnings of inter-area commuters. For example, the adjustment for residence of Alabama is the difference between amount that residence of Alabama earns from job in other states less the amount that residence of other states earn from jobs in Alabama. It is considered that adjustment for residence would have two opposite effects on income tax rates. If states are motivated to shift some of their income tax burdens to nonresident workers, then it is expected that states with lower amount of adjustment for residence would have higher income tax rates. However, if states consider that nonresident workers increase their individual income tax bases, then they may reduce income tax rates to attract more nonresident workers to work in their states. In such case, it is expected that the lower the value of a state's adjustment of residence, the lower the income tax rates of the state. It is not a priori clear which effect will dominate income tax rates. Meanwhile, it is expected

that reciprocity agreement would have a negative influence on states' income tax rates. Reciprocity agreement allows a person's income to be taxed in a state of her residence even though it is earned in another state. Since nonresident workers no longer contribute to the individual income tax base of states that have reciprocity agreements with other states, these states are less likely to decrease their income tax rates to gain nonresident workers.

### 3.5.2 *Data Sources*

Data for my variables came from various sources. Cigarette, gas, and sales tax rates data were obtained from the World Tax Database (WTD) of the University of Michigan. There were missing gas tax rates for some states for 1997 in the WTD website. Thus, I collected those missing gas tax rates data by contacting each state government official. Top marginal income tax rates data were obtained from the Bureau of Economic Analysis (BEA).

Data for per capita outstanding debt, per capita federal grant to the state, the proportion of young population, and the proportion of old population were obtained from the U.S. Census Bureau, while data for state's total population, gross state product, gross state product from hotels, adjustment for residence, and per capita income were collected from the Bureau of Economic Analysis (BEA). State motor vehicle registrations data were obtained from the United States Department of Transportation - Federal Highway Administration. Data on tobacco production value were collected from the United States Department of Agriculture – National Agricultural Statistics Service. Unemployment rate data were obtained from the Bureau of Labor Statistics, while reciprocity data were collected from Rork and Wagner (2007). Data related to a state's political environment such as the political party of the governor, the percentage of Democrats in the House, and the dummy variable indicating if the year of observation was an election year for the governor position in a state were obtained from the University of Kentucky Center for Poverty Research and the U.S. Census Bureau, Statistical Abstract of the United States.

To construct population contiguity weights, I identify which counties of a state and its neighboring states are twenty five miles away from their common border (Holmes, 2008). Then, I obtain the population of all these counties in 1977. In this way, I determine a state's and its neighboring states' population living twenty-five miles from their common border. Table 3.1 presents the descriptive statistics. The mean cigarette tax rates, gas tax rates, sales tax rates, and top marginal income tax rates for forty-eight contiguous states from 1977 to 2002 are about twenty-four cents per package, fifteen cents per gallon, 4.34 percent, and six percent, respectively.

*Table 3.1—Descriptive Statistics, 1977–2002*

<b>Variables</b>	<b>Description</b>	<b>Mean</b>	<b>Std. Dev.</b>
Cigarette Tax	State's cigarette tax rate (dollar per package)	0.239	0.183
Gas Tax	State's gasoline tax rate (dollar per gallon)	0.149	0.058
Sales Tax	State's sales tax rate (percent)	4.338	1.688
Income Tax	State's top marginal Income tax rate (percent)	5.990	3.81
Population	Total state population (in million)	5.191	5.463
Elderly	Percentage of state population over 65 years old	12.708	2.200
Young	Percentage of state population 5-17 years old	19.464	1.909
Income per capita	State's income per capita (in thousands of dollars)	17.867	7.276
Unemployment	State's Unemployment rate (in percent)	5.941	2.044
Grant per capita	Grant per capita (in thousands of dollars)	0.577	0.322
Debt per capita	Outstanding debt per capita (in current dollars)	3.048	1.608
Gross State Product per capita	Gross state product (GSP) per capita (in thousands of dollars)	21.031	8.597
Party of Governor	Party of the Governor (=1 if Democrats; 0 = other)	0.519	
Election Year	Election year (=1 if year t was an election year for the state's governor position; 0 = other)	0.274	

*Table 3.1 continued*

<b>Variables</b>	<b>Description</b>	<b>Mean</b>	<b>Std. Dev.</b>
Democrats in the House	Percentage of state House that is Democratic	56.392	19.610
Tobacco Production	Tobacco production value (in billions of dollars)	0.053	0.177
Motor Vehicle Registration	Motor vehicle registrations (in million)	3.865	3.985
Hotels	Percentage of state's GSP generated by hotels and other lodging places	1.020	1.844
Residence	Adjustment for Residence (in billions of dollars)	0.380	4.120
Reciprocity	Reciprocity Agreement (1= yes; 0= no)	0.280	

In addition, Table 3.2 demonstrates how cigarette tax rates, gas tax rates, sales tax rates, and income tax rates vary in the forty-eight contiguous states and seven U.S. census divisions in years 1977 and 2002. It also reports the number of times that each tax rate had changed across the forty-eight contiguous states and seven U.S. census divisions over the period 1977 to 2002.

In the case of cigarette tax rates, table 3.2 shows that Kentucky, Virginia, North Carolina, and South Carolina had the lowest cigarette tax rates of less than eight cents per package in both 1977 and 2002. Connecticut and Massachusetts had the highest cigarette tax rates of twenty-one cents per package in 1977, while New Jersey and New York had the highest cigarette tax rates of one dollar and fifty cents in 2002. Moreover, during these twenty-six years, while Georgia, Virginia, Kentucky, and Tennessee had no change in their cigarette tax rates, Washington and Rhode Island had the highest number of changes in their cigarette tax rates.

In the case of gas tax rates, Texas had the lowest gas tax rates of five cents per gallon in 1977, and Florida set the lowest gas tax rates of four cents per gallon in 2002. Connecticut had the highest gas tax rates of eleven cents per gallon in 1977, and Rhode Island scored the highest gas tax rates of twenty-eight cents per gallon in 2002. Over these twenty-six years, Nebraska changed its gas tax rates around twenty-two times,

while Georgia had no change in its gas tax rates. There were also forty-one states that changed their gas tax rates more than three times during 1977 to 2002. In addition, states on average changed their gas tax rates about seven times over these twenty-six periods.

In the case of sales tax rates, there were four states that did not have sales tax rates between 1977 and 2002 – Delaware, Montana, New Hampshire, and Oregon. For the states that did have sales tax rates, New York, New Jersey and Oklahoma had the lowest sales tax rates of two percent in 1977, while Colorado imposed the lowest sales tax rates of 2.9 percent in 2002. Connecticut set the highest sales tax rates of seven percent in 1977, while Mississippi and Rhode Island imposed the highest sales tax rates of seven percent in 2002. Five states experienced no changes in their sales tax rates over these twenty-six years: Maryland, Alabama, Massachusetts, New York, and Pennsylvania. On the contrary, four states changed their sales tax rates the highest five times over the period 1977 to 2002.

In the case of income tax rates, there were eight states that did not levy individual income tax rates during 1977 to 2002 – Florida, Nevada, New Hampshire, South Dakota, Tennessee, Texas, Washington, and Wyoming. In 1977, Vermont had the highest top marginal income tax rates of eighteen percent, but Montana imposed the highest top marginal income tax rates of eleven percent in 2002. States on average changed their highest top marginal income tax rates about three times between 1977 and 2002. Moreover, for the states that did have income tax rates, eight states did not change their top marginal income tax rates, while twenty states changed their top marginal income tax rates more than three times over these twenty-six years.

Furthermore, Table 2 also shows that during the period 1977 to 2002, while the East South Central division had the lowest number of changes in cigarette and income tax rates, the New England division had the highest number of changes in cigarette and income tax rates. Similarly, the Middle Atlantic division had the lowest number of changes in gas and sales tax rates, but the divisions of Mountain and West North Central scored some of the highest number of changes in gas and sales tax rates during 1977 to 2002.



Table 3.2—A Comparison of State Tax Rates

Census Divisions and State	Cigarette tax			Gas tax			Sales tax			Income tax		
	1977	2002	Number of tax changes <sup>1</sup>	1977	2002	Number of tax changes <sup>1</sup>	1977	2002	Number of tax changes <sup>1</sup>	1977	2002	Number of tax changes <sup>1</sup>
New England	0.17	0.94	32	0.09	0.22	43	4.33	4.67	9	7.17	6.20	37
Connecticut	0.21	1.11	6	0.11	0.25	15	7	6	3	0	4.5	2
Maine	0.16	1.00	6	0.09	0.22	5	5	5	3	8	8.5	4
Massachusetts	0.21	0.76	3	0.085	0.21	5	5	5	0	5	5.3	4
New Hampshire	0.12	0.52	4	0.09	0.18	5	0	0	0	0	0	0
Rhode Island	0.18	1.32	8	0.1	0.28	7	6	7	1	12	9.65	15
Vermont	0.12	0.93	5	0.09	0.19	6	3	5	2	18	9.26	12
Middle Atlantic	0.17	1.10	13	0.08	0.10	7	5.00	5.33	3	6.67	5.34	19
New Jersey	0.19	1.5	6	0.08	0.105	3	5	6	3	3	6.37	5
New York	0.15	1.5	6	0.08	0.08	2	4	4	0	15	6.85	7
Pennsylvania	0.18	0.31	1	0.09	0.12	2	6	6	0	2	2.8	7
East North Central	0.12	0.72	21	0.08	0.20	41	4.00	5.45	6	5.00	4.95	35
Illinois	0.12	0.98	5	0.075	0.19	4	4	6.25	2	3	3	4
Indiana	0.06	0.56	3	0.08	0.15	5	4	5	1	2	3.4	4
Michigan	0.11	0.75	3	0.09	0.19	4	4	6	1	5	4.1	8
Ohio	0.15	0.55	4	0.07	0.22	8	4	5	1	4	7.5	13
Wisconsin	0.16	0.77	6	0.07	0.273	20	4	5	1	11	6.75	6
West North Central	0.12	0.40	28	0.08	0.21	58	3.29	4.95	22	8.86	5.93	31
Iowa	0.13	0.36	5	0.07	0.2	7	3	5	2	13	8.98	2
Kansas	0.11	0.7	3	0.08	0.21	8	3	4.9	3	7	6.45	5
Minnesota	0.18	0.48	4	0.09	0.2	5	4	6.5	3	15	7.85	7

Notes: <sup>1</sup>Number of times that a tax rate had changed during 1977–2002.

Table 3.2 (continued)

Census Divisions and State	Cigarette tax			Gas tax			Sales tax			Income tax		
	1977	2002	Number of tax changes	1977	2002	Number of tax changes	1977	2002	Number of tax changes	1977	2002	Number of tax changes
Missouri	0.09	0.17	2	0.07	0.17	5	3	4.23	3	6	6	0
Nebraska	0.13	0.34	4	0.085	0.245	22	3	5	5	11	6.68	11
North Dakota	0.11	0.44	6	0.07	0.21	6	3	5	4	10	5.54	6
South Dakota	0.12	0.33	4	0.08	0.22	5	4	4	2	0	0	0
South Atlantic	0.10	0.25	12	0.09	0.17	48	3.13	4.19	8	6.50	5.53	21
Delaware	0.14	0.24	1	0.09	0.23	7	0	0	0	11	5.95	9
Florida	0.17	0.34	3	0.08	0.04	5	4	6	2	0	0	0
Georgia	0.12	0.12	0	0.075	0.075	0	3	4	1	6	6	0
Maryland	0.1	1	5	0.09	0.235	4	5	5	0	5	4.75	6
North Carolina	0.02	0.05	1	0.09	0.242	17	3	4	1	7	8.25	2
South Carolina	0.06	0.07	1	0.08	0.16	6	4	5	1	7	7	0
Virginia	0.03	0.03	0	0.09	0.175	5	3	3.5	1	6	5.75	1
West Virginia	0.12	0.17	1	0.085	0.205	4	3	6	2	10	6.5	3
East South Central	0.10	0.13	3	0.08	0.17	20	4.63	5.75	5	3.75	4.00	1
Alabama	0.12	0.17	2	0.07	0.16	2	4	4	0	5	5	0
Kentucky	0.03	0.03	0	0.09	0.15	4	5	6	1	6	6	0
Mississippi	0.11	0.18	1	0.09	0.18	3	5	7	2	4	5	1
Tennessee	0.13	0.13	0	0.07	0.2	11	4.5	6	2	0	0	0
West South Central	0.15	0.31	13	0.07	0.19	20	3.00	4.97	13	4.75	4.91	3
Arkansas	0.18	0.34	4	0.085	0.215	6	3	5.13	4	7	7	0
Louisiana	0.11	0.24	3	0.08	0.2	2	3	4	1	6	6	0
Oklahoma	0.13	0.23	2	0.066	0.16	9	2	4.5	4	6	6.65	3
Texas	0.19	0.41	4	0.05	0.2	3	4	6.25	4	0	0	0

Table 3.2 (continued)

Census Divisions and State	Cigarette tax			Gas tax			Sales tax			Income tax		
	1977	2002	Number of tax changes	1977	2002	Number of tax changes	1977	2002	Number of tax changes	1977	2002	Number of tax changes
Mountain	0.10	0.33	25	0.08	0.21	63	3.00	4.22	21	6.50	5.46	18
Arizona	0.13	0.58	3	0.08	0.18	6	4	5.6	2	8	5.04	5
Colorado	0.1	0.2	4	0.07	0.22	7	3	2.9	3	8	4.63	4
Idaho	0.09	0.28	2	0.095	0.25	9	3	5	3	8	7.8	3
Montana	0.12	0.18	4	0.078	0.27	8	0	0	0	11	11	0
Nevada	0.1	0.35	3	0.06	0.24	13	3	6.5	2	0	0	0
New Mexico	0.12	0.21	2	0.07	0.17	9	4	5	5	9	8.2	3
Utah	0.08	0.7	6	0.07	0.245	7	4	4.75	5	8	7	3
Wyoming	0.08	0.12	1	0.08	0.13	4	3	4	1	0	0	0
Pacific	0.12	0.99	17	0.08	0.22	23	3.12	4.17	8	7.00	6.10	4
California	0.1	0.87	3	0.07	0.18	6	4.75	6	5	11	9.3	3
Oregon	0.09	0.68	5	0.07	0.24	11	0	0	0	10	9	1
Washington	0.16	1.43	9	0.09	0.23	6	4.6	6.5	3	0	0	0

### 3.6 Results

Tables 3.3–3.6 show results from estimating equations (3.6) to (3.9) for rates on four tax bases I consider. Each table contains four columns, corresponding to four dependent variables that are cigarette tax rates, gas tax rates, sales tax rates and income tax rates. These results are based on population contiguity weights. Overall, I find that a home state’s cigarette tax rates are positively affected by neighboring states’ cigarette tax rates in all specifications. For rates on other tax bases, the impacts on the home state tax rates from neighboring states’ rates on the same tax base or other tax bases are sensitive to an inclusion of rates on other tax bases of neighboring states or the home state. Thus, I consider that the impacts of neighboring states’ tax rates on the home state tax rates to be noteworthy if the coefficients on the neighboring states’ tax rates are found significant in the last specification (3.9), which is a complete model that accounts for both home states’ rates on other tax bases and neighboring states’ rates on the same tax base and other tax bases. Thus, based on the results from the last specification, while I find that the home state gas tax rates respond positively to neighboring states’ gas tax rates, I find that the home state sales and income tax rates do not respond to neighboring states’ sales and income tax rates, respectively. In terms of strategic interaction across multiple tax rates, I find that the home state rates on one tax base respond to neighboring states’ rates on other tax bases for rates on all four tax bases.

Table 3.3 shows the results from estimating equation (3.6), which relates state tax rates only to neighboring states’ same tax rates. Before discussing the results of this table, note that in each column, neighboring states’ average tax rates are instrumented with a selection of the weighted average of neighboring states’ exogenous variables. In each column, the F-statistic shows that the instruments are jointly significant in the first state regressions. Moreover, the test of over-identification does not reject the validity of the instruments in each column. Consistent with most previous studies in tax competition, the results from Table 3.3 demonstrate that neighboring states’ tax rates have significant effects on a home state tax rates for cigarette tax rates and income tax rates. The coefficient on the weighted average of neighboring states’ cigarette tax rates is 0.634; that

is, a one dollar increase in neighboring states' cigarette tax rates would induce a sixty-three cent increase in the home state's cigarette tax rates. In contrast, the coefficient on the weighted average of neighboring states' income tax rates is -0.36, which indicates that for every one percent increase in a neighboring state's income tax rate, there is about a 0.36 percent reduction in the home state's income tax rates. The coefficient on the weighted average of neighboring states' gas tax rates and sales tax rates are insignificant, thereby suggesting that there are no tax competition among states for gas tax rates and sales tax rates.

Table 3.3—Strategic Interaction within One Tax Base considering population contiguity weights

	Dependent Variables			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.634 (10.71)***			
Neighbor Gas Tax		0.119 (0.77)		
Neighbor Sales Tax			-0.149 (-1.2)	
Neighbor Income Tax				-0.36 (-3.84)***
F-test	65.86	19.57	23.13	28.19
Over-identification test	0.71	0.96	0.99	0.28
Observations	1248	1248	1248	1248

*Notes.*

1. t-statistics appear in parentheses. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%.
2. Other variables and controls include population, elderly, young, income per capita, unemployment, grant per capita, party of governor, election year, House Democrats, years fixed effects and state fixed effects. Additional control variable(s) consists of tobacco production for Column (1), motor vehicle registration for Column (2), hotels for Column (3), and residence and reciprocity for Column (4).
3. Instruments. Column (1): weighted average of neighbors' population, elderly, young, income per capita, unemployment rate, House Democrats, debt per capita, tobacco production; Column (2): weighted average of neighbors' elderly, unemployment rate, House Democrats, motor vehicle registration, and gross state product per capita; Column (3): weighted average of neighbors' elderly, income per capita, grant per capita, party of governor, debt per capita, gross state product per capita, and hotels; Column (4): weighted average of neighbors' population, elderly, young, income per capita, unemployment rate, House Democrats, debt per capita, residence, and reciprocity.
4. The F-statistic is the test of excluded instruments obtained from the first-stage equation. A standard test of over-identification is presented; the test statistic is distributed as  $\chi^2(d)$  where d is the degrees of freedom – the table presents the p-value.
5. Detailed estimates are reported in Table B2.1 in Appendix B.

Table 3.4 presents the results from estimating equation (3.7), which includes a home state's rates on other tax bases to examine the relationship between neighboring states' tax rates and home state's tax rates on the same base. Column (1) shows that neighboring states' cigarette tax rates still have positive effects on the home state's cigarette tax rates. In addition, gas tax rates of the home state also have positive impacts

on its cigarette tax, thus suggesting that cigarette tax rates and gas tax rates are complement taxes within the same state. Column (2) demonstrates that neighboring states' gas tax rates have a positive effect on home state's gas tax rates. An increase in one dollar in a neighboring state's gas tax rates would tend to increase the home state's gas tax rates by around one dollar and thirty-five cents. The cigarette tax rates of the home state have a positive influence on its gas tax rates, thus indicating that cigarette tax rates and gas tax rates are complement taxes within the same state. Similarly, income tax rates also have positive influences on gas tax rates within the same state. Column (3) reveals that sales tax rates in neighboring states' have no significant effect on sales tax rates in the home state. However, within the same state, while sales tax rates are found to be substitute tax rates of gas tax rates, they are found to be complement tax rates of income tax rates. Column (4) shows that the home state's income tax rates are negatively affected by neighboring states' income tax rates. Moreover, it also indicates that income tax rates of the home state are negatively influenced by its cigarette tax rates. Thus, this suggests that income tax rates and cigarette tax rates are substitute taxes within the same state.

Table 3.4—Strategic Interaction within One Tax Base along with Interdependence among Tax Bases within the Same State considering population contiguity weights

	Dependent Variables			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.636 (9.37)***			
Neighbor Gas Tax		1.348 (3.29)***		
Neighbor Sales Tax			0.11 (0.66)	
Neighbor Income Tax				-0.331 (-2.65)***
Cigarette Tax		0.098 (2.11)**	0.847 (1.43)	-5.042 (-4.17)***
Gas Tax	1.608 (5.08)***		-6.194 (-3.07)***	5.5 (0.84)
Sales Tax	-0.01 (-0.49)	-0.016 (-1.46)		-0.308 (-0.58)
Income Tax	-0.002 (-0.26)	0.021 (4.11)***	0.084 (2.44)**	
Observations	1248	1248	1248	1248

*Notes.*

1. t-statistics appear in parentheses. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%.
2. See notes in Table 3.3 for control variables.
3. Instruments. Column (1): weighted average of neighbors' population, elderly, young, income per capita, unemployment rate, House Democrats, debt per capita, tobacco production, and state's own motor vehicle registration, hotels, residence, and reciprocity; Column (2): weighted average of neighbors' elderly, unemployment rate, House Democrats, motor vehicle registration, gross state product per capita, and state's own tobacco production, hotels, residence, and reciprocity; Column (3): weighted average of neighbors' elderly, income per capita, grant per capita, party of governor, debt per capita, gross state product per capita, hotels, and state's own tobacco production, motor vehicle registration, residence, and reciprocity; Column (4): weighted average of neighbors' population, elderly, young, income per capita, unemployment rate, House Democrats, debt per capita, residence, reciprocity, and state's own tobacco production, motor vehicle registration, and hotels.
4. Detailed estimates are reported in Table B2.2 in Appendix B.



Table 3.5 reports the results from estimating equation (3.8) that relates a home state one tax rate to neighboring states' same and different tax rates. Column (1) shows that cigarette tax rates in neighboring states have significant positive effects on the home state cigarette tax rates. However, neighboring states' gas tax rates, sales tax rates and income tax rates do not have significant effects on the home state cigarette tax rates. This suggests that cigarette tax rates in the home state do not react to changes in neighboring states' rates on other tax bases. Column (2) reveals that gas tax rates in the home state depend positively to neighboring states' gas tax rates. Moreover, gas tax rates in the home state also depend on sales tax rates and income tax rates in neighboring states. An increase in one percent sales tax rates in neighboring states is expected to increase gas tax rates in the home state by around three cents. On the contrary, an increase in one percent in neighboring states' income tax rates is predicted to decrease gas tax rates in the home state by about one cent. Column (3) demonstrates that neighboring states' sales tax rates have significant negative impacts on the home state sales tax rates. This result is different from the ones that are obtained in column (3) of previous tables, which have shown that there is no significant effect of an increase in neighboring states' sales tax rates on the home state sales tax rates. Besides, column (3) of this table also show that cigarette tax rates and gas tax rates in neighboring states have significant negative effects on sales tax rates in the home state. Column (4) illustrates that neighboring states' income tax rates have negative effects on the home state's income tax rates; however, the coefficient on neighboring states' income tax rates is not significant. Furthermore, cigarette tax rates and gas tax rates of neighboring states have significant negative effects on the home state's income tax rates, while sales tax rates of neighboring states have significant positive effects on the home state income tax rates.

Table 3.5—Strategic Interaction over Multiple Tax Bases considering population contiguity weights

	Dependent Variables			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.592 (9.15)***	-0.02 (-0.82)	-0.992 (-2.40)**	-2.353 (-2.15)**
Neighbor Gas Tax	0.443 (0.78)	0.472 (2.66)***	-4.999 (-1.70)*	-34.499 (-3.68)***
Neighbor Sales Tax	-0.031 (-1.04)	0.026 (2.51)**	-0.398 (-2.65)***	0.852 (1.79)*
Neighbor Income Tax	-0.005 (-0.7)	-0.01 (-4.71)***	-0.051 (-1.51)	-0.057 (-0.46)
Observations	1248	1248	1248	1248

*Notes.*

1. t-statistics appear in parentheses. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%.
2. See notes in Table 3.3 for control variables.
3. Instruments. Column (1): weighted average of neighbors' population, elderly, young, income per capita, unemployment rate, House Democrats, debt per capita, tobacco production, motor vehicle registration, hotels, residence, and reciprocity; Column (2): weighted average of neighbors' elderly, unemployment rate, House Democrats, motor vehicle registration, gross state product per capita, tobacco production, hotels, residence, and reciprocity; Column (3): weighted average of neighbors' elderly, income per capita, grant per capita, party of governor, debt per capita, gross state product per capita, hotels, tobacco production, motor vehicle registration, residence, and reciprocity; Column (4): weighted average of neighbors' population, elderly, young, income per capita, unemployment rate, House Democrats, debt per capita, residence, reciprocity, tobacco production, motor vehicle registration, and hotels.
4. Detailed estimates are reported in Table B2.3 in Appendix B.

Table 3.6 provides the regression results from estimating the complete model, which is equation (3.9). Column (1) presents clear evidence that cigarette tax rates in neighboring states still have positive effects on the home state cigarette tax rates. Moreover, unlike in column (1) of Table 3.5, it shows that one percent increase in neighboring states' sales tax rates is expected to decrease home state's cigarette tax rates by around eight cents, thereby inferring that a state cigarette tax rates react to changes in neighboring states' rates on other tax bases. Column (2) demonstrates that neighboring states' gas tax rates still have positive effects on home state gas tax rates. Furthermore, one percent increase in neighboring states' sales tax rates is expected to increase home

state gas tax rates by around three cents, thereby suggesting that these two taxes are strategic complement taxes. Similarly, as neighboring states' cigarette tax rates and income tax rates have negative effects on home state gas tax rates, cigarette tax rates and income tax rates are strategic substitute taxes of gas tax rates. Column (3) reveals that sales tax rates and income tax rates are strategic substitute taxes, thereby suggesting that if income tax rates of neighboring states increase by one percent, sales tax rates of the home state would decrease by around 0.09 percent. Column (4) indicates that one cent increase in neighboring states' gas tax rates would increase home state's income tax rates by around 0.3 percent, thereby suggesting that these two taxes are strategic substitute taxes.

*Table 3.6—Strategic Interaction over Multiple Tax Bases along with Interdependence among Tax Bases within the Same State considering population contiguity weights*

	<b>Dependent Variables</b>			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.514 (7.27)***	-0.102 (-3.21)***	-0.602 (-1.31)	0.352 (0.16)
Neighbor Gas Tax	-0.244 (-0.42)	0.435 (2.03)**	1.521 (0.48)	-31.622 (-3.40)***
Neighbor Sales Tax	-0.082 (-2.98)***	0.029 (3.18)***	-0.108 (-0.73)	0.749 (1.03)
Neighbor Income Tax	-0.0003 (-0.03)	-0.008 (-2.29)**	-0.085 (-2.23)**	0.034 (0.2)
Cigarette Tax		0.143 (3.51)***	0.657 (1.19)	-3.855 (-1.70)*
Gas Tax	1.375 (4.08)***		-5.643 (-2.96)***	8.051 (0.97)
Sales Tax	-0.021 (-0.91)	-0.008 (-1.08)		0.485 (0.56)
Income Tax	-0.007 (-0.8)	0.001 (0.28)	0.021 (0.49)	
Observations	1248	1248	1248	1248

*Notes.*

1. t-statistics appear in parentheses. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%.
2. See notes in Table 3.3 for control variables.
3. Instruments. Column (1): weighted average of neighbors' population, elderly, young, income per capita, unemployment rate, House Democrats, debt per capita, tobacco production, motor vehicle registration, hotels, residence, reciprocity, and state's own motor vehicle registration, hotels, residence, and reciprocity; Column (2): weighted average of neighbors' elderly, unemployment rate, House Democrats, motor vehicle registration, gross state product per capita, tobacco production, hotels, residence, reciprocity, and state's own tobacco production, hotels, residence, and reciprocity; Column (3): weighted average of neighbors' elderly, income per capita, grant per capita, party of governor, debt per capita, gross state product per capita, hotels, tobacco production, motor vehicle registration, residence, reciprocity and state's own tobacco production, motor vehicle registration, residence, and reciprocity; Column (4): weighted average of neighbors' population, elderly, young, income per capita, unemployment rate, House Democrats, debt per capita, residence, reciprocity, tobacco production, motor vehicle registration, hotels, and state's own tobacco production, motor vehicle registration, and hotels.
4. Detailed estimates are reported in Table B2.4 in Appendix B.

### 3.7 Conclusion

Motivated by the question of how state governments compensate for the forgone excise tax revenues due to excise tax competition, I examine whether state governments engage in strategic competition in several tax bases to maintain their balanced budgets. Using a panel of the United States' state-level data for the period 1977–2002, I estimate reaction functions not for a single tax rate but multiple tax rates. Specifically, I analyze how rates on one tax base respond to neighboring states' rates on the same and other tax bases. The results from this analysis suggest that strategic interaction occurs not only within the same tax base but also across different tax bases among state governments. For example, in terms of strategic interaction within the same tax base among state governments, I find that a home state responds to neighboring states' lower cigarette tax rates and gas tax rates by decreasing its own cigarette tax rates and gas tax rates, respectively. Hence, these findings present evidence of a "race to the bottom" in the state cigarette tax rates and gas tax rates, consistent with previous work such as Rork (2003). On the contrary, I find that the home state's sales tax rates and income tax rates do not react to neighboring states' sales tax rates and income tax rates, respectively. These results are not surprising because sales tax rates and income tax rates have less mobile tax bases than cigarette tax rates and gas tax rates, and thus, states are less inclined to adjust their sales and income tax rates in response to changes in neighboring states' sales and income tax rates, respectively.

In terms of strategic interaction across different tax rates among state governments, I find that the home state responds to neighboring states' higher sales tax rates by decreasing its cigarette tax rates, and it reacts to higher income tax rates of neighboring states by decreasing its sales or gas tax rates. Moreover, the home state's income tax rates are negatively influenced by neighboring states' gas tax rates, thereby suggesting that if there is "a race to the bottom" in competitive taxes such as gas tax rates, states would adjust rates on less competitive taxes such as income tax rates to substitute for lower gas tax rates.

In this way, this study shows how one tax rate substitutes or complements the same or other tax rates of neighboring states. This finding can be helpful for state governments to gain better understanding of the impacts of neighboring states' tax rates on their state revenues. Furthermore, this analysis not only contributes to the growing empirical literature on fiscal competition by showing that strategic interactions among state governments are not confined to only single identical tax rate, but also suggests that studies that ignore strategic interaction across multiple tax rates may not reveal the overall degree of strategic competition in tax rates among state governments.

For future research, since states have freedom to determine their own expenditure policies, we can examine whether state governments also interact strategically with each other in more than one expenditure policy. Previous works such as Case et al. (1993) confirm the presence of expenditure competition among state governments by estimating how home state expenditure policies respond to neighboring states' same expenditure policies. However, it is possible that home state responds to changes in neighboring states' one expenditure policy by not only changing the same expenditure policy but also changing other expenditure policies. Therefore, to gain better understanding of how neighboring states' expenditure policies influence home state's spending and balanced budget, future research can explore whether state governments engage in strategic behavior in more than a single expenditure policy.

## **Chapter 4**

### **Conclusion**

This dissertation consists of two main chapters (chapters 2 and 3) that look at the consequences of US consumers' cross-border shopping activities to low commodity taxed states. The second chapter, in particular, analyzes how consumers' border shopping to low commodity taxed states influences retail activity of the US states' counties. Most previous studies focus on the economic impacts of consumers' cross-border shopping by estimating the effects of interstate sales or excise tax differentials on retail activity such as retail sales aggregated to state level. This chapter extends previous studies in two ways. First, it looks at the impacts of sales or excise tax rates of domestic and neighboring states on retail activity aggregated to county level rather than on retail activity aggregated to state level. Since the time and transportation costs to engage in cross-border shopping activities are presumably lower in counties near the state border than in counties far away from the state border, the impacts on retail activity from sales and excise tax rates of own and the nearest neighboring states may not be the same across states, potentially higher in states' counties closer to the state border and lower in states' counties further away from the state border. Second, instead of addressing the impacts of cross-border shopping on retail sales of goods, this study focuses on counties' retail establishments and employment of goods subject to states' sales or excise tax rates. The intuition here is that as more consumers border shop in low commodity taxed states to take advantage of lower-after tax retail prices, retail owners of high commodity taxed counties, especially those closer to low commodity taxed states, will respond by decreasing the number of retail establishments or/and employment. Hence, this chapter investigates if distance to the state border influences the impacts of sales or excise tax rates of domestic and the nearest neighboring states on counties' establishments and employment of five retail industries. These retail industries include grocery stores, gasoline stations, furniture stores, clothing stores and liquor stores that are most likely to be affected by consumers' cross-border shopping activities. Using a county-level data of the forty-eight contiguous states over the period 1998 to 2007, this study finds that the

distance to the state border impacts the responsiveness of counties' retail establishments and employment to domestic and the nearest neighboring states' sales and excise tax rates, however, the impacts tend not to be very robust.

The third chapter investigates how consumers' cross-border shopping activities influence tax competition among state governments. The theoretical literature on tax competition, in particular Kanbur and Keen (1993), suggests that states will compete against one another to choose lower commodity tax rates to deter consumers' cross-border shopping to low commodity taxed neighboring states. Similarly, the empirical analysis on commodity tax competition, especially Devereux et al. (2007) documents that states mutually undercut each other cigarette tax rates, and cigarette taxes are lower among states in which the greater share of consumers is on borders. If a "race to the bottom" occurs in commodity tax rates such as cigarette tax rates to avoid consumers' cross-border shopping activities, states' cigarette tax revenues will decrease due to lower cigarette tax rates, and thus, this may then persuade states to rely on other less mobile tax bases to meet their state revenue goals. Most previous studies have focused on tax competition among state governments by estimating how rates on states' one tax base respond to changes in rates on neighboring states' same tax base. However, they have not analyzed whether changes in rates on neighboring states' one tax base also influence changes in home state's rates on other tax bases. For instance, Kentucky may respond to lower gas tax rates of neighboring states by not only decreasing their gas tax rates but also increasing their individual income tax rates to maintain its state revenue goals. Therefore, this chapter extends the previous studies on tax competition by analyzing how home state rates on one tax base are affected by changes in neighboring states' rates on the same tax base and other tax bases. Using a panel data on the forty-eight contiguous states over the period 1977–2002, this chapter finds evidence that tax competition among state governments do not limit within only the same tax base. For instance, a home state cigarette tax rates respond not only positively to neighboring states' cigarette tax rates, but also negatively to neighboring states' sales tax rates. Similarly, while home state gas tax rates react positively to neighboring states gas tax rates and sales tax rates, home state gas tax rates respond negatively to neighboring states' cigarette tax rates and income tax



rates. The sales tax rates and income tax rates do not respond to changes in neighboring states' sales tax rates and income tax rates, respectively. However, the home state increases its sales tax rates in response to lower income tax rates of neighboring states. Likewise, home state increases its income tax rates in response to lower gas tax rates of neighboring states, thereby indicating that if there is "a race to the bottom" in commodity tax rates such as gas tax rates to deter consumers' cross-border shopping phenomenon, states would respond to lower gas tax rates of neighboring states by increasing rates on individual income tax rates to maintain their state revenue goals. Besides, the results in general suggest that ignoring strategic competition in multiple tax rates would cause underestimation of the overall degree of strategic interaction in tax rates among state governments.

In terms of policy perspectives, the second chapter of this dissertation suggests policy makers that sales or excise tax rates of domestic and the nearest neighboring states have significant effects on counties' establishments and employment of most retail industries. However, it is inconclusive whether the distance to the state border plays a significant role on the responsiveness of counties' retail establishments and employment to own and the nearest neighboring states' sales and excise tax rates. Besides, the third chapter of my dissertation suggests policy makers that states engage in tax competition in more than one common tax base, and thus, we need to consider tax competition in multiple tax rates to understand the influence of neighboring states' tax rates on home state tax revenues.

For future study, one possible extension of this study might be to examine the same issue again by using a county-level panel data with different time periods, particularly a time period that captures higher frequency of changes in states' sales and excise tax rates. In my analysis, I use a county-level panel data set of a ten-year time period from 1998 to 2007, and during this ten-year period, states on average have changed their sales tax rates around one time, while gas tax rates and tobacco tax rates around two times. Since the average frequency in which states have changed their sales and excise tax rates is relatively small over the period 1998 to 2007, the time period used

in this analysis possibly did not have enough number of changes in state sales and excise tax rates to realize the robust impacts of the distance to the state border on the responsiveness of counties' retail establishments and employment to sales and excise tax rates of own and the nearest neighboring states.

Similarly, another possible extension of the second chapter might be to examine whether the findings of the second chapter also pertain to counties' retail sales. Since the cost of avoiding higher sales and excise tax rates are presumably easier and less costly for consumers than retailers, the distance to the state border perhaps have more marked effects on the responsiveness of counties' retail sales, rather than retail establishments and employment, to sales and excise tax rates of own and the nearest neighboring states. Thus, if county-level panel data is available on retail sales for forty-eight contiguous states' counties, future study can investigate whether the impacts of own and the nearest neighboring states' sales and excise tax rates on retail sales of counties vary with the distance to the state border.

In addition, future study can also extend the finding of the third chapter by addressing whether state governments participate in strategic competition across several expenditure policies. Previous works such as Case et al. (1993) document the presence of expenditure competition among state governments by estimating how home state expenditure policies respond to neighboring states' same expenditure policies. However, it is possible that home states may respond to changes in neighboring states' one expenditure policy by not only changing the same expenditure policy but also adjusting other expenditure policies. Therefore, to gain better understanding of how neighboring states' expenditure policies influence home state's spending and balanced budget, future research can explore whether state governments show strategic behavior in more than one expenditure policy.

## Appendix A

### Appendix to Chapter 2

*Table A1—Impacts of Sales and Excise Tax Rates on the Total Number of Establishments of Grocery Stores per 1,000 County Residents*

Variable\Specification	(1)	(2)	(3)	(4)	(5)
Grocery Stores <sub>t-1</sub>				0.642 (9.60)***	
Neighboring County Grocery Stores					0.013 (0.96)
Sales Tax	-0.029 (3.39)***	-0.037 (3.88)***	-0.025 (6.88)***	-0.039 (2.55)**	-0.036 (3.74)***
Sales Tax × Distance		0.0001 (0.85)	-0.0001 (1.62)	0.00002 (0.08)	0.0003 (1.29)
Neighboring State Sales Tax	0.003 (0.51)	0.001 (0.10)	-0.016 (4.90)***	0.003 (0.18)	0.016 (0.89)
Neighboring State Sales Tax × Distance		0.00003 (0.33)	0.00008 (1.93)*	0.0002 (0.74)	-0.00004 (0.33)
Tobacco Tax	0.012 (0.44)	0.062 (1.81)*	-0.152 (3.61)***	-0.013 (0.25)	0.07 (1.70)*
Tobacco Tax × Distance		-0.001 (1.51)	0.001 (1.45)	-0.001 (0.76)	-0.0002 (0.20)
Neighboring State Tobacco Tax	0.127 (5.33)***	0.146 (4.58)***	0.032 (0.89)	0.045 (0.98)	0.108 (1.94)*
Neighboring State Tobacco Tax × Distance		-0.0004 (0.73)	0.001 (1.18)	-0.0004 (0.53)	-0.001 (0.85)
Local Sales Tax	-0.055 (6.79)***	-0.054 (6.66)***	-0.056 (14.43)***	-0.022 (1.22)	-0.034 (1.51)
Neighboring State Local Sales Tax	0.012 (1.58)	0.013 (1.70)*	-0.022 (7.25)***	-0.006 (0.48)	0.041 (1.34)
Food Tax Exemption	0.008 (0.97)	0.008 (1.06)	0.003 (0.96)	0.023 (1.52)	0.021 (1.40)
Neighboring State Food Tax Exemption	-0.008 (1.31)	-0.009 (1.35)	-0.014 (4.22)***	0.00002 (0)	0.002 (0.14)
Income Tax	-0.004 (0.71)	-0.008 (1.06)	-0.011 (5.13)***	-0.02 (2.00)**	-0.037 (1.17)
Income Tax × Distance		0.00005 (0.57)	-0.00002 (0.69)	0.0001 (0.90)	0.001 (1.03)
Neighboring State Income Tax	-0.008 (1.36)	-0.013 (1.69)*	-0.032 (13.35)***	0.01 (0.82)	-0.012 (1.22)
Neighboring State Income Tax × Distance		0.0001 (0.51)	-0.00009 (2.45)**	-0.0002 (1.35)	0.00004 (0.29)

Table A1 continued

Variable\Specification	(1)	(2)	(3)	(4)	(5)
Property Tax	-0.016 (2.23)**	0.004 (0.42)	0.043 (4.52)***	0.00002 (0)	-0.003 (0.24)
Property Tax × Distance		-0.001 (2.08)**	0.0004 (1.64)	0.0001 (0.56)	0.0003 (0.34)
Neighboring State Property Tax	-0.012 (2.03)**	-0.01 (1.15)	0.01 (1.04)	0.005 (0.56)	-0.01 (0.82)
Neighboring State Property Tax × Distance		-0.0001 (0.35)	0.0002 (1.05)	-0.0003 (1.74)*	0.0001 (0.36)
Income	0.004 (4.53)***	0.004 (4.28)***	-0.001 (2.58)***	0.002 (1.32)	0.002 (1.66)*
Male	-0.005 (1.26)	-0.005 (1.26)	0.012 (13.06)***	-0.026 (3.67)***	-0.009 (1.90)*
Black	0.004 (2.85)***	0.004 (2.88)***	0.002 (20.75)***	0.006 (0.93)	0.008 (1.72)*
Other Race	0.013 (3.04)***	0.013 (2.95)***	0.002 (6.39)***	-0.014 (1.89)*	-0.01 (0.40)
Elderly	-0.009 (2.58)***	-0.009 (2.47)**	0.036 (38.26)***	-0.017 (2.18)**	-0.01 (4.06)***
Young	-0.004 (1.09)	-0.004 (1.15)	0.018 (11.24)***	-0.011 (1.38)	-0.009 (1.57)
Constant	0.652 (3.05)***	0.666 (3.11)***	-0.658 (9.24)***		0.576 (2.11)**
F-Statistic p-value <sup>a</sup>		0	0	0.01	0
F-Statistic p-value <sup>b</sup>		0.89	0	0.51	0.54
F-Statistic p-value <sup>c</sup>		0.18	0	0.3	0.23
F-Statistic p-value <sup>d</sup>		0	0.04	0.61	0.15
Observations	27693	27693	27693	24616	27693
R-squared	0.09	0.09	0.2		
County fixed	Y	Y	N	Y	Y
Year fixed	Y	Y	Y	Y	Y

Notes: Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels.

<sup>a</sup>Test for the joint significance of sales tax variables.

<sup>b</sup>Test for the joint significance of neighboring state sales tax variables.

<sup>c</sup>Test for the joint significance of tobacco tax variables.

<sup>d</sup>Test for the joint significance of neighboring state tobacco tax variables.

Table A2—Impacts of Sales and Excise Tax Rates on the Total Number of Establishments of Gasoline Stations per 1,000 County Residents

Variable\Specification	(1)	(2)	(3)	(4)	(5)
Gasoline Stations <sub>t-1</sub>				0.527 (10.39)***	
Neighboring County Gasoline Stations					-0.004 (1.70)*
Fuel Tax	-0.113 (4.00)***	-0.078 (2.00)**	0.259 (10.93)***	-0.122 (0.98)	-0.096 (2.30)**
Fuel Tax × Distance		-0.001 (1.22)	-0.001 (3.76)***	0.0004 (0.13)	-0.001 (1.42)
Neighboring State Fuel Tax	0.008 (0.28)	0.022 (0.61)	0.16 (5.78)***	-0.072 (0.48)	0.02 (0.53)
Neighboring State Fuel Tax × Distance		-0.0003 (0.57)	0.003 (6.59)***	0.001 (0.39)	-0.0002 (0.33)
Tobacco Tax	-0.065 (1.94)*	-0.094 (1.99)**	-1.079 (21.57)***	1.622 (0.83)	-0.136 (2.65)***
Tobacco Tax × Distance		0.0005 (0.66)	0.008 (11.01)***	-0.02 (0.80)	0.001 (1.23)
Neighboring State Tobacco Tax	-0.216 (6.42)***	-0.205 (4.63)***	-0.116 (2.27)**	-1.115 (0.60)	-0.24 (4.97)***
Neighboring State Tobacco Tax × Distance		-0.0003 (0.45)	-0.001 (0.86)	0.003 (0.08)	-0.0003 (0.49)
Sales Tax	0.025 (2.89)***	-0.009 (0.84)	-0.001 (0.19)	0.033 (0.83)	-0.006 (0.50)
Sales Tax × Distance		0.001 (4.23)***	-0.0004 (6.50)***	-0.0002 (0.25)	0.001 (3.73)***
Neighboring State Sales Tax	0.008 (0.96)	0.003 (0.32)	-0.012 (2.24)**	-0.025 (0.93)	0.006 (0.67)
Neighboring State Sales Tax × Distance		0.00005 (0.41)	-0.0003 (4.35)***	0.0004 (0.59)	0.00004 (0.31)
Local Sales Tax	0.04 (4.31)***	0.038 (4.03)***	0.041 (9.28)***	0.038 (1.25)	0.046 (3.73)***
Neighboring State Local Sales Tax	-0.011 (1.24)	-0.012 (1.32)	0.052 (12.82)***	0.021 (0.49)	-0.012 (1.08)
Income Tax	0.005 (0.72)	-0.008 (0.77)	-0.022 (7.19)***	-0.001 (0.04)	-0.019 (1.47)
Income Tax × Distance		0.0003 (2.46)**	0.0001 (1.59)	0.0002 (0.53)	0.0004 (2.30)**
Neighboring State Income Tax	0.014 (2.00)**	0.016 (1.84)*	-0.019 (6.01)***	0.024 (1.14)	0.01 (0.91)
Neighboring State Income Tax × Distance		-0.00001 (0.05)	-0.00002 (0.44)	-0.0002 (0.31)	0.00003 (0.19)

Table A2 continued

Variable\Specification	(1)	(2)	(3)	(4)	(5)
Property Tax	0.01 (1.26)	0.014 (1.34)	0.108 (11.54)***	-0.003 (0.10)	0.013 (0.97)
Property Tax × Distance		-0.0001 (0.32)	-0.002 (13.29)***	0.001 (0.57)	0.00005 (0.20)
Neighboring State Property Tax	0.005 (0.67)	-0.002 (0.18)	0.081 (7.44)***	-0.025 (1.41)	-0.001 (0.05)
Neighboring State Property Tax × Distance		0.0001 (1.04)	-0.001 (4.76)***	0.0002 (0.55)	0.0001 (0.56)
Income	-0.001 (0.67)	-0.001 (0.76)	-0.005 (13.62)***	0.006 (3.05)***	-0.002 (2.01)**
Male	0.006 (1.29)	0.007 (1.32)	0.018 (12.52)***	0.007 (1.08)	0.004 (1.30)
Black	-0.011 (5.54)***	-0.011 (5.46)***	-0.001 (5.82)***	-0.005 (1.23)	-0.009 (3.93)***
Other Race	0.025 (4.06)***	0.024 (3.94)***	-0.001 (2.74)***	0.009 (1.09)	0.021 (4.82)***
Elderly	0.013 (2.99)***	0.013 (3.02)***	0.045 (31.99)***	0.017 (1.87)*	0.013 (5.18)***
Young	-0.015 (3.56)***	-0.014 (3.40)***	0.033 (13.16)***	0.001 (0.17)	-0.016 (5.96)***
Constant	0.598 (2.27)**	0.582 (2.20)**	-0.99 (9.12)***		0.963 (3.94)***
F-Statistic p-value <sup>a</sup>		0	0	0.38	0
F-Statistic p-value <sup>b</sup>		0.13	0	0.88	0.07
F-Statistic p-value <sup>c</sup>		0.08	0	0.68	0.02
F-Statistic p-value <sup>d</sup>		0	0	0.69	0
F-Statistic p-value <sup>e</sup>		0	0	0.38	0
F-Statistic p-value <sup>f</sup>		0.71	0	0.61	0.46
Observations	27693	27693	27693	24616	27693
R-squared	0.02	0.02	0.24		
County fixed	Y	Y	N	Y	Y
Year fixed	Y	Y	Y	Y	Y

Notes: Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels.

<sup>a</sup>Test for the joint significance of fuel tax variables.

<sup>b</sup>Test for the joint significance of neighboring state fuel tax variables.

<sup>c</sup>Test for the joint significance of tobacco tax variables.

<sup>d</sup>Test for the joint significance of neighboring state tobacco tax variables.

<sup>e</sup>Test for the joint significance of sales tax variables.

<sup>f</sup>Test for the joint significance of neighboring state sales tax variables.

Table A3—Impacts of Sales Tax Rates on the Total Number of Establishments of Furniture Stores per 1,000 County Residents

Variable\Specification	(1)	(2)	(3)	(4)	(5)
Furniture Stores <sub>t-1</sub>				0.512 (10.54)***	
Neighboring County Furniture Stores					0.012 (4.12)***
Sales Tax	-0.004 (1.49)	0.005 (1.22)	0.005 (3.03)***	0.005 (0.81)	-0.001 (0.16)
Sales Tax × Distance		-0.0002 (3.71)***	0.000006 (0.28)	-0.00003 (0.45)	0.0001 (1.09)
Neighboring State Sales Tax	0.001 (0.31)	0.002 (0.47)	0.013 (8.40)***	0.008 (1.01)	0.005 (1.43)
Neighboring State Sales Tax × Distance		0.000006 (0.21)	0.000004 (6.58)***	-0.00003 (0.58)	-0.00001 (0.35)
Local Sales Tax	-0.002 (0.55)	-0.001 (0.31)	0.013 (6.15)***	-0.005 (1.00)	0.0005 (0.10)
Neighboring State Local Sales Tax	-0.005 (1.72)*	-0.004 (1.48)	0.015 (6.94)***	-0.002 (0.47)	0.001 (0.31)
Income Tax	-0.001 (0.24)	-0.003 (0.81)	0.012 (10.68)***	0.001 (0.23)	0.001 (0.16)
Income Tax × Distance		0.00003 (0.73)	0.000004 (0.28)	0.00006 (1.40)	-0.0002 (2.45)**
Neighboring State Income Tax	-0.001 (0.51)	-0.001 (0.37)	-0.004 (2.68)***	-0.005 (0.92)	-0.003 (0.63)
Neighboring State Income Tax × Distance		-0.00002 (0.40)	0.0002 (7.62)***	0.00009 (1.78)*	0.00003 (0.63)
Property Tax	-0.00011 (0.02)	0.006 (1.44)	0.03 (6.09)***	0.001 (0.15)	-0.014 (1.93)*
Property Tax × Distance		-0.0002 (2.06)**	-0.0002 (2.11)**	-0.00002 (0.21)	0.001 (2.81)***
Neighboring State Property Tax	0.006 (2.01)**	0.006 (1.38)	0.023 (5.00)***	0.003 (0.59)	0.001 (0.16)
Neighboring State Property Tax × Distance		0.000008 (0.13)	0.0001 (0.62)	-0.00006 (0.75)	0.00006 (0.61)
Income	0.001 (3.39)***	0.001 (3.31)***	0.006 (29.98)***	-0.001 (1.85)*	0.0001 (0.28)
Male	-0.001 (0.60)	-0.001 (0.63)	-0.009 (19.56)***	0.005 (2.03)**	0.002 (1.42)
Black	0.0004 (0.64)	0.0004 (0.58)	0.0002 (3.23)***	-0.005 (3.31)***	0.0004 (0.45)
Other Race	0.004 (2.49)**	0.004 (2.37)**	-0.001 (5.98)***	0.007 (2.35)**	-0.0001 (0.06)

Table A3 continued

<b>Variable\Specification</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
Elderly	0.0002 (0.19)	0.0003 (0.21)	-0.008 (15.96)***	0.004 (1.76)*	0.003 (2.58)***
Young	-0.003 (2.26)**	-0.003 (2.27)**	-0.017 (21.44)***	-0.001 (0.68)	-0.002 (1.79)*
Constant	0.214 (2.96)***	0.22 (3.04)***	0.601 (18.22)***		-0.142 (1.22)
F-Statistic p-value <sup>a</sup>		0	0	0.69	0.41
F-Statistic p-value <sup>b</sup>		0.89	0	0.59	0.25
Observations	27693	27693	27693	24616	27693
R-squared	0.01	0.02	0.15		
County fixed	Y	Y	N	Y	Y
Year fixed	Y	Y	Y	Y	Y

Notes: Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels.

<sup>a</sup>Test for the joint significance of sales tax variables.

<sup>b</sup>Test for the joint significance of neighboring state sales tax variables.



Table A4—Impacts of Sales Tax Rates on the Total Number of Establishments of Clothing Stores per 1,000 County Residents

Variable\Specification	(1)	(2)	(3)	(4)	(5)
Clothing Stores <sub>t-1</sub>				0.538 (6.02)***	
Neighboring County Clothing Stores					0.005 (2.52)**
Sales Tax	0.005 (1.10)	0.013 (2.33)**	0.017 (3.64)***	0.006 (0.50)	0.012 (1.88)*
Sales Tax × Distance		-0.0002 (2.19)**	-0.0002 (2.70)***	0.00003 (0.23)	- 0.0000007 (0.01)
Neighboring State Sales Tax	0.007 (1.23)	0.019 (2.77)***	0.017 (4.37)***	0.003 (0.32)	0.023 (4.00)***
Neighboring State Sales Tax × Distance		-0.0002 (3.44)***	0.00004 (0.95)	0.00006 (0.71)	-0.0002 (3.73)***
Local Sales Tax	0.015 (2.48)**	0.015 (2.56)**	0.013 (2.11)**	0.006 (0.52)	0.02 (2.80)***
Neighboring State Local Sales Tax	0.026 (6.28)***	0.027 (6.52)***	0.048 (8.17)***	0.001 (0.24)	0.029 (4.30)***
Sales Tax Holidays	-0.003 (1.65)*	-0.002 (1.36)	0.007 (1.24)	-0.003 (1.16)	-0.002 (1.03)
Neighboring State Sales Tax Holidays	-0.0004 (0.19)	-0.001 (0.31)	0.006 (1.01)	-0.002 (0.55)	-0.002 (0.91)
Income Tax	0.021 (5.15)***	0.028 (5.12)***	0.013 (4.86)***	0.023 (2.56)**	0.02 (2.68)***
Income Tax × Distance		-0.0002 (2.81)***	-0.00002 (0.55)	-0.00002 (0.32)	-0.0003 (2.87)***
Neighboring State Income Tax	0.007 (1.51)	0.001 (0.10)	-0.014 (4.32)***	-0.008 (0.94)	-0.01 (1.30)
Neighboring State Income Tax × Distance		0.0001 (1.88)*	0.0004 (7.23)***	0.00006 (0.75)	0.0002 (1.99)**
Property Tax	-0.01 (2.09)**	0.008 (1.16)	0.036 (2.98)***	0.001 (0.12)	-0.014 (1.19)
Property Tax × Distance		-0.0005 (3.51)***	-0.0003 (1.72)*	-0.0003 (1.54)	0.001 (1.20)
Neighboring State Property Tax	0.005 (1.01)	0.013 (1.73)*	0.048 (4.22)***	0.004 (0.64)	0.021 (2.47)**
Neighboring State Property Tax × Distance		-0.0002 (1.98)**	-0.0001 (0.76)	-0.00007 (0.71)	-0.0002 (1.57)
Income	0.001 (1.46)	0.001 (1.32)	0.018 (26.38)***	0.0001 (0.10)	0.0002 (0.65)

Table A4 continued

Variable\Specification	(1)	(2)	(3)	(4)	(5)
Male	0.0002 (0.10)	0.00008 (0.03)	-0.024 (21.06)***	0.006 (1.07)	0.003 (1.46)
Black	0.000006 (0)	-0.0001 (0.08)	0.001 (8.11)***	-0.003 (1.09)	-0.002 (1.36)
Other Race	-0.002 (0.66)	-0.002 (0.84)	0.002 (7.48)***	-0.002 (0.40)	-0.01 (2.62)***
Elderly	0.0003 (0.13)	0.0003 (0.13)	-0.031 (20.19)***	0.006 (2.01)**	0.001 (0.66)
Young	-0.00003 (0.01)	-0.0002 (0.08)	-0.052 (19.10)***	-0.006 (2.12)**	-0.001 (0.86)
Constant	0.163 (1.08)	0.171 (1.13)	1.791 (17.41)***		-0.008 (0.05)
F-Statistic p-value <sup>a</sup>		0	0	0.76	0.06
F-Statistic p-value <sup>b</sup>		0	0	0.63	0
Observations	27693	27693	27693	24616	27693
R-squared	0.08	0.08	0.2		
County fixed	Y	Y	N	Y	Y
Year fixed	Y	Y	Y	Y	Y

Notes: Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels.

<sup>a</sup>Test for the joint significance of sales tax variables.

<sup>b</sup>Test for the joint significance of neighboring state sales tax variables.

Table A5—Impacts of Sales and Excise Tax Rates on the Total Number of Establishments of Liquor Stores per 1,000 County Residents

Variable\Specification	(1)	(2)	(3)	(4)	(5)
Alcohol Stores <sub>t-1</sub>				0.429 (6.07)***	
Neighboring County Alcohol Stores					-0.004 (1.42)
Alcohol Tax	0.122 (2.48)**	0.087 (1.13)	0.049 (1.15)	-0.104 (0.87)	0.165 (1.41)
Alcohol Tax × Distance		0.0004 (0.49)	-0.00003 (0.05)	-0.001 (0.69)	-0.001 (0.46)
Neighboring State Alcohol Tax	-0.105 (1.63)	-0.041 (0.44)	-0.278 (7.04)***	-0.004 (0.03)	-0.039 (0.39)
Neighboring State Alcohol Tax × Distance		-0.001 (0.63)	0.001 (1.51)	-0.001 (0.71)	-0.001 (0.78)
Sales Tax	-0.005 (1.71)*	-0.001 (0.24)	0.009 (5.66)***	0.002 (0.39)	-0.001 (0.33)
Sales Tax × Distance		-0.00007 (1.26)	-0.0002 (9.51)***	-0.0001 (1.65)*	-0.0001 (1.19)
Neighboring State Sales Tax	0.004 (1.28)	0.005 (1.25)	-0.004 (2.93)***	0.005 (0.66)	0.006 (1.77)*
Neighboring State Sales Tax × Distance		-0.00002 (0.45)	0.00005 (3.11)***	-0.0001 (1.30)	-0.00002 (0.56)
Local Sales Tax	0.001 (0.41)	0.002 (0.64)	0.013 (7.07)***	0.006 (1.21)	0.0004 (0.08)
Neighboring State Local Sales Tax	-0.005 (1.97)**	-0.005 (2.05)**	0.012 (6.86)***	0.006 (1.10)	-0.008 (1.77)*
Income Tax	-0.003 (1.21)	0.003 (0.90)	0.004 (3.19)***	-0.003 (0.73)	0.003 (0.63)
Income Tax × Distance		-0.0001 (2.62)***	-0.0000007 (0.05)	0.00002 (0.52)	-0.0001 (1.55)
Neighboring State Income Tax	-0.001 (0.20)	-0.004 (1.31)	-0.002 (1.44)	-0.003 (0.72)	-0.002 (0.49)
Neighboring State Income Tax × Distance		0.00007 (1.54)	0.0001 (5.90)***	0.0001 (1.03)	0.0001 (1.20)
Property Tax	-0.011 (2.80)***	-0.02 (3.69)***	0.016 (4.13)***	-0.019 (4.50)***	-0.02 (4.23)***
Property Tax × Distance		0.0002 (1.85)*	-0.0003 (4.30)***	0.0001 (0.71)	0.0002 (1.83)*
Neighboring State Property Tax	-0.006 (1.74)*	-0.008 (1.78)*	0.015 (4.16)***	-0.008 (2.42)**	-0.008 (1.67)*
Neighboring State Property Tax × Distance		0.00005 (0.81)	-0.00003 (0.51)	0.0001 (2.32)**	0.0001 (0.68)

Table A5 continued

Variable\Specification	(1)	(2)	(3)	(4)	(5)
Income	0.001 (2.04)**	0.001 (2.24)**	0.004 (27.75)***	-0.001 (2.03)**	0.001 (3.27)***
Male	-0.002 (1.15)	-0.002 (1.09)	0.006 (13.47)***	-0.004 (2.02)**	-0.001 (1.03)
Black	0.001 (2.67)***	0.001 (2.57)**	0.0003 (5.30)***	0.002 (1.41)	0.002 (2.16)**
Other Race	-0.002 (1.07)	-0.002 (0.93)	0.001 (5.73)***	-0.004 (1.35)	-0.0003 (0.17)
Elderly	-0.001 (0.53)	-0.001 (0.60)	0.011 (22.59)***	-0.001 (0.47)	-0.001 (0.67)
Young	0.002 (1.16)	0.002 (1.17)	0.01 (13.28)***	0.002 (0.53)	0.003 (2.20)**
Constant	0.123 (1.57)	0.116 (1.49)	-0.588 (16.65)***		0.092 (1.50)
F-Statistic p-value <sup>a</sup>		0.05	0.39	0.08	0.21
F-Statistic p-value <sup>b</sup>		0.34	0	0.6	0.36
F-Statistic p-value <sup>c</sup>		0.12	0	0.14	0.13
F-Statistic p-value <sup>d</sup>		0.4	0	0.42	0.15
Observations	27693	27693	27693	24616	27693
R-squared	0.003	0.004	0.08		
County fixed	Y	Y	N	Y	Y
Year fixed	Y	Y	Y	Y	Y

Notes: Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels.

<sup>a</sup>Test for the joint significance of alcohol tax variables.

<sup>b</sup>Test for the joint significance of neighboring state alcohol tax variables.

<sup>c</sup>Test for the joint significance of sales tax variables.

<sup>d</sup>Test for the joint significance of neighboring state sales tax variables.

Table A6—Impacts of Sales and Excise Tax Rates on the Total Number of Employees of Grocery Stores per 1,000 County Residents

Variable\Specification	(1)	(2)	(3)	(4)
Grocery Store				0.464
Employees <sub>t-1</sub>				(10.10)***
Sales Tax	0.028 (0.22)	0.139 (0.82)	-0.358 (6.40)***	0.259 (0.99)
Sales Tax × Distance		-0.003 (1.30)	0.004 (5.73)***	-0.007 (2.60)***
Neighboring State	-0.09 (0.84)	0.058 (0.40)	0.124 (2.40)**	0.336 (1.30)
Neighboring State		-0.002 (1.34)	-0.005 (8.11)***	0.002 (0.96)
Sales Tax × Distance				
Tobacco Tax	-0.851 (1.84)*	1.523 (2.30)**	0.186 (0.27)	1.059 (1.16)
Tobacco Tax × Distance		-0.053 (4.38)***	0.015 (1.38)	-0.045 (2.91)***
Neighboring State	-0.508 (1.15)	-0.387 (0.63)	2.517 (3.66)***	-0.195 (0.23)
Tobacco Tax		-0.003 (0.32)	-0.034 (3.05)***	0.003 (0.27)
Neighboring State				
Tobacco Tax × Distance				
Local Sales Tax	-0.056 (0.32)	0.014 (0.08)	-0.043 (0.64)	1.478 (4.14)***
Neighboring State Local	-0.553 (2.92)***	-0.498 (2.63)***	0.09 (1.41)	0.473 (2.11)**
Sales Tax				
Food Tax Exemption	-0.203 (1.32)	-0.205 (1.34)	0.753 (12.53)***	-0.051 (0.20)
Neighboring State	0.119 (1.22)	0.026 (0.25)	0.372 (6.29)***	0.123 (0.77)
Food Tax Exemption				
Income Tax	0.493 (5.11)***	0.62 (4.41)***	0.115 (2.66)***	0.514 (2.92)***
Income Tax × Distance		-0.003 (2.00)**	0.002 (4.18)***	-0.005 (3.53)***
Neighboring State	0.354 (3.30)***	0.184 (1.37)	0.035 (0.76)	0.073 (0.43)
Income Tax		0.002 (1.05)	0.001 (1.71)*	-0.001 (0.50)
Neighboring State				
Income Tax × Distance				
Property Tax	0.156 (1.45)	0.507 (3.37)***	1.482 (11.02)***	-0.098 (0.47)
Property Tax × Distance		-0.01 (3.53)***	-0.017 (6.57)***	-0.007 (1.55)
Neighboring State	0.281 (2.91)***	0.288 (1.83)*	0.56 (3.46)***	0.173 (0.99)
Property Tax				

Table A6 continued

Variable\Specification	(1)	(2)	(3)	(4)
Neighboring State		-0.0005	-0.002	0.001
Property Tax × Distance		(0.19)	(0.79)	(0.34)
Income	0.048 (2.74)***	0.043 (2.42)**	0.108 (17.83)***	-0.028 (1.84)*
Male	0.164 (2.84)***	0.161 (2.79)***	-0.164 (8.12)***	-0.239 (2.60)***
Black	-0.11 (4.16)***	-0.108 (4.07)***	-0.001 (0.39)	-0.041 (0.71)
Other Race	0.53 (8.02)***	0.52 (7.82)***	-0.002 (0.31)	0.098 (0.76)
Elderly	0.06 (1.14)	0.084 (1.59)	0.066 (3.86)***	-0.058 (0.85)
Young	-0.138 (2.72)***	-0.153 (3.01)***	-0.141 (5.08)***	-0.142 (1.87)*
Constant	2.145 (0.73)	2.503 (0.86)	10.649 (7.89)***	
F-Statistic p-value <sup>a</sup>		0.43	0	0.02
F-Statistic p-value <sup>b</sup>		0.33	0	0.01
F-Statistic p-value <sup>c</sup>		0	0.09	0.01
F-Statistic p-value <sup>d</sup>		0.46	0	0.96
Observations	15440	15440	15440	9886
R-squared	0.13	0.14	0.17	
County fixed	Y	Y	N	Y
Year fixed	Y	Y	Y	Y

Notes: Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels.

<sup>a</sup>Test for the joint significance of sales tax variables.

<sup>b</sup>Test for the joint significance of neighboring state sales tax variables.

<sup>c</sup>Test for the joint significance of tobacco tax variables.

<sup>d</sup>Test for the joint significance of neighboring state tobacco tax variables.

Table A7—Impacts of Sales and Excise Tax Rates on the Total Number of Employees of Gasoline Stations per 1,000 County Residents

Variable\Specification	(1)	(2)	(3)	(4)
Gasoline Station Employees <sub>t-1</sub>				0.133 (1.19)
Fuel Tax	0.182 (0.61)	0.255 (0.66)	2.695 (9.52)***	-4.453 (1.03)
Fuel Tax × Distance		-0.005 (0.67)	0.003 (0.62)	0.033 (0.33)
Neighboring State Fuel Tax	-0.183 (0.68)	-0.063 (0.18)	2.062 (6.85)***	-9.62 (2.23)**
Neighboring State Fuel Tax × Distance		-0.003 (0.47)	0.005 (0.94)	0.1 (1.39)
Tobacco Tax	-0.793 (2.64)***	-0.112 (0.27)	-7.577 (12.87)***	53.959 (1.02)
Tobacco Tax × Distance		-0.015 (2.68)***	0.073 (8.38)***	-1.476 (1.31)
Neighboring State Tobacco Tax	-1.26 (4.12)***	-0.83 (2.10)**	0.171 (0.30)	103.148 (1.71)*
Neighboring State Tobacco Tax × Distance		-0.011 (1.75)*	-0.016 (1.58)	-0.906 (1.09)
Sales Tax	-0.071 (0.78)	-0.313 (2.49)**	-0.057 (0.95)	-0.857 (1.02)
Sales Tax × Distance		0.005 (2.81)***	-0.002 (2.25)**	-0.002 (0.08)
Neighboring State Sales Tax	-0.022 (0.24)	-0.018 (0.16)	-0.008 (0.12)	-0.602 (0.76)
Neighboring State Sales Tax × Distance		0.00002 (0.02)	-0.003 (3.05)***	0.021 (0.82)
Local Sales Tax	0.578 (4.30)***	0.562 (4.16)***	0.109 (2.12)**	2.304 (1.83)*
Neighboring State Local Sales Tax	-0.007 (0.07)	-0.003 (0.03)	0.281 (6.43)***	1.871 (1.89)*
Income Tax	0.155 (2.43)**	0.036 (0.38)	-0.079 (2.14)**	1.248 (2.06)**
Income Tax × Distance		0.002 (2.21)**	0.001 (1.75)*	0.002 (0.23)
Neighboring State Income Tax	0.162 (2.44)**	0.23 (2.60)***	0.006 (0.17)	1.057 (1.35)
Neighboring State Income Tax × Distance		-0.001 (1.06)	-0.0005 (0.70)	-0.011 (0.71)
Property Tax	0.304 (4.06)***	0.297 (2.96)***	1.053 (9.69)***	-0.941 (1.07)

Table A7 continued

Variable\Specification	(1)	(2)	(3)	(4)
Property Tax × Distance		0.0002 (0.12)	-0.019 (10.71)***	0.034 (1.05)
Neighboring State Property Tax	0.127 (2.17)**	0.009 (0.10)	0.354 (3.35)***	-0.002 (0.01)
Neighboring State Property Tax × Distance		0.003 (1.73)*	-0.004 (1.95)*	-0.005 (0.77)
Income	-0.005 (0.64)	-0.006 (0.75)	-0.024 (5.62)***	-0.038 (1.04)
Male	-0.039 (0.96)	-0.036 (0.90)	0.268 (14.09)***	-0.14 (1.45)
Black	-0.079 (4.77)***	-0.079 (4.75)***	-0.018 (11.48)***	-0.091 (1.26)
Other Race	0.149 (2.18)**	0.151 (2.21)**	0.012 (2.14)**	0.237 (1.16)
Elderly	0.063 (1.68)*	0.069 (1.84)*	0.416 (27.47)***	0.071 (0.35)
Young	-0.239 (6.00)***	-0.24 (5.95)***	0.501 (20.38)***	-0.541 (2.08)**
Constant	10.643 (4.74)***	10.585 (4.72)***	-18.892 (15.59)***	
F-Statistic p-value <sup>a</sup>		0.77	0	0.19
F-Statistic p-value <sup>b</sup>		0.63	0	0.03
F-Statistic p-value <sup>c</sup>		0	0	0.4
F-Statistic p-value <sup>d</sup>		0	0.14	0.1
F-Statistic p-value <sup>e</sup>		0.01	0	0.1
F-Statistic p-value <sup>f</sup>		0.98	0	0.71
Observations	25357	25357	25357	21508
R-squared	0.02	0.02	0.14	
County fixed	Y	Y	N	Y
Year fixed	Y	Y	Y	Y

Notes: Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels.

<sup>a</sup>Test for the joint significance of fuel tax variables.

<sup>b</sup>Test for the joint significance of neighboring state fuel tax variables.

<sup>c</sup>Test for the joint significance of tobacco tax variables.

<sup>d</sup>Test for the joint significance of neighboring state tobacco tax variables.

<sup>e</sup>Test for the joint significance of sales tax variables.

<sup>f</sup>Test for the joint significance of neighboring state sales tax variables.



Table A8—Impacts of Sales Tax Rates on the Total Number of Employees of Furniture Stores per 1,000 County Residents

Variable\Specification	(1)	(2)	(3)	(4)
Furniture Store Employees <sub>t-1</sub>				0.526 (8.51)***
Sales Tax	0.02 (0.88)	0.05 (1.56)	-0.039 (2.54)**	0.025 (0.50)
Sales Tax × Distance		-0.001 (1.48)	0.001 (4.68)***	0.00002 (0.03)
Neighboring State Sales Tax	-0.082 (3.46)***	-0.096 (2.77)***	0.079 (5.89)***	-0.034 (0.67)
Neighboring State Sales Tax × Distance		0.0002 (0.73)	-0.001 (7.92)***	-0.0001 (0.35)
Local Sales Tax	0.082 (2.61)***	0.088 (2.76)***	0.099 (5.01)***	-0.012 (0.27)
Neighboring State Local Sales Tax	-0.048 (1.67)*	-0.041 (1.42)	0.08 (3.84)***	-0.118 (1.96)*
Income Tax	0.028 (1.28)	-0.014 (0.45)	0.107 (10.24)***	-0.042 (1.04)
Income Tax × Distance		0.001 (2.02)**	0.0002 (1.34)	0.001 (2.42)**
Neighboring State Income Tax	-0.026 (1.07)	-0.046 (1.46)	0.003 (0.25)	0.013 (0.30)
Neighboring State Income Tax × Distance		0.0003 (0.98)	0.001 (6.29)***	-0.00002 (0.06)
Property Tax	0.001 (0.03)	0.095 (2.22)**	0.185 (4.29)***	0.03 (0.39)
Property Tax × Distance		-0.002 (3.88)***	-0.002 (3.36)***	-0.001 (1.02)
Neighboring State Property Tax	0.067 (2.98)***	0.046 (1.46)	0.105 (2.99)***	-0.007 (0.16)
Neighboring State Property Tax × Distance		0.0004 (0.69)	0.0001 (0.15)	0.001 (1.78)*
Income	0.016 (6.83)***	0.016 (6.56)***	0.055 (30.51)***	0 (0.04)
Male	-0.005 (0.40)	-0.005 (0.44)	-0.127 (27.79)***	0.062 (2.06)**
Black	0.011 (1.72)*	0.012 (1.77)*	0.005 (7.35)***	-0.011 (0.77)
Other Race	0.038 (3.64)***	0.036 (3.42)***	-0.003 (3.97)***	0.015 (1.05)
Elderly	-0.017 (2.30)**	-0.016 (2.13)**	-0.147 (35.15)***	0.031 (1.64)

Table A8 continued

Variable\Specification	(1)	(2)	(3)	(4)
Young	-0.023 (3.34)***	-0.024 (3.36)***	-0.183 (26.15)***	-0.013 (1.21)
Constant	1.764 (3.40)***	1.831 (3.56)***	8.528 (25.87)***	
F-Statistic p-value <sup>a</sup>		0.26	0	0.76
F-Statistic p-value <sup>b</sup>		0.001	0	0.59
Observations	18589	18589	18589	13637
R-squared	0.01	0.01	0.28	
County fixed	Y	Y	N	Y
Year fixed	Y	Y	Y	Y

Notes: Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels.

<sup>a</sup>Test for the joint significance of sales tax variables.

<sup>b</sup>Test for the joint significance of neighboring state sales tax variables.

Table A9—Impacts of Sales Tax Rates on the Total Number of Employees of Clothing Stores per 1,000 County Residents

Variable\Specification	(1)	(2)	(3)	(4)
Clothing Store Employees <sub>t-1</sub>				0.063 (0.86)
Sales Tax	-0.015 (0.37)	0.046 (0.72)	0.102 (2.33)**	0.155 (1.76)*
Sales Tax × Distance		-0.001 (1.11)	-0.0003 (0.51)	-0.003 (1.75)*
Neighboring State Sales Tax	0.121 (3.13)***	0.174 (2.94)***	0.12 (3.32)***	0.125 (1.80)*
Neighboring State Sales Tax × Distance		-0.001 (0.73)	0.001 (1.49)	-0.001 (0.59)
Local Sales Tax	-0.05 (0.59)	-0.049 (0.59)	-0.041 (0.78)	-0.05 (0.81)
Neighboring State Local Sales Tax	-0.035 (0.76)	-0.024 (0.52)	0.184 (3.43)***	-0.027 (0.18)
Sales Tax Holidays	-0.082 (4.02)***	-0.074 (3.53)***	0.275 (4.62)***	-0.063 (2.98)***
Neighboring State Sales Tax Holidays	-0.01 (0.48)	-0.011 (0.51)	0.192 (3.12)***	0.005 (0.24)
Income Tax	0.262 (6.33)***	0.234 (3.97)***	0.184 (6.58)***	0.068 (1.13)
Income Tax × Distance		0.0003 (0.36)	-0.001 (2.09)**	-0.0002 (0.30)
Neighboring State Income Tax	0.047 (0.71)	0.097 (1.36)	-0.04 (1.22)	0.057 (0.58)
Neighboring State Income Tax × Distance		-0.001 (0.54)	0.003 (5.22)***	-0.003 (0.78)
Property Tax	-0.112 (2.06)**	0.081 (1.10)	0.349 (2.90)***	0.001 (0.02)
Property Tax × Distance		-0.005 (2.53)**	-0.006 (3.10)***	-0.002 (1.24)
Neighboring State Property Tax	0.062 (1.28)	0.101 (1.06)	0.288 (2.59)***	0.071 (1.01)
Neighboring State Property Tax × Distance		-0.001 (0.77)	0.00006 (0.03)	-0.001 (1.05)
Income	0.021 (3.11)***	0.02 (2.88)***	0.183 (32.46)***	0.013 (1.72)*
Male	-0.067 (4.18)***	-0.068 (4.25)***	-0.277 (22.52)***	-0.02 (0.69)
Black	0.094 (5.01)***	0.094 (4.99)***	0.017 (10.89)***	0.038 (1.83)*

Table A9

Variable\Specification	(1)	(2)	(3)	(4)
Other Race	0.128 (4.93)***	0.124 (4.72)***	0.02 (8.13)***	0.03 (1.06)
Elderly	-0.065 (4.16)***	-0.064 (4.05)***	-0.38 (34.11)***	-0.027 (1.60)
Young	0.068 (4.88)***	0.067 (4.77)***	-0.48 (25.73)***	0.038 (1.07)
Constant	1.776 (2.06)**	1.851 (2.13)**	21.446 (25.49)***	
F-Statistic p-value <sup>a</sup>		0.52	0.016	0.18
F-Statistic p-value <sup>b</sup>		0.001	0	0.07
Observations	20518	20518	20518	15885
R-squared	0.03	0.03	0.3	
County fixed	Y	Y	N	Y
Year fixed	Y	Y	Y	Y

Notes: Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels.

<sup>a</sup>Test for the joint significance of sales tax variables.

<sup>b</sup>Test for the joint significance of neighboring state sales tax variables.

Table A10—Impacts of Sales and Excise Tax Rates on the Total Number of Employees of Liquor Stores per 1,000 County Residents

Variable\Specification	(1)	(2)	(3)	(4)
Alcohol Store Employees <sub>t-1</sub>				0.22 (1.17)
Alcohol Tax	-0.134 (0.54)	0.404 (1.06)	-2.774 (9.98)***	-1.37 (2.39)**
Alcohol Tax × Distance		-0.008 (1.58)	0.024 (6.37)***	0.008 (0.93)
Neighboring State Alcohol Tax	0.073 (0.23)	0.155 (0.34)	-1.866 (7.24)***	-0.294 (0.32)
Neighboring State Alcohol Tax × Distance		-0.0002 (0.05)	0.004 (0.85)	-0.017 (1.54)
Sales Tax	0.02 (1.82)*	0.033 (1.77)*	0.062 (4.76)***	0.025 (1.00)
Sales Tax × Distance		-0.0003 (0.94)	-0.0004 (2.96)***	-0.0003 (0.52)
Neighboring State Sales Tax	0.008 (0.52)	0.009 (0.38)	0.042 (3.79)***	-0.041 (1.08)
Neighboring State Sales Tax × Distance		-0.00003 (0.16)	-0.0003 (2.67)***	0.00001 (0.05)
Local Sales Tax	0.017 (1.55)	0.022 (1.88)*	0.032 (2.39)**	0.078 (2.19)**
Neighboring State Local Sales Tax	-0.006 (0.78)	-0.005 (0.54)	0.065 (5.13)***	0.019 (0.71)
Income Tax	0.034 (2.63)***	0.037 (1.82)*	0.08 (6.85)***	0.014 (0.34)
Income Tax × Distance		-0.00006 (0.29)	-0.00004 (0.29)	0.0003 (0.89)
Neighboring State Income Tax	0.044 (3.01)***	0.036 (1.91)*	0.048 (4.00)***	0.047 (1.36)
Neighboring State Income Tax × Distance		0.0001 (0.76)	-0.0001 (0.61)	0.0001 (0.56)
Property Tax	-0.124 (3.87)***	-0.143 (3.24)***	0.158 (5.60)***	-0.08 (1.19)
Property Tax × Distance		0.001 (0.87)	-0.003 (5.28)***	-0.001 (0.88)
Neighboring State Property Tax	0.018 (1.08)	0.034 (1.07)	0.043 (1.35)	-0.063 (1.59)
Neighboring State Property Tax × Distance		0.0006 (0.75)	-0.001 (1.28)	0.001 (1.38)
Income	0.001 (0.65)	0.001 (0.65)	0.024 (19.68)***	-0.006 (1.92)*

Table A10 continued

Variable\Specification	(1)	(2)	(3)	(4)
Male	0.0003 (0.05)	0.0003 (0.06)	0.004 (1.39)	0.018 (1.99)**
Black	-0.013 (2.54)**	-0.014 (2.58)***	0.0002 (0.71)	-0.03 (2.86)***
Other Race	0.014 (1.98)**	0.014 (2.00)**	0.001 (1.04)	-0.001 (0.08)
Elderly	0.003 (0.93)	0.004 (1.05)	-0.005 (1.61)	0.021 (1.51)
Young	0.013 (3.26)***	0.013 (3.17)***	-0.004 (0.99)	-0.007 (1.19)
Constant	-0.111 (0.47)	-0.124 (0.52)	-0.387 (1.62)	
F-Statistic p-value <sup>a</sup>		0.28	0	0.03
F-Statistic p-value <sup>b</sup>		0.91	0	0.15
F-Statistic p-value <sup>c</sup>		0.15	0	0.49
F-Statistic p-value <sup>d</sup>		0.9	0	0.31
Observations	14560	14560	14560	10174
R-squared	0.01	0.01	0.12	
County fixed	Y	Y	N	Y
Year fixed	Y	Y	Y	Y

Notes: Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels.

<sup>a</sup>Test for the joint significance of alcohol tax variables.

<sup>b</sup>Test for the joint significance of neighboring state alcohol tax variables.

<sup>c</sup>Test for the joint significance of sales tax variables.

<sup>d</sup>Test for the joint significance of neighboring state sales tax variables.

Table A11—Alternative Distance Static Specification: Establishments per 1,000 County Residents

	Dependent Variables				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Sales Tax	-0.029 (3.01)***	0.033 (3.57)***	-0.005 (1.65)*	0.007 (1.62)	-0.007 (2.58)***
Sales Tax × D10	-0.011 (0.52)	-0.065 (3.00)***	0.007 (0.87)	-0.02 (1.95)*	0.016 (2.13)**
Neighboring State Sales Tax	0.007 (0.95)	0.009 (1.02)	-0.0002 (0.07)	0.006 (0.98)	0.008 (2.46)**
Neighboring State Sales Tax × D10	-0.038 (2.53)**	-0.011 (0.50)	0.013 (1.67)*	0.006 (0.44)	-0.038 (4.83)***
Tobacco Tax	0.009 (0.29)	-0.071 (1.94)*			
Tobacco Tax × D10	0.012 (0.22)	0.042 (0.56)			
Neighboring State Tobacco Tax	0.134 (5.07)***	-0.231 (6.27)***			
Neighboring State Tobacco Tax × D10	-0.032 (0.62)	0.064 (0.83)			
Fuel Tax		-0.113 (3.72)***			
Fuel Tax × D10		-0.005 (0.08)			
Neighboring State Fuel Tax		-0.013 (0.39)			
Neighboring State Fuel Tax × D10		0.14 (2.04)**			
Alcohol Tax					0.141 (2.84)***
Alcohol Tax × D10					-0.192 (1.02)
Neighboring State Alcohol Tax					-0.171 (2.38)**
Neighboring State Alcohol Tax × D10					0.361 (2.48)**
Local Sales Tax	-0.054 (6.72)***	0.041 (4.38)***	-0.002 (0.61)	0.015 (2.47)**	0.001 (0.54)
Neighboring State Local Sales Tax	0.012 (1.57)	-0.011 (1.28)	-0.005 (1.66)*	0.026 (6.28)***	-0.005 (2.00)**
Food Tax Exemption	0.008 (1.03)				

Table A11 continued

	Dependent Variables				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Neighboring State Food Tax Exemption	-0.008 (1.26)				
Sales Tax Holidays				-0.003 (1.74)*	
Neighboring State Sales Tax Holidays				-0.003 (0.18)	
Income Tax	-0.003 (0.51)	0.004 (0.62)	0.0003 (0.11)	0.022 (5.07)***	-0.002 (0.63)
Income Tax × D10	-0.008 (0.59)	0.001 (0.06)	-0.009 (1.31)	-0.012 (1.36)	-0.008 (1.48)
Neighboring State Income Tax	-0.009 (1.30)	0.019 (2.56)**	-0.003 (0.99)	0.007 (1.26)	0.0004 (0.16)
Neighboring State Income Tax × D10	0.004 (0.34)	-0.039 (2.56)**	0.011 (1.77)*	0.004 (0.45)	-0.004 (0.71)
Property Tax	-0.017 (2.07)**	0.007 (0.73)	-0.004 (0.93)	-0.014 (2.21)**	-0.008 (1.80)*
Property Tax × D10	0.006 (0.44)	0.011 (0.72)	0.014 (1.91)*	0.012 (1.15)	-0.011 (1.27)
Neighboring State Property Tax	-0.012 (1.92)*	0.003 (0.43)	0.006 (1.99)**	0.003 (0.77)	-0.006 (1.62)
Neighboring State Property Tax × D10	0.002 (0.11)	0.01 (0.55)	-0.005 (0.61)	0.009 (0.41)	0.002 (0.18)
Income	0.004 (4.50)***	-0.001 (0.72)	0.001 (3.38)***	0.001 (1.44)	0.001 (2.08)**
Male	-0.005 (1.24)	0.007 (1.34)	-0.001 (0.65)	0.0002 (0.10)	-0.002 (1.12)
Black	0.004 (2.96)***	-0.011 (5.54)***	0.0003 (0.55)	-0.00004 (0.03)	0.002 (2.97)***
Other Race	0.013 (3.02)***	0.025 (4.03)***	0.004 (2.50)**	-0.002 (0.66)	-0.002 (1.06)
Elderly	-0.009 (2.55)**	0.013 (3.04)***	0.0001 (0.12)	0.0003 (0.13)	-0.001 (0.46)
Young	-0.004 (1.06)	-0.015 (3.52)***	-0.003 (2.28)**	-0.00004 (0.02)	0.002 (1.17)



*Table A11 continued*

	<b>Dependent Variables</b>				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Constant	0.651 (3.05)***	0.593 (2.25)**	0.217 (3.00)***	0.167 (1.10)	0.122 (1.56)
Observations	27693	27693	27693	27693	27693
R-squared	0.09	0.02	0.01	0.08	0.005

*Notes:* See Parentheses contain absolute values of t-statistics robust to heteroskedasticity. \*, \*\*, and \*\*\*, respectively, indicate statistical significance at the 10%, 5%, and 1% levels. All regressions include county fixed effects and year fixed effects.

Table A12—Alternative Distance Dynamic Specification: Establishments per 1,000 County Residents

	Dependent variables				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Grocery Stores <sub>t-1</sub>	0.643 (9.58)***				
Gasoline Stations <sub>t-1</sub>		0.523 (11.99)***			
Furniture Stores <sub>t-1</sub>			0.512 (10.56)***		
Clothing Stores <sub>t-1</sub>				0.537 (6.03)***	
Alcohol Stores <sub>t-1</sub>					0.429 (6.07)***
Sales Tax	-0.039 (2.93)***	0.019 (1.53)	0.007 (1.47)	0.01 (0.82)	-0.007 (1.53)
Sales Tax × D10	0.005 (0.17)	0.061 (1.15)	-0.022 (1.54)	-0.014 (1.06)	0.019 (1.48)
Neighboring State Sales Tax	0.019 (1.38)	0.008 (0.69)	0.007 (1.06)	0.009 (1.02)	0.0004 (0.07)
Neighboring State Sales Tax × D10	-0.055 (1.93)*	-0.054 (1.69)*	-0.01 (0.84)	-0.025 (1.77)*	-0.014 (1.31)
Tobacco Tax	-0.042 (1.14)	-0.02 (0.49)			
Tobacco Tax × D10	-0.054 (0.68)	-0.05 (0.70)			
Neighboring State Tobacco Tax	0.036 (0.92)	-0.076 (1.81)*			
Neighboring State Tobacco Tax × D10	-0.092 (1.12)	0.087 (1.15)			
Fuel Tax		-0.07 (1.44)			
Fuel Tax × D10		-0.102 (1.16)			
Neighboring State Fuel Tax		-0.063 (1.39)			
Neighboring State Fuel Tax × D10		0.198 (1.57)			
Alcohol Tax					-0.201 (2.45)**
Alcohol Tax × D10					0.393 (1.34)

Table A12 continued

	Dependent variables				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Neighboring State Alcohol Tax					-0.1 (0.91)
Neighboring State Alcohol Tax × D10					0.248 (1.03)
Local Sales Tax	-0.022 (1.26)	0.05 (3.16)***	-0.005 (1.01)	0.006 (0.54)	0.006 (1.18)
Neighboring State Local Sales Tax	-0.006 (0.50)	0.008 (0.56)	-0.003 (0.50)	0.002 (0.25)	0.006 (1.09)
Food Tax Exemption	0.022 (1.51)				
Neighboring State Food Tax Exemption	0.0004 (0.04)				
Sales Tax Holidays				-0.003 (1.17)	
Neighboring State Sales Tax Holidays				-0.002 (0.52)	
Income Tax	-0.015 (2.03)**	0.015 (1.85)*	0.005 (1.52)	0.022 (3.23)***	0.001 (0.19)
Income Tax × D10	-0.005 (0.27)	-0.048 (1.87)*	-0.004 (0.46)	-0.004 (0.45)	-0.016 (1.88)*
Neighboring State Income Tax	-0.006 (0.60)	0.009 (0.74)	0.00001 (0)	-0.006 (0.84)	0.001 (0.30)
Neighboring State Income Tax × D10	0.016 (0.91)	0.019 (1.04)	0.001 (0.16)	0.015 (1.29)	-0.00005 (0.01)
Property Tax	0.007 (0.88)	0.02 (2.29)**	0.001 (0.21)	-0.008 (1.51)	-0.017 (4.18)***
Property Tax × D10	-0.01 (0.66)	-0.025 (1.22)	-0.003 (0.27)	-0.0003 (0.03)	-0.003 (0.51)
Neighboring State Property Tax	-0.009 (1.48)	-0.012 (1.74)*	0.001 (0.17)	-0.001 (0.28)	-0.002 (0.80)
Neighboring State Property Tax × D10	0.018 (0.87)	0.003 (0.15)	-0.002 (0.22)	0.017 (1.27)	-0.003 (0.40)
Income	0.002 (1.34)	0.005 (3.56)***	-0.001 (1.87)*	0.0001 (0.11)	-0.001 (2.05)**
Male	-0.026 (3.71)***	0.006 (0.92)	0.005 (2.05)**	0.006 (1.06)	-0.004 (2.01)**
Black	0.006 (0.97)	-0.005 (1.29)	-0.005 (3.30)***	-0.003 (1.06)	0.002 (1.45)

*Table A12 continued*

	<b>Dependent Variables</b>				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Other Race	-0.014 (1.91)*	0.009 (1.14)	0.007 (2.35)**	-0.002 (0.40)	-0.004 (1.31)
Elderly	-0.017 (2.20)**	0.017 (1.92)*	0.004 (1.76)*	0.005 (1.99)**	-0.001 (0.45)
Young	-0.011 (1.37)	0.004 (0.52)	-0.001 (0.64)	-0.006 (2.16)**	0.002 (0.56)
Observations	24616	24616	24616	24616	24616

*Notes:* See notes to Table A11.

Table A13—Alternative Distance Spatial Specification: Establishments per 1,000 County Residents

	Dependent Variables				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Neighboring County Grocery Stores	0.013 (1.12)				
Neighboring County Gasoline Stations		-0.005 (1.81)*			
Neighboring County Furniture Stores			0.011 (4.13)***		
Neighboring County Clothing Stores				0.004 (2.55)**	
Neighboring County Alcohol Stores					-0.004 (1.50)
Sales Tax	-0.021 (2.08)**	0.033 (4.04)***	0.003 (0.82)	0.013 (2.50)**	-0.009 (2.73)***
Sales Tax × D10	-0.013 (0.65)	-0.06 (2.76)***	0.004 (0.52)	-0.022 (1.74)*	0.018 (2.25)**
Neighboring State Sales Tax	0.018 (1.52)	0.012 (1.62)	0.003 (1.07)	0.006 (1.56)	0.009 (3.27)***
Neighboring State Sales Tax × D10	-0.04 (1.97)**	-0.011 (0.48)	0.015 (1.64)	0.007 (0.54)	-0.039 (4.73)***
Tobacco Tax	0.073 (1.12)	-0.093 (2.55)**			
Tobacco Tax × D10	-0.085 (0.76)	-0.001 (0.01)			
Neighboring State Tobacco Tax	0.099 (2.25)**	-0.267 (6.70)***			
Neighboring State Tobacco Tax × D10	-0.057 (0.78)	0.056 (0.72)			
Fuel Tax		-0.138 (4.04)***			
Fuel Tax × D10		0.026 (0.34)			
Neighboring State Fuel Tax		-0.006 (0.19)			
Neighboring State Fuel Tax × D10		0.128 (1.77)*			
Alcohol Tax					0.151 (2.01)**
Alcohol Tax × D10					-0.215 (0.91)

Table A13 continued

	Dependent Variables				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Neighboring State Alcohol Tax					-0.175 (2.11)**
Neighboring State Alcohol Tax × D10					0.381 (1.97)**
Local Sales Tax	-0.032 (1.40)	0.049 (4.02)***	0.0004 (0.08)	0.02 (2.82)***	-0.0003 (0.08)
Neighboring State Local Sales Tax	0.041 (1.48)	-0.012 (1.04)	0.002 (0.47)	0.029 (4.31)***	-0.008 (1.80)*
Food Tax Exemption	0.019 (1.57)				
Neighboring State Food Tax Exemption	0.001 (0.05)				
Sales Tax Holidays				-0.002 (0.99)	
Neighboring State Sales Tax Holidays				-0.002 (1.02)	
Income Tax	-0.003 (0.36)	-0.0004 (0.04)	-0.01 (2.47)**	0.008 (1.13)	-0.001 (0.35)
Income Tax × D10	-0.039 (1.18)	-0.009 (0.43)	-0.001 (0.17)	-0.017 (1.40)	-0.006 (0.85)
Neighboring State Income Tax	-0.01 (1.35)	0.015 (1.73)*	-0.003 (0.91)	0.0002 (0.04)	0.002 (0.74)
Neighboring State Income Tax × D10	-0.002 (0.09)	-0.043 (2.21)**	0.01 (1.29)	-0.008 (0.65)	-0.004 (0.58)
Property Tax	0.015 (0.48)	0.01 (0.94)	0.007 (1.39)	0.003 (0.36)	-0.012 (2.55)**
Property Tax × D10	-0.017 (0.60)	0.011 (0.50)	-0.001 (0.10)	-0.0004 (0.03)	-0.01 (1.21)
Neighboring State Property Tax	-0.007 (0.78)	0.002 (0.21)	0.003 (0.79)	0.009 (1.53)	-0.006 (1.71)*
Neighboring State Property Tax × D10	0.011 (0.43)	0.022 (0.82)	0 (0)	0.012 (0.76)	0.0003 (0.03)
Income	0.002 (1.61)	-0.002 (2.05)**	0.00007 (0.19)	0.0002 (0.50)	0.001 (3.14)***
Male	-0.009 (2.04)**	0.004 (1.31)	0.002 (1.20)	0.003 (1.39)	-0.001 (1.06)
Black	0.008 (1.99)**	-0.009 (4.00)***	0.0003 (0.44)	-0.002 (1.19)	0.002 (2.53)**
Other Race	-0.01 (0.49)	0.021 (4.86)***	-0.0004 (0.20)	-0.01 (2.53)**	-0.0005 (0.27)

*Table A13 continued*

	<b>Dependent Variables</b>				
	Grocery Stores	Gasoline Stations	Furniture Stores	Clothing Stores	Liquor Stores
Elderly	-0.01 (4.23)***	0.013 (5.23)***	0.003 (2.53)**	0.001 (0.79)	-0.001 (0.55)
Young	-0.009 (1.72)*	-0.016 (6.16)***	-0.002 (1.88)*	-0.001 (0.71)	0.003 (2.27)**
Constant	0.468 (2.15)**	0.921 (3.84)***	-0.129 (1.22)	-0.043 (0.34)	0.099 (1.64)
Observations	27693	27693	27693	27693	27693

*Notes:* See notes to Table A11.

Table A14—Alternative Distance Static Specification: Employment per 1,000 County Residents

	Dependent Variables				
	Grocery Store	Gasoline Station	Furniture Store	Clothing Store	Liquor Store
Sales Tax	0.064 (0.47)	-0.047 (0.50)	0.031 (1.22)	0.008 (0.18)	0.024 (1.99)**
Sales Tax × D10	-0.244 (0.73)	-0.228 (0.83)	-0.097 (1.60)	-0.143 (1.22)	-0.044 (1.41)
Neighboring State Sales Tax	-0.162 (1.47)	-0.029 (0.30)	-0.077 (3.04)***	0.103 (2.57)**	0.019 (1.18)
Neighboring State Sales Tax × D10	0.756 (2.08)**	0.059 (0.25)	-0.08 (1.14)	0.151 (0.96)	-0.135 (2.16)**
Tobacco Tax	-1.242 (2.45)**	-0.719 (2.18)**			
Tobacco Tax × D10	2.317 (2.14)**	-0.176 (0.26)			
Neighboring State Tobacco Tax	-0.424 (0.92)	-1.254 (3.77)***			
Neighboring State Tobacco Tax × D10	-0.743 (0.66)	-0.078 (0.12)			
Fuel Tax		0.409 (1.27)			
Fuel Tax × D10		-1.685 (2.65)***			
Neighboring State Fuel Tax		-0.304 (1.04)			
Neighboring State Fuel Tax × D10		0.652 (0.94)			
Alcohol Tax					-0.041 (0.16)
Alcohol Tax × D10					-0.946 (1.11)
Neighboring State Alcohol Tax					-0.014 (0.04)
Neighboring State Alcohol Tax × D10					0.018 (0.02)
Local Sales Tax	-0.069 (0.40)	0.573 (4.25)***	0.084 (2.68)***	-0.054 (0.65)	0.019 (1.68)*
Neighboring State Local Sales Tax	-0.553 (2.91)***	-0.009 (0.10)	-0.046 (1.59)	-0.035 (0.76)	-0.007 (0.79)
Food Tax Exemption	-0.207 (1.35)				



Table A14 continued

	Dependent Variables				
	Grocery Store	Gasoline Station	Furniture Store	Clothing Store	Liquor Store
Neighboring State Food Tax Exemption	0.116 (1.20)				
Sales Tax Holidays				-0.084 (4.13)***	
Neighboring State Sales Tax Holidays				-0.01 (0.47)	
Income Tax	0.446 (4.42)***	0.145 (2.17)**	0.04 (1.70)*	0.29 (6.58)***	0.037 (2.67)***
Income Tax × D10	0.313 (1.17)	0.125 (0.70)	-0.102 (1.85)*	-0.229 (2.26)**	-0.03 (0.90)
Neighboring State Income Tax	0.372 (3.22)***	0.201 (2.78)***	-0.023 (0.87)	0.028 (0.39)	0.057 (3.44)***
Neighboring State Income Tax × D10	-0.193 (0.76)	-0.243 (1.56)	-0.015 (0.27)	0.123 (0.97)	-0.072 (2.65)***
Property Tax	0.087 (0.62)	0.394 (4.32)***	-0.047 (0.96)	-0.174 (2.33)**	-0.156 (3.97)***
Property Tax × D10	0.265 (1.28)	-0.321 (2.10)**	0.165 (2.31)**	0.174 (1.51)	0.111 (1.86)*
Neighboring State Property Tax	0.315 (3.08)***	0.124 (2.02)**	0.066 (2.76)***	0.036 (1.04)	0.007 (0.43)
Neighboring State Property Tax × D10	-0.399 (1.06)	0.06 (0.33)	-0.008 (0.10)	0.171 (0.54)	0.166 (1.37)
Income	0.047 (2.69)***	-0.006 (0.65)	0.016 (6.79)***	0.021 (3.10)***	0.001 (0.64)
Male	0.163 (2.80)***	-0.038 (0.96)	-0.004 (0.38)	-0.067 (4.21)***	0.001 (0.15)
Black	-0.112 (4.21)***	-0.08 (4.80)***	0.011 (1.72)*	0.093 (4.93)***	-0.013 (2.46)**
Other Race	0.528 (7.99)***	0.15 (2.19)**	0.038 (3.69)***	0.128 (4.96)***	0.014 (2.04)**
Elderly	0.062 (1.18)	0.063 (1.70)*	-0.017 (2.21)**	-0.066 (4.18)***	0.004 (1.12)
Young	-0.141 (2.77)***	-0.241 (6.03)***	-0.023 (3.31)***	0.069 (4.89)***	0.013 (3.26)***
Constant	2.227 (0.76)	10.69 (4.75)***	1.779 (3.43)***	1.821 (2.11)**	-0.108 (0.45)
Observations	15440	25357	18589	20518	14560
R-squared	0.13	0.02	0.01	0.03	0.01

Notes: See notes to Table A11.

Table A15—Alternative Distance Dynamic Specification: Employment per 1,000 County Residents

	Dependent Variables				
	Grocery Store	Gasoline Station	Furniture Store	Clothing Store	Liquor Store
Grocery Store Employees <sub>t-1</sub>	0.464 (10.04)***				
Gasoline Station Employees <sub>t-1</sub>		0.217 (2.28)**			
Furniture Store Employees <sub>t-1</sub>			0.527 (8.55)***		
Clothing Store Employees <sub>t-1</sub>				0.065 (0.93)	
Alcohol Store Employees <sub>t-1</sub>					0.219 (1.14)
Sales Tax	-0.105 (0.50)	-0.0004 (0)	0.009 (0.23)	-0.02 (0.30)	0.023 (1.44)
Sales Tax × D10	0.187 (0.34)	-0.629 (1.69)*	0.126 (1.20)	0.127 (0.98)	-0.113 (1.48)
Neighboring State Sales Tax	0.378 (1.92)*	0.138 (1.13)	-0.041 (0.86)	0.068 (1.31)	-0.019 (0.68)
Neighboring State Sales Tax × D10	0.275 (0.41)	-0.261 (1.04)	0.012 (0.13)	-0.016 (0.13)	-0.209 (1.30)
Tobacco Tax	-0.664 (0.93)	0.494 (1.33)			
Tobacco Tax × D10	0.059 (0.04)	-1.079 (1.76)*			
Neighboring State Tobacco Tax	-0.098 (0.16)	-0.597 (1.57)			
Neighboring State Tobacco Tax × D10	-0.646 (0.39)	1.212 (2.01)**			
Fuel Tax		0.458 (0.92)			
Fuel Tax × D10		-1.009 (1.36)			
Neighboring State Fuel Tax		-1.056 (1.97)**			
Neighboring State Fuel Tax × D10		1.039 (1.23)			
Alcohol Tax					-1.179 (2.32)**
Alcohol Tax × D10					1.636 (1.03)

Table A15 continued

	Dependent Variables				
	Grocery Store	Gasoline Station	Furniture Store	Clothing Store	Liquor Store
Neighboring State Alcohol Tax					-0.755 (1.10)
Neighboring State Alcohol Tax × D10					-2.927 (1.42)
Local Sales Tax	1.475 (4.12)***	-0.469 (1.35)	-0.012 (0.28)	-0.049 (0.81)	0.08 (2.26)**
Neighboring State Local Sales Tax	0.487 (2.18)**	0.199 (1.05)	-0.118 (1.94)*	-0.024 (0.16)	0.018 (0.68)
Food Tax Exemption	-0.035 (0.14)				
Neighboring State Food Tax Exemption	0.143 (0.90)				
Sales Tax Holidays				-0.071 (3.61)***	
Neighboring State Sales Tax Holidays				0.005 (0.21)	
Income Tax	0.177 (1.47)	0.067 (0.84)	0.016 (0.52)	0.072 (1.44)	0.031 (1.32)
Income Tax × D10	-0.052 (0.17)	-0.042 (0.22)	0.011 (0.18)	-0.087 (0.89)	0.004 (0.06)
Neighboring State Income Tax	0.072 (0.47)	0.035 (0.33)	0.016 (0.47)	-0.121 (0.76)	0.062 (2.42)**
Neighboring State Income Tax × D10	-0.026 (0.09)	0.279 (1.59)	-0.036 (0.44)	0.105 (0.61)	-0.061 (1.85)*
Property Tax	-0.433 (2.86)***	0.004 (0.05)	-0.02 (0.36)	-0.064 (1.00)	-0.132 (1.78)*
Property Tax × D10	0.35 (1.10)	-0.063 (0.35)	0.061 (0.56)	0.051 (0.62)	0.085 (0.93)
Neighboring State Property Tax	0.213 (1.49)	-0.103 (1.68)*	0.052 (2.27)**	-0.021 (0.49)	-0.029 (1.66)*
Neighboring State Property Tax × D10	0.157 (0.44)	0.274 (1.56)	-0.081 (0.69)	0.268 (1.18)	-0.149 (0.76)
Income	-0.027 (1.79)*	-0.004 (0.23)	-0.0001 (0.04)	0.013 (1.71)*	-0.006 (1.98)**
Male	-0.235 (2.54)**	-0.051 (1.10)	0.063 (2.08)**	-0.02 (0.71)	0.019 (2.10)**
Black	-0.043 (0.75)	-0.014 (0.44)	-0.011 (0.79)	0.039 (1.87)*	-0.03 (2.89)***
Other Race	0.11 (0.86)	0.103 (1.00)	0.015 (1.06)	0.031 (1.10)	-0.002 (0.21)

*Table A15 continued*

	<b>Dependent Variables</b>				
	Grocery Store	Gasoline Station	Furniture Store	Clothing Store	Liquor Store
Elderly	-0.069 (0.99)	0.058 (1.22)	0.031 (1.63)	-0.026 (1.57)	0.022 (1.59)
Young	-0.137 (1.81)*	-0.031 (0.30)	-0.013 (1.24)	0.039 (1.10)	-0.007 (1.19)
Observations	9886	21508	13637	15885	10174

*Notes:* See notes to Table A11.

## Appendix B

### Appendix to Chapter 3

#### **B1. The OLS Estimates for Strategic Interaction within One Tax Base considering population contiguity weights**

Table B1 shows the OLS estimation of equation (3.6). I find that the OLS results differ from the results obtained in Table 3.3 in the following ways. First, in the OLS results, I find that the magnitudes of the coefficients of neighboring states' cigarette tax rates and income tax rates are smaller than the ones found in columns (1) and (4) of Table 3.3. Second, in contrast to the results found in columns (2) and (3) of Table 3.3, I find that neighboring states' gas tax rates and sales tax rates are significant in the OLS results. Therefore, as seen in Table B1, by not considering the endogeneity of neighboring states' tax rates, either the magnitude or the significance of the coefficients of neighboring states' tax rates changes from those observed in the instrumental variable results in Table 3.3.

*Table B1—OLS Results, Strategic Interaction within One Tax Base considering population contiguity weights*

	<b>Dependent Variables</b>			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.393 (12.12)***			
Neighbor Gas Tax		0.27 (6.25)***		
Neighbor Sales Tax			-0.233 (5.39)***	
Neighbor Income Tax				-0.086 (2.20)**
Population	0.018 (4.43)***	-0.003 (2.13)**	0.079 (4.20)***	0.069 (1.12)
Elderly	-0.01 (1.46)	0.007 (3.56)***	-0.091 (2.84)***	0.275 (2.58)**
Under 18	0.026 (5.42)***	0.0005 (0.37)	0.046 (2.10)**	-0.071 (0.99)
Income per capita	0.032 (8.25)***	-0.003 (2.56)**	-0.109 (6.08)***	0.227 (3.78)***
Unemployment	-0.004 (1.44)	0.003 (3.68)***	0.006 (0.48)	0.203 (4.88)***
Grant per capita	0.034 (1.02)	-0.021 (2.36)**	-0.654 (4.21)***	-0.71 (1.34)
Party of Governor	0.002 (0.27)	0.004 (2.30)**	0.09 (3.21)***	-0.233 (2.52)**
Election Year	-0.002 (0.24)	-0.0002 (0.12)	0.018 (0.53)	-0.09 (0.81)
Democrats in the House	0.001 (2.68)***	0.0002 (1.52)	0.003 (1.70)*	-0.019 (3.01)***
Debt per capita	0.003 (0.50)	0.0002 (0.18)	-0.087 (3.73)***	0.128 (1.64)
Gross State Product per capita	-0.009 (3.78)***	0.002 (3.56)***	-0.04 (3.71)***	-0.144 (4.02)***
Tobacco Production	0.097 (1.40)			
Motor Vehicle Registration		-0.002 (2.17)**		
Hotels			0.284 (5.70)***	
Residence				0.18 (7.08)***

*Table B1 continued*

	<b>Dependent Variables</b>			
	Cigarette	Gas	Sales	Income
Reciprocity				-0.565 (1.39)
Constant	-0.709 (5.24)***	-0.036 (1.01)	4.859 (7.65)***	5.278 (2.48)**
Observations	1248	1248	1248	1248
R-squared	0.66	0.77	0.59	0.21

*Notes:* Parentheses contain absolute values of t-statistics. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%. See notes in Table 3.3 for control variables.

## B2. Population Contiguity Weights

Table B2.1—Strategic Interaction within One Tax Base considering Population Contiguity Weights

	Dependent Variables			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.634 (10.71)***			
Neighbor Gas Tax		0.119 (0.77)		
Neighbor Sales Tax			-0.149 (1.20)	
Neighbor Income Tax				-0.36 (3.84)***
Population	0.023 (5.32)***	-0.003 (2.23)**	0.079 (4.22)***	0.09 (1.42)
Elderly	-0.009 (1.32)	0.006 (3.36)***	-0.088 (2.70)***	0.236 (2.15)**
Under 18	0.018 (3.42)***	0.001 (0.74)	0.038 (1.58)	-0.184 (2.26)**
Income per capita	0.027 (6.60)***	-0.003 (2.73)***	-0.101 (4.82)***	0.176 (2.79)***
Unemployment	-0.004 (1.59)	0.003 (3.79)***	0.008 (0.63)	0.218 (5.10)***
Grant per capita	0.003 (0.08)	-0.02 (2.20)**	-0.602 (3.51)***	-0.87 (1.60)
Party of Governor	-0.002 (0.34)	0.004 (2.30)**	0.087 (3.04)***	-0.215 (2.28)**
Election Year	-0.002 (0.26)	-0.0003 (0.14)	0.018 (0.54)	-0.096 (0.84)
Democrats in the House	0.001 (1.16)	0.0002 (1.80)*	0.003 (1.74)*	-0.021 (3.24)***
Debt per capita	-0.004 (0.85)	0.001 (0.53)	-0.078 (2.96)***	0.257 (2.88)***
Gross State Product per capita	-0.009 (3.93)***	0.002 (2.95)***	-0.038 (3.47)***	-0.14 (3.83)***
Tobacco Production	0.069 (0.98)			
Motor Vehicle Registration		-0.001 (1.91)*		
Hotels			0.294 (5.70)***	
Residence				0.13 (4.29)***



Table B2.1 continued

	<b>Dependent Variables</b>			
	Cigarette	Gas	Sales	Income
Reciprocity				-0.231 (0.54)
Constant	-0.482 (3.31)***	-0.034 (0.96)	4.543 (5.90)***	10.072 (3.83)***
F-test	65.86	19.57	23.13	28.19
Over-identification test	0.71	0.96	0.99	0.28
Observations	1248	1248	1248	1248

*Notes:* Parentheses contain absolute values of t-statistics. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%. See notes in Table 3.3 for control variables. Instruments and econometric issues are dealt with as in Table 3.3.

*Table B2.2—Strategic Interaction within One Tax Base along with Interdependence among Tax Bases within the Same State considering Population Contiguity Weights*

	<b>Dependent Variables</b>			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.636 (9.37)***			
Neighbor Gas Tax		1.348 (3.29)***		
Neighbor Sales Tax			0.11 (0.66)	
Neighbor Income Tax				-0.331 (2.65)***
Cigarette Tax		0.098 (2.11)**	0.847 (1.43)	-5.042 (4.17)***
Gas Tax	1.608 (5.08)***		-6.194 (3.07)***	5.5 (0.84)
Sales Tax	-0.01 (0.49)	-0.016 (1.46)		-0.308 (0.58)
Income Tax	-0.002 (0.26)	0.021 (4.11)***	0.084 (2.44)**	
Population	0.03 (6.00)***	-0.001 (0.55)	0.045 (1.90)*	0.184 (2.10)**
Elderly	-0.019 (2.27)**	-0.0005 (0.12)	-0.071 (1.78)*	0.142 (1.17)
Under 18	0.015 (2.78)***	-0.007 (2.10)**	-0.004 (0.10)	0.021 (0.21)
Income per capita	0.032 (5.67)***	-0.013 (3.86)***	-0.162 (4.87)***	0.384 (3.92)***
Unemployment	-0.009 (2.72)***	-0.003 (1.48)	0.019 (1.15)	0.191 (3.82)***
Grant per capita	0.024 (0.61)	-0.004 (0.24)	-0.449 (2.25)**	-0.58 (0.83)
Party of Governor	-0.008 (1.08)	0.008 (2.49)**	0.106 (3.12)***	-0.167 (1.50)
Election Year	-0.001 (0.15)	0.002 (0.68)	0.027 (0.70)	-0.098 (0.84)
Democrats in the House	0.00004 (0.09)	0.0001 (0.50)	0.006 (2.16)**	-0.011 (1.50)
Debt per capita	-0.007 (1.24)	-0.005 (1.79)*	-0.055 (1.83)*	0.287 (2.80)***
Gross State Product per capita	-0.013 (4.33)***	0.008 (4.18)***	0.002 (0.14)	-0.21 (3.79)***
Tobacco Production	0.117 (1.54)			

Table B2.2 continued

	Dependent Variables			
	Cigarette	Gas	Sales	Income
Motor Vehicle Registration		-0.004 (2.54)**		
Hotels			0.368 (5.81)***	
Residence				0.132 (3.80)***
Reciprocity				-0.677 (0.94)
Constant	-0.384 (2.14)**	0.08 (0.90)	4.031 (4.27)***	5.671 (1.30)
Observations	1248	1248	1248	1248

Notes: Parentheses contain absolute values of t-statistics. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%. See notes in Table 3.4 for control variables. Instruments and econometric issues are dealt with as in Table 3.4.

Table B2.3—Strategic Interaction over Multiple Tax Bases considering Population Contiguity Weights

	Dependent Variables			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.592 (9.15)***	-0.02 (0.82)	-0.992 (2.40)**	-2.353 (2.15)**
Neighbor Gas Tax	0.443 (0.78)	0.472 (2.66)***	-4.999 (1.70)*	-34.499 (3.68)***
Neighbor Sales Tax	-0.031 (1.04)	0.026 (2.51)**	-0.398 (2.65)***	0.852 (1.79)*
Neighbor Income Tax	-0.005 (0.70)	-0.01 (4.71)***	-0.051 (1.51)	-0.057 (0.46)
Population	0.022 (5.19)***	-0.002 (1.15)	0.062 (2.86)***	0.011 (0.15)
Elderly	-0.011 (1.56)	0.005 (2.37)**	-0.124 (3.51)***	0.305 (2.49)**
Under 18	0.018 (2.79)***	-0.006 (2.99)***	0.092 (2.38)**	0.073 (0.66)
Income per capita	0.024 (4.94)***	-0.002 (1.36)	-0.13 (5.24)***	0.319 (3.88)***
Unemployment	-0.006 (1.88)*	0.004 (3.93)***	0.014 (1.00)	0.291 (5.80)***
Grant per capita	-0.011 (0.28)	0.001 (0.12)	-0.558 (3.05)***	-0.036 (0.05)
Party of Governor	-0.0003 (0.05)	0.003 (1.62)	0.114 (3.62)***	-0.207 (1.90)*
Election Year	-0.002 (0.26)	-0.0003 (0.13)	0.014 (0.41)	-0.098 (0.79)
Democrats in the House	0.0004 (0.89)	0.0002 (1.06)	0.008 (2.82)***	-0.001 (0.11)
Debt per capita	-0.006 (0.90)	0.009 (4.56)***	-0.03 (0.98)	0.361 (3.45)***
Gross State Product per capita	-0.009 (3.42)***	0.004 (4.60)***	-0.046 (3.73)***	-0.199 (4.52)***
Tobacco Production	0.072 (1.03)			
Motor Vehicle Registration		-0.002 (2.00)**		
Hotels			0.26 (4.32)***	
Residence				0.134 (3.76)***
Reciprocity				-0.932 (1.92)*

*Table B2.3 continued*

	<b>Dependent Variables</b>			
	Cigarette	Gas	Sales	Income
Constant	-0.329 (1.48)	0.044 (0.63)	5.561 (4.68)***	-0.626 (0.16)
Observations	1248	1248	1248	1248

*Notes:* Parentheses contain absolute values of t-statistics. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%. See notes in Table 3.5 for control variables. Instruments and econometric issues are dealt with as in Table 3.5.

*Table B2.4—Strategic Interaction over Multiple Tax Bases along with Interdependence among Tax Bases within the Same State considering Population Contiguity Weights*

	<b>Dependent Variables</b>			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.514 (7.27)***	-0.102 (3.21)***	-0.602 (1.31)	0.352 (0.16)
Neighbor Gas Tax	-0.244 (0.42)	0.435 (2.03)**	1.521 (0.48)	-31.622 (3.40)***
Neighbor Sales Tax	-0.082 (2.98)***	0.029 (3.18)***	-0.108 (0.73)	0.749 (1.03)
Neighbor Income Tax	-0.0003 (0.03)	-0.008 (2.29)**	-0.085 (2.23)**	0.034 (0.20)
Cigarette Tax		0.143 (3.51)***	0.657 (1.19)	-3.855 (1.70)*
Gas Tax	1.375 (4.08)***		-5.643 (2.96)***	8.051 (0.97)
Sales Tax	-0.021 (0.91)	-0.008 (1.08)		0.485 (0.56)
Income Tax	-0.007 (0.80)	0.001 (0.28)	0.021 (0.49)	
Population	0.028 (5.72)***	-0.004 (2.26)**	0.046 (1.74)*	0.096 (0.90)
Elderly	-0.02 (2.48)**	0.006 (2.35)**	-0.078 (2.04)**	0.237 (1.58)
Under 18	0.028 (4.17)***	-0.008 (3.65)***	-0.002 (0.06)	0.149 (1.01)
Income per capita	0.026 (4.09)***	-0.007 (2.75)***	-0.158 (5.11)***	0.48 (3.44)***
Unemployment	-0.009 (2.07)**	0.004 (2.24)**	0.028 (1.46)	0.223 (3.80)***
Grant per capita	-0.028 (0.65)	-0.001 (0.07)	-0.577 (2.96)***	0.523 (0.44)
Party of Governor	-0.002 (0.24)	0.004 (1.91)*	0.115 (3.52)***	-0.303 (1.83)*
Election Year	-0.002 (0.25)	0.0003 (0.13)	0.019 (0.51)	-0.109 (0.88)
Democrats in the House	0.0003 (0.68)	0.0001 (0.87)	0.005 (1.68)*	-0.003 (0.33)
Debt per capita	-0.012 (1.58)	0.008 (2.56)**	-0.015 (0.43)	0.298 (2.25)**
Gross State Product per capita	-0.015 (4.50)***	0.005 (3.01)***	-0.009 (0.50)	-0.218 (2.48)**
Tobacco Production	0.124 (1.67)*			

Table B2.4 continued

	Dependent Variables			
	Cigarette	Gas	Sales	Income
Motor Vehicle Registration		-0.002 (1.93)*		
Hotels			0.304 (4.52)***	
Residence				0.166 (3.15)***
Reciprocity				-0.627 (0.59)
Constant	-0.145 (0.50)	0.107 (1.11)	5.885 (4.49)***	-5.191 (0.70)
Observations	1248	1248	1248	1248

Notes: Parentheses contain absolute values of t-statistics. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%. See notes in Table 3.6 for control variables. Instruments and econometric issues are dealt with as in Table 3.6.

### **B3. Comparison to Contiguity weights**

To check if the results obtained with contiguity weights are similar to the results obtained with population contiguity weights, I perform the same analysis considering contiguity weights. The results are presented in Tables B3.1–B3.4, where Table B3.1 reveals results from estimating equation (3.6), while Tables B3.2, B3.3, and B3.4 provide results from estimating equations (3.7), (3.8), and (3.9), respectively. In general, I find that most of the results obtained with contiguity weights are the same as those obtained with population contiguity weights. For instance, in columns (1) of respective Tables 3.6 and B3.4, I find that cigarette tax rates in a home state respond positively not only to cigarette tax rates in neighboring states, but also to sales tax rates in neighboring states. Nevertheless, some results that are obtained with contiguity weights are different from those obtained with population contiguity weights. For example, in column (4) of Table B3.4, I find that neighboring states' cigarette tax rates have significant positive effects on the home state income tax rates. This is different from the results obtained with population contiguity weights, which show that neighboring states' cigarette tax rates do not have significant positive effects on the home state income tax rates. One of the possible reasons why results using contiguity weights differ from results using population contiguity weights is that contiguity weights treat neighboring states with lightly and heavily bordered population equally.



*Table B3.1—Strategic Interaction within One Tax Base considering contiguity weights*

	<b>Dependent Variables</b>			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.99 (11.73)***			
Neighbor Gas Tax		1.754 (8.14)***		
Neighbor Sales Tax			-0.033 (0.35)	
Neighbor Income Tax				-0.612 (4.26)***
Population	0.019 (4.46)***	-0.002 (1.27)	0.08 (4.24)***	0.122 (1.89)*
Elderly	-0.026 (3.63)***	0.007 (3.20)***	-0.085 (2.53)**	0.323 (2.95)***
Under 18	0.015 (2.86)***	-0.007 (3.95)***	0.026 (1.20)	-0.192 (2.38)**
Income per capita	0.032 (7.98)***	-0.003 (2.21)**	-0.089 (4.85)***	0.107 (1.56)
Unemployment	-0.005 (1.68)*	0.0003 (0.30)	0.011 (0.90)	0.221 (5.16)***
Grant per capita	0.021 (0.60)	-0.029 (2.80)***	-0.53 (3.21)***	-0.323 (0.59)
Party of Governor	-0.0003 (0.04)	0.005 (2.65)***	0.083 (2.86)***	-0.174 (1.82)*
Election Year	-0.003 (0.33)	0.0003 (0.14)	0.019 (0.56)	-0.094 (0.83)
Democrats in the House	-0.0004 (0.85)	-0.0002 (1.36)	0.003 (1.67)*	-0.023 (3.38)***
Debt per capita	-0.008 (1.51)	0.0002 (0.14)	-0.064 (2.71)***	0.252 (2.90)***
Gross State Product per capita	-0.015 (6.22)***	0.004 (4.95)***	-0.036 (3.27)***	-0.11 (2.94)***
Tobacco Production	0.031 (0.43)			
Motor Vehicle Registration		-0.002 (2.07)**		
Hotels			0.308 (6.12)***	
Residence				0.145 (5.23)***
Reciprocity				-0.646 (1.57)

*Table B3.1 continued*

	<b>Dependent Variables</b>			
	Cigarette	Gas	Sales	Income
Constant	-0.172 (1.09)	0.042 (0.98)	4.141 (5.44)***	10.984 (4.12)***
Observations	1248	1248	1248	1248

*Notes:* Parentheses contain absolute values of t-statistics. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%. See notes in Table 3.3 for control variables. Instruments and econometric issues are dealt with as in Table 3.3.

Table B3.2—Strategic Interaction within One Tax Base along with Interdependence among Tax Bases within the Same State considering contiguity weights

	Dependent Variables			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.838 (8.89)***			
Neighbor Gas Tax		1.852 (7.43)***		
Neighbor Sales Tax			0.249 (1.83)*	
Neighbor Income Tax				-0.336 (1.86)*
Cigarette Tax		0.008 (0.24)	1.121 (1.95)*	-7.38 (4.98)***
Gas Tax	0.747 (2.14)**		-9.78 (5.53)***	13.095 (1.87)*
Sales Tax	-0.006 (0.33)	-0.034 (4.06)***		-0.61 (1.56)
Income Tax	-0.011 (2.00)**	0.005 (2.03)**	0.059 (1.70)*	
Population	0.022 (4.70)***	0.001 (0.59)	0.03 (1.22)	0.267 (3.17)***
Elderly	-0.024 (2.99)***	0.003 (1.07)	-0.02 (0.45)	0.136 (1.06)
Under 18	0.017 (3.31)***	-0.007 (3.16)***	-0.01 (0.28)	0.156 (1.39)
Income per capita	0.039 (7.73)***	-0.007 (2.94)***	-0.174 (5.00)***	0.477 (3.80)***
Unemployment	-0.004 (1.36)	-0.001 (0.45)	0.037 (2.13)**	0.163 (3.08)***
Grant per capita	0.019 (0.48)	-0.04 (2.96)***	-0.495 (2.46)**	-0.143 (0.22)
Party of Governor	-0.003 (0.50)	0.009 (3.76)***	0.102 (2.80)***	-0.13 (1.16)
Election Year	-0.003 (0.39)	0.001 (0.51)	0.024 (0.59)	-0.092 (0.75)
Democrats in the House	-0.001 (1.03)	-0.00002 (0.12)	0.007 (2.53)**	-0.007 (2.53)**
Debt per capita	-0.006 (2.53)**	-0.001 (0.77)	-0.055 (1.91)*	0.222 (2.30)**
Gross State Product per capita	-0.018 (6.55)***	0.003 (6.55)***	0.009 (6.55)***	-0.248 (4.60)***
Tobacco Production	0.054 (0.74)			

Table B3.2 continued

	Dependent Variables			
	Cigarette	Gas	Sales	Income
Motor Vehicle Registration		-0.003 (2.43)**		
Hotels			0.403 (2.43)**	
Residence				0.159 (5.12)***
Reciprocity				-1.576 (2.51)**
Constant	-0.236 (2.51)**	0.193 (2.77)***	3.484 (3.53)***	2.831 (0.65)
Observations	1248	1248	1248	1248

Notes: Parentheses contain absolute values of t-statistics. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%. See notes in Table 3.3 for control variables. Instruments and econometric issues are dealt with as in Table 3.4.

Table B3.3—Strategic Interaction over Multiple Tax Bases considering contiguity weights

	Dependent Variables			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.919 (8.11)***	0.102 (2.83)***	0.437 (0.84)	3.116 (1.60)
Neighbor Gas Tax	-0.141 (0.19)	0.951 (4.50)***	-15.536 (3.23)***	-58.212 (4.57)***
Neighbor Sales Tax	-0.009 (0.26)	0.032 (3.77)***	0.05 (0.33)	3.219 (5.30)***
Neighbor Income Tax	0.031 (3.04)***	0.003 (0.95)	-0.149 (2.66)***	-0.049 (0.24)
Population	0.015 (3.36)***	-0.001 (0.77)	0.095 (4.04)***	0.095 (1.23)
Elderly	-0.026 (3.36)***	0.008 (3.99)***	-0.099 (2.47)**	0.494 (3.72)***
Under 18	0.026 (4.25)***	-0.006 (3.80)***	0.052 (1.34)	-0.001 (0.01)
Income per capita	0.04 (7.49)***	-0.001 (0.80)	-0.136 (4.74)***	0.339 (3.71)***
Unemployment	-0.005 (1.71)*	0.002 (1.93)*	0.041 (2.38)**	0.322 (5.90)***
Grant per capita	-0.016 (0.40)	-0.015 (1.45)	-0.222 (1.07)	1.71 (2.33)**
Party of Governor	-0.002 (0.24)	0.002 (0.82)	0.072 (1.97)**	-0.498 (3.83)***
Election Year	-0.002 (0.28)	0.00004 (0.02)	0.012 (0.30)	-0.108 (0.81)
Democrats in the House	-0.0002 (0.29)	-0.0001 (0.48)	0.007 (2.09)**	0.007 (0.76)
Debt per capita	-0.017 (2.76)***	-0.001 (0.42)	-0.017 (0.52)	0.271 (2.55)**
Gross State Product per capita	-0.018 (6.25)***	0.002 (2.91)***	-0.041 (2.87)***	-0.168 (3.50)***
Tobacco Production	0.053 (0.72)			
Motor Vehicle Registration		-0.002 (2.86)***		
Hotels			0.379 (5.50)***	
Residence				0.232 (6.15)***
Reciprocity				-0.937 (1.90)*

*Table B3.3 continued*

	<b>Dependent Variables</b>			
	Cigarette	Gas	Sales	Income
Constant	-0.596 (2.28)**	-0.083 (1.21)	5.256 (3.47)***	-9.652 (2.07)**
Observations	1248	1248	1248	1248

*Notes:* Parentheses contain absolute values of t-statistics. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%. See notes in Table 3.3 for control variables. Instruments and econometric issues are dealt with as in Table 3.5.

*Table B3.4—Strategic Interaction over Multiple Tax Bases along with Interdependence among Tax Bases within the Same State considering contiguity weights*

	<b>Dependent Variables</b>			
	Cigarette	Gas	Sales	Income
Neighbor Cigarette Tax	0.729 (7.26)***	-0.068 (1.20)	1.435 (1.93)*	14.693 (2.47)**
Neighbor Gas Tax	-0.919 (1.14)	1.266 (5.67)***	0.504 (0.09)	-34.593 (1.49)
Neighbor Sales Tax	-0.05 (1.77)*	0.021 (1.82)*	0.193 (1.22)	2.989 (3.39)***
Neighbor Income Tax	0.016 (1.48)	-0.005 (1.05)	-0.06 (0.96)	0.57 (1.48)
Cigarette Tax		0.133 (2.49)**	0.052 (0.08)	-12.996 (2.95)***
Gas Tax	1.052 (2.55)**		-10.904 (5.01)***	-1.141 (0.07)
Sales Tax	0.015 (0.80)	-0.02 (3.13)***		1.469 (1.71)*
Income Tax	-0.008 (1.29)	0.005 (1.85)*	0.027 (0.76)	
Population	0.018 (3.77)***	-0.001 (0.76)	0.056 (2.01)**	0.175 (1.44)
Elderly	-0.029 (3.50)***	0.008 (2.29)**	-0.04 (0.84)	0.126 (0.62)
Under 18	0.03 (4.68)***	-0.01 (3.82)***	-0.018 (0.38)	0.253 (1.43)
Income per capita	0.043 (6.83)***	-0.011 (4.39)***	-0.154 (4.12)***	0.951 (3.91)***
Unemployment	-0.006 (1.59)	0.001 (0.88)	0.042 (2.09)**	0.157 (1.94)*
Grant per capita	0.008 (0.19)	-0.018 (1.29)	-0.549 (2.49)**	2.861 (2.39)**
Party of Governor	-0.004 (0.52)	0.006 (2.54)**	0.105 (2.64)***	-0.68 (3.32)***
Election Year	-0.003 (0.40)	0.001 (0.48)	0.018 (0.42)	-0.154 (0.94)
Democrats in the House	-0.0003 (0.50)	0.0001 (0.57)	0.004 (1.30)	-0.0004 (0.03)
Debt per capita	-0.011 (1.71)*	0.002 (0.75)	-0.056 (1.60)	0.116 (0.83)
Gross State Product per capita	-0.019 (6.20)***	0.006 (4.05)***	-0.01 (0.48)	-0.269 (2.86)***
Tobacco Production	0.086 (1.15)			

Table B3.4 continued

	Dependent Variables			
	Cigarette	Gas	Sales	Income
Motor Vehicle Registration		-0.002 (2.64)***		
Hotels			0.407 (5.44)***	
Residence				0.324 (4.29)***
Reciprocity				1.282 (0.76)
Constant	-0.442 (1.57)	0.143 (1.69)*	4.695 (2.96)***	-24.268 (2.44)**
Observations	1248	1248	1248	1248

Notes: Parentheses contain absolute values of t-statistics. \* denotes significance at 10%, \*\* denotes significance at 5%; \*\*\* denotes significance at 1%. See notes in Table 3.3 for control variables. Instruments and econometric issues are dealt with as in Table 3.6.



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### Education

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M.S. Economics, University of Kentucky, 2006

B.A. Economics, *magna cum laude*, Randolph-Macon Woman's College (R-MWC), 2004

### Research Fields

Primary Fields: Public Economics, Industrial Organization

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### Professional Experience

Instructor, University of Kentucky, Summer 2006–Spring 2009

Teaching Assistant, University of Kentucky, Fall 2005–Spring 2007

### Research Papers

“Distance to the Border: The Impact of Own and Neighboring States’ Sales and Excise Tax Rates on County Retail Activity.”

“The Battle of Taxes: Strategic Interaction in Multiple Tax Policies among States.”

### Conferences and Seminars

“The Battle of Taxes: Strategic Interaction in Multiple Tax Policies among States”

Midwest Economics Association Annual Meeting, St. Louis, MO, March 2011.

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### Honors and Awards

Kentucky Graduate Scholarship, University of Kentucky, 2005–2009

Graduate Assistantship, Department of Economics, University of Kentucky, 2005–2009

Research Challenge Trust Fund II Gatton Doctoral Fellowship, University of Kentucky, 2007

Theodore Jack Scholarship, R-MWC, 2000–2004

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### Professional Memberships

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