Dynamic Sales Tax Competition: Evidence from Panel Data at the Border

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Abstract:
We examine both vertical and horizontal tax competition over time by studying the strategic response of county sales taxation to state sales taxes and to cross-border neighboring municipalities' combined (state and county) taxes. Using county and state sales tax data from 2003 through 2009, we employ both static and dynamic panel analysis as well as an instrumental variables approach in combination with a border analysis. Our results confirm the presence of tax competition in the cross section, as previous studies have found. Results from the fixed-effects and dynamic panel analysis also indicate the presence of vertical competition, though quite small, as counties are consistently responsive to changes in their own state sales tax level across all models and specifications. However, the panel findings suggest little to no horizontal tax competition. Following Parchet (2019), we address additional concerns about endogeneity by instrumenting the neighboring-county sales tax rate with the state-level sales tax rate of the neighboring state. Results from instrumental variables analysis reinforce the presence of a small vertical tax competition between local and state sales tax policies. Interestingly, our results, like those of Parchet (2019), indicate that cross-border local sales tax rates act as strategic substitutes.

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1. Introduction

Differences in local tax rates have the potential to influence consumer and firm behavior, including where consumers spend their money and where firms choose to locate. With local governments interested in attracting firms and the jobs they generate, and thus capturing the potential tax revenues associated with this economic activity, there are incentives for tax competition between local governments. Local jurisdictions are expected to adjust their tax rates in response to rate changes in nearby jurisdictions (horizontal tax competition) as well as to tax changes in their own state (vertical tax competition). Tax competition is important not only for how it affects basic elements of the urban economy—where consumers shop and where firms locate—but also because it helps us to understand the decision-making process of local policymakers and the determinants of tax policy.

There has been a push recently to understand the intricacies of tax competition both theoretically (for a review, please see Wilson 1999; Keen and Konrad 2013) and empirically (Agrawal 2014; Agrawal 2015; Parchet 2019) and how local tax changes affect local economic conditions, including employment and payroll (Fox 1986; Hoyt and Harden 2005; Rohlin and Thompson 2018; Thompson and Rohlin 2012). However, little is known about the dynamics of local tax competition, as most of the research focuses on cross-sectional analysis, both at the national level and for specific states; see Agrawal (2015) for an excellent overview of the existing literature. As Agrawal (2014) states, "We know relatively little concerning the dynamics of tax competition" (page 154). The recent literature also emphasizes the importance of including county tax rates in addition to state tax rates in the analysis; see Agrawal (2014) and Rohlin and Thompson (2018).

This paper studies tax competition in county and state sales taxation by examining both static and dynamic effects. However, studying tax competition presents several challenges. First, the determinants of county tax policies are plausibly numerous, often unobserved by the researcher, and at times ambiguous as to the expected sign. For instance, economic conditions are known to influence state tax policy decisions (Omer and Shelley 2004; Shi, Aydemir, and Wu 2018). An economic downturn, for example, results in simultaneous pressures to raise state tax rates to offset declining revenues and to lower tax rates to provide relief to struggling taxpayers. Both policy responses are observed in practice (Johnson, Collings, and Singham 2010). We address this identification challenge by using a border methodology that compares

geographically contiguous jurisdictions—in our case, counties—that are located in different states. This approach allows us to examine how a cross-border combined state and county sales tax change affects a neighboring county's sales tax policy. With border approaches, the identifying assumption is that since local economic conditions tend to vary smoothly across space, contiguous areas should have similar observable and unobservable characteristics, both in levels and trends, and thus the differential responses in county-level tax policies are not driven by economic conditions. To study vertical tax competition, we examine how changes in a county's own-state sales tax rate affect its ability to increase its own-county sales tax rate.[1] A second challenge to studying sales tax competition at the national level involves the collection of local sales tax information over time across the United States. In addition to collecting state sales tax rates, we obtained county-level sales tax rates from 2003 through 2009 by personally contacting state and local tax offices.[2]

Lastly, determining whether estimates of tax competition are causal is difficult. Parchet (2019) proposes that tax policy changes at the state level are a plausibly exogenous source of variation in the tax rate at the local level and uses this variation in an instrumental variables (IV) approach to examine tax competition in personal income taxation in Switzerland. This approach relies on the fact that state borders provide spatial discontinuities in state-level policies across contiguous areas that are otherwise highly interconnected. The underlying assumption making this a valid instrument is that specific local jurisdictions do not substantively affect state-level tax policy and that individuals respond to the combined (state plus local) tax rate. To examine sales tax competition around state border areas, we follow Parchet (2019) and employ an IV approach that instruments cross-border neighboring local sales taxes with the state sales tax rate in the neighboring state.

Our study contributes to the tax competition literature in several ways. First, after following previous studies in estimating static tax competition results by using state and county sales tax rates, we extend the existing literature by conducting a dynamic panel analysis for the entire United States. Previous studies focus on a cross-sectional analysis at the national level or

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[1] We follow previous studies, such as Agrawal (2016), and define vertical tax competition as tax competition between a state and county and horizontal tax competition as tax competition between two neighboring jurisdictions.
[2] Although they do not do so as prevalently as counties do, smaller jurisdictions such as cities and towns can enact their own sales taxes. We attempted to collect information about such taxes but found it difficult to ensure that we had obtained all the data. Given this concern, we keep our focus on county tax policy changes and define the "local" sales tax rate as the county tax rate.

for specific states due to data constraints and the difficulty in acquiring data over time that include both state sales tax rates and county sales tax rates. Second, we are able to study both dynamic vertical and dynamic horizontal tax competition. Third, we exploit the accessibility of state borders, measured as the percentage of residents working in the neighboring state, as an indicator of cross-state commuting to see if the degree of geographic accessibility affects tax competition. Fourth, we investigate the effects of horizontal and vertical tax competition on the passage of a sales tax increase (the extensive margin) and the size of the sales tax increase (the intensive margin). Finally, we extend Parchet's (2019) approach to causal estimates to examine sales tax competition in the United States.

As does the existing literature, we find strong evidence of static horizontal and vertical tax competition. Specifically, a jurisdiction is likely to have high county sales taxes if its cross-border neighbors have high combined state and county sales taxes (horizontal competition), whereas a jurisdiction is likely to have low local sales taxes if it is in a state with high state sales taxes (vertical competition).

When examining tax competition over time along the extensive margin, we find evidence that a county is more likely to pass a sales tax rate *increase* when its cross-border neighbor passes a sales tax increase, whereas it is much less likely to pass a sales tax rate *increase* when its own state passes a sales tax increase. Interestingly, we also find the likelihood of a county passing a sales tax rate *decrease* plummets when its cross-border neighbor increases its sales tax rate 1.0 percentage point, whereas the likelihood of the county passing a sales tax rate *decrease* rises when its own state passes a sales tax rate increase. More specifically, in our preferred specification, when a county's own state increases the sales tax rate 1.0 percentage point, the county is 85 percent more likely to decrease its tax rate.

Moving to the intensive margin, we find consistent evidence in support of vertical tax competition. The results from fixed-effects and dynamic panel regressions show that local sales taxes respond, in the direction predicted in the tax competition literature, to changes in the own-state sales tax rate. The estimated coefficients are precise but economically quite small. In the preferred specification from the dynamic panel analysis, when a county's own state increases its tax rate 1.0 percentage point, the county responds by decreasing its local rate 0.02 percentage point. Additionally, results are robust in both sign and magnitude in the IV setting, with a 0.015

percentage point decrease in the local rate due to a 1.0 percentage point increase in a county's own state rate.

The case is different, however, for horizontal tax competition. Static and dynamic panel analyses find little to no horizontal tax competition, with coefficients that are even smaller uniformly, almost always statistically indistinguishable from zero, and have no consistent sign. Our IV approach finds some evidence that cross-border neighboring local jurisdictions act as strategic substitutes, with statistically precise but economically small coefficients.[3]

In summary, we find that tax competition in the cross section follows the results shown in the existing literature. While we continue to find evidence of vertical tax competition in the dynamic panel analysis, this competition is very small, which potentially has important policy implications. The small magnitude of the dynamic tax competition also leads us to believe it is likely that most of the correlation in tax competition found in the cross section is due to selection, not causation.

Throughout this paper we also explore whether the presence of tax competition is influenced by the degree of the economic connection between cross-border neighbors, similar in spirit to the study by Rohlin and Thompson (2018). The pressure that motivates local governments to set taxes in a competitive fashion is hypothesized to be more intense in regions where the labor market is more interconnected, meaning those areas with higher levels of cross-border commuting and shopping. Our econometric analysis produces mixed results. In the cross section, we observe a higher level of vertical and horizontal competition in the predicted direction occurring in those regions where larger shares of residents commute across the state line for work, our measure of the economic connectedness of county pairs. When we move into fixed-effects and dynamic panel models, however, the differential responses measured in various specifications tend not to be statistically significant or to have a consistent sign. There appears to be no difference in vertical tax competition between areas of low and high commuting across the state line, and allowing for a heterogeneous response across areas with different levels of economic connectedness does not reveal any evidence of horizontal competition along the intensive margin.

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[3] Interestingly, Parchet (2019) finds evidence that neighboring local jurisdictions act as strategic substitutes with regard to personal income taxation in Switzerland.

The remainder of this paper includes a discussion of the existing literature, in Section 2. Section 3 discusses the methodology and data, including the panel data and border estimation techniques. Section 4 presents the results and is followed by a conclusion in Section 5.

2. The Tax Competition Literature

The strategic behavior that local municipalities exhibit in responding to a neighboring municipality's changes in statutory tax rates is known as tax competition. While the existing literature presents a plethora of evidence about tax competition in the cross section, little is known about the dynamic effects of tax competition over time, as underscored by Agrawal (2014). Three strands of the literature are particularly pertinent to understanding tax competition across time.

First, a substantial literature on tax competition tends to show that local jurisdictions respond to changes in statutory tax rates in neighboring jurisdictions, but most of this literature focuses on specific states or localities and/or relies on cross-sectional analysis. Much of the existing literature on tax competition uses the size of the area as the dimension along which to explore competition (Haufler 1996; Kanbur and Keen 1993; Mintz and Tulkens1986; Trandel 1994; Nielsen 2001), with the majority of papers finding that the smaller areas/counties lose out in tax competition. Because of the difficulty in obtaining national data over time, much of the tax competition literature in the United States focuses on specific states, such as Georgia (Zhoa 2005; Sjoquist et al. 2007), Tennessee (Luna 2003; Luna, Bruce, and Hawkins 2007), and Oklahoma (Rogers 2004; Burge and Rogers 2011; Burge and Piper 2012).

Agrawal (2015) extends the tax competition literature by accessing a national cross section of data to explore whether distance matters. He finds that the tax gradient is steepest at the border and that in general, the area affected falls within a 30-minute travel radius. However, he finds that when tax differentials between the areas on either side of the border are large, the travel radius expands to as much as an hour. Again, using a cross section of data and driving distances, Agrawal (2016) finds that border cities react significantly to changes in their cross-border neighbor's tax rates, and that when vertical tax competition is present across different levels of government (that is, state and county) and horizontal tax competition is found across the same level of government (that is, county versus county), tax competition can occur at the border when the retail sales tax base can move across the border. While these two papers make

important contributions to the literature, they consider tax competition in the cross section only and could be omitting important dynamic tax competition effects that can be found only by employing a panel-data approach.

Second, a few studies do explore tax competition at the border using panel data. Burge and Rogers (2016) consider the panel dynamics of tax competition for Oklahoma by developing an index to categorize leaders and followers over several decades in the local area tax competition. They find that leaders are less likely to react to changes in statutory tax rates made by other local jurisdictions. Agrawal (2014) uses a panel of national data to show that there is "a significant association between one state's tax system and its neighboring states' tax systems." More specifically, he finds that "local tax rates are higher in low-tax states." However, his paper aims to document correlations and stylized facts about local tax changes using state-by-month population averages. A recent addition to this growing literature is Parchet's (2019) paper incorporating an instrumental variables (IV) approach into panel tax competition methods. He develops a method to instrument local personal income taxes in Switzerland and state income taxes and finds that taxes are strategic substitutes. Our paper adds to the literature by using a panel-data approach in the United States to estimate exogenous dynamic sales tax competition at the border. We then extend our analysis to incorporate Parchet's (2019) IV approach and provide plausibly exogenous estimates.

Finally, a growing body of literature studies the broader economic effects of changes in taxation by using border methods to explore the implications for shopping, employment, and migration. The advantage of using a border methodology is that the two local areas—in our case, counties on opposite sides of a state border—have access to the same local labor market, natural resources, and customer pool. One of the earliest border-method papers is by Holmes (1998), who shows that a state's "pro-business" policies matter for firm location. The literature has been extended to look at the effects of the minimum wage on firm location (Rohlin 2011), food sales tax changes (Greenhalgh-Stanley, Rohlin, and Thompson 2018), all taxes (Rohlin, Rosenthal, and Ross 2014), and state sales taxes (Fox 1986; Hoyt and Harden 2005; Thompson and Rohlin 2012).

Due to data availability issues, most of the existing literature considers only general state sales tax rates at the border; however, Rohlin and Thompson (2018) extend the literature by including local sales tax rates at the county level. Greenhalgh-Stanley, Rohlin, and Thompson

(2018) consider local sales taxes at the county level along with state food sales taxes. Importantly, they find that leaving the food sales tax rate out of regressions does not result in omitted-variable bias for estimates of the general sales tax on employment.

While the majority of the tax competition literature considers state sales taxes, Agrawal and Hoyt (2018) look at the responses of both people and employment to changes in income taxes. They examine households whose members reside in one state and work in an adjacent state to show that if two bordering states do have a reciprocity agreement for income taxes, then the state with the higher income taxes will have fewer interstate commuters. When adjacent states do not have reciprocity agreements, Agrawal and Hoyt (2018) find, both population and employment rates are affected by tax changes. Their results are robust to using a panel-data technique, meaning the authors are able to find dynamic responses to income taxes when there is a tax discontinuity at the state border.

In addition to the above literature focusing on the United States, several recent studies focus on tax-mimicking behavior in Europe, mostly by using quasi experiments in different countries. The studies typically use a differences-in-differences approach and panel data and find mixed evidence for whether there is tax mimicking across municipalities. Lyytikäinen (2012) does not find evidence of tax mimicking after Finland changed the statutory lower limits for taxes. Similarly, Baskaran (2014) does not find evidence of tax mimicking after one state in Germany changed its business and property tax rates.

Alternatively, Eugster and Parchet (2019) use the language barrier (between German speakers and French speakers) in Switzerland as a cultural barrier and find that "competition among jurisdictions for mobile and heterogeneous individuals impedes governments from setting their culturally preferred tax rates." In addition, they find that French-speaking municipalities had higher tax rates. Baskaran (2019) uses the 1990 reunification of Germany as a quasi experiment, because that period marked the first time in decades that East German municipalities were allowed to change their local tax rates. He finds that in 1992, the East German border areas mimicked their West German neighbors' tax behavior, but that over time they did not exhibit tax-mimicking behavior.

3. Methods and Data Used to Identify Sales Tax Competition

We study the relationship between county sales taxes and own-state sales taxes, as well as the relationship between county sales taxes and the combined county-state tax rates in cross-border neighboring counties using several methods. First, we examine these relationships in the cross-sectional framework. We then examine these relationships over time in a panel fixed-effects model, using both the extensive and intensive margins. Finally, we explore dynamic interactions using a dynamic panel framework.

A. Strengths and Weaknesses of the Border Approach

For all empirical estimations, we employ a border approach, which creates county-border pairs from counties that are contiguous and located on opposite sides of a state border. We use a border approach for several reasons. First, practically speaking, counties at state borders that have contiguous cross-border neighbors are the most likely to be affected by changes in sales taxation in the neighboring state (or county) given their geographic proximity. Second, endogeneity and omitted-variable bias are real concerns when studying determinants of local (county) sales taxation. Specifically, the concern is that county economic conditions drive local policymakers to raise (or lower) sales tax rates, but it is impossible to adequately condition on these local economic conditions. The border approach, highlighted and made prominent by papers such as those by Holmes (1998) and Card and Krueger (1994), attempts to minimize the differences in local economic conditions by assuming that they vary smoothly across space. Specifically, the identifying assumption in our preferred specification, panel analysis, is that two neighboring counties separated by a state border experience similar economic shocks over time.

However, using the border approach is not costless. Focusing the analysis at the border provides little information about tax competition in the interior of a state, and the estimates obtained can often be considered an upper bound for the rest of the state. Another challenge with using the border approach is determining the appropriate level of clustering of standard errors. The existing literature clusters at the county pair because much of the variation is at the county level. However, we examine how state sales tax rates affect county sales tax rates, so the standard errors should be clustered at the state-border pair. Perhaps the ideal level of clustering is somewhere in between. We proceed by presenting results with robust standard errors at the county pair and discuss the implications of the choice of clustering for particularly relevant

specifications. As it so happens, we generally find economically small point estimates when examining changes in sales tax rates (the intensive margin), making this decision less critical to this paper's takeaways.

B. Cross-Sectional Analysis

We begin by following the recent work examining tax competition in the cross-sectional data for each year of our sample, 2003 through 2009, and in a pooled cross-sectional setting. This dual analysis examines the relationships (correlations) between a county's local sales tax rate and its own-state sales tax rate as well as its cross-border neighbor's combined state and county sales tax rate. The estimating equation for our cross-sectional analysis for each year is:

$$County\_STR_{s1,j} = \alpha + \beta_1 Comb\_Opp\_STR_{s2,j} + \beta_2 Own\_State\_STR_{s1,j} + \varepsilon. \quad (1)$$

For all tax variables, we use the statutory sales tax rates, so the dependent variable, *County_STR*, represents the county sales tax rate; *Comb_Opp_STR* represents the combined state and county sales tax rate; and *Own_State_STR* represents the sales tax rate of the state where the county is located.[4]

We also want to understand the role that the accessibility of borders plays in these relationships. We utilize data from the 2000 US census to calculate the percentage of residents who work in the neighboring state, which is used as a proxy for how easy it is to commute across the state border in these counties. The level of cross-border traffic can be viewed as a proxy for how easy it is for local residents and firms to take advantage of lower after-tax prices in the cross-border areas. Counties in highly accessible areas can be expected to be more sensitive to changes in the own-state sales tax rate, as they will be more likely to lose cross-border shoppers to their lower-tax neighbor, all else being equal. Similarly, in the case of horizontal tax competition, border areas with little economic connection (proxied here by the level of cross-border commuting) should be less responsive to the tax policy of their neighbor. With few people commuting to the cross-border neighboring county for work, changing shopping behavior will be more costly, and consumers will not be as responsive to the change in the after-tax price difference. In highly connected areas, however, the cross-border neighbor's tax level is expected to act as an effective constraint on local policymakers.

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[4] The subscripts, s_1 and s_2, simply help demonstrate from which side of the border pair the variable comes.

We empirically test these proposed implications of economic accessibility in two ways. First, we run specifications that include the cross-border work share, *CS_Work_Share*, and we interact our two tax competition variables with the work-share variable indicated with an "INT" suffix. In these specifications our estimating equation is:

$$County\_STR_{s1,j} = \alpha + \beta_1 Comb\_Opp\_STR_{s2,j} + \beta_2 Own\_State\_STR_{s1,j} +$$
$$\beta_3 CS\_Work\_Share_j + \beta_4 Comb\_Opp\_STR\_INT_j + \beta_5 Own\_State\_STR\_INT_j + \varepsilon. \quad (2)$$

For completeness, we also run a pooled cross-sectional analysis by combining all years and include a year fixed effect, θ_t. The pooled cross-sectional estimating equation is:

$$County\_STR_{s1,j,t} = \beta_1 Comb\_Opp\_STR_{s2,j,t} + \beta_2 Own\_State\_STR_{s1,j,t} +$$
$$\beta_3 CS\_Work\_Share_j + \beta_4 Comb\_Opp\_STR\_INT_{j,t} + \beta_5 Own\_State\_STR\_INT_{j,t} + \beta_6 X_{j,t} +$$
$$\theta_t + \varepsilon. \quad (3)$$

Here, $X_{j,t}$ is a vector of time-varying controls, including the county unemployment rate and county per capita personal income.

Our second approach to exploring heterogeneous tax competition by the level of commuting is to split the sample into low- and high-commuting areas (halving the sample) and run the panel equivalents of equation (1) separately on each half of the sample. The coefficient on the combined cross-border commuting rate is expected to have a larger positive magnitude in highly accessible areas, and the coefficient on the own-state rate is expected to have a larger negative coefficient.

Although cross-sectional analysis provides some descriptive statistics and correlations to understand the relationships in a moment of time, we expand our analysis to panel estimation to understand the causal effects. When these specifications are estimated in a cross section, we remain concerned that the observed correlation between own-local taxes and either cross-border taxes or own-state taxes could actually be the result of an unobserved factor.

C. Panel Fixed Effects Analysis

To account for unobserved, and unchanging, attributes that might influence sales tax rates and rate differentials relative to cross-border neighbors, we can estimate versions of the previous specifications using border-pair fixed effects. These fixed effects eliminate the influence of the fixed characteristics associated with county pairs and produce estimates of the relationship

between the change in cross-border sales taxes and own-state sales taxes on the change in own-county sales tax rates, which arguably is more consistent with the theory of tax competition being explored. We incorporate both time fixed effects, θ_t—to remove any macro shocks affecting all county pairs in a given time period—and county-pair fixed effects, γ_j, which removes any time-invariant county-pair specific confounders.

In our panel analysis, we structure our dependent and independent tax variables in two ways. First, we create dummy variables that indicate when a jurisdiction changes its sales tax rate, which is the extensive margin. This allows us to examine whether the passage of a sales tax increase, regardless of the magnitude, in one county affects the ability to pass a sales tax increase in the county with which it is paired. We run a multinomial logistical estimation because we have counties that increase and decrease their sales taxes. Therefore, our estimating equation for our panel fixed-effect estimation (extensive margin) is:

$$County\_ST\_Dum_{s1,j,t} = \beta_1 Comb\_Opp\_ST\_Dum_{s2,j,t} + \beta_2 Own\_State\_ST\_Dum_{s1,j,t} +$$
$$\beta_3 X_{j,t} + \theta_t + \gamma_j + \varepsilon. \tag{4}$$

Second, we examine how the magnitude of a change in sales tax rates (the intensive margin) can affect the passage of a local sales tax change (the extensive margin). This provides insight into how the magnitude of a sales tax change affects the ability of the locality to pass its own sales tax change. The estimating equation for this analysis is:

$$County\_ST\_Dum_{s1,j,t} = \beta_1 Comb\_Opp\_STR_{s2,j,t} + \beta_2 Own\_State\_STR_{s1,j,t} + \beta_3 X_{j,t} +$$
$$\theta_t + \gamma_j + \varepsilon. \tag{5}$$

Third, we use the statutory sales tax rates to investigate how the magnitude of the sales tax rate increase in one county affects the other county's statutory sales tax rates. For this analysis, the estimating equation for the intensive margin is:

$$County\_STR_{s1,j,t} = \beta_1 Comb\_Opp\_STR_{s2,j,t} + \beta_2 Own\_State\_STR_{s1,j,t} + \beta_3 X_{j,t} + \theta_t + \gamma_j + \varepsilon. \tag{6}$$

As in the pooled cross-sectional analysis, we examine how the ease of commuting between the two border counties affects tax competition by interacting our variables of interest with the share of residents working in the neighboring state. We also estimate both the fixed-effects panel (5) and the dynamic panel (6) models on samples split by the two levels of cross-border commuting.

One variable that we know is strongly correlated with a county's current sales tax rate is the past values of the county's sales tax rates. This is true both in levels and in changes.

Including the lagged values of the dependent variable in both OLS and the panel specification improves the fit of the model dramatically. And instead of viewing this autocorrelation simply as a violation of the assumptions of a linear model, which results in incorrect—but fixable— standard errors, we can treat it as evidence that the appropriate model is a dynamic one. Simply put, the current tax policy decisions of local governments are influenced by their previous tax policies.

D. Dynamic Panel Analysis

Estimating panel data models with lagged values of the dependent variable is known to generate inconsistent estimates (Cameron and Trivedi 2005). Fixed-effects models in particular are also known to produce biased estimates when they include lagged values of the dependent variable as regressors and are estimated on data that have relatively small "t" (Nickell 1981). For this analysis we use seven years of local tax data, and thus we are concerned about both consistency and bias. To address these concerns, we estimate the dynamic panel models using the Arrelano-Bond estimator, which employs first differencing and lagged levels of the dependent variable as instruments to produce consistent, unbiased estimates for the coefficients of interest. The estimating equation for the dynamic panel model is:

$$County\_STR_{s1,j,t} = \beta_1 Comb\_Opp\_STR_{s2,j,t} + \beta_2 Own\_State\_STR_{s1,j,t} +$$
$$\beta_3 County\_STR_{s1,j,t-1} + \beta_4 X_{j,t} + \theta_t + \gamma_j + \varepsilon. \tag{7}$$

E. Instrumental Variables Analysis

Since differencing and border methods do not address all the concerns over exogeneity in the tax competition setting, we follow Parchet (2019) and employ an instrumental variables (IV) approach that instruments neighboring local sales taxes with the lagged own-state sales tax rate. The underlying identifying assumptions are that 1) a local jurisdiction does not substantively effect state sales tax policy, and 2) consumer behavior is affected by the combined (state plus local) sales tax policy regardless of the policy's composition. Following the methodology outlined in Parchet (2019), we restrict the model to show only contemporaneous effects. We diverge by keeping Own_State_STR in the estimation in order to remain consistent with our previous models and to continue estimating the role of vertical competition. Parchet (2019)

recommends weighting the instrument to account for the fact that some localities will be more strongly impacted by cross-border behavior than others, and so we weight our instrument by the cross-border work share of the local county.[5] For completeness, we present both weighted and unweighted results. In this approach the first-stage equation is:

$$County\_Opp\_STR_{s2,j,t} = \beta_1 State\_STR_{s2,j,t-1} + \beta_2 X_{j,t} + \theta_t + \gamma_j + \varepsilon, \tag{8}$$

and the second-stage estimating equation is:

$$County\_STR_{s1,j,t} = \beta_1 \widehat{County\_Opp}\_STR_{s2,j,t} + \beta_2 Own\_State\_STR_{s1,j,t}$$
$$+ \beta_3 X_{j,t} + \theta_t + \gamma_j + \varepsilon. \tag{9}$$

F. Local and State Sales Taxation Data

Tax competition, particularly at the county level, is relatively understudied largely due to the difficulty of obtaining county sales tax rates. To our knowledge, there is no publicly available data source for all county sales taxation rates in the United States over time.[6] The literature has responded by focusing on either single states or regions (Burge and Rogers 2016; Fox 1986; Luna, Bruce, and Hawkins 2007; Walsh and Jones 1988) or by focusing on one time period using cross-sectional analysis (Agrawal 2015). Our approach was to personally collect as many local (county, city, and township) sales taxation rates as possible from each state's respective revenue authority and from legislative documents.[7] We define local sales taxes at the county level because the accuracy of the data for sub-county jurisdictions (cities, villages, townships, and so on) is difficult to confirm. In the continental United States, 1,092 counties border state lines; of those counties, 1,046 have state sales tax rates, and 634 have county sales tax rates. As illustrated in Table 1, county sales tax rates are typically much lower than state sales tax rates, with the median county sales tax rate being 1.0 percent. There is some variation in county sales tax changes, with 25 percent of counties experiencing a sales tax rate change ranging from –1.0 to +2.0 percentage points and a mean change of 0.09 percentage points.

State sales tax rates are substantially higher, with the median rate ranging from 5.0 to 5.5 percent over our 2003–2009 time period. During this period, 16 states raised their sales tax rates.

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[5] Parchet (2019) uses the share of neighbors in the bordering canton as the weight, since, in his preferred specification, he includes all municipalities and not solely cross-border pairs.
[6] Local sales taxation rates can be obtained by private companies (see Agrawal 2015).
[7] Full data collection was undertaken by two separate parties so that we could confirm its accuracy.

These increases were generally small, with an average cumulative climb of 1.0 percentage point; California had the largest state tax rate change, a 2.5 percentage point increase.

An important concern for this analysis is the autonomy that local county governments have regarding sales tax rate changes. If county sales tax rates changed because the state imposed a new local rate, rather than due to an independent decision by the county, we wanted to account for that type of change. During our time period, California was the only state that imposed a local-level sales tax rate change; it occurred in 2005.[8]

Our measure of accessibility in the cross-border neighboring county, obtained from the 2000 census, is the percentage of a county's residents working in the other state, which we use as a proxy for how easy it is to travel between communities on opposite sides of the border. We take the average percentage of county A's residents working in county B's state and vice versa. To give an idea of the variation in border accessibility, in the top tercile of the cross-border county pairs, an average of at least 11 percent of a county's residents work in the neighboring state, whereas in the lowest tercile, an average of no more than 5.5 percent of a county's residents work in the neighboring state. Our analysis halves our sample by the percentage of residents working in the neighboring state.

4. Results

A. Cross-Sectional Analysis

We begin by benchmarking our data with the existing literature and examining correlations between a county's local sales tax rate and its own state tax rate as well as its cross-border neighboring county's combined state and county sales tax rate. In Table 2, Panel A lists the results from our simplest specification; they show that a county's sales tax rate is likely to be higher when its cross-border neighboring county has a high combined rate; this correlation seems to have grown during our time period, 2003 through 2009. Additionally, a county's sales tax rate

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[8] For that year, California reduced the county-level sales tax rates 0.25 percent and raised the state rate 0.25 percent. Thus, there was a net zero change in the combined rate. To correct for this, we set the extensive margin dummies for rate changes equal to zero for California in 2005 because the California "state" rate increased 0.25 percent and the local rates decreased 0.25 percent across the entire state at the same time. Similarly, on the intensive margin we did not want the local rate change in that year to be attributed to local-level competition when the change was enacted at the state level. We forced the rates in California in 2005 to reflect their previous values and then allowed for rate changes on top of that. For example, the state's sales tax rate in 2004 was 6 percent, and the next change (after 2005), in 2007, increased the rate 1 percent. In forcing the 2005 rate to stay at 6 percent rather than increase to 6.25 percent, we marked the 2007 change as 7 percent rather than 7.25 percent. We used the same process to correct the county rates.

is likely to be smaller when its own-state sales tax rate is higher, with the correlation becoming slightly weaker in magnitude over the time period. We are also interested in determining the role that accessibility of the county (or economic distance) plays with respect to these relationships. The specifications reported in Panel B of Table 2 include the cross-border commuter work share as an additional control variable. The coefficient on the share of residents working in another state is positive, indicating that more accessible regions tend to have higher county sales taxes, but the inclusion of this additional control has a minimal impact on the combined-opposite rate or the own-state rate coefficient. Panel C of Table 2 goes further by interacting the cross-state work share with our tax variables. The results indicate that when accessibility across state lines is high, the rates of a county's cross-border neighbor are more positively correlated, but the correlation with the county's own-state sales tax rate is reduced. Overall, the results from the cross-sectional analysis seem to indicate that county tax rates are lower in states with higher state sales tax rates, and tax rate preferences are common across a region. In summary, our cross-sectional results confirm the tax competition findings in the existing literature and the predicted influence of economic accessibility.

Table 3 pools the results for all the sample years including year fixed effects, and it adds county per capita personal income and the county unemployment rate. Overall, the correlations in Table 3 are similar both economically and statistically. Specifically, column 2 of Table 3 shows the correlation between a county's sales tax rate and its cross-border neighbor is 0.07, and the correlation with a county's own-state rate is –0.11; both correlations are statistically significant at the 1 percent level. For transparency, we provide estimates with standard errors clustered at the state-border pair in Table A2. In the pooled cross-sectional results, the cross-border commuting levels no longer consistently enhance the tax competition analysis, as is the case with the summary statistics presented in Table 1. Any heterogeneous response by cross-border work is completely absent in the case of horizontal competition. This can be seen in columns 3 and 4 of Table 3, where the coefficient on the interaction between the commuting shares and the cross-border combined tax rate is vanishingly small and not statistically significant. This absence is also shown in columns 5 and 6, where the split-sample regressions on low-commuting regions (column 5) and high-commuting regions (column 6) have coefficients of similar magnitude. For vertical competition, however, both approaches suggest that there is a heterogeneous tax competition response based on degree of economic accessibility. The

coefficients on the interaction terms in columns 3 and 4 are negative and significant, while the split-sample regressions show a larger negative coefficient in high-accessibility areas (column 6).

B. The Likelihood of Adopting a Tax Change

In order to estimate the causal effects of horizontal and vertical tax competition, we examine tax changes over time to investigate how a county's sales tax policy changes when its cross-border neighbor increases its combined state and county sales tax rate and when the county's own state increases its sales tax rate. We begin by looking at the extensive margin to see how the passage of sales tax increases by a county's cross-border neighbor and its own state affect the likelihood of a local jurisdiction passing a sales tax increase. Table 4 provides estimates for equation (4) using a panel fixed-effects model that includes both time and county-pair fixed effects.[9] This approach removes time-invariant border-pair specific determinants such as access to transportation (ports, rail, etc.), proximity to amenities (oceans, lakes, tourist attractions, and so on), and any local economic determinants that rarely change. Combining the panel fixed-effects model with the border approach attempts to minimize differences in trends (particularly economic) between the two county pairs. The identifying assumption is that two neighboring counties located on opposite sides of a shared state border have similar economic conditions.

Table 4 presents estimates of horizontal and vertical tax competition with and without county time-varying controls (county unemployment and average per capita personal income), as well as with and without the inclusion of a one-year lag. Displaying the results from a multinomial logistic regression, Panel A of Table 4 shows odds ratios of an increase in the county sales tax; the base case is no rate change. The point estimates in Panel A suggest that when the cross-border neighbor passes a sales tax increase, the likelihood that the neighboring county passes a contemporaneous sales tax increase rises 17.5 percent to 34.1 percent, depending on the specification. Although this is suggestive evidence of horizontal tax competition, these estimates are statistically imprecise. Column 3 of Table 4, which includes the one-year lags, offers strong evidence of vertical tax competition. Specifically, when a state passes a sales tax increase, the likelihood of one of its counties passing a local sales tax increase falls 67.4 percent (statistically significant at the 1 percent level).

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[9] Note that the number of observations is reduced because of a lack of within-group variation.

Panel B of Table 4 examines the likelihood of passing a local sales tax *decrease*. These findings suggest that there is little evidence of county policymakers passing sales tax decreases when their cross-border neighbor passes an increase. Although all the point estimates are imprecisely estimated, our most robust model including one-year lags finds the likelihood of a county passing a sales tax rate decrease falls 77.3 percent when its cross-border neighbor passes a sales tax increase. However, Panel B of Table 4 provides substantive evidence that counties pass sales tax decreases when their state passes a sales tax increase. It seems that border counties are concerned about their constituents' welfare and losing economic activity to their cross-border neighbor, as the likelihood of a county sales tax rate decrease rises 83 percent to 489 percent, depending on the specification. Taken together, these findings suggest that local policymakers respond to state sales tax increases by passing fewer local sales tax increases and are more likely to lower their own-county sales tax rates.

The passage of county sales tax changes could be affected not only by the passage of sales tax increases by a cross-border neighbor and by a county's own state (the extensive margin), but also by the magnitude of these changes (the intensive margin). Table 4 focuses solely on whether a sales tax increase occurred and ignores the size of the increase. Table 5 also uses a multinomial logistic regression to estimate equation (5) and determine how the size of a sales tax increase in a competing jurisdiction affects the likelihood that a county will pass a sales tax change. Again, Panel A examines the likelihood of a local sales tax increase, and Panel B presents the likelihood of a local sales tax decrease.

Overall, Table 5 presents evidence that the size of a sales tax increase in a county's cross-border neighboring county and the size of an increase in its own-state sales tax substantively affect the county's ability to make local sales tax changes. In Panel A we see that when a county's cross-border neighbor raises its sales tax rate 1 percentage point, the likelihood that the county will pass a local sales tax increase rises 103 percent to 183 percent (the latter probability is statistically significant at the 5 percent level). At the same time, when a county's own state raises its sales tax rate 1 percentage point, it reduces the likelihood of the county passing a local sales tax increase 32.8 percent to 64.1 percent (the higher probability is statistically significant at the 5 percent level). We find that when a county's cross-border neighbor raises its sales tax rate, the likelihood that the county will lower its sales tax rate decreases 99.6 percent to 99.8 percent (both probabilities are statistically significant at conventional levels). We also find large

estimates for vertical tax competition, but they lack statistical significance. Judging from the results presented in Tables 4 and 5, there seems to be evidence that dynamic tax competition is involved when a county decides whether to change its local sales tax.[10]

C. *The Magnitude of Tax Changes*

To determine whether the magnitude of a sales tax increase by a county's own state or in the cross-border neighboring county has an effect on the size of the local sales tax change (the intensive margin), Table 6 uses the statutory sales tax rates for the county sales tax rate as the dependent variable, and the cross-border combined state and county sales tax rate and the county's own-state sales tax rate as the independent variables. Beginning with horizontal tax competition, we see no evidence that counties respond to sales tax changes by their cross-border neighbors; the coefficient in column 1 does have a negative sign, but it is very small and not statistically different from zero. We continue to see no evidence of horizontal tax competition when we explore heterogeneous responses by the level of cross-border commuting (columns 2 through 4). The panel estimate for vertical competition (–0.013), however, has a negative sign and is precisely estimated (column 1). For the heterogeneous response by commuting level, both the main effect and the interaction term are negative, but neither is estimated precisely. The coefficients from the split-sample regressions are both negative, but neither is estimated precisely, and the estimate for areas of low cross-border commuting is not statistically different from the one for areas of high cross-border commuting.

One possible explanation for the failure to detect the presence of horizontal competition along the intensive margin is that it might take time for local governments to respond to the tax policy changes enacted by their cross-border neighbors. There could be a lagged response that we cannot detect using the contemporaneous tax rates from both sides of the border. We explore this possibility by introducing lags of various durations for the cross-border combined state and county rate as well as the own-state rate. We sequentially introduce lags of one to four years in the remaining columns of Table 6. The pattern of results shown in columns 5 through 8 do not support the horizontal tax competition hypothesis, as only one of the 14 coefficients is statistically significant and half of them have a negative sign. We continue, however, to find

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[10] It was not possible to explore heterogeneous responses by the extent of cross-border work in the multinomial logit specifications, as the estimates failed to converge.

evidence in support of vertical competition in our preferred panel specifications. The coefficients for the own-state tax rate are always negative for the contemporaneous rate, almost always negative on the one-year lag, and typically precisely estimated.[11] While these findings confirm the presence of vertical tax competition identified in previous studies and in our cross-sectional analysis, the estimates are considerably smaller. For instance, the coefficient in column 5 for a change in state sales tax rates is equivalent to a –0.02 elasticity.

For completeness and as a robustness check, we investigate how the passage of a sales tax increase (the extensive margin) by a county's own state or its cross-border neighbor affects the county's statutory rate (the intensive margin). These results, shown in Table A1, are unsurprisingly similar to those shown in Table 6. There is no discernable evidence of horizontal tax competition, and vertical tax competition is shown to have statistically precise, though small, negative effects.

D. Dynamic Effects of Tax Competition

The implications of including lagged values of the dependent variable are shown in Table 7. Column 1 replicates the baseline fixed-effects specification used to compute the results shown in Table 6, but it uses OLS with county-pair and year fixed effects to show the R-squared measure of fit. Column 2 includes a lag of the own-county sales tax rate. The coefficient on the lagged dependent variable is large in magnitude and highly significant, but its inclusion has a negligible impact on the coefficients for the cross-border combined sales tax rate or the own-state sales tax rate. The share of the within-variation that is explained, however, jumps from 3.2 percent to nearly 28 percent. Due to the previously discussed problems with bias and consistency caused by introducing a lag of the dependent variable, we estimate the specification in column 2 employing a dynamic panel specification, the xtabond one-step estimator using robust standard errors.[12] Using the consistent approach in a dynamic panel setting, column 3 produces a slightly larger, but same-signed, coefficient for the county's own-state sales tax rate, thus confirming this part of the dynamic tax competition hypothesis. The coefficient on the combined opposite rates for the cross-border neighboring county, however, remains insignificantly different from zero.

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[11] Estimated with standard errors clustered at the state-border pair and the one-year lags of the own-state sales tax rate to retain statistical significance.
[12] The xtabond post-estimation test for serial correlation narrowly confirms the absence of serial correlations in the errors, as the model assumes, with $p(1) = .002$; $p(2) = .071$, and; $p(3) = .054$.

Column 4 adds a second lag of the dependent variable, and we continue to see a negative and statistically significant coefficient on the own-state rate, but no evidence of horizontal tax competition on the intensive margin. Columns 5 and 6 consider the presence of a heterogeneous tax competition response using the split sample. The coefficients on the own-state rate are indistinguishable, and the coefficients on the cross-border combined rate are quite different, but not consistent with the hypothesized impact stemming from differences in the economic accessibility of border regions.

E. Instrumental Variables Results

Up to this point the results presented have relied on the border approach (along with time and county fixed effects) for identification, using state borders to provide a spatial discontinuity between two contiguous areas that are similar economically, in both levels and trends. However, to further ameliorate endogeneity concerns, we follow Parchet (2019) and use the neighboring state-level sales tax rate as an instrument for the neighboring county-level sales tax rate.

Table 8 presents estimates of vertical and horizontal tax competition in sales taxation in the United States using the instrumental variables (IV) approach. Columns 1 and 3 present first-stage estimates from equation (8), while columns 2 and 4 present second-stage estimates from equation (9). Beginning with the non-weighted and weighted first-stage estimates in columns 1 and 3, we find the lagged neighboring state sales tax rate is positively correlated with the neighboring county sales tax rate and statistically significant, with partial F-statistics of 559.05 and 232.77, respectively. Second-stage IV estimates continue to suggest there is an economically small but statistically significant negative vertical tax competition between counties and state tax policy. IV results on horizontal tax competition suggest that when a neighboring county increases its sales tax rate 1.0 percentage point it leads to a decrease of 0.0238 percentage points (without weighting) and 0.0273 percentage points (with weighting) in a county's own sales tax rate. Although the effect is modest, it suggests neighboring counties act as substitutes competing for mobile consumers, causing a "race to the bottom" effect. Interestingly, Parchet (2019) also finds that cross-border neighboring local jurisdictions in Switzerland act as substitutes when setting local personal income tax policy. Overall, this additional analysis to further isolate causal estimates largely supports our earlier findings.

5. Conclusion

The presence of two neighboring jurisdictions with varying tax structures can affect consumer behavior and the spatial distribution of economic activity (firms and employment). These economic incentives may induce local policymakers to respond to tax policy changes made by their state government and neighboring jurisdictions. The existing literature shows that, in the cross section, there is tax competition at the national level as well as in certain states. However, these previous studies do not examine important dynamic effects in sales tax policy for the national level.

We extend the literature by investigating static and dynamic tax competition effects while also including a proxy for the ease of crossing of state borders when economic activity is shared. Our results match those of the existing literature in finding important tax competition behavior in the cross-sectional analysis. However, our findings are somewhat mixed when using dynamic estimation. When we examine the decision to pass a sales tax rate change (the extensive margin), our results suggest that vertical and horizontal tax competition is present; yet when we examine sales tax rate changes in levels (the intensive margin), we find either no effect (in the panel analysis) or possibly small negative effects of horizontal tax competition (counties act as substitutes).

One of our main contributions to the literature on tax competition is presenting evidence of the presence of vertical tax competition over time (in static and dynamic panel analysis and instrumental variables). These estimates are statistically significant but quite small in magnitude, especially when comparing these findings with the results in the existing literature and those obtained from our cross-sectional analysis. Specifically, our preferred set of estimates in both the static and dynamic settings find vertical competition elasticities that are equivalent to –0.02 to –0.05. This finding may have important policy implications, as it likely means that much of the correlation in tax competition in the cross-sectional data is explained by selection, not causality. Additionally, we follow the Parchet (2019) method to fully account for potential endogeneity in the tax competition literature.

We feel that while conducting a national panel analysis of tax competition in the United States is an important contribution to the literature, there is room for more work. Future research could look for an exogenous shock to state borders, similar to the European work (that is, looking at the German reunification), although it is difficult to think of a shock that would

change conditions on enough borders. Additionally, future research could collect data on city and municipal taxes over time for the entire United States.

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Table 1: Summary Statistics (Percentages)					
	Min	1st Tercile	Median	3rd Tercile	Max
Average Percent of Residents Working Out-of-State	0.92%	4.46%	7.96%	13.31%	45.16%
Own-County Sales Tax Rate					
2003	0.00%	0.25%	1.00%	2.00%	4.00%
2004	0.00%	0.25%	1.00%	2.00%	4.50%
2005	0.00%	0.25%	1.00%	2.00%	4.50%
2006	0.00%	0.25%	1.00%	2.00%	4.50%
2007	0.00%	0.25%	1.00%	2.00%	4.50%
2008	0.00%	0.35%	1.00%	2.00%	4.50%
2009	0.00%	0.38%	1.00%	2.00%	4.50%
Own-State Sales Tax Rate					
2003	0.00%	4.00%	5.00%	6.00%	7.00%
2004	0.00%	4.25%	5.13%	6.00%	7.00%
2005	0.00%	4.00%	5.30%	6.00%	7.00%
2006	0.00%	4.00%	5.30%	6.00%	7.00%
2007	0.00%	4.25%	5.30%	6.00%	7.25%
2008	0.00%	4.25%	5.30%	6.00%	7.25%
2009	0.00%	4.50%	5.50%	6.00%	8.25%

Table 2: Investigating Tax Competition in a Cross-Sectional Setting
(Dependent Variable: Own County Sales Tax Rate)

	(1) 2003	(2) 2004	(3) 2005	(4) 2006	(5) 2007	(6) 2008	(7) 2009
Panel A							
Combined Opp. Rate	0.0626***	0.0513***	0.0610***	0.0641***	0.0738***	0.0941***	0.0882***
	(0.0150)	(0.0147)	(0.0146)	(0.0143)	(0.0142)	(0.0142)	(0.0144)
Own-State Rate	-0.1219***	-0.1195***	-0.1107***	-0.1105***	-0.1171***	-0.1223***	-0.1142***
	(0.0244)	(0.0241)	(0.0240)	(0.0240)	(0.0241)	(0.0247)	(0.0230)
Constant	1.0686***	1.1359***	1.0449***	1.0236***	1.0146***	0.9277***	0.9478***
	(0.1590)	(0.1625)	(0.1629)	(0.1637)	(0.1657)	(0.1693)	(0.1631)
Number	1,223	1,223	1,223	1,223	1,223	1,223	1,223
Panel B							
Combined Opp. Rate	0.0629***	0.0517***	0.0617***	0.0647***	0.0745***	0.0947***	0.0889***
	(0.0150)	(0.0147)	(0.0146)	(0.0143)	(0.0141)	(0.0142)	(0.0143)
Own-State Rate	-0.1209***	-0.1184***	-0.1091***	-0.1092***	-0.1159***	-0.1210***	-0.1127***
	(0.0245)	(0.0241)	(0.0240)	(0.0241)	(0.0243)	(0.0249)	(0.0232)
Cross-State Work Share (CSWS)	-0.0018	-0.0021	-0.0028	-0.0023	-0.0022	-0.0020	-0.0024
	(0.0041)	(0.0042)	(0.0042)	(0.0041)	(0.0042)	(0.0041)	(0.0041)
Constant	1.0797***	1.1489***	1.0606***	1.0368***	1.0257***	0.9370***	0.9597***
	(0.1610)	(0.1644)	(0.1645)	(0.1654)	(0.1671)	(0.1697)	(0.1638)
Number	1,223	1,223	1,223	1,223	1,223	1,223	1,223
Panel C							
Combined Opp. Rate	0.0715***	0.0657***	0.0665***	0.0655***	0.0657***	0.0976***	0.0962***
	(0.0249)	(0.0246)	(0.0244)	(0.0242)	(0.0238)	(0.0235)	(0.0233)
Combined Opp. Rate X CSWS	-0.0011	-0.0017	-0.0006	-0.0001	0.0012	-0.0004	-0.0010
	(0.0028)	(0.0028)	(0.0028)	(0.0028)	(0.0027)	(0.0026)	(0.0026)
Own-State Rate	-0.0761*	-0.0842**	-0.0851**	-0.0820**	-0.0761*	-0.0657	-0.0477
	(0.0404)	(0.0399)	(0.0398)	(0.0400)	(0.0399)	(0.0404)	(0.0369)
Own-State Rate X CSWS	-0.0048	-0.0037	-0.0026	-0.0030	-0.0044	-0.0062	-0.0073*
	(0.0039)	(0.0038)	(0.0038)	(0.0039)	(0.0041)	(0.0043)	(0.0040)
Cross-State Work Share (CSWS)	0.0289	0.0270	0.0143	0.0134	0.0131	0.0325	0.0436
	(0.0266)	(0.0266)	(0.0264)	(0.0270)	(0.0285)	(0.0300)	(0.0293)
Constant	0.8124***	0.8980***	0.9126***	0.8967***	0.8796***	0.6380**	0.5747**
	(0.2631)	(0.2710)	(0.2693)	(0.2715)	(0.2773)	(0.2792)	(0.2633)
Number	1,223	1,223	1,223	1,223	1,223	1,223	1,223

Table 3: Investigating Tax Competition in a Pooled Cross-Sectional Setting
(Dependent Variable: Own County Sales Tax Rate)

Years: 2003 to 2009	(1)	(2)	Adding Interactions		Bottom Half of OOS	Top Half of OOS
			(3)	(4)	(5)	(6)
Combined Opp. Rate	0.0706***	0.0700***	0.0756***	0.0703***	0.0801***	0.0601***
	(0.0055)	(0.0055)	(0.0091)	(0.0091)	(0.0071)	(0.0085)
Combined Opp. Rate X Cross-State Work Share			-0.0006	0.0000		
			(0.0010)	(0.0010)		
Own-State Rate	-0.1168***	-0.1102***	-0.0737***	-0.0688***	-0.0860***	-0.1310***
	(0.0091)	(0.0090)	(0.0148)	(0.0145)	(0.0116)	(0.0142)
Own-State Rate X Cross-State Work Share			-0.0046***	-0.0044***		
			(0.0015)	(0.0015)		
Cross-State Work Share			0.0249**	0.0202*		
			(0.0104)	(0.0105)		
County Unemployment Rate		-0.0497***		-0.0482***	-0.0420***	-0.0539***
		(0.0057)		(0.0058)	(0.0077)	(0.0087)
County Personal Income per Capita (1,000s)		-0.0005		-0.0010	0.0010	-0.0023*
		(0.0011)		(0.0011)	(0.0015)	(0.0014)
Constant	0.9969***	0.9558***	0.7717***	0.7690***	0.8260***	1.0778***
	(0.0659)	(0.0655)	(0.1046)	(0.1035)	(0.0872)	(0.1000)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
County-Pair Fixed Effects	No	No	No	No	No	No
Number	8,561	8,330	8,561	8,330	4,158	4,172

The estimates from columns 1 and 2 represent the results from equations (1) and (2), while columns 3 and 4 represent the results from equation (3). The dependent variable is a county's own sales tax rate. Our measure of accessibility, labeled the cross-state work share, is the percentage of residents working in the opposite state (averaging the percentages of the two counties in each pair). The unit of observation is the county pair, and all standard errors are robust to heteroscedasticity.

Table 4: Investigating Tax Competition in a Fixed Effects Multinomial Logit Setting with Lagged Explanatory Variables
(Dependent Variable: Dummy Variable for Own County Sales Tax Rate Increase)

	Base Specification	Contemporaneous Rates	Adding 1-year Lag
Years: 2003 to 2009	(1)	(2)	(3)
Base Case: No Rate Change			
Panel A: Increasing Rate Case			
Dummy Variable for Combined Opp. Rate Increase	1.3350	1.3414	1.1752
	(0.3779)	(0.3831)	(0.3663)
First Lag of Dummy Variable for Combined Opp. Rate Increase			1.4997
			(0.5626)
Dummy Variable for Own-State Rate	0.9293	0.9220	0.3265***
	(0.2679)	(0.2729)	(0.1228)
First Lag of Dummy Variable for Own-State Rate Increase			0.6291
			(0.3729)
County Unemployment Rate		0.8726	0.9210
		(0.0921)	(0.1093)
County Personal Income per Capita (1,000s)		0.9912	1.0161
		(0.0206)	(0.0367)
Panel B: Decreasing Rate Case			
Dummy Variable for Combined Opp. Rate Increase	1.0965	1.0008	0.2275
	(0.7971)	(0.8538)	(0.2457)
First Lag of Dummy Variable for Combined Opp. Rate Increase			0.0000***
			(0.0000)
Dummy Variable for Own-State Rate	1.8505*	1.8300*	4.8945**
	(0.6644)	(0.6539)	(3.0446)
First Lag of Dummy Variable for Own-State Rate Increase			2.5236*
			(1.3327)
County Unemployment Rate		0.9064	0.7937
		(0.1086)	(0.1405)
County Personal Income per Capita (1,000s)		0.9756	0.8718
		(0.0428)	(0.1618)
Year Fixed Effects	Yes	Yes	Yes
County-Pair Fixed Effects	Yes	Yes	Yes
Number	978	972	690

All the estimates represent the results from equation (4). The dependent variable is a county's own sales tax rate. The unit of observation is the county pair, and all standard errors are robust to heteroscedasticity.

The coefficient magnitudes in column 3 are overinflated due to the small number of observations. The 95% confidence interval for the coefficient of 4.8945 is 1.4462 to 16.5653, and the confidence interval on the coefficient of 2.5236 is 0.8964 to 7.1044.

Table 5: Investigating Tax Competition in a Fixed Effect Multinomial Logit Setting
with Different Lagged Explanatory Variables
(Dependent Variable: Dummy Variable for Own County Sales Tax Increase)

Years: 2003 to 2009	Contemporaneous Rates	Adding 1-year Lag
	(1)	(2)
Base Case: No Rate Change		
Panel A: Increasing Rate Case		
Combined Opp. Rate	2.0337	2.8148**
	(0.9370)	(1.4287)
First Lag of Combined Opp. Rate		0.4907
		(0.3563)
Own-State Rate	0.6721	0.3589**
	(0.2650)	(0.1619)
First Lag of Own-State Rate		3.2521***
		(1.3134)
County Unemployment Rate	0.8891	0.8966
	(0.0903)	(0.0900)
County Personal Income per Capita (1,000s)	0.9865	0.9882
	(0.0205)	(0.0193)
Panel B: Decreasing Rate Case		
Combined Opp. Rate	0.0036***	0.0019**
	(0.0036)	(0.0049)
First Lag of Combined Opp. Rate		2.8769
		(9.4357)
Own-State Rate	4.9981	4.5214
	(6.6076)	(5.6276)
First Lag of Own-State Rate		0.7175
		(0.4874)
County Unemployment Rate	0.7261**	0.7189**
	(0.1099)	(0.1118)
County Personal Income per Capita (1,000s)	0.9513	0.9555
	(0.0541)	(0.0566)
Year Fixed Effects	Yes	Yes
County-Pair Fixed Effects	Yes	Yes
Number	972	690

All the estimates represent the results from equation (4). The dependent variable is a county's own sales tax rate.
The unit of observation is the county pair, and all standard errors are robust to heteroscedasticity.

Table 6: Investigating Tax Competition in a Static Panel Fixed Effects Setting with Different Lagged Explanatory Variables
(Dependent Variable: Own County Sales Tax Rate)

| Years: 2003 to 2009 | | Contemporaneous Rates | | | Adding 1-year Lag | Adding 2-Year Lag | Adding 3-Year Lag | Adding 4-Year Lag |
| | | With interactions | Bottom Half of OOS | Top Half of OOS | | | | |
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Combined Opp. Rate	-0.0008	0.0046	0.0079	-0.0074	0.0022	0.0034	-0.0005	0.0060
	(0.0068)	(0.0125)	(0.0126)	(0.0065)	(0.0072)	(0.0083)	(0.0081)	(0.0086)
First Lag of Combined Opp. Rate					-0.0071	-0.0016	0.0007	-0.0105**
					(0.0055)	(0.0061)	(0.0098)	(0.0042)
Second Lag of Combined Opp. Rate						-0.0011	0.0085	0.0144
						(0.0086)	(0.0089)	(0.0111)
Third Lag of Combined Opp. Rate							-0.0074	0.0059
							(0.0103)	(0.0112)
Fourth Lag of Combined Opp Rate								-0.0048
								(0.0093)
Own-State Rate	-0.0131**	-0.0094	-0.0148	-0.0110	-0.0137**	-0.0170**	-0.0126*	-0.0085
	(0.0064)	(0.0105)	(0.0113)	(0.0073)	(0.0064)	(0.0085)	(0.0068)	(0.0062)
First Lag of Own-State Rate					0.0005	-0.0060	-0.0321***	-0.0168***
					(0.0122)	(0.0101)	(0.0076)	(0.0035)
Second Lag of Own-State Rate						0.0262**	0.0447***	0.0016
						(0.0127)	(0.0167)	(0.0040)
Third Lag of Own-State Rate							0.0166	0.0303
							(0.0126)	(0.0218)
Fourth Lag of Own-State Rate								0.0120
								(0.0162)
County Unemployment Rate	-0.0004	-0.0003	-0.0001	-0.0006	-0.0017	-0.0014	-0.0012	-0.0022
	(0.0018)	(0.0018)	(0.0022)	(0.0030)	(0.0018)	(0.0020)	(0.0021)	(0.0022)
County Personal Income per Capita (1,000s)	-0.0004	-0.0004	-0.0001	-0.0010	-0.0008	-0.0009*	-0.0017*	-0.0020*
	(0.0005)	(0.0005)	(0.0006)	(0.0008)	(0.0005)	(0.0005)	(0.0009)	(0.0010)
Combined Opp. Rate X Cross-State Work Share		-0.0005						
		(0.0008)						
Own State Rate X Cross-State Work Share		-0.0003						
		(0.0005)						
Constant	0.9037***	0.9011***	0.9095***	0.8855***	0.9362***	0.8312***	0.7606***	0.7066***
	(0.0526)	(0.0540)	(0.0946)	(0.0541)	(0.0735)	(0.1044)	(0.1305)	(0.2282)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-Pair Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number	8,330	8,330	4,158	4,172	7,140	5,950	4,760	3,570

The estimates in column 2 represent the results from equation (5). All the other estimates represents the results from equation (4). The dependent variable is a county's own sales tax rate. The unit of observation is the county pair, and all standard errors are robust to heteroscedasticity.

Table 7: Dynamic Modeling (Dependent Variable: Own County Sales Tax Rate)

	Linear FE	Linear FE w/lagged Dep Var	Dynamic Panel			
			Adding 1st Lag Own Rate	Adding 2nd Lag Own Rate	Bottom Half of OOS	Top Half of OOS
Years: 2003 to 2009	(1)	(2)	(3)	(4)	(5)	(6)
Combined Opp. Rate	-0.0008	0.0005	-0.0045	-0.0017	0.0030	-0.0115*
	(0.0068)	(0.0049)	(0.0051)	(0.0050)	(0.0091)	(0.0069)
Own-State Rate	-0.0131**	-0.0120***	-0.0206***	-0.0164***	-0.0235***	-0.0245***
	(0.0064)	(0.0040)	(0.0046)	(0.0039)	(0.0071)	(0.0078)
County Unemployment Rate	-0.0004	-0.0015	-0.0011	-0.0022	-0.0013	-0.0004
	(0.0018)	(0.0016)	(0.0015)	(0.0016)	(0.0016)	(0.0026)
County Personal Income per Capita (1,000s)	-0.0004	-0.0004	-0.0007*	-0.0008**	-0.0009*	0.0001
	(0.0005)	(0.0003)	(0.0004)	(0.0004)	(0.0005)	(0.0007)
Own-County Rate Last Year		0.5506***	0.3578***	0.1139	0.2836***	0.6565**
		(0.0316)	(0.0836)	(0.1357)	(0.0822)	(0.2825)
Own-County Rate Two Years Prior				-0.0877**		
				(0.0421)		
Constant	0.9037***	0.4384***	0.7108***	0.9611***	0.7807***	0.4685**
	(0.0526)	(0.0486)	(0.0754)	(0.1442)	(0.0929)	(0.2072)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
County-Pair Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,330	7,140	5,950	4,760	2,970	2,980
Xtabond?		Yes	Yes	Yes	Yes	Yes
Number of Unique County Pairs	1,190	1,190	1,190	1,190	594	596
Share of Within Variation Explained	0.0323	0.2763				

All estimates represents results from equation (7). The dependent variable is a county's own sales tax rate. The unit of observation is the county pair, and all standard errors are robust to heteroscedasticity.

Table 8: IV Strategy

	Non-weighted		Weighted	
	First Stage	IV	First Stage	IV
Years: 2003 to 2009	(1)	(2)	(3)	(4)
Combined Opp. Rate		-0.0238***		-0.0273***
		(0.009)		(0.0062)
Own State Rate	-0.0478***	-0.0150**	-0.0643***	-0.0152***
	(0.0084)	(0.0064)	(0.0090)	(0.0063)
County Unemployment Rate	0.0025	-0.0016	0.0014	-0.0016
	(0.0028)	(0.0018)	(0.0031)	(0.0018)
County Personal Income per Capita (1,000s)	0.0008	-0.0008*	0.0007	-0.0008*
	-0.0007	(0.0004)	(0.0007)	(0.0004)
Lagged Opp. State Rate	0.5715***		0.0345***	
	(0.0242)		(0.0023)	
First Stage F-test on Instrument	559.05		232.77	
Year Fixed Effects	Yes	Yes	Yes	Yes
County-Pair Fixed Effects	Yes	Yes	Yes	Yes
Observations	7,140	7,140	7,140	7,140
Number of Unique County Pairs	1,190	1,190	1,190	1,190

The estimates in columns 1 and 3 result from equation (8), while estimates in columns 2 and 4 result from equation (9). The dependent variable in the IV is a county's own sales tax rate, and it has been instrumented by the lagged opposite state rate in the first-stage regression. The unit of observation is the county pair, and all standard errors are robust to heteroscedasticity.

Table A1: Investigating Tax Competition in a Static Panel Fixed Effects Setting with Different Lagged Explanatory Variables (RHS Extensive)
(Dependent Variable: Own County Sales Tax Rate)

Years: 2003 to 2009	Contemporaneous Rates (1)	Adding 1-year Lag (2)	Adding 2-Year Lag (3)	Adding 3-Year Lag (4)	Adding 4-Year Lag (5)
Dummy Variable for Combined Opp. Rate Increase	0.0019	0.0023	0.0001	0.0001	0.0002
	(0.0033)	(0.0041)	(0.0052)	(0.0053)	(0.0054)
First Lag of Dummy Variable for Combined Opp. Rate Increase		0.0050	0.0050	-0.0018	0.0015
		(0.0044)	(0.0063)	(0.0068)	(0.0058)
Second Lag of Dummy Variable for Combined Opp. Rate Increase			0.0021	0.0001	0.0137
			(0.0063)	(0.0100)	(0.0118)
Third Lag of Dummy Variable for Combined Opp. Rate Increase				-0.0006	0.0072
				(0.0077)	(0.0083)
Fourth Lag of Dummy Variable for Combined Opp. Rate Increase					0.0045
					(0.0044)
Dummy Variable for Own-State Rate	-0.0109*	-0.0150**	-0.0145***	-0.0163**	-0.0287***
	(0.0057)	(0.0070)	(0.0054)	(0.0070)	(0.0059)
First Lag of Dummy Variable for Own-State Rate Increase		-0.0162***	-0.0351***	-0.0300**	-0.0603***
		(0.0057)	(0.0100)	(0.0117)	(0.0140)
Second Lag of Dummy Variable for Own-State Rate Increase			-0.0111	-0.0281*	-0.0762***
			(0.0068)	(0.0152)	(0.0192)
Third Lag of Dummy Variable for Own-State Rate Increase				-0.0080	-0.0343
				(0.0098)	(0.0236)
Fourth Lag of Dummy Variable for Own-State Rate Increase					0.0128*
					(0.0068)
County Unemployment Rate	-0.0016	-0.0015	-0.0015	-0.0022	-0.0042*
	(0.0018)	(0.0021)	(0.0022)	(0.0022)	(0.0025)
County Personal Income per Capita (1,000s)	-0.0008	-0.0009*	-0.0018*	-0.0021*	-0.0009
	(0.0005)	(0.0005)	(0.0009)	(0.0011)	(0.0006)
Constant	0.8428***	0.8497***	0.8490***	0.8642***	0.8732***
	(0.0029)	(0.0032)	(0.0033)	(0.0030)	(0.0023)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
County-Pair Fixed Effects	Yes	Yes	Yes	Yes	Yes
Number	7,140	5,950	4,760	3,570	2,380

All the estimates represent the results from equation (4). The dependent variable is a county's own sales tax rate The unit of observation is the county pair and all standard errors are clustered at the state-border pair level.

Table A2: Investigating Tax Competition in a Pooled Cross-Sectional Setting
(Dependent Variable: Own Local County Sales Tax Rate)

Years: 2003 to 2009	(1)	(2)	(3)	(4)
Combined Opp. Rate	0.0706	0.0700	0.0756	0.0703
	(0.0532)	(0.0522)	(0.0590)	(0.0588)
Combined Opp. Rate X Cross-State Work Share			-0.0006	0.0000
			(0.0051)	(0.0049)
Own-State Rate	-0.1168	-0.1102	-0.0737	-0.0688
	(0.0852)	(0.0835)	(0.0914)	(0.0867)
Own State Rate X Cross-State Work Share			-0.0046	-0.0044
			(0.0076)	(0.0074)
Cross-State Work Share			0.0249	0.0202
			(0.0518)	(0.0508)
County Unemployment Rate		-0.0497		-0.0482
		(0.0303)		(0.0304)
County Personal Income per Capita (1,000s)		-0.0005		-0.0010
		(0.0040)		(0.0038)
Constant	0.9969*	0.9558*	0.7717	0.7690
	(0.5704)	(0.5545)	(0.6345)	(0.6104)
Year Fixed Effects	Yes	Yes	Yes	Yes
County-Pair Fixed Effects	No	No	No	No
Number	8,561	8,330	8,561	8,330

Columns 1 and 2 represent the results from equation (4), while columns 3 and 4 represent the results from equation (5). The dependent variable is a county's own sales tax rate. The unit of observation is the county pair and all standard errors are clustered at the state-border pair level.