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Local option sales taxes and consumer spending patterns: Fiscal interdependence under multi-tiered local taxation

Gregory Burge *, Cynthia Rogers [1]

Department of Economics, University of Oklahoma, 729 Elm Avenue, Norman, OK 73019, United States

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ABSTRACT

Twenty US states currently allow both county and municipal governments to impose sales taxes on purchases within their jurisdictions. This study investigates the complex multi-jurisdiction and multi-tier dimensions of local option sales taxes (LOSTs) in this setting. We estimate own-rate and cross-tier elasticities using data from 1993 to 2006 for Oklahoma municipalities and counties. Using a variety of panel data techniques including first differenced and random trends models, we show both are significant determinants of consumer spending patterns. Additionally, accounting for localized tax rate differentials reveals important nuances in the interpretation of cross-tier and own-rate elasticities. Our results suggest that municipal LOST revenues can be significantly affected by the rate setting decisions of parent counties as well as nearby regional retail centers. Therefore, the ability of municipal governments to control LOST revenues by varying their own LOST rate is affected by both vertical and horizontal fiscal spillovers. Understanding the nature of fiscal interdependence in this setting is important for the 34 US states that authorize some form of LOSTs as well as any considering their implementation.

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1. Introduction

A local option sales tax (LOST) is a general retail sales tax imposed at a sub-state jurisdiction level where the proceeds are returned to the local jurisdiction of the purchase location.[2] LOSTs are imposed at some level in thirty-four US states generating over 55 billion dollars in local government tax revenues in 2005–06. Historical evidence suggests that states experiencing budgetary crises are more likely to increase sales tax rates and/or extend their coverage, as opposed to increasing state income taxes or local property taxes (Brunori, 2007). Hence, LOSTs are likely to become even more deeply entrenched in the US fiscal landscape, especially given the recent, widespread economic turmoil (Dye, 2008).

The US experience provides a rich set of examples regarding LOST implementation and expansion from which to base LOST policy decisions. Creating the potential for sales taxes to be imposed concurrently at the state, county, and municipal level, LOSTs introduce complex, multi-jurisdictional and multi-tiered dimensions to the local public finance landscape. LOST rate decisions impact jurisdictions own revenues as well as those in competing and neighboring jurisdictions at both higher and lower tiers of government. The implications of such policies, however, are not well understood.

The complexities associated with multi-tiered taxation, and particularly those related to county and municipal fiscal interactions, are largely unexplored.[3] The literature primarily focuses on single-tiered dimensions of LOST policy. For instance, spillover models (Baicker, 2005; Buettner, 2003; Case et al., 1993) and tax competition models (e.g., Rork, 2003; Luna, 2004; Rork and Wagner, 2008) generally analyze interactions within a single governmental tier (i.e., states, counties, or municipalities). Studies employing multi-tiered settings (e.g., Luna et al., 2007; Hill, 2005) focus on state-local interdependencies. The absence of research investigating county-municipal fiscal interdependencies in this context is somewhat surprising given that they are present in forty percent of US States.

We address the gap in the literature by investigating municipal (within-tier) and county (cross-tier) elasticities with respect to municipal LOST revenues. Drawing upon the existing literature concerning vertical and horizontal fiscal interdependencies between local governments, we develop five testable hypotheses. We construct a rich set of data on annual LOST rates and revenues for Oklahoma counties and municipalities from 1993 to 2006. Oklahoma is a prime case in which local autonomy regarding LOST implementation and rate determination is extensive. Widespread local LOST implementation in the state reduces concern about self-selection bias relating to local adoption decisions. Because Oklahoma's sales tax base is uniform at all levels of government and the state sales tax rate has not changed since 1990, we are able to focus on the effects of county and municipal LOST rate variation. In addition, using a

* Corresponding author. Tel.: +1 405 325 2358; fax: +1 405 325 5842.
E-mail addresses: gburge@ou.edu (G. Burge), crogers@ou.edu (C. Rogers).

[1] Tel.: +1 405 325 5843; fax: +1 405 325 5842.

[2] Local excise taxes, such as a hotel or recreation levy, are classified separately, even though they often serve the same purpose of generating funds for local expenditures.

[3] Esteller-Moré and Solé-Ollé (2001) investigate vertical tax externalities and fiscal interdependencies with respect to federal-state income taxation. Although conceptually similar, our study investigates taxation of a common sales tax base.

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panel that is both wide and long, we are better able to address two challenging estimation issues: the potential bias associated with suspected endogeneity of our tax variables, and the likely simultaneity of the relationship between LOST rates and municipal tax bases. Accordingly, we construct, estimate, and test a variety of panel data models to mitigate these concerns.

An important contribution of our study is that we account for multi-jurisdictional competitive factors. LOST rates in a given municipality are compared with those in the nearest retail center as well as with the weighted average of LOST rates in its home county. In both cases, competitive pressures influence the magnitude and significance of own-rate and cross-tier LOST elasticities. Consistent with our predictions, distance serves as a buffer that mitigates competitive pressures. We also model changes in relative LOST rate differentials as being either conforming or nonconforming. We define conforming changes as those that lessen, but do not reverse, absolute differentials with respect to the competition faced by a municipality. Nonconforming changes either reverse the sign of the tax differential with respect to the competition or exacerbate a municipality's relative position (i.e., widen an already existing gap). In our first differenced and random trends models, conforming changes are found to have minimal impacts on consumer spending. In contrast, nonconforming rate changes are consistently found to have an inverse effect on consumer spending patterns. Hence, the subtle nuances that characterize a given municipalities' preexisting situation can influence the magnitude of own-rate and cross-tier LOST elasticities.

An implication of our findings is that local competitive factors affect the incentives (and ability) of municipal governments to attract retail activity. In addition, models ignoring the nature of local competition can produce conclusions that are, at best, incomplete, and are, at worst, potentially misleading. From a policy perspective, our results provide indirect evidence to support the commonly raised concern that an increased overall reliance on LOSTs for raising municipal revenues may exacerbate problems of fiscal inequality among urban, suburban, and rural localities in the US.

2. Overview of LOSTs in the U.S.

State authorization of general sales taxes varies considerably across and within US states (see Brunori, 2007; National Conference of State Legislatures, 1997, 2008). Delaware, Montana, New Hampshire, and Oregon impose no sales taxes at the state or local level. Twelve states impose only state level sales taxes (Connecticut, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, Mississippi, New Jersey, Rhode Island, Vermont and West Virginia). Alaska is unique because it allows municipal but not state-level sales taxation. In the remaining states, general retail sales are taxed by both state and local governments.

Multi-tiered sales taxation occurs in 33 states and takes two general forms. In thirteen states (Florida, Idaho, Iowa, Minnesota, Nebraska, Nevada, North Carolina, Ohio, Pennsylvania, South Dakota, Virginia, Wisconsin, and Wyoming) LOSTs are imposed by the state and by one level of local government. More commonly, multi-LOSTs involves three tiers of government: total sales tax rates imposed in a given jurisdiction equals the sum of state, county, and municipal rates. The twenty states where this currently occurs are Alabama, Arizona, Arkansas, California, Colorado, Georgia, Hawaii, Illinois, Kansas, Louisiana, Missouri, New Mexico, New York, North Dakota, Oklahoma, South Carolina, Tennessee, Texas, Utah, and Washington.[4]

The extent of effective local autonomy regarding LOST adoption and implementation also varies considerably across and within states (see Mu and Rogers, 2005). In most cases, implementation of LOSTs requires local voter approval. Some locally imposed sales taxes, however, involve no local option. For example, the county sales tax in California is automatically imposed at a uniform rate on top of the state sales tax and, thus, involves no local autonomy regarding implementation. Illinois, which also imposes automatic local sales taxes, allows local jurisdictions to adopt additional sales taxes. Typically, LOSTs are authorized for a broad range of localities. However, some states limit local implementation by requiring special enactment legislation or by limiting authorization to certain qualified jurisdictions (i.e., the major cities/counties in Pennsylvania, and resort cities in Idaho). Although most states authorize sales subject to local taxation using a uniform state definition, Alabama, Arizona, and Colorado allow local jurisdictions to have considerable discretion as to the definition of taxable transaction. There is also substantial variation in maximum LOST rates that county and municipal level jurisdictions may impose.

Pinning down precise statutory and effective local tax rate limits is difficult due to the sheer variety of state sales tax structures, as well as the ongoing evolution of state fiscal policies. Table 1 places the states with multi-tiered LOSTs are grouped into three categories – hard, soft and no cap – according to how binding the authorized local sales tax rates are. Hard cap limits on general sales taxes or combined special purpose local sales taxes allowed are binding in California, Georgia, Hawaii, New Mexico, South Carolina, Tennessee, Texas, Utah, and Washington. For example, Virginia allows only a one percent city LOST rate to be imposed, and Arkansas caps the maximum single transaction value at $25 for large ticket items such as cars.

However, the degree to which such statutory rate limits are binding is often mitigated either through special legislation or by allowing additional special purpose local sales taxes in the soft cap states. For example, Louisiana commonly allows jurisdictions to go over its three percent total combined local cap via special legislation. Arkansas, New York, and Missouri allow for multiple special purpose sales taxes to be implemented in a single jurisdiction raising the total possible effective local sales tax rate well above that of the specified limits. In fact, Arkansas authorizes six additional special purposes municipal level sales taxes up to 1% each. Unlimited local autonomy is present in the seven no cap states. Arizona, Colorado (as of May 2008) and Oklahoma have no explicit statutory limits on municipal LOST rates (other than local voter approval). Kansas has no limit on county LOST rates. Alabama, Illinois (home rule localities) and North Dakota do not limit either municipal or county LOST rates.

Local autonomy influences the degree to which local government can rely on LOSTs as a revenue source. Fig. 1 shows the share of local (county plus municipal) revenues generated from LOSTs and sources in 2002 for 17 of the 20 states with multi-tiered LOST.[5] In general, local governments with more LOST autonomy rely on LOST revenues to a great extent. For example Oklahoma, Arkansas, and Colorado collect more than half of their local tax revenues from LOSTs. However, authority does not always translate into local implementation. For example, Illinois grants extensive local LOST rate autonomy but collects about the same share of local LOST revenues as US states on average.

Importantly for our study, environments where flexibility has been given to both county and municipal governments in terms of LOST implementation create a great deal of potential horizontal and vertical tax interactions regarding local sales taxation. In the next section, we discuss the nature of these interactions.

3. LOSTs in a multi-tiered setting

We present a simple discussion that considers the effects of LOSTs on municipal revenues in a setting where both municipal and county level governments autonomously set tax rates on a common retail

[4] Arizona, Hawaii and New Mexico impose gross receipt taxes rather than sales taxes. These are generally more broadly applied than retail sales taxes, but are commonly treated as sales tax equivalents in professional outlets (e.g. see various state comparison table presented by the http://www.taxfoundation.org).

[5] Georgia, Hawaii, and South Carolina are excluded from Fig. 1 but were included in the original reference to 20 states demonstrating multi-tiered LOST implementation at the local level. This is because authorization at one local level in each of these cases is minimal. (e.g., Atlanta levies the only municipal general purpose LOST in Georgia).

Table 1
LOST rate limitations: states with multi-tiered LOSTs.

Hard Cap	Soft Cap	No Cap
California	Arkansas	No County Cap
Georgia	Louisiana	Kansas
Hawaii*	Missouri	No Municipal Cap
New Mexico*	New York	Arizona*
South Carolina		Colorado
Tennessee		Oklahoma
Texas		No County or Municipal Cap
Utah		Alabama
Washington		Illinois
		North Dakota

* Arizona, Hawaii, and New Mexico impose gross receipt taxes. See Footnote 3.

base. Our framework examines the nature of vertical and horizontal fiscal interactions in this context and highlights the influence of jurisdictions containing retail agglomerations. Throughout our discussion we assume that, *ceteris paribus*, consumers prefer to shop in jurisdictions with: 1) lower prices, 2) shorter drive times from their residence, and 3) larger and/or more diverse retail opportunities.

3.1. Local tax rates, bases, and revenues — investigating the Laffer Curve for LOSTs

To begin, we focus on the relationship between three important and related variables. For municipality *i* at time *t*, let $\tau_{i,t}$, $BASE_{i,t}$, and $r_{i,t}$ denote the LOST rate currently in place, total consumer spending within the jurisdiction, and municipal LOST revenues, respectively. At the beginning of the period, consumer's observe $\tau_{i,t}$ and make decisions over where to shop and how much to spend. For small purchases, it is unlikely that any additional travel costs associated with tax avoidance are worthwhile. However, for large purchases the potential savings associated with reaching a jurisdiction with a comparatively low tax rate may outweigh travel costs. Consumer decisions lead to the realization of the tax base and, in turn, to the municipal revenues collected. By definition then, the following equation must hold during a given period of time:

$$r_{i,t} = BASE_{i,t}{}^{*}\tau_{i,t}. \quad (1)$$

Since higher tax levels lead directly to higher prices, and consumers prefer lower prices, we expect the following:

Hypothesis 1. Higher (lower) own-rate municipal LOST levels will reduce (increase) levels of consumer spending in the jurisdiction. In turn, increases (decreases) in a LOST rate will have a less than (greater than) proportional effect on municipal LOST revenues.

Identifying the causal effect of $\tau_{i,t}$ on $BASE_{i,t}$, however, is complicated since we suspect a potential two-way causal relationship. When *t* is relatively short, it is reasonable to assume that sales tax rates can influence the tax base but that the tax base does not influence the sales tax rate. When a local government implements or changes their LOST rate, consumers immediately face new prices and can modify behavior quickly. On the other hand, if local governments wish to adjust their LOST rate in response to changes in consumer behavior, they must develop the initiative, agree to a final proposal, wait a minimum of 60 days between the posting of the ballot initiative and the election, receive electoral support for the measure, and then have the policy implemented (which typically takes anywhere from a few weeks to six months after passage). As such, we are comfortable with the assertion that within a relative short period of time, τ_i can exert causal influence over $BASE_i$ while the reverse is not possible.

However, over the medium to long run, the possibility that the tax base could influence the municipality's desired LOST rate must be acknowledged. Two distinct and opposing factors are likely at play. On the one hand, higher tax bases create budgetary slack for a community by creating higher revenues. Thus, municipalities with stable revenue needs may be less likely to increase their LOST rates over time. This parallels the well documented tendency of local governments to leave millage rates untouched (or even lessened) while still experiencing increased revenues as property values rise. This would tend to cause jurisdictions to adopt

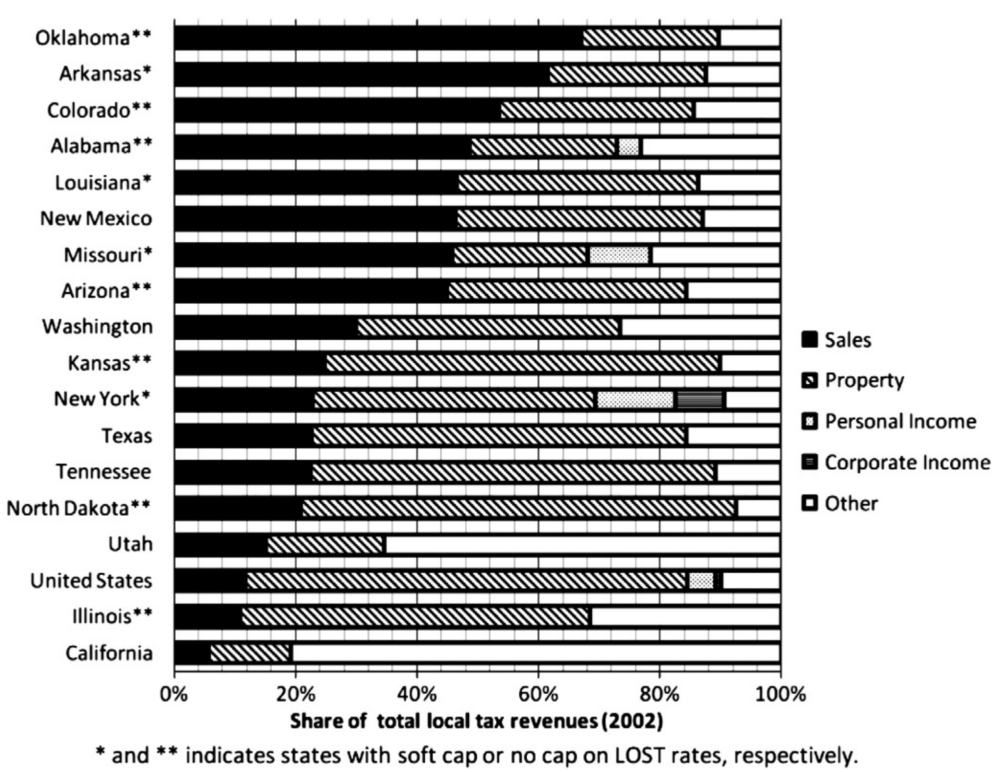

Fig. 1. Revenue Sources: US and states with multi-tiered LOSTs.

lower LOSTs over time if the tax base is large and/or increasing. On the other hand, higher tax bases may indicate that the per capita level of retail activity is high and/or increasing over time within a municipality. In this scenario, not all revenues collected under the LOST are paid by voting residents of the municipality and the potential to engage in effective tax exportation must be acknowledged. Accordingly, jurisdictions would tend to adopt higher LOSTs over time if the base is large and/or increasing.

A precise investigation of the nature of this long run feedback extends beyond the scope of the current investigation. Rather, our goal is to obtain unbiased estimates of the contemporaneous causal effect of changes in $\tau_{i,t}$ on $BASE_{i,t}$ under the acknowledged possibility of longer run reverse causality. This is conceptually similar to the strategy of studies that seek to estimate the short run elasticity of labor supply with respect to income tax rates (Stuart, 1981; Blundell et al., 1998) or the effect of local property taxes on the magnitude of the property tax base (Ladd and Bradbury, 1988; Stine, 1988). Framed in this light, our study carries out a simple application of the Laffer curve and estimates the responsiveness of the tax base to instantaneous changes in the tax rate. Since the counterfactual of interest (i.e., truly exogenous variation in tax rates between otherwise identical tax bases) is not directly observed, empirical studies address endogeneity through various econometric modeling techniques. In Section 3 we discuss this issue in detail and present panel data specifications that effectively provide unbiased estimates of the causal effect of LOSTs on consumer spending patterns and, operating through Eq. (1), on local sales tax revenues.

In addition to our interest in the municipal own-rate elasticity, a multi-tiered tax environment creates complex cross-tier elasticity dynamics. Note that the after-tax price in a municipality can be affected by tax policy changes made by *other governmental units*. Vertical interactions arise from state and county governments that encompass the municipality. Let $\tau_{s,i,t}$ and $\tau_{c,i,t}$ respectively denote the state and county sales tax rate affecting purchases in municipality *i* at time *t*. Horizontal interactions stem from LOST rates imposed by other municipal governments ($\tau^*_{j,t}$). Vertical and horizontal effects may simultaneously come from the LOST rates of non-parent county governments ($\tau^*_{c,j,t}$). We now briefly discuss some insights from previous investigations of vertical and horizontal fiscal interactions and develop four additional hypotheses regarding local environments where both are simultaneously present.

3.2. Cross-tier (vertical) fiscal interactions

Vertical fiscal spillovers result when multiple levels of government have taxing authority over a common geographical tax base. Keen and Kotsogiannis (2002) and Madiés (2008) contribute to a recently developed literature demonstrating that vertical fiscal externalities have important implications for optimal levels of taxation in a federation. However, only a scant literature investigates the implications of fiscal externalities occurring at the sub-state level. For example, Luna et al. (2007) and Hill (2005) both consider the spillover effects of county rate adoptions in a state-county cross-tier interaction setting. As such, the nature of fiscal interactions between county and municipal governments in the context of a multi-tiered local taxation remains unexplored. County imposed LOSTs influence the relative price of consumption within subsumed municipalities and are expected to have an inverse relationship with $BASE_{i,t}$.

Hypothesis 2. Higher (lower) county LOST levels will reduce (increase) levels of consumer spending and, in turn, municipal LOST revenues, in subsumed jurisdictions.

That is to say, we expect to find that the policy choices made by higher order governments impact the revenues of municipal governments. We find no *a priori* reason to assume own rate ($\tau_{i,t}$) and parent county ($\tau_{c,i,t}$) rates influence $BASE_{i,t}$ in an identical manner, largely since the real costs of tax avoidance should play a role in determining consumer reactions to changes in $\tau_{i,t}$ and $\tau_{c,i,t}$. Counties are considerably larger than municipalities. Therefore, consumers must drive longer distances to avoid paying $\tau_{c,i,t}$ than they would to avoid $\tau_{i,t}$. Note that if a consumer could benefit from driving to avoid an increase in the county rate then, by definition, they would also have benefitted from avoiding a similar increase in the municipal rate. On the other hand, the reverse need not hold. Hence, $BASE_{i,t}$ may be *less sensitive* to changes in $\tau_{c,i,t}$ than to changes in $\tau_{i,t}$. However, as we discuss below, factors related to agglomeration economies and local competition between communities for consumers further complicate the comparison.

3.3. Within-tier (horizontal) fiscal interactions

Wilson (1999) provides a survey of the extensive literature focusing on horizontal fiscal interactions among jurisdictions competing for a mobile tax base. We present a simple discussion of local competitive retail forces that is consistent with the primary conclusions of this literature. Consider an increase in either $\tau_{c,i,t}$ or $\tau_{i,t}$, holding all else constant. This creates a change in the *relative* effective tax rates across locations. An increase in $\tau_{c,i,t}$ detracts from a municipality's competitiveness relative to municipalities outside its home county. Similarly, an increase in $\tau_{i,t}$ would lower a municipality's competitiveness relative to other municipalities in both the home and neighboring counties.

Hypothesis 3. The level of LOST rates in a municipality *relative to those in alternative shopping jurisdictions* should affect the municipal base, and in turn, municipal LOST revenues. Having higher (lower) rates than competing jurisdictions will decrease (increase) consumer spending in the municipality.

The extent to which local competitive forces play a role in determining $BASE_{i,t}$ is expected to be influenced by the geographic configuration of alternate shopping opportunities (spatial competition) as well as consumer agglomeration externalities.

Recall our earlier statement that consumers prefer larger and more diverse retail opportunities. This is consistent with the findings of studies investigating agglomeration economies in retail, which suggest consumers will be drawn to relatively distant regional shopping centers over closer, smaller venues (Fotheringham, 1985; Abdel-Rahman, 1990). While our preferred empirical results focus on tax rate differentials between a municipality and the nearest regional retail center (RRC, defined in Section 4.3), we considered other approaches as well.[6] The larger the tax rate differential between the home municipality and the nearest RRC, the more consumers are expected to shift the location of their purchases. Note that RRCs are not confined to those servicing only the largest urban areas; we consider smaller rural RRCs as well.

Regarding fiscal spillovers, the commonality (or lack thereof) of a county designation between a municipality and the nearest RRC should influence the elasticity with respect to county LOST rate changes.

Hypothesis 4. Changes in parent county LOST rates should have less of an effect on $BASE_{i,t}$ when the municipality lies within the same county as the nearest RRC.

The intuition is straightforward and flows from the discussion supporting hypothesis 3. When country rate changes affect both home municipality *i* and the nearest RRC, relative prices between the two are preserved. On the other hand, county rate changes that affect home municipality *i* without affecting the nearest RRC alter the relative prices between the two. As such, we later allow county rates to differentially affect $BASE_{i,t}$ depending on this distinction.

Finally, *positional rate changes with regards to competing jurisdictions*, or changes in the sign of the rate differentials between a municipality and the nearest RRC are expected to play an important role in the competition for

[6] Another possible specification is the ratio of the home municipal rate to the minimum rate found within adjacent counties (Ballard and Lee, 2007). As we later outline, our qualitative findings hold when we measure local/spatial competitive forces using alternative reference points to calculate the tax rate differential.

consumer spending. To investigate the important role of rate differentials, we define two distinct types of rate changes. Conforming rate changes occur when a municipality alters $\tau_{i,t}$, but the change moves the total tax rate in municipality *i* towards the total tax rate prevailing in the nearest RRC without passing it. For example, suppose a municipality where rates are 2% less than that of the nearest RRC passes an increase of 1%. It still levies the lower overall tax rate, but provides a smaller savings after the change. In contrast, non-conforming changes occur when changes in $\tau_{i,t}$ reverse the sign of the relative differential and when policy changes are movements towards more extreme rate positions. For example, suppose a municipality starts with a LOST rate that is 1% below its nearest RRC and adopts a 1.5% LOST increase. It is no longer the low-tax jurisdiction. Note the definition holds for decreases as well, reversals occur when rates fall from above the nearest RRC to below. Having defined these two types of LOS rate changes, we expect to find the following:

Hypothesis 5. Non-conforming changes in $\tau_{i,t}$ should have relatively stronger impacts on $BASE_{i,t}$ than conforming LOST changes.

The intuition supporting this prediction is illuminated by combining two reasonable assumptions. First, assume at least some consumer purchases are for durable items that are not consumed immediately. Consumers purchasing shoes, clothing, electronics, non-perishable foods and other similar items can easily substitute purchases chronologically within relatively short time frames. Second, assume that consumers spend at least some amount of time shopping in their nearest RRC. Note that some types of items are *only available in jurisdictions with shopping agglomerations*. Automobiles, museums, concerts, sporting events, professional services, furniture and other similar items must be purchased outside smaller jurisdictions regardless of tax prices. When coupled, these assumptions suggest that threshold effects regarding the sign of rate differentials should play an important role.

4. Empirical specification and data

4.1. Panel data specification

The equilibrium level of the tax base within municipality *i* at time *t* ($BASE_{i,t}$) depends on a wide range of factors. Conceptually, these factors can be grouped into two broad categories: 1) time-invariant factors that affect consumer spending in a municipality expressed as vector X_i, and 2) time-varying factors that affect consumer spending in the municipality expressed as vectors $T_{i,t}$, $T^*_{i,t}$, and Y_t. The use of panel data makes the observation of variables in X_i irrelevant as municipality specific fixed effects will control for their effect on $BASE_{i,t}$. $T_{i,t}$ contains the municipal and corresponding county level LOST tax rates (τ_i, $\tau_{c,i}$) levied on retail purchases in municipality *i* at time *t*. $T^*_{i,t}$ contains a set of variables that relates the tax rates in vector $T_{i,t}$ to the corresponding tax rates prevailing in the nearest regional center ($\tau_{rrc,i}$). Finally, Y_t represents a vector of non-tax related variables that are expected to exert a uniform effect on consumer spending levels across all municipalities. Any variables of this type are effectively controlled for using annual fixed effects. That is to say, consistent estimation of the effects of variables in $T_{i,t}$ and $T^*_{i,t}$ on consumer spending patterns is feasible, even when X_i and Y_t remain unobservable.

We investigate consumer spending levels using a naïve reduced form semi-log model that does not account for the importance of local competition effects as:

$$\ln\left(BASE_{i,t}\right) = \alpha X_i + \beta T_{i,t} + \delta Y_t + e_{i,t}. \tag{2a}$$

Then we include variables that measure local competition by introducing $T^*_{i,t}$:

$$\ln\left(BASE_{i,t}\right) = \alpha X_i + \beta T_{i,t} + \gamma T^*_{i,t} + \delta Y_t + e_{i,t} \tag{2b}$$

Eqs. (2a) and (2b) are estimated using fixed effects (FE) panel data regressions that include municipality specific dummy variables to effectively control for any unobserved variables in X_i and time dummies to control for unobserved variables in Y_t. In these specifications, all tax rate variables found in $T_{i,t}$ and $T^*_{i,t}$ enter as levels.Alternatively, Eqs. (2a) and (2b) can be estimated using a first differenced (FD) approach, producing the following analogue specifications:

$$\%\,\Delta BASE_{i,t} = \beta\Delta T_{i,t} + \delta\Delta Y_t + \Delta e_{i,t} \tag{3a}$$

and

$$\%\,\Delta BASE_{i,t} = \beta\Delta T_{i,t} + \gamma\Delta T^*_{i,t} + \delta\Delta Y_t + \Delta e_{i,t}. \tag{3b}$$

Note that X_i drops out and unobserved factors that vary over time (Y_t) are still controlled for using period specific time dummies. In the FD specification, variables in $T_{i,t}$ and $T^*_{i,t}$ most frequently take the value of zero, deviating only when year-to-year rate changes occur.

The FE and FD models are straightforward to estimate and easy to interpret. In addition, they should effectively control for any potential misspecification bias due to unobserved heterogeneity between municipalities coming from 1) jurisdiction specific factors that do not vary over time, and 2) time varying factors that influence consumer spending but are common to all areas. However, the FE and FD specifications are not specifically constructed to account for two other potential problems: 1) potential endogeneity bias related to omitted variables, and 2) potential endogeneity bias related to reverse causality.

Regarding the former, it is possible that unobserved factors that influence consumer spending patterns vary across *both time and place* (i.e., over time *and within* municipalities). For example, commonly identified demand shifters such as population and income fit this description. If these factors are systematically correlated with both current tax rates and bases, FE and FD regressions that fail to control for these factors could yield biased estimates of the causal effects of LOSTs. We are able to control for population using annual population estimates at the municipal level obtained from the Oklahoma Department of Commerce (2010). Since annual data on other potential control variables (e.g. per capita income) at the municipal level are unavailable, we took several steps to directly investigate how our results may be affected. First, we explored how the inclusion/exclusion of population from each of our estimate models affected our elasticity estimates of interest. We find that, although the estimated population coefficient is always highly significant in the predicted direction, other slope estimates are affected little (if any) by its inclusion. We expect that if population exhibits this behavior, then other unobserved control variables are likely to as well. Therefore, we argue it is highly unlikely that the endogeneity bias caused by omitted variables is present in our models.

Regarding the potential problem of endogeneity as it relates to reverse causality, we argued in Section 3.1 that consumers can react to changes in tax rates immediately. On the other hand, if changes in consumer spending levels in a jurisdiction do significantly influence LOST rates, we argue they could only do so only over longer periods of time. It would be convenient if this meant that FE and FD models, which correlate the contemporaneous values of these variables, were insulated from potential problems related to reverse causality. However, that is not the case. As outlined by Wooldridge (2002, pg. 254), when estimating panel data models, consistent estimation of causal effects requires that regressors exhibit strict exogeneity rather than simple contemporaneous exogeneity. Strict exogeneity implies that explanatory variables *in each time period* are uncorrelated with the idiosyncratic error term in each time period. Hence, the condition is violated if current values of the dependent variable ($BASE_{i,t}$) influence *future* LOST rates.

One strategy to dealing with issues of long run reverse causality involves identifying one or more natural/random experiments. Unfortunately, we are not aware of any such natural experiments regarding local option sales taxes in Oklahoma. Another common approach is to use instrumental variables (2SLS) methods. In our application, this would require a relatively large number of instruments that varied across both time and place, and were strongly correlated with municipal LOSTs. A third commonly used approach – and the one that best suits the current empirical application – is to utilize strict exogeneity tests to find where the suspected reverse causality could, and more importantly, could not be affecting our estimates of interest.

For all of our FE models, tests for strict exogeneity follow a procedure explained by Wooldridge (2002, pg 146). Current values of the tax base are regressed on future tax rates to see if they are significantly correlated. While no specific recommendation is given as to exactly how future tax rates are defined — we tried the first and second lead values. We find no evidence of a significant correlation between current bases and future tax rates in our FE models, which suggest Eqs. (2a) and (2b) produce consistent estimates. However, note that the results of the tests are reversed if the municipal specific fixed effects are removed, supporting the idea that the fixed effects play an important role. For the FD models, the tests follow a different structure since the regressions are already based on differenced data. As outlined by Wooldridge (2002, pg 285), the test for strict exogeneity here involves modifying the preferred estimation equation to include lead levels of the tax rates variables as regressors while still leaving current changes in the model. If future tax rates are significantly correlated with current changes in the municipal tax base, then reverse causality is potentially affecting other coefficients estimated by the model. Alternatively, if future tax rates are not correlated with current changes in the municipal tax base in the specified equation, then, although they are still potentially present, issues related to reverse causality are not biasing the estimated slope coefficients from that specific model. Again, we examine the first and second lead levels separately. Contrary to the outcome of the tests for the FE models, here we find that our FD models typically (but not always), fail the test.

For this reason, we further investigate a slightly modified version of the FD models that we verified as consistently passing the same strict exogeneity tests that our original FD models failed — the random trends (RT) model. To our knowledge, the first use of this approach comes from Papke (1994), where potential endogeneity concerns regarding issues of reverse causality with enterprise zone designation were present. The RT model effectively controls for *municipality specific time trends in the tax base over time* by reintroducing the municipality specific dummy variables that were eliminated by first differencing. We then have:

$$\%\,\Delta BASE_{i,t} = \alpha X_i + \beta \Delta T_{i,t} + \delta \Delta Y_t + \Delta e_{i,t} \tag{4a}$$

and

$$\%\,\Delta BASE_{i,t} = \alpha X_i + \beta \Delta T_{i,t} + \gamma \Delta T^*_{i,t} + \delta \Delta Y_t + \Delta e_{i,t}. \tag{4b}$$

Under these specifications, first differencing the data controls for unobserved heterogeneity in *levels*, and including municipal fixed effects controls for unobserved heterogeneity in *systematic trends over time within communities*. For example, under the RT specification, an unobserved factor causing both consumer spending and municipal LOST rates in a community to rise over time would not introduce bias into the estimation procedure, since only *deviations* from the trend in consumer spending patterns within the municipality over time are used to identify LOST effects. Interestingly, while the RT models all consistently pass the recommended strict exogeneity tests and the FD models generally fail them, the two sets of models each produces elasticity estimates for the effects of LOSTs that are highly similar in magnitude. A reasonable interpretation of this finding is that causality likely flows in both directions to some extent, but the timing of the rate-affecting-base causal flow is stronger and more contemporaneous, while the base-affecting-rate causal flow is not only much slower, but also potentially much weaker/smaller. Note also that our investigation of these various strict exogeneity tests is, in many ways, taking us towards some of the more recent extensions of the basic Granger causality test for time series data from a single unit of observation, to the panel data application.

Another econometric issue that arose when estimating several of our models is that heteroskedasticity and serial correlation were consistently detected in the residuals.[7] Accordingly, we report robust standard errors generated using the robust extension for fixed effects panel regression in Stata.

4.2. Sales taxes in Oklahoma

State, county, and municipal sales taxes in Oklahoma are levied as a percentage of the purchase price from the sale or rental of tangible personal property and from the provision of certain services. The sales tax base is uniform across all jurisdictions and includes most retail sales as well as some business purchases of non-retail items with exemptions for motor vehicle sales, agricultural sales, sales subject to the Federal Food Stamp exemption, sales to tax-exempt organizations, and non-taxable services (labor). Administrative records of Oklahoma's state, county, and municipal sales tax rates and collections were provided by the Oklahoma Tax Commission (OTC).[8]

Oklahoma was among the early adopters of municipal LOSTs. Beginning in 1966, Oklahoma municipalities were authorized to implement LOSTs subject to voter approval. Other than conforming to the state definition of taxable sales, there were no rate limitations imposed. As shown in Fig. 2, the prevalence of municipal LOSTs was widespread by the early 1980s. The distribution of imposed LOST rates shifted from a modal rate of 1% in the 1970s to 3% by the mid 1990s.[9]

As of 1984, county governments in Oklahoma were also authorized to implement specific purpose LOSTs, subject to voter approval.[10] Unlike municipal LOSTs, county LOSTs are limited to a two percent rate maximum and the revenues must be designated for a specific purpose. Fig. 3 shows that county LOST implementation in Oklahoma was widespread by the late 1990s. The modal rate has remained around 1% since inception; however, the counties that adopted LOSTs since the 1990s tended to favor rates less than or equal to .5%.

Fig. 4 shows the distribution of total combined municipal and county sales tax rates imposed in Oklahoma municipalities since 1984. In Oklahoma, a small number of municipalities cross county boundaries. We treat these cases as a single observation and assign the county rate corresponding to the location of the majority of its population. The modal maximum total local rate imposed gradually increased from 2% in the mid 1980s to 4% in recent years. The state sales tax rates, which changed only four times since inception in 1933, increased to its current level of 4.5% on May 1, 1990.

A municipality's annual sales tax base is constructed by dividing the annual tax collections by the tax rate. In cases where LOST rates changed during the fiscal year, the applicable weighted tax rate is computed as follows:

$$\textit{weighted average rate} = rate_1 {}^* month_1 \,/\, 12 + rate_2 {}^* month_2 \,/\, 12 \tag{4}$$

where $month_1$ and $month_2$ are the number of months that the corresponding tax rates were in effect. This adjustment may not fully reflect the seasonality of LOST revenues. In a tourism-dependent community, for example, retail sales may be higher in summer

[7] The hettest command in STATA was used to identify problems of heteroskedasticity. The preferred test for serial correlation involves regressing Δe_{it} on $\Delta e_{i,t-1}$, for various time periods as suggested by Wooldridge (2002, pg 283).

[8] Annual data are reported in OTC annual publication, *State Payments of Local Governments*.

[9] Within each rate range category in Figs. 2 and 3, rates commonly fall on the whole percentage 1%, 2%, etc.

[10] Initially, county authorization was limited to the largest counties, but this rule was rapidly changed to allow LOSTs in all Oklahoma counties.

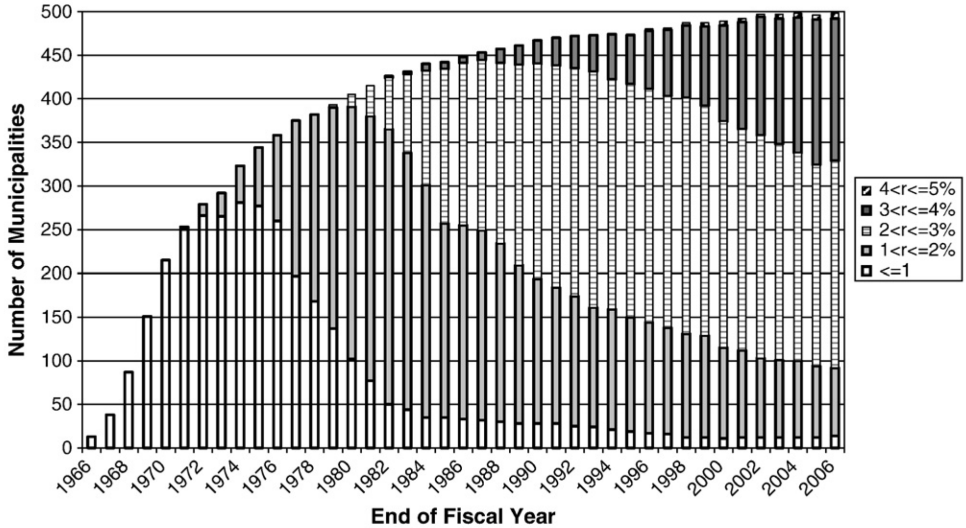

Fig. 2. Local option sales tax rates: Oklahoma municipalities 1966–2006.

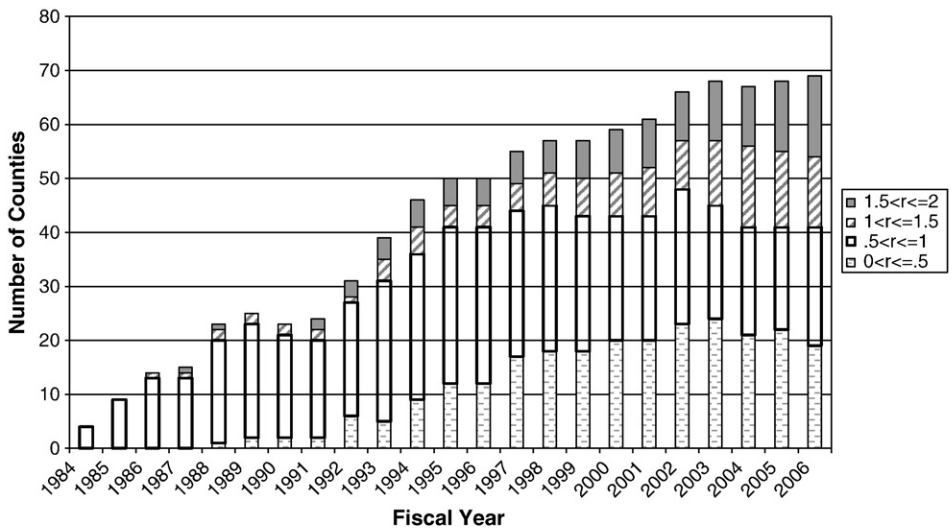

Fig. 3. Local option sales tax rates: Oklahoma counties 1984–2006.

months than in winter months. In this case our weighting scheme would put too much weight on the rate in effect during the winter months. The approximation, however, serves our application well given the small number of mid-year rate changes relative to the total number of observations.[11]

4.3. Defining regional retail centers

Our theory suggests that consumers preferred larger and more diverse retail opportunities (retail agglomerations) and also shorter driving times to reach their destinations. To account for competitive factors from nearby retail agglomerations in our empirical models, we defined several municipalities to be regional retail centers (RRCs). To identify RRCs, we first selected all municipalities where $BASE_i$ was greater than $100,000,000 in the year 2000. This yielded 42 candidates. Some of these, however, were clearly suburbs of the two dominant jurisdictions in the State: Oklahoma City and Tulsa.[12] As such, 12 candidates that were within 15 miles of either Oklahoma City or Tulsa were eliminated, leaving the 30 RRCs we used for our later analysis. Each municipality was assigned the geographically closest RRC. Fig. 5 shows the geographic dispersion as well as the distribution of total LOST rates imposed during 2006 for all cities in our sample. Unsurprisingly, the RRCs are spread widely throughout the state and LOST rates varied considerably across RRCs.

Our simple framework suggests the attraction due to enhanced retail opportunities and/or any potential LOST rate advantages are expected to weaken as consumers face higher travel costs (longer drive times).[13] We can think of no *a priori* reason to prefer any particular specification regarding distance measures, due to a lack of

[11] Furthermore, using a potentially inaccurate procedure would only bias later results to the extent that prediction errors were systematic in nature. We can think of no *a priori* reason why this would apply to our procedure.

[12] The tax bases of Oklahoma City and Tulsa were each consistently larger than the third largest tax base in the state (Norman, OK) by a factor of over 6.

[13] All municipality-to-municipality distance measures were calculated using ArcGIS software and publically available maps from the Oklahoma Center for Spatial Analysis. Calculated distance measures reflect the straight line distance between municipal geographic centroids.

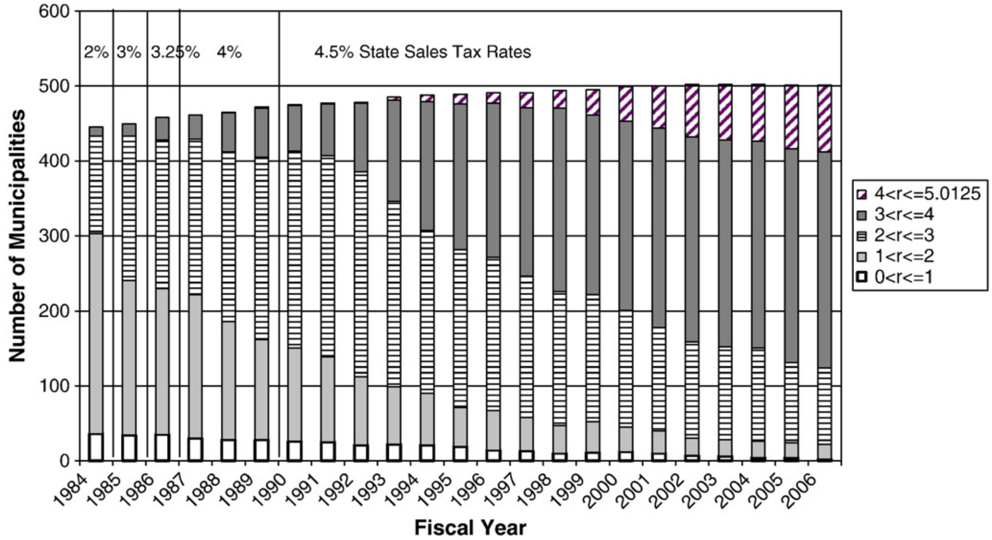

Fig. 4. Total Municipal + Country LOST rates in Oklahoma municipalities.

theoretical or empirical research on this matter. As such, we explored both continuous and intuitive categorical measures of distance in our early empirical analysis.

Our primary results come from regressions that employ a very simple dichotomy to capture competitive effects as influenced by drive times. All municipalities within 12 miles of their RRC were coded as "close" and all other municipalities were coded as "non-close". The 12 mile cutoff was driven by three factors. First, the distribution of distances to the nearest RRC in our data exhibits a considerable positive skew. In addition, nearly half of the mass of the distribution lies within five miles above or below the mean distance (approximately 18.3 miles). Finally, we closely examined the density function and noticed somewhat distinctive natural breaks at the 25th percentile (12.1 miles) and just below the 75% percentile (23.6 miles) of the distribution. We used both of these natural breaks as group cutoffs in early regression analysis to define three categories (close, moderate, and far). However, finding no advantage of a three tiered system over the two tiered system, we present regression results that employed the simpler classification system.

4.4. Sample selection and data filters

While the stylized facts presented in the previous section document trends in LOSTs beginning with 1966 for municipalities and 1984 for counties, we earlier mentioned that our panel data spanned the years 1993–2006. The historical context of Oklahoma's

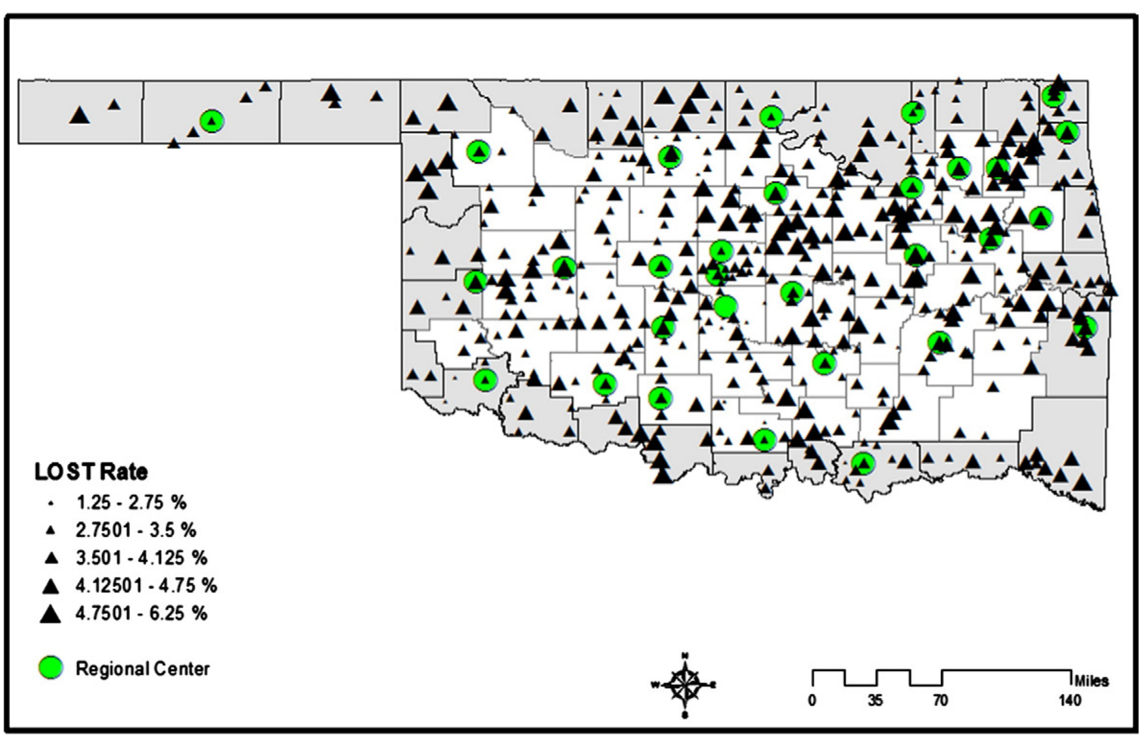

Fig. 5. Municipal plus country LOST rates, 2006.

LOST experiences, as well as our modeling approach, motivates this eventual refinement.

From the OTC data on LOST rates and municipal tax collections we construct an initial panel covering the years 1990 through 2006 that contained the 467 municipalities that had LOSTs in place as of 1990. By this time both municipal and county LOSTs were firmly entrenched in the state and there was considerable variation in both types of LOSTs. As such, our empirical work investigates the effects of changes in existing LOST rates over time and does not directly estimate the effects of new LOST adoptions. In addition, while there were a handful of minor changes to the states definition of the retail base (mostly in terms of adding exemptions for groups like non-profit organizations or modifying how specific activities were classified); there were no major modifications after 1990.

Although our panel initially covered the years 1990 to 2006, we estimated all our final empirical models using only observations from 1993 to 2006 for three reasons. First, the use of first-differenced data in several models forces us to drop 1990. Secondly, there was a change in the state sales tax rate during 1990. We wanted to minimize any potential impact of the statewide change on municipal retail bases and/or and local LOST rate setting decisions, so we dropped 1991 and 1992. In doing so, any significant local reactions to the state rate change would not complicate our estimation procedure. Finally, our empirical approach was greatly advantaged by possessing data from 1990 to 2006, but only using observations from 1993 to 2006 for our final regressions. The leading buffer allowed on to explore specifications and diagnostic tests that required multiple lagged values, without being forced to depart from our full estimation panel. Furthermore, regressions that include 1991 and 1992 yielded qualitatively similar estimates to the ones presented below.

Some straightforward procedures are used to clean the data. We eliminated 144 municipalities located in the twenty-nine counties that bordered other states. This was done for two (related) reasons. First, although cross-border shopping patterns are directly influenced by sales tax rates (e.g., Fox, 1986 and several other more recent studies), a direct analysis of these issues is not a focus of this paper. By dropping municipalities in border counties, we are better able to control for unobserved changes in sales tax rates in jurisdictions across state lines that may affect consumer spending patterns near the border. Secondly, an important aspect of our empirical strategy is to account for local competition effects by relating the prevailing tax conditions in municipalities to those found in the nearest RRC. For municipalities near the state border it is possible that we could incorrectly assign an Oklahoma retail center when, in reality, a closer retail center exists in the bordering state.

Our selected method of investigating local competition effects also meant that we needed to drop the observations from the relatively small number of municipalities that were designated as RRCs from the estimated models. This left us with a final panel of 302 municipalities.[14] As such, our empirical results should be interpreted as most accurately capturing the effects of LOST rates on consumer spending in municipalities that face competition from other jurisdictions that are larger and offer more diverse retail opportunities.[15]

At this point, our panel was still both wide and long (4228 observations from 302 municipalities multiplied by 14 years). Still, data entry errors, large random shocks, and the presence of extreme outliers were suspected to be issues. Controlling for these issues led to the removal of twenty additional observations. Any year-to-year change in the municipal LOST base that fell outside of a 3:1 or 1:3 ratio (i.e., was more extreme) was dropped from the panel. For example, if $BASE_{i,t-1}$ was $200,000, then a value greater than $600,000 or less than $66,667 for $BASE_{i,t}$ would cause the year t observation to be dropped. This led to several "pairs" of consecutive year data points for the same municipality being dropped — one from a large drop and the other from a large increase (in either order). This is the clearest indication that we have likely mitigated any potential errors from the original OTC data. Also, in one case, we identified a merger between two previously autonomous cites. Hence, we were forced to drop two observations for each community, since the pre and post-merger annual data are not directly comparable.[16] Finally, in the process of running several initial estimations of our FE, FD and RT models, we checked for extreme outliers by identifying observations that had undue influence on LOST coefficient estimates. Following standard procedure associated with outliers, we drop six observations that were consistently found to be outliers across initial runs of all our FE, FD, and RT models.[17] We estimate all of our final regressions using the 4208 observations remaining after applying all the filters. Descriptive statistics for the variables in our full panel, as well as for the first and final year of the panel, are presented in Table 2. Because they provide the basis for our identification strategy, we present further analysis of county and municipal LOST changes in Table 3.

Table 3
Analysis of LOST rate changes (N = 4208).

Implementing level and direction of LOST rate change	Number of observations	Average change	Standard deviation	Largest rate change
Municipal level change				
LOST rate increase	180	.934	.390	2.0
LOST rate decrease	30	−.925	.384	−2.0
County level change				
LOST rate increase	383	.609	.310	1.25
LOST rate decrease	96	−.593	.369	−1.0

Table 2
Panel data descriptive statistics.[a]

Variable description	All Years mean (st.dev.)	1993 mean (st.dev.)	2006 mean (st.dev.)
Log of municipal tax base	15.147 (1.747)	14.928 (1.712)	15.357 (1.785)
Municipal LOST rate	3.011 (0.718)	2.758 (0.698)	3.218 (0.691)
County LOST rate	0.532 (0.533)	0.273 (0.485)	0.771 (0.571)
Population	2624 (6729)	2480 (6106)	2799 (7419)
Distance to regional center	18.325 (8.349)	18.291 (8.388)	18.348 (8.353)
Municipal LOST rate differential relative to regional center	−0.270 (0.784)	−0.323 (0.792)	−0.379 (0.772)

[a] The number of observations is 4208 (all years), 301 (1993), and 300 (2006).

[14] Of the 30 RRCs, nine were in border counties. Hence, the RRC filter only drops 21 *additional* cities, producing the final sample of 302 (467-144-21) municipalities. For our naïve regressions that do not include rate differentials to the nearest RRC, we obtain highly similar regression results when these 21 additional cities are included.

[15] We are interested in LOST effects pertaining to municipalities with retail agglomerations as well, but the relatively small number of RRCs in our data limited our ability to investigate this issue with our data.

[16] Norman took over what had previously been the city of Hall Park, leaving no way of determining the portion of Norman's tax base attributable to economic activity occurring in the area that had previously been Hall Park.

[17] Specifically, we employ the "dfbeta" command in STATA which reports the sensitivity of the estimated variable coefficients to each individual observation. Data points causing a movement of the estimated coefficient on the tax rate variable that was greater than 0.25, in either direction, were defined as outliers. We justify the 0.25 cutoff point on the grounds that it is rather large in comparison with our estimated coefficients and the observable evidence suggests this cutoff serves as a natural break. Using a value of 0.20 caused the number of observations designated as outliers to increase significantly, suggesting any lower cutoff would likely drop data points that did not lie in either extreme tail of the distribution. None of our qualitative findings are sensitive to the inclusion or exclusion of outliers, but the attainment of statistical significance is affected in a small number of cases, as would be expected.

Table 4
Regression estimates (N = 4208).

Variables	FE Base (1a)[a] Log($BASE_{i,t}$)	FE Full (1b) Log($BASE_{i,t}$)	FD Base (2a) (% $\Delta BASE_{i,t}$)	FD Full (2b) (% $\Delta BASE_{i,t}$)	RT Base (3a) (% $\Delta BASE_{i,t}$)	RT Full (3b) (% $\Delta BASE_{i,t}$)
Municipal LOST rate (τ_m)	−0.00487 (0.01034)	−0.00414 (0.01577)				
($\tau_m - \tau_{regional\ center}$) * close		-0.04475^{**} (0.01983)				
($\tau_m - \tau_{regional\ center}$) * not close		0.00176 (0.01162)				
$\Delta\ \tau_m$			-0.01600^{**} (0.00779)		-0.01503^{*} (0.00776)	
$\Delta\ \tau_m$ * conforming				0.01291 (0.01890)		0.01065 (0.01930)
$\Delta\ \tau_m$ * non-conforming				-0.02128^{**} (0.00833)		-0.01962^{**} (0.00833)
County LOST Rate (τ_c)	-0.02772^{**} (0.01260)					
τ_c * Regional Center same County		−0.00445 (0.01875)				
τ_c * Regional Center different County		-0.03977^{**} (0.01615)				
$\Delta\ \tau_c$			-0.02501^{**} (0.01076)	-0.02500^{**} (0.01077)	-0.02401^{**} (0.01140)	-0.02404^{**} (0.01140)
Population	0.05741^{**} (0.00810)	0.05791^{**} (0.00810)				
Δ Population			0.03554^{**} (0.00776)	0.03556^{**} (0.00776)	0.02017^{**} (0.00719)	0.02012^{**} (0.00719)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Municipal Dummies	Yes	Yes	No	No	Yes	Yes
F-statistics	145.61	123.59	10.08	9.63	9.14	8.66
R^2	0.9898	0.9898	0.0357	0.0360	0.0880	0.0882

*, **Denote significance at the 10% and 5% level, respectively.
[a] Robust standard errors in parentheses.

5. Results

Table 4 provides the estimation results for our FE (2a and 2b), FD (3a and 3b), and RT (4a and 4b) regression models. We briefly discuss the performance of population – the only available demand shifting control variable – then move into a more detailed discussion of the effects of LOSTs on consumer spending patterns. The simple result is that population always performs exactly as we expected, with estimated effects that are positive and highly significant across all estimated models. A more important point that was briefly mentioned earlier is that our estimated coefficients on other variables of interest do not fluctuate much when population is excluded. This is reassuring given our inability to obtain other important covariates.

For comparative purposes only, we briefly discuss the results of the three baseline models (2a), (3a), and (4a) that do not account for local competition effects before moving to our discussion of the preferred sets of results. Confirming hypotheses 1 and 2, we find from models (2a), (3a), and (4a), that the effects of municipal and county LOSTs on the municipal tax base is negative and generally achieves statistical significance at conventional levels. The estimated coefficients for county LOST rates are uniformly significant and of similar magnitudes across all three models, with a one percentage point county LOST increase corresponding roughly to a 2.5% decline in the municipal tax base. Coefficients on municipal LOST rates are also negative, but only achieve statistical significance in the FD and RT models. Somewhat surprisingly, these three models collectively suggest the municipal own-rate LOST elasticity is slightly smaller than the estimated county LOST driven cross-tier elasticity. A 1% increase in the municipal LOST rate is associated with a 1.5% decline in the tax base in the regressions where this relationship is found to be significant. Collectively, these models not only indicate that cross-tier elasticities are significant, but also suggest that they may be slightly larger in magnitude than municipal own-rate elasticities — a somewhat surprising finding given that our conceptual framework outlined how county LOST rate increases would be more costly for consumers to avoid.

An intuitive post-estimation exercise puts the magnitude of this difference into perspective. Setting aside model (2a) due to the insignificance of municipal rate coefficients, we take the effects of municipal and county level LOSTs to be the average effect across models (3a) and (4a). The average sized municipal tax base (for observations included in final models) was just over $25 million in 2006. A 1% increase in the municipal LOST rate with a base of that size would lead to a predicted reduction in consumer spending of about $397,000. A similar 1% increase in the county LOST rate affecting the municipality would lead to a predicted reduction in the municipal base of about 2.5%, or roughly $634,000. So the one percentage point rate increase would cause the municipal tax base to decrease by about $237,000 more if it were implemented at the county level versus the municipal level.[18]

However, moving to models (2b), (3b), and (4b), the models that account for the nature of the local competitive environment, we find that a more nuanced story surfaces. Focusing first on the estimates from Eq. (2b) – our FE regression accounting for local competition – we see several interesting results. Supporting hypothesis 3, there is clear evidence that municipalities face significant competition from nearby retail agglomerations (their RRCs) and that rate differentials play a more important role than the absolute levels of LOST rates. When both variables are included, it is not the municipalities own LOST rate that significantly influences consumer spending, but the differential between this rate and the prevailing municipal LOST rate of their RRC. Furthermore, the distance between the municipality and its RRC plays an important role, as was expected. When a municipality is close to its RRC, the differential between its own LOST rate and the municipal LOST rate of the RRC exerts a considerable influence on the home municipality's tax base. A municipal LOST that is one percentage point higher (lower) than a nearby RRC leads to around a 4.5% decline (increase) in consumer spending in the municipality. On the other hand, when jurisdictions are located farther away from their RRC,

[18] Admittedly, the intuition of this exercise focuses solely on the estimated point effects. Standard tests fail to reject the null hypothesis that the two estimated coefficients are equal to one another. However, the gap between the two effects does not persist when moving to models that account for local competition. As such, it is worth highlighting the gap when it is present.

competition effects are found to be much weaker. In fact, our results imply that competition effects fully dissipate once consumers have to make longer drives.[19]

The importance of accounting for local competition is further demonstrated by the set of county LOST rate interaction terms included in regression (2b). Recall that the estimation results from FE model (2a) suggested a one percent county LOST rate increase is associated with a corresponding decline in consumer spending around 2.5%. However, the results from Eq. (2b) suggest this is an overstatement of the true elasticity if the municipality shares a county designation with its RRC and an understatement of the true elasticity if it does not. This result is consistent with hypothesis 4: if a jurisdiction shares a county designation with its RRC, the county LOST rate does not influence the relative cost of goods between their local retail opportunities and those found in the RRC. On the other hand, municipalities that do not share a county designation with their RRC experience changes in the local competitive environment when $\tau_{c,i}$ changes. This decomposition presents a solid example of how fiscal interdependence in this complex setting can be quite nuanced.

While the results of the FE model (2b) represent the clearest and cleanest support for the predictions found in hypotheses 1–4, models (3b) and (4b), our FD and RT regressions provide additional evidence that our identification strategy is operating as we intend. These additions are non-trivial because they help develop the strongest case possible that our results are not arbitrarily affected by any type of endogeneity bias — with particular concern for longer run reverse causality. Whereas the identification strategy in model (2b) makes use of both inter-municipality and intra-municipality variation, *models (3b) and (4b) identify LOST rate effects based only on intra-municipality variation over time*. This is a lofty goal given that a great deal of the variation in our raw data comes from differences in rates across municipalities. Competition effects enter these models in a slightly different manner due to practical data constraints. Notably, rate differentials or any other relationship that is relatively stable over time no longer provide any informative variation. Additionally, when rates and rate differentials are both first differenced, they become highly correlated. While this is not surprising, it complicates the basic identification strategies employed in models (3b) and (4b) to some extent.

As shown in Table 4, the results from models (3b) and (4b) contain cross-tier elasticity estimates that remain negative, highly significant, and of a plausible magnitude. The point estimates for the cross-tier elasticity do not change much in comparison with the results from model (2a): −2.5 and −2.4, respectively, as opposed to −2.8. However, some of our other extensions that involved a more direct first differencing of model (2b) produced somewhat counterintuitive results. When we interacted $\Delta LOST_c$ with the dummies reflecting whether or not the municipality and the RRC were in the same county, the estimated effect was stronger and more significant for cases where the RRC was in the same county — the reverse of our findings from model (2b) and clearly counterintuitive. We suspect the corresponding pure first-differenced estimates of Eq. (2b) may not be appropriate given the nature of the data in this application (i.e., the complete lack of variation over time regarding the variable upon which the interaction is based).

In light of these somewhat limiting practical problems, we examine local competition effects in our FD and RT models by introducing the two categorical variables we briefly described in Section 3.3: *conforming* and *non-conforming* LOST rate changes. These classify each municipal LOST rate change based on the direction of the rate movement relative to that of the LOST rate imposed in the RRC.[20] Conforming changes occur when a municipality changes its LOST rate but the change moves the total rate towards that of the nearest RRC without passing it. Non-conforming changes occur when changes in the municipal LOST rate *reverse* the sign of the municipality-RRC differential and when policy changes are movements towards more extreme rate positions. The regression results from models (3b) and (4b) reveal that local competition effects are still found to be important using this alternative identification strategy. In particular, note that a non-conforming municipal rate increase (decrease) of 1% reduces (increases) consumer spending by approximately 2%. Conversely, conforming changes are not found to significantly influence consumer spending across municipalities.[21] Collectively, we argue these results provide support for hypothesis 5.

Thus, we see additional evidence that competition effects matter in models where the identification strategy rests *solely* upon isolating the effects of within-jurisdiction variation over time. Our results focusing on conforming and non-conforming rate changes imply it may be feasible for municipalities falling far enough below the rates of their competition to raise their LOST rates without causing a significant reduction in consumer spending. Municipalities in other situations do not have this luxury and would feel the full effect of a LOST tax increase on their tax base.[22]

5.1. Robustness checks

We further investigate the robustness of our main empirical findings using alternative methods of capturing local competition effects. While our conceptual framework indicates that municipalities are likely to lose revenue to larger retail agglomerations providing enhanced shopping opportunities, it is also possible that consumers from a given jurisdiction may shop in nearby communities that have *similar* retail options (i.e., *are not* a regional center as we have defined). As an alternative to using the closest RRCs to reflect local competition, we took the simple and weighted (by size of tax base) average of municipal LOST rates within every county. Thus, for this alternative approach, the own municipal LOST minus the simple and weighted average of the home county captures local competition effects. Regressions akin to model (2b) but using these alternative measures of local competition produce highly similar results — it is still the rate differential that surfaces as having a negative and significant relationship while the level of the rate alone is insignificant. Similarly, when county-wide municipal LOST averages (of either type) are used as the benchmark to classify conforming and non-conforming rate changes, FD and RT models similar to Eqs. (3b) and (4b) also yield qualitatively similar results. Non-conforming changes are negative, highly significant, and similar in magnitude to our presented elasticity estimates, while conforming changes are always insignificant. Hence, the nature of local competition seems to play an important role whether we quantify it by focusing on

[19] Although the estimated effect of the tax rate differential becomes insignificant when the RRC is further away, note that this does not imply consumers from the home (smaller) jurisdiction no longer shop in the RRC. Some goods may simply not be available in small municipalities: new automobiles, professional sporting events or concerts, and museums are just a few examples. For these goods, consumers must travel to the RRC to make purchases regardless of their travel costs. However, for more frequently purchased goods available in both markets, consumers are able to choose the purchase location. We conceptualize these types of choices as driving the statistically significant competition effects we find. However, as the costs of making a trip to the RRC become higher, consumers become less responsive to relative LOST rate differentials, as potential cost savings or selection advantages are rapidly offset by the higher transportation costs.

[20] We also tried *further* breaking down our non-conforming changes into two categories: movements towards more extreme positions as one case and central movements that flip relative standings as another (producing a total of three categories). However, both categories of non-conforming changes perform similarly in all estimations. Hence, the simpler classification system is presented.

[21] While the positive point estimate was unexpected, the estimated standard errors are much larger than the coefficients, leading us to fail to reject the null hypothesis that there is no deterministic relationship.

[22] An interesting related research topic that is beyond the scope of this study would involve investigating the determinants of municipal and county rates in a multi-tiered LOST setting. It is possible that some municipalities actually follow a strategy where they purposely stay below their competition. This may be likely in communities where voters are highly tax averse.

comparisons to RRCs that offer enhanced retail experiences or use a broadly defined measure where communities feel competition from nearby communities without large retail sectors.

We also investigated whether or not the initial level of the LOST rate was important in determining consumer reactions to rate changes (i.e., is there non-linearity with respect to the own-rate and cross-tier LOST elasticities). This was accomplished by specifying an interaction term equal to the LOST rate change multiplied by the pre-change LOST rate. The interaction was insignificant for both municipal and county LOSTs in estimations of various FD and RT models. In a similar vein, we were concerned that initial county LOST adoptions may create differential effects compared with increases in existing county LOSTs.[23] We investigated this possibility by interacting the change in county LOST rate with a dummy variable equal to one if the change was an initial LOST adoption. Across several models similar to those presented in Table 4, this interaction term was always insignificant.

A final robustness check examines the sensitivity of our main findings to the technique used to control for border related issues.[24] Recall that in Section 4.4 we outlined our rational for dropping observations located within counties bordering another state. An alternative approach is to eliminate municipalities based on their actual distance to the state border. We explored how this alternative approach could have affected our results. While the number of excluded municipalities fluctuates predictably with the acceptable distance to the border is varied, the results of estimations using anything between 10 and 25 miles as a buffer are highly similar to those we presented above.

6. Conclusion

Our analysis investigates the effects of LOSTs on consumer spending patterns in the context of multi-tiered local taxation. In doing so, we account for spatial competition effects in the presence of retail agglomerations. Specifically, across a number of empirical specifications that follow somewhat different identification strategies, we find consistent evidence that both own-rate and cross-tier elasticities are statistically and economically significant, and of the expected sign. Naïve models (i.e., that do not control for the nature of local competition) suggest mean elasticities that are just below and above −2.0, respectively. For the own-rate LOST elasticity, this validates previous empirical studies in the literature. Regarding our cross-tier LOST elasticities estimates, our findings are novel and relevant to both scholars and practitioners interested in the nature of county-municipal fiscal interactions.

Another important finding is that municipalities face significant competition from nearby retail agglomerations (RRCs) for consumer spending. Notably, the difference between the municipal LOST and that of the corresponding RRC, rather than the municipal rate itself, is found to significantly influence consumer spending levels. Furthermore, the distance between the municipality and the RRC plays a critical role. When a municipality is closer to (farther from) its corresponding RRC, the difference between its own municipal LOST rate and the municipal LOST rate of the RRC exerts a stronger (weaker) influence on consumers. Thus, distance clearly serves as a buffer from local competitive pressures.

We also find evidence that municipalities falling far enough below the LOST rates of their competition (using any of the three alternative definitions of 'competition' that we consider) should be able to raise LOST rates without causing a significant reduction in their municipal tax base. On the other hand, municipalities without a cushion do not have this luxury. From a policy perspective, this suggests the ability of municipal governments to influence LOST revenues by changing their own LOST rate is somewhat constrained by competitive pressures and proximity to nearby retail agglomerations. From a modeling perspective, we reinforce Rork and Wagner's (2008) conclusion that empirical models investigating the local policy environment need to capture complex interactions. By modeling the complex cross-tiered nature of the county-municipal LOST taxing environment, our findings are relevant to policy makers who must address difficult decisions regarding potential extensions of multi-tiered LOST authorization to local governments.

LOSTs are a viable option for county and municipal governments in need of immediate revenues, particularly among those that have limited or no capacity to raise revenues from LOSTs currently. For example, Dye (2008) urges New England states to consider new local revenue sources. Indeed, for the 17 states with negligible LOST authorization, introducing LOSTs may seem like an attractive alternative to cutting funding or implementing other tax increases. However, along with the beneficial aspect of increasing local own-source revenue, any expanded reliance of LOSTs can have unfortunate unintended consequences. In this study, we have demonstrated that municipal LOST revenues are affected by both vertical spillovers (i.e., cross-tier elasticities) and horizontal spillovers due to the nature of competition for consumer spending. We highlighted the important role of regional retail centers in attracting and retaining sales tax revenues, thus emphasizing concerns about the fiscalization of local taxation policy towards the retail sector. This is particularly relevant in settings (such as Oklahoma and many other states) where local public finance is so heavily dependent upon LOST revenues.

Our results also provide indirect support for the often argued claim that cities with large retail bases are able to export a portion of their tax burden through LOST revenues, while those without retail agglomerations are forced to rely more heavily on municipal fees. Zhao and Hou (2008) conclude that LOST authorization perpetuates and exacerbates fiscal inequalities across county jurisdictions. Our results indirectly reinforce this claim. As Dan Galloway, City Manager of Bethany, Oklahoma summarized, "if you don't want cities to condemn neighborhoods to build shopping centers, don't make cities rely on sales taxes collected within their boundaries to fund municipal services."[25]

From a broader perspective, our results document several interesting relationships that likely affect the nature of local public revenues in states that have extended LOST autonomy to both municipal and county governments. Many of our findings suggest states looking to initially implement LOSTs or expand their role in local public finance should move forward with caution. Regarding concerns for efficiency, local governments should better understand how their policy decisions may have spillover effects on other jurisdictions. Regarding equity based concerns; we find evidence to support the idea that rural communities may be disproportionately constrained when states rely heavily upon LOST revenues for local finance.

Extensions of this study are planned. In particular, we want to examine aspects of local tax competition as they pertain to raising county government revenues (county–county and county–municipal). In addition, while a small literature has emerged regarding feedback and imitation effects in the determination of LOST adoptions and changes (for example, Sjoquist, et al., 2007), to our knowledge, no study has directly investigated the determinants of LOST implementation patterns in a multi-tiered (county–municipal) rate setting environment. Modeling the complexity of the cross-tier and cross county LOST policy interactions is a worthwhile endeavor that will contribute to a better understanding of local tax structure for the many US states currently

[23] We are not able to investigate initial adoption effects for municipalities, as we constructed our panel using only jurisdictions with LOSTs in place by 1990. Only a small number of municipalities adopted initial LOSTs after this (see Fig. 2).

[24] We thank an anonymous referee for this helpful suggestion.

[25] "Time to Head for the Basement" by Michael Bates submitted on July 1, 2005 10:39 PM. http://www.batesline.com/archives/2005/07/time-to-head-to.html. Downloaded 10/20/2008.

authorizing multi-tiered LOSTs as well as the others that might consider LOST enabling legislation in the future.

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