Policy Leadership and Tax Competition: The Case of Local Option Sales Taxes

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Abstract:
While studies of local tax competition are prevalent, leader-follower dynamics within this environment are poorly understood. We investigate local option sales tax (LOST) competition by focusing on policy leadership. LOSTs represent the second largest source of local revenue in the US and have become increasingly important over recent decades. To operationalize the concept of influential jurisdictions, we build a policy leadership index respecting early adoption, high tax rates, large tax bases, and the regional significance of the jurisdiction. We examine longitudinal data from 506 jurisdictions in Oklahoma from 1966 to 2010, finding evidence that vertical and horizontal tax competition play a role in municipal LOST rate setting decisions, and that nuanced leader-follower dynamics are present. Our approach can be adapted to other settings where taxes exhibit an extensive and intensive margin, and are observed longitudinally.

Keywords: *Asymmetric tax competition, policy leadership, local option sales taxes.*

JEL Codes: H71, R5, H20.

The existence and identity of a leader matter a lot in tax competition.
(Kempf and Rota-Graziosi, 2010, p. 771)

1. Introduction

The nature of interaction among governments making fiscal policy choices is the focus of an extensive theoretical literature and an emerging empirical literature. Most tax competition models assume policy spillovers are symmetric and that all governmental decisions are made simultaneously. Recent research identifies important sources of asymmetries, including differences in the size of countries, level of development, and agglomeration forces (Baldwin and Krugman, 2004; Andersson and Forslid, 2003; Kind et al. 1998). Kempf and Rota-Graziosi (2010) further question the simultaneous move assumption and show how differences between jurisdictions stimulate leader-follower dynamics. Although the importance of leader-follower dynamics has frequently been considered in the context of oligopoly markets, international trade, monetary policy, and even international corporate tax policy, it has largely been ignored when it comes to local intergovernmental policy spillovers.[1]

In this paper, we consider the nature of asymmetric policy spillovers by empirically modeling tax rate decisions regarding local option sales taxes (LOSTs) in an environment where some jurisdictions (leaders) exert strong influence, while others (followers) have weak influence. We develop a generalizable approach where the evolution of policy decisions during the early periods of policy implementation endogenously determines multiple leaders. In the first stage, we construct a leadership index that considers early actions taken on both the extensive (policy adoption) and intensive (rate levels) margins. In the second stage we use the remaining 34 years

[1] To our knowledge only two exceptions exist: de Mello (2008) and Janeba and Osterloh (2012). These papers are discussed below.

of the panel to estimate strategic tax competition models, finding evidence that leaders and followers play asymmetric roles.

We make several contributions to the tax competition literature. First, we complement Kempf and Rota-Graziosi (2010), an important theoretical contribution, by investigating endogenous policy leadership in an empirical application. Second, we develop a flexible, data driven approach for identifying multiple leaders that addresses a gap in the literature. Typically, researchers have no readily available mechanism for identifying leaders and followers. De Mello (2008) analyzes a case with a single pre-designated leader in a regional context. Janeba and Osterloh (2012) identify multiple leaders and followers based on an extensive survey of local elected public officials. The expense and time required for this intuitive approach precludes its general applicability. In contrast, our approach can easily be adapted to a variety of situations where researchers have access to panel data containing tax policy decisions. Finally, our approach applies to environments within a single government tier or over multiple tiers.

Our investigation focuses on LOSTs for several reasons. First, they are used in over two-thirds of US states and provide more revenue than any other local fiscal instrument, save the property tax (Brunori, 2007). Also, comprehensive panel data on LOST rates and revenues are available. Finally, LOST programs allow local US governments to display leadership on the extensive margin (early adoption), as well as an intensive margin (higher rate levels). This is relevant, since a government may demonstrate leadership on one margin but not the other. At least within the US context, no other local revenue mechanism demonstrates all three traits.[2]

Our empirical analysis employs LOST data from a single state - Oklahoma - to respect the influence of state specific institutional features, which are otherwise difficult to empirically

[2] Impact fees meet the second and third criteria, but not the first. Property taxes meet the first two, but not the third. Property tax programs would be an ideal fit if historical data on adoptions was available.

model (Fletcher and Murray, 2006).[3] Notably, our dataset includes annual municipal and county LOSTs in from initial state authorization in 1966 to the end of our study period (2010). This 45 year panel yields 22,770 observations on municipal rate setting behavior and tax revenues for 506 jurisdictions that are eventually classified as 469 followers and 37 leaders.

Our results highlight the presence of horizontal and vertical interactions and the influence of leader/follower dynamics on both. Although followers display within period co-movement with respect to rates, we find no evidence of causality. In contrast, followers are more likely to raise their rates during the three year period following leader rate increases and are less likely to raise their rates over the three years following a parent county's increase. Weak evidence also suggests that leaders react similarly to their parent counties, but statistical significance is not achieved. Our results also demonstrate the importance of state border tax competition effects.

The following section frames our work within a review of the existing literature. Section 3 presents a brief history of LOSTs in the US. Section 4 introduces our data. Section 5 outlines the construction of the leadership index. Section 6 introduces our empirical approach to modeling the determinants of LOST rate setting behavior, with a focus on leadership-driven competition asymmetries. Section 7 presents our results and Section 8 concludes.

2. Local tax competition with strategic interaction

In a Tiebout (1956) setting, small jurisdictions provide public services funded by non-distortionary taxes. Heterogeneous mobile households benefit from governmental competition by selecting optimal tax-service bundles. These models do not account for strategic interactions that can arise for a number of reasons, including benefits spillovers, competition for a mobile tax

[3] Agrawal (2013a, 2013b) has recently compiled nationwide LOST tax rate data for a 10 year period. The advantage of our 45 year panel is that it reports initial adoptions as well as annual tax revenues.

base, and tax mimicking behavior (Wilson, 1999; Zodrow, 2010; and Lyytikäinen, 2012). In tax competition models from Mintz and Tulkens (1986) and Wildasin (1988, 1989), individual jurisdictions affect the rate of return on fiscal policy choices. Inefficient outcomes occur when a tax in one jurisdiction affects the utility of residents in another. For the case of a mobile tax base, equilibrium tax rates are set too low, causing an under provision of public goods.

The emerging literature on the nature of asymmetric tax competition generally focuses on differences in size to explore horizontal and/or vertical spillovers. Bucovetsky (1991), Haufler and Wooton (1999), and Peralta and van Ypersele (2005) all consider strategic interaction among national governments of unequal size. The typical conclusion is that larger countries tax at higher rates than smaller countries in equilibrium. Results from sub-national studies are more nuanced. Using German data, Buettner (2001) finds that small jurisdictions experience fiscal spillovers when larger neighboring jurisdictions change their local business taxes. Examining provincial corporate income taxes in Canada, Hayashi and Boadway (2001) find asymmetries with respect to vertical and horizontal channels of tax competition. Provinces were found to lower (increase) taxes in response to federal tax rate (other provinces') increases. Investigations at the US county-municipal level have also identified horizontal and vertical asymmetries (Wu and Hendrick, 2009). Baldwin and Krugman (2004) attribute differences in tax rates between the core and the periphery to agglomeration economies, where higher tax rates in the core influence rates in the periphery. Using municipal sales and property taxes in the US, Hill (2008) also finds evidence that agglomeration influences tax policy.

Fiscal policy interactions are often considered in a simultaneous move Nash equilibrium framework (Wilson, 1986; Zodrow and Mieszkowski, 1986; and Wildasin, 1988). Recent work considers potential asymmetries regarding the timing of decisions. In vertical tax competition models, the higher order government moves first in a Stackelberg setting, whereas in horizontal models first movers are often identified by size or agglomeration (Baldwin and Krugman, 2004). Kempf and Rota-Graziosi (2010) extend the literature by investigating the implications of endogenous leadership in models with asymmetric tax competition. They find the extent of asymmetry among jurisdictions influences equilibrium outcomes, and that smaller jurisdictions sometimes lead. Unlike previous work, they conclude that the downward pressure on tax rates is less than predicted in models without endogenous timing of moves.

Sorting jurisdictions into leaders and followers is a critical component of dynamic empirical investigations. The literature lacks a robust sorting mechanism and is limited to a handful of studies that make assumptions appropriate for their investigated environment. In the international context, for example, Altshuler and Goodspeed (2002) characterize the US as a Stackelberg leader, with European Countries moving second. Studies of vertical tax competition model interactions where the national government first implements, with state, local, or regional governments reacting as followers (Besley and Rosen, 1998; Goodspeed 2000, 2002; and Esteller-Moré and Solé-Ollé, 2001). Although this is reasonable in the vertical context, arbitrary decisions to pre-determine leaders at the sub-national level may be more problematic.

To our knowledge, only two empirical investigations consider tax competition asymmetries driven by sequential policy decisions made within a single tier of local government. De Mello (2008) considers local VAT rates in Brazil where a single Stackelberg leader is designated among local jurisdictions. Using data from 1985-2001, the study demonstrates that neighbors react strongly to one another's VAT policies, as well as to the regional leader. Janeba and Osterloh (2012) examine local business and land tax rates in the state of Baden-Württenberg, Germany. They use a field survey where elected mayors reported which jurisdictions they perceive as competitors. Their findings suggest that smaller jurisdictions rely less heavily on capital taxation than larger ones, and show that competition within regions plays a major role in a sequential rate setting environment. Although a survey-based approach to determining policy leadership has advantages, it is not cost-effective for most studies of fiscal interactions.

We add to this emerging literature by developing a data-driven method for identifying leaders and followers, respecting the historical evolution of the timing of initial implementation and of subsequent rate changes. Specifically, we create a leadership index that allows multiple local governments to surface as leaders based on early tax policy decisions. We then use this dichotomy to investigate potentially asymmetric fiscal spillovers within a context that respects sequential decision making. This data-driven approach is generalizable to a wide range of applications where lengthy panel data on local tax policies are available.

Our approach also addresses some shortcomings in the empirical literature which estimates reaction functions (see Brueckner 2003 for a review). Many studies use cross-sectional data on local property tax rates in a variety of settings: Ladd (1992) and Bruckner and Saavedra (2001) use US data, while Heyndels and Vuchelen (1998) and Brett and Pinkse (2000) use data from Belgium and Canada, respectively. Each finds evidence that tax rates react by moving in the same direction as rate changes in competing jurisdictions. The main advantage of the cross-sectional approach is that regression models of local policy choices can control for various socio-economic and demographic factors that may affect the distribution of tax rates. An important disadvantage, however, is that in the presence of strategic tax competition, cross-sectional observation of policy choices represents an endogenous system.

Endogeneity problems have been addressed using techniques such as maximum likelihood and instrumental variables. Quasi-experimental methods have also been employed by

Eugster and Parchet (2011) and Lyytikäinen (2012). The former bases causality arguments on the presence of the French/German language border for Swiss municipalities while the latter investigates municipalities in Finland using spatial econometric approaches. Neither of these studies addresses potential leader-follower dynamics. Furthermore, the quasi-experimental approach is only valid in cases where exogenous variation has differential influence over policy choices. An advantage of our approach is that by using panel data that is long and wide we can classify jurisdictions *prior* to exploring potentially asymmetric policy reaction functions. Also, if some determinants of tax rates are unobservable, panel estimation with fixed effects is likely to outperform well specified cross-sectional models.

3. Local option sales taxes and policy autonomy in the US

Although local sales taxes are now firmly entrenched in the US, their prominent role is a relatively recent phenomenon. The first US experience with a broad based retail sales tax actually came at the *federal* level when a national sales tax was enacted following World War I. Soon after being revoked at the federal level, states began to implement sales tax programs. Shoup (1936) documents that 24 states as well as New York City had broad based ad valorem retail sales taxes in place as the nation was digging out of the ravages of the Great Depression. And while they rapidly grew in popularity at the state level, it would take three additional decades before sales taxes spread (in any systematic way) to local governments. Throughout the 1960s and 1970s, many states passed legislation that allowed their local governments to tax general sales occurring within their jurisdiction. LOSTs currently raise more own source revenue for local governments in the US than any other policy, save the property tax (Brunori, 2007).

Across the US, the increase in LOSTs popularity has been far from uniform.[4] Delaware, Montana, New Hampshire, and Oregon have no sales taxes at all. 12 states (Connecticut, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, Mississippi, New Jersey, Rhode Island, Vermont and West Virginia) have a state levy, but no local taxes. Alaska authorizes local sales tax programs but has no state levy. Among the remaining states with sales taxes at both the state and local level, heterogeneity still exists. In 13 cases (Florida, Idaho, Iowa, Minnesota, Nebraska, Nevada, North Carolina, Ohio, Pennsylvania, South Dakota, Virginia, Wisconsin, and Wyoming) LOSTs are imposed by municipalities or counties, but not by both. The 20 remaining states (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) use a three-tiered (state/county/municipal) stacking rate structure.[5] Because this multi-tiered environment creates nuanced pressures regarding LOST policy choices, it is a natural choice for investigating LOST leader-follower dynamics.

Local governments in many states have little control over the timing of LOST adoption or rate setting decisions. For example, Georgia, Hawaii, New Mexico, South Carolina, Tennessee, Texas, Utah, and Washington all use binding rate caps that ensure most local governments have uniform rates with no ability to increase them. In Tennessee, municipalities can only implement a LOST if a gap is present between the county rate and the total rate cap of 2.75%. Since most counties are at the cap, cities are crowded out (Luna et al., 2007). In fact, only seven states (Alabama, Arizona, Colorado, Illinois, Kansas, North Dakota, and Oklahoma) have effectively unbounded LOST autonomy.[6] Figure 1 shows the percentage of local tax revenue coming from

[4] Readers interested in a more detailed overview of LOST policy in the US should see Burge and Rogers (2011).
[5] While Georgia, Hawaii, and South Carolina are included, it is worth noting authorization at one local level is minimal in each case. For example, Atlanta levies the only general purpose municipal LOST in Georgia.
[6] To have effectively unbounded local autonomy one of two scenarios must exist. First, all local governments could be unconstrained (subject to voter approval) in setting their rates. Second, one level is unconstrained while the other faces a rate cap high enough that rates at the capped value are rarely seen.

LOSTs in states where both municipalities and counties have at least some discretion over rates. [Figure 1 about here] For the majority, including Oklahoma, LOST revenues are very important.

An optimal environment for investigating the nature of policy leadership and dynamic tax competition should exhibit four characteristics: 1) local governments should enjoy autonomy regarding initial LOST implementation, 2) local governments should enjoy autonomy over initial and subsequent rate setting decisions, 3) variation regarding both the extensive (adoption) and intensive (rate levels) margins should be meaningful, and 4) local governments should rely on LOSTs for a significant portion of their own-source tax revenues. As we discuss below, Oklahoma serves as an ideal case for our investigation because it meets all of these conditions.

4. The Oklahoma LOST Policy Setting

Oklahoma municipalities were among the earliest adopters of local sales tax programs. Beginning in 1966, municipalities were authorized to enact LOSTs, subject to voter approval. The tax base is defined uniformly across municipalities and includes the majority of consumer retail sales, as well as business purchases of some non-retail items. We obtained histories of all municipal, county, and state sales tax rates and revenues from the Oklahoma Tax Commission (OTC). The panel covers 1966 through 2010 and contains the entire population of the 506 municipalities that had programs in place by 2010.[7] The tax base for each municipality is not reported. According, we calculate the tax base using the following identity:

$$BASE_{i,t} = r_{i,t} / \tau_{i,t} \quad (1)$$

In cases where rates change within a fiscal year, a time weighted rate enters (1) and our later regressions analysis uses the December tax rate. The weighted tax rate is calculated as

[7] This also represents complete coverage of the municipalities that could have reasonably implemented programs, such that selection bias is not an issue in our analysis. While the US Census Bureau lists a handful of towns that are not in our sample, these jurisdictions generally have fewer than 100 reported residents, little to no retail activity, and do not provide significant public services. Hence, we do not view these cases as viable taxing entities.

$$\tau_{i,t}\ (weighted) = tax\ rate_1 * month_1/12 + tax\ rate_2 * month_2/12 \quad (2)$$

where $month_1$ and $month_2$ are the number of months that each tax rate was in effect. While this adjustment may not fully reflect the seasonality of LOST revenues, it serves our application well given the small number of mid-year rate changes relative to the total number of observations.[8]

Figure 2 summarizes the timing of adoptions and subsequent rate increases for Oklahoma municipalities. [Figure 2 about here] Adoptions were common in the late 1960s and early 1970s: by 1970 over 150 municipalities had programs in place. During this period, adopted rates were uniformly one percent. The frequency of adoptions remained high over the next five years, and by 1975, over 300 municipalities had LOSTs in place. While one percent remained the most commonly adopt rate during this period, higher rates began to surface in the mid 1970s. By 1980, nearly 400 municipalities had LOSTs and, for the first time, municipal LOST rates exceeding one percent were more prevalent than lower rates. Initial adoptions were infrequent in the decades that followed, and the variation in rate levels increased substantially.

We use the LOST data for two distinct purposes: to identify policy leaders and to investigate of how leadership influences the timing of tax competition. We split our panel into two distinct parts and use one for each task. Logically, the early panel is appropriate for identifying leaders. Our cutoff point was the earliest year that met two objectives. First, the majority of program adoptions should occur in the early period. This ensures LOST programs are common when we investigate municipal rate setting decisions. Also, the first period must be long enough for jurisdictions to display leadership by raising their rate above the prevailing 1% norm (i.e., reveal the intensive margin). Figure 1 shows that rates above 1% surfaced in the 1970s.

[8] Furthermore, using a less than perfect weighting procedure would only bias later results to the extent that weighting errors were systematic in nature. We can think of no *a priori* reason why this would apply.

We settled on 1966 through 1976 as the early panel, leaving 34 years to analyze rate setting decisions. Since over 150 programs were implemented during the 1960s, municipalities display leadership on the extensive margin within just a few years. However, municipalities did not expand rates beyond 1% until 1971; roughly five years after the first programs were adopted. For symmetry, we include five years past 1971, allowing the same amount of time to measure leadership on the intensive margin as it took to reach significant variation on the extensive margin. By 1976, nearly 100 municipalities levied rates above 1%.[9]

Both stages of our analysis respect the role of economic regions. We use the eleven Workforce Investment Regions (WIR) currently endorsed by the Oklahoma Department of Commerce (ODC). The WIR regions have several appealing properties for our application. First, no county is split into multiple regions. This is important since county governments have their own LOST programs. Another is that the WIR designations have been remarkably stable over long periods of time, alleviating concerns about potential endogeneity (i.e., the possibility that municipalities' choices regarding LOSTs influenced development patterns).[10] Finally, they are reasonably sized. With the exception of the northwest region (containing the panhandle), one could drive across each region in under two hours.

5. Constructing the leadership index

[9] Further exploration revealed the eventual leadership index values were robust to the choice of the cutoff year, as long as the cutoff was in the mid 1970s or later. In fact, a strong correlation exists between the index values (and designated leaders) we obtain using 1966-1976 and those obtained using the entire 45 year panel.

[10] The WIR definitions are defined by the 1998 Federal Workforce Investment Act, but are identical to a similar classification system from the 1982 Job Training Partnership Act. We spoke with ODC officials to see if the same system was in the 1973 Comprehensive Employment and Training Act, or the 1962 Manpower Development and Training Act. Although we could not confirm this, there was speculation on the part of ODC officials it was likely.

In the first stage of our procedure, we construct an index which reflects multiple aspects of leadership. This motivates the need for factor analysis.[11] In general, any number of variables could be used, based on data availability. We utilize five variables and identify others that are not well suited to our analysis, but could be useful in other applications. The leadership follows two principles. First, positive/high values reflect leadership, while negative/low values reflect a lack of leadership. Second, because the raw data have dramatic differences in scale, all variables are standardized prior to factor analysis.

Of the five variables used to construct the index, two reflect leadership on the extensive margin, two reflect leadership on the intensive margin, and the fifth is a hybrid. While the final index only uses data from the 1966-1976, we also explored using the entire panel. The result was remarkably similar - suggesting leadership surfaced early on and was persistent.

We follow a basic theory and assume jurisdictions adopt a LOST when the benefits of doing so exceed the costs. For early adopters, the net benefits may have been positive before 1966, when programs were not allowed. Focusing on costs, the earliest adopters likely faced higher costs of implementation than other jurisdictions. The ability to copy the successful practices of other adopters affords government's lower costs via a savings of time and money. In addition, local governments may be more able to generate voter support if other jurisdictions have already implemented a LOST (e.g., yardstick competition). For this reason, it is reasonable to assume early adopters also carried higher benefits associated with adoption than other communities. To reflect these ideas, we construct *First_in_state* which equals a value of 1 if the municipality adopted in 1966, and 0 otherwise. As shown in Table 1, a majority of the thirteen municipalities adopting in 1966 are located in the central region containing Oklahoma City and

[11] Specifically, the first factor is selected as the index value. Factors are not rotated in our analysis. Unsurprisingly, the estimated index values are highly correlated with the simple summation of factor values. This is reassuring as it indicates that the index itself is fairly robust to the factor loadings of any individual factor.

its suburbs. [Insert Table 1 about here] Although large cities adopted earlier on average, not all initial adopters were large, and not all large municipalities adopted in 1966.

Table 1 shows only five of the eleven regions contained a 1966 adopter. Tax mimicking and yardstick competition effects should dissipate with distance. This dissipation may have been more intense in the 1960s compared to now, when information flows more freely. Accordingly, we construct *First_in_region* to equal 1 if the municipality adopted in the year that programs first appeared in its region, and zero otherwise. Table 2 shows the initial adoption within each region. [Insert Table 2 about here] LOSTs surfaced in the north central, east central, Tulsa, northeastern, and northwestern regions in 1967. The southwestern region was the last to have LOSTs implemented in 1968. Figure 4 shows two regions, the central and north central, with significantly different overall adoption patterns. [Insert Figure 4 about here] Compared to the north central region, adoptions in the central region are *both* more heavily front-loaded and back-loaded. For example nearly half of the jurisdictions in the central region had programs by 1968, while only 3 programs were observed in the north central. However, the central region also had five jurisdictions adopt during the last half of the panel, compared to only 1 in the north central.

Unlike *First_in_state* and *First_in_region* which focus on implementation, the remaining variables reflect the intensive margin. *Relative_intensity* is constructed as each municipality's mean LOST rate from 1966-1976 less the average mean LOST rate in the region.[12] Interestingly, the central region contained seven of the thirteen 1966 adopters, but fell short of the Tulsa region in terms of overall intensity. An important trait of the 1966-76 sub-panel is the dominance of 0% and 1% LOST rates. Of the 5,566 (506 x 11) municipal/year observations in these years, 3,213 (57.7%) are 0% and 2,103 (37.8%) are 1%. Only 250 cases, roughly 4.5% of the data, display rates of 2%. Hence, a rate of 2% clearly represented leadership. We define the variable

[12] Tax rates of 0 enter the average for years where no program was in place.

Relative_above1 as the number of years a municipality had a 2% rate, less the same calculation averaged over the parent region. The variation across regions is reflected in the last column of Table 2. This explains why the Tulsa region passed the central region in terms of overall intensity. An average community in the Tulsa region had a rate of 2% in place for 1.34 years; while the 2% rate was rare in the central region (a single municipality/year observation).

The final variable reflects the extensive and intensive margins by considering the rate charged at initial adoption. It should be more difficult to gain voter support for a LOST program if the proposed rate is relatively high. *Relative_adoptionrate* compares the regional median LOST rate in the year of adoption with each municipality's initial adoption rate. Municipalities adopting a rate higher than the current regional median are assigned a value of 2. Those adopting rates less than or equal to the median are given a 1. If initial LOST adoption took place after 1976 the community is given a 0. While this variable loads significantly in our factor analysis, a reasonable criticism is that it replicates information conveyed by the other measures. In fact, *Relative_adoptionrate* is highly correlated with our early adoption measures, since early adopters, by definition, adopt a rate above their regional average. However, this variable should display unique information in applications where tax rates at adoption display more variation than in our particular case. A last point worth noting is that, while regional leadership dynamics are well established by 1976, the intensity of regional LOST utilization varies over the rest of our sample. For example, Figure 5 shows three regions and their average LOST rates over our panel. [Insert Figure 5 about here] In 1976, the Tulsa region was highest, followed by the Southeast and then the East Central. By the end of the panel, the East Central region moved from the lowest to the highest in the group. Importantly, leadership dynamics seem largely determined at the cutoff point of our panel, in contrast to the dynamic rate setting decisions.

As mentioned above, variables are standardized to have mean 0 and standard deviation 1 prior to performing factor analysis.[13] In our application, the outcome of the factor analysis is similar to taking the simple sum of the five variables. This is not surprising as the five variables have strong positive correlations with one another. Accordingly our final index values are not particularly sensitive to the specification we select. We find evidence that distinctive groups exist within our data. The kernel density estimate shown in Figure 6 provides visual evidence regarding the distribution of leadership. [Insert Figure 6 about here] We choose to define leaders as jurisdictions located in the distinctive hump in the right tail. We select a cutoff value of 3.3, as the density function reveals a local minimum near the value of 3. As mentioned previously, 37 municipalities lie above this cutoff while 469 fall below. Table 3 documents the leadership index estimation, with summary statistics given by region. The central region has more leaders than the other regions (with seven) and the northwest region contains only a single leader.

6. Exploring vertical, horizontal and asymmetric policy responses

Our second stage uses the 34 years from 1977 through 2010 to explore the determinants of municipal LOST rates. Following the theoretical models discussed in Section 2, we begin with three simple models which differ in terms of the sample of jurisdictions and the nature of tax competition channels considered:

Baseline: $$\tau_{i,r,c,t} = \beta_1 TO_{r,t} + \beta_3 TC_{i,c,t} + \beta_4 Y_t + \beta_5 X_i + e_{i,t} \quad (3a)$$

Follower: $$\tau_{i,r,c,t} = \beta_1 TL_{r,t} + \beta_2 TOF_{r,t} + \beta_3 TC_{i,c,t} + \beta_4 Y_t + \beta_5 X_i + e_{i,t} \quad (3b)$$

Leader: $$\tau_{i,r,c,t} = \beta_1 TOL_{r,t} + \beta_2 TF_{r,t} + \beta_3 TC_{i,c,t} + \beta_4 Y_t + \beta_5 X_i + e_{i,t} \quad (3c)$$

[13] Other variable combinations were investigated. For example, we replaced *Relative_intensity*, *Relative_above1*, and *Relative_adoptionrate* with similar variables that ignored regions (i.e., made comparisons to state averages). The correlation between index values across the two approaches was 0.96, and the set of municipalities defined as leaders was nearly identical.

where $\tau_{i,r,c,t}$ is the LOST rate in jurisdiction *i*, located in region *r* and county *c*, at time *t*. The baseline model (3a) exams all 506 jurisdictions and omits any tax competition variables that treat leaders and followers differently. $TO_{r,t}$ *is* the population weighted LOST average for the all other municipalites in region *r* during time *t*. The follower model explores the rate setting behavior of the 469 followers where $TL_{r,t}$ and $TOF_{r,t}$ are the populated weighted LOST average for all the leaders and all of the other followers in the region, respectively. Similarly the leader model investigates the rate setting behavior for the 37 leaders using the weighted average LOST for the other leaders ($TOL_{r,t}$) and all followers ($TF_{r,t}$) in the region.

Vertical tax competition is captured via $TC_{i,c,t}$ which reflects the LOST rate of the parent county of municipality *i* at time *t*. Unfortunately, many important factors that affect municipal LOST rates are unobservable, particularly on a yearly basis for small jurisdictions. Accordingly, our variables are limited to time and area specific fixed effects and border dummies. Y_t is a vector of annual dummy variables that controls for factors commonly affecting rates in all municipalities for a given year. X_i is a vector of municipality dummy variables which control for unobserved time invariant factors that are unique to municipality *i*. We also account for recognized findings of enhanced local tax competition near state borders, by include dummies indicating whether the jurisdiction is in a county sharing a border with Texas, Kansas, and/or Arkansas. Finally, to address the presences of heteroskedasticity, we cluster all estimated standard errors at the municipal level.[14]

Despite the advantages of using a long panel, theory offers no *a priori* stance regarding how to incorporate timing dynamics. In cross-sectional studies, the observed system of tax rates is generally acknowledged to be endogenous, and steps are taken to mitigate endogeneity bias in

[14] Clustering errors at the regional level leads to slightly larger standard errors for most variables. However, all the effects we later discuss retain significance at conventional levels.

the estimated regressions. In a panel data setting, it is possible to estimate the effect of *previous changes* in the rates of other jurisdictions on *current policy actions*. It is important to determine the appropriate number of lags to include in the model.

A natural starting point is with the first-difference of equations 3a, 3b, and 3c. For example the baseline estimate would be specified as:

$$\Delta \tau_{i,r,c,t} = \beta_1 \Delta TO_t + \beta_3 \Delta TC_{i,c,t} + \beta_4 Y_t + e_{i,t} \qquad (4a)$$

Equations 4b and 4c, the first-differences of 3b and 3c, are analogous. Note that X_i is removed and the annual dummy variables now represent year-to-year transitions. Using first-differenced data allows us to separate the effects of contemporaneous and prior changes in our tax variables. In this context, significant correlation with contemporaneous rate changes reveals the likelihood of simultaneity, whereas significant correlation with lagged rate changes likely reflects causal influences stemming from tax competition. The drawback of first-differencing is that it produces R-squared measures which are an order of magnitude smaller than models explaining rate levels.

We explored alternative estimates of equations 4a, 4b, and 4c to find the appropriate lag structure. The results of specification tests (Akaike's) can suggest different lag structures for tax variables that are otherwise expected to perform similarly. Fortunately we did not face this issue, as preliminary explorations were consistent regarding the rate variables for leaders, followers, and parent counties. Lagged changes in the 1-3 year range were individually meaningful (i.e., t-statistics above 1) and of the signs expected, while longer lags produced point estimates near 0 and of random sign. Accordingly, we simplify matters by including the contemporaneous rate changes (meant to register correlation driven by simultaneity) and variables reflecting changes that occurred during the preceding three-year window.

7. Results

Tables 4, 5, and 6 contain the results of our first-differenced panel OLS regressions for the baseline, follower and leader specifications, respectively. [Insert Tables 4, 5, and 6 about here] The baseline model from Table 4 suggests that when leader-follower dynamics are ignored, the nature of horizontal and vertical policy spillovers differs. This comes through a difference in timing and the direction of effect. While both contemporaneous and lagged changes are positively correlated with current rate changes, only contemporaneous changes are significant. This significant co-movement in the absence of sequential effects may suggest municipalities respond to common shocks or changes in the political environment that we are not able to observe, as opposed to causally influencing one another through horizontal tax competition spillovers. At the same time, vertical tax competition spillovers display different timing. No strong correlation is present with contemporaneous changes in the rates of parent counties, but a decline in the likelihood of municipal rate increases emerges over the three years that follow. These results support the intuitive idea that higher tax rates among county governments crowd out rate increases at the municipal level.

The disparity between horizontal and vertical spillovers is also apparent in the follower specification. Table 5 shows the contemporaneous changes of other followers in the region are significantly positively correlated, while no effect of lagged rate changes is present. Mirroring the baseline model, followers are no more likely to increase rates in the year parent counties increase rates, but are less likely to do so over the next three years. In contrast to the baseline results, however, the complicated nature of horizontal tax competition in this setting can be seen by comparing these effects with those from the regional leader variables. Followers are no more likely to increase their rates during the year that regional leaders do, but are more likely to raise rates over the next three years. Hence, the timing sequence mirrors the pattern from the county rate variable, but now with the opposite directional effect, as would be expected.

As shown in Table 6 the estimation using leaders reveals other nuanced aspects of local tax competition. First, leaders seem to have less influence over one another than they collectively exert over followers. The tax rate variable tracking contemporaneous changes in other regional leaders is positive and significant, but the lagged variable has no effect on current rate setting decisions. Leaders are found to be sensitive to the previous rate increases of followers, but not in the direction we expected. When followers within their region raised rates more consistently, leaders were unaffected during the current year but were less likely to raise their rates over the three years that followed. Whether vertical competition affects leaders as strongly as followers in our sample is difficult to say. As was the case for followers, contemporaneous changes of parent counties have no effect while the size and direction of the lagged parent county rate changes remain similar, losing significance only due to a larger standard error. Given the regression has so many fewer jurisdictions, we remain cautious and do not interpret this loss in significance as evidence the leaders in our sample were unaffected by vertical tax competition.

Beyond our primary variables of interest, note that the performance of the year-to-year transition dummies also reveals the presence of vertical tax competition.[15] The observed pattern of coefficients, in terms of magnitude, sign, and significance or lack thereof, stems from omitting the first transition as the reference group. In the baseline and follower models, coefficients for the early transition dummies are small and of random sign. This pattern changes with the 1983-84 transition, when the transition dummies in both estimations become negative and significant.

Two factors relating to vertical tax competition help explain this dramatic shift. First, county governments in Oklahoma were first able to implement LOST programs of their own in

[15] To save space, we omit the transition dummies from our presented results. Full results are available upon request.

1984. Second, after sitting at 2% between 1936 and 1983, the state tax increased to 3% in 1984 and again to 3.25% in 1985. Thus, it seems that at least followers responded to tax increases at higher levels of government by raising their own tax rates less frequently. However, we do not observe strong responses in the group of leaders. In this case, coefficients remain insignificant and of random sign throughout the entire 1980's, and in fact, for most of the entire sample. Only six of the over thirty transitions, mostly during the 1990s, are significant (all negative), providing some evidence that leaders were less sensitive to tax increases at higher levels than followers, although we must note that leaders were more likely to raise their rates in the omitted transition – affecting the nature of their reference comparison.

Regarding horizontal tax competition near state borders, we typically find significant effects. Of the nine estimated state border coefficients, all are negative and six are statistically significant at conventional confidence levels. The Texas border coefficient achieves significance in all three estimations and appears to exert the strongest negative pressure on LOST rates. This was expected since total sales tax rates were lower on average in Texas than in Oklahoma during our sample. Kansas also had lower average sales tax rates over this period, and we observe a negative spillover on this border for our baseline and followers estimations, but not for leaders. On the other hand, leaders seemed more sensitive to the Arkansas border than followers were.

8. Conclusions, Limitations and Extensions

This paper utilizes a 45 year panel of local option sales tax rates imposed by 506 municipalities in Oklahoma in an environment where county governments also tax the retail base and where LOST revenues play a prominent role in both levels of local governance. By first identifying tax policy leaders and followers, and then empirically investigating the extent to which horizontal and vertical tax competition influences the two groups, we add to an emerging branch of the tax competition literature that explores asymmetric leader-follower dynamics.

Previous studies empirically modeled leadership in horizontal tax competition either by assuming a single leader exists or by using costly survey data. By developing a leadership index, our paper is the first to use early policy decisions to endogenously determine which jurisdictions are leaders and followers. This approach could be useful in a wide array of other applications.

We find that both horizontal and vertical tax competition influences the rate setting behavior of leaders and followers, and that accounting for leader-follower dynamics provides a more refined understanding of the nature of horizontal tax competition. Municipalities displaying sufficient leadership during the early part of our panel to be designated as leaders played a disproportionately large role in determining the overall policy dynamics during the remainder of the panel. Followers, a group constituting nearly 93% of our sample, were less likely to raise LOST rates if their parent county recently had a rate increase, but were more likely to do so if leaders in their region recently raised their rates. On the other hand, followers do not seem to exert the same type of causal influence over one another. Leaders also seem to be subject to vertical tax competition pressures, but not to the point where statistical significance was attained – possibly due to the considerably smaller number of jurisdictions in the group of leaders.

Given the sparseness of the literature addressing potential leader-follower dynamics in tax competition, there is a need for further work examining the issue using data from other areas and/or other types of tax policies.

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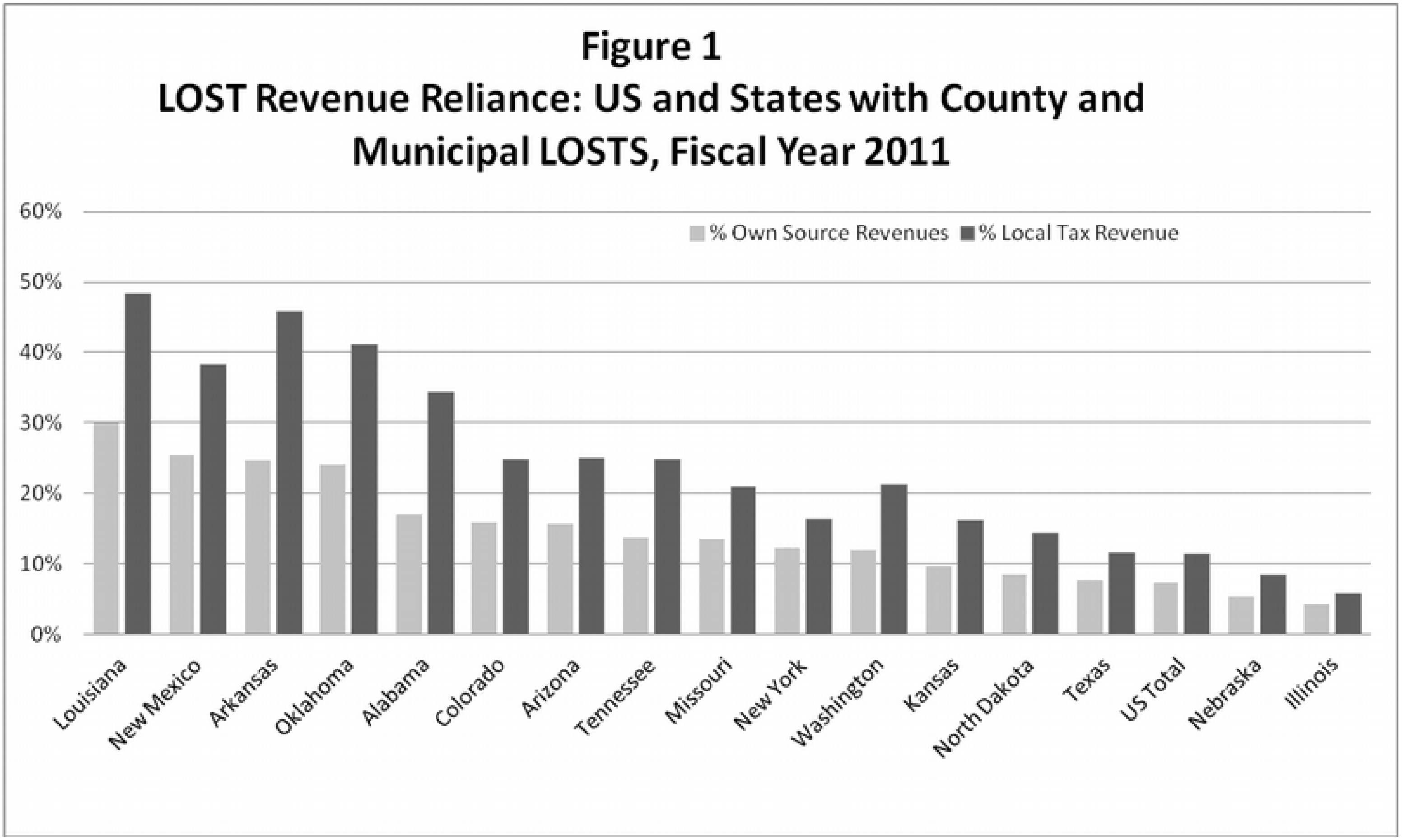
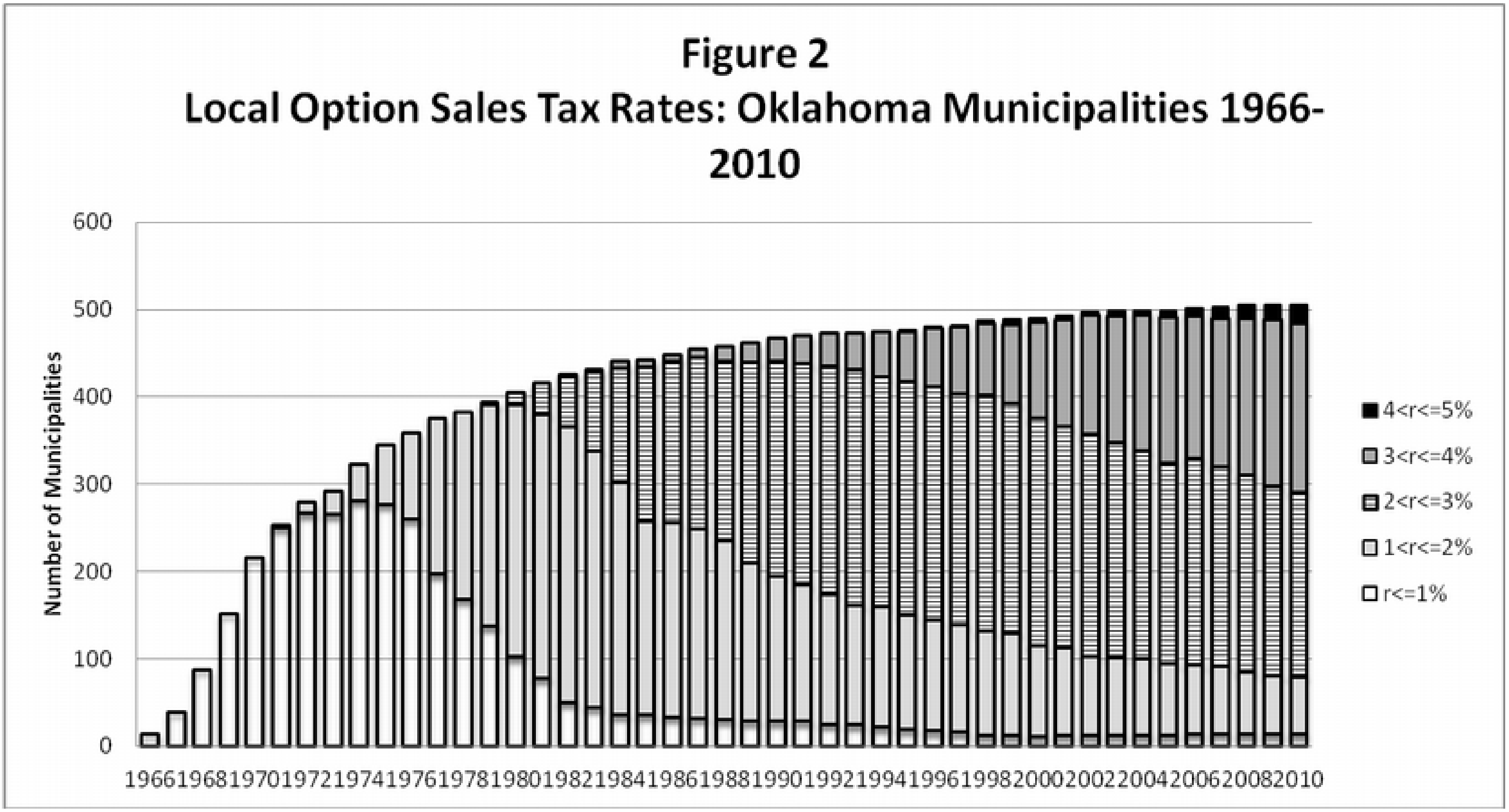
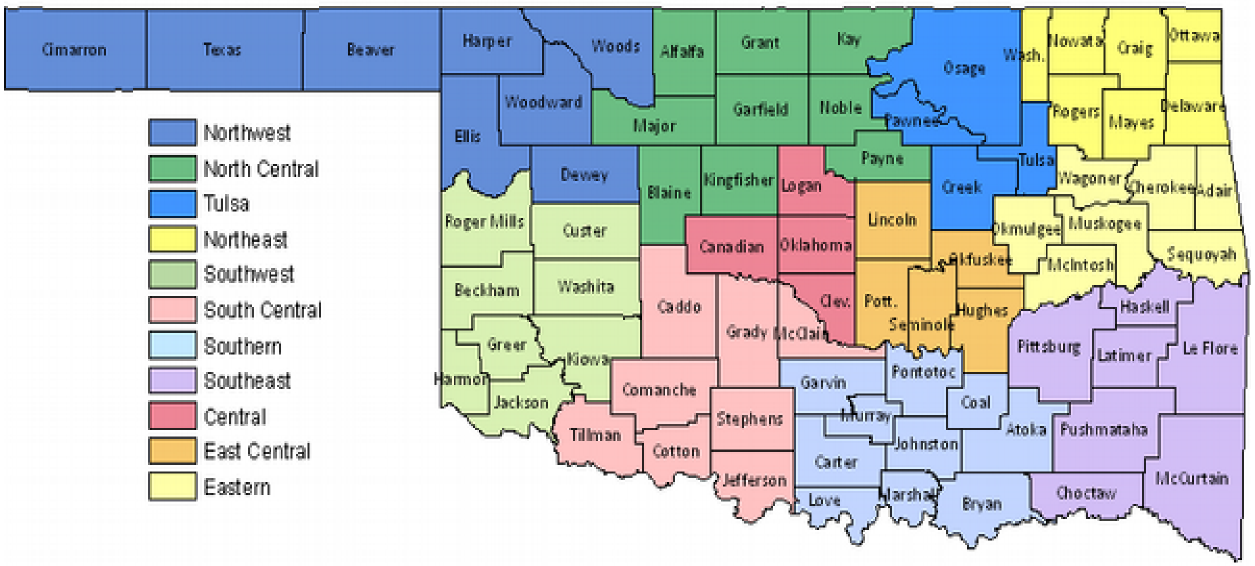


Source: US Census, 2011 Annual Survey of State and Local Government Finances



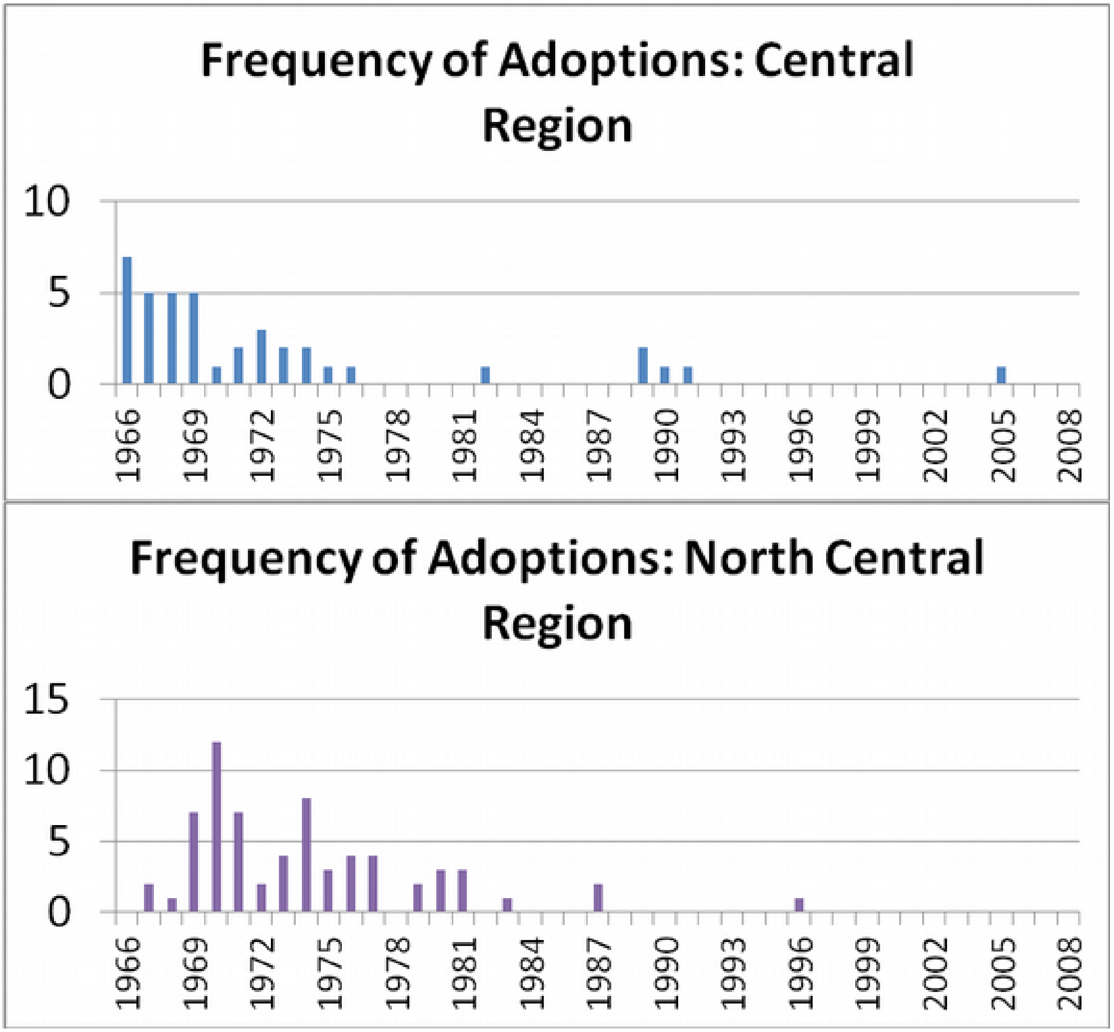
Source: Oklahoma Tax Commission.

Figure 3: Workforce Investment Regions in Oklahoma



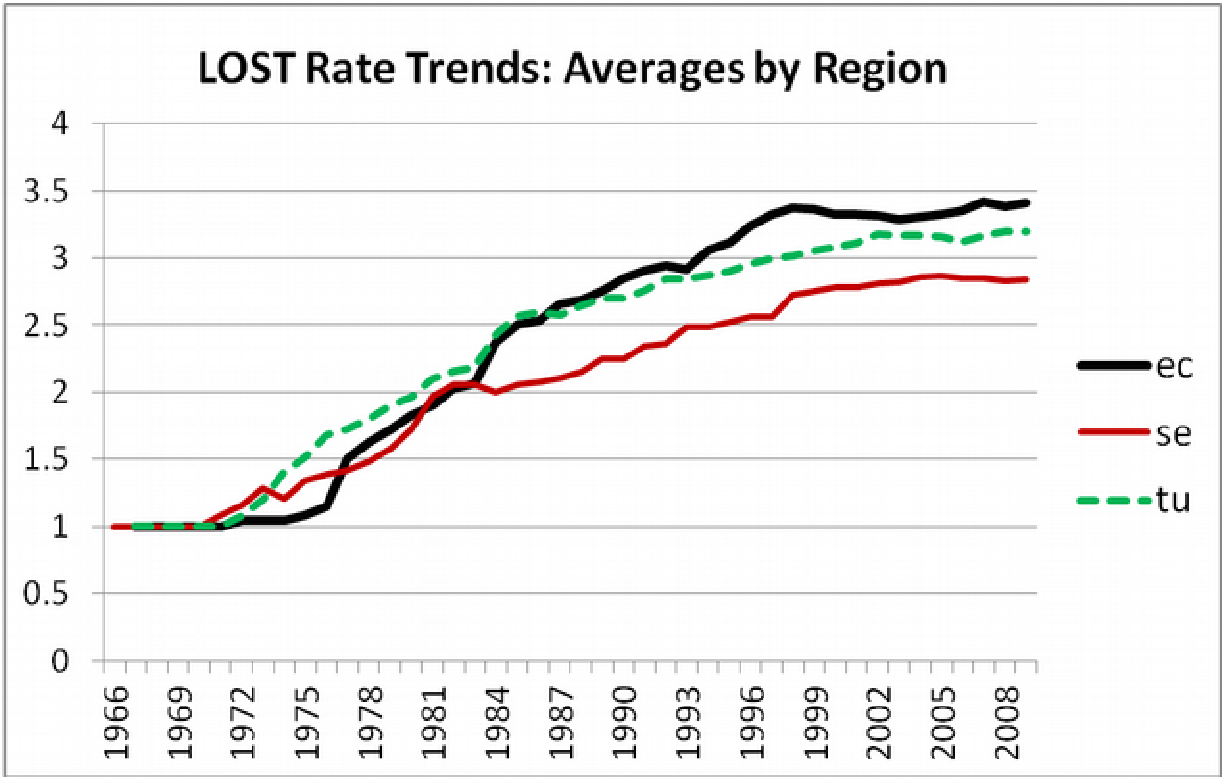
Source: Oklahoma Department of Commerce

Figure 4: Frequency of LOST adoptions by year: selected regions



Source: Oklahoma Tax Commission

Figure 5: Mean LOST rates by year: selected regions



Source: Oklahoma Tax Commission

Figure 6: Kernel density function for the leadership index

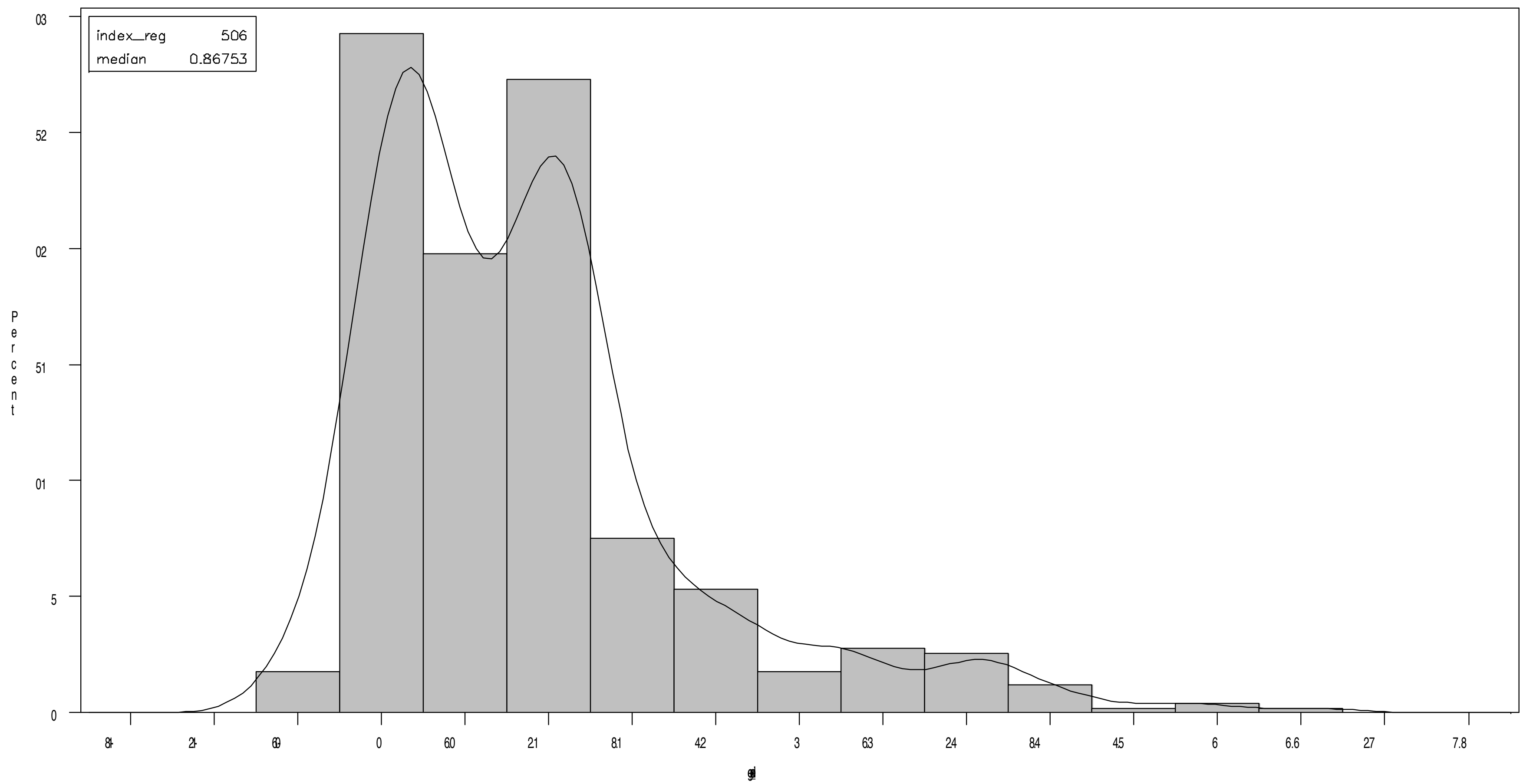


Table 1: Municipalities adopting a LOST program in 1966

Municipality	County	Region	1960 Population
Ardmore	Carter	Southern	20,184
Bethany	Oklahoma	Central	12,342
Chickasha	Grady	South Central	14,866
Healdton	Carter	Southern	2,898
McAlester	Pittsburg	Southeast	17,419
Midwest City	Oklahoma	Central	36,058
Muskogee	Muskogee	Eastern	38,059
Nichols Hills	Oklahoma	Central	4,897
Norman	Cleveland	Central	33,412
Oklahoma City	Oklahoma	Central	322,355
Poteau	Leflore	Southeast	4,428
The Village	Oklahoma	Central	12,118
Warr Acres	Oklahoma	Central	7,135

Source: Oklahoma Tax Commission

Table 2: LOST implementation and rate summaries: 1966-1976

Region	Total Jurisdictions	First Adoption	Mean	Frequency above 1
Central	42	1966	0.59	0.0238
Eastern	41	1966	0.55	0.6098
East Central	39	1967	0.42	0.2308
North Central	55	1967	0.40	0.2727
Northeast	52	1967	0.39	0.2115
Northwest	29	1967	0.48	0.5172
Southern	52	1966	0.37	0.2115
South Central	66	1966	0.43	0.5758
Southeast	50	1966	0.52	0.9000
Southwest	42	1968	0.44	0.6905
Tulsa	38	1967	0.64	1.3421
Total	**506**	**1966**	**0.47**	**0.4940**

Source: Oklahoma Tax Commission

Table 3: Leadership index summary statistics

Region	Mean	Standard Deviation	Minimum	Maximum	Total Jurisdictions	Leaders
Central	1.22	1.06	0.14	3.31	42	7
Eastern	1.04	1.29	-0.16	4.47	41	4
East Central	0.98	1.02	0.16	5.63	39	1
North Central	1.05	0.90	0.16	4.98	55	2
Northeast	1.07	0.87	0.20	4.38	52	2
Northwest	1.06	1.06	-0.05	4.13	29	1
Southern	1.11	0.89	0.22	3.39	52	2
South Central	0.99	1.32	-0.04	5.71	66	4
Southeast	1.09	1.70	-0.30	6.74	50	7
Southwest	1.11	1.18	-0.11	4.63	42	3
Tulsa	1.11	1.66	-0.65	4.81	38	4
Total	1.07	1.20	-0.65	6.74	506	37

Table 4: Panel OLS regression 4a results: full sample without leader-follower designations

Dependent Variable: Change in tax rate ($\Delta \tau$)	Coefficient	Robust standard error	t-stat	P-value
Change in other regional municipalities (contemporaneous)	0.1761	0.0575	3.06**	0.002
Change in other regional municipalities (3 year lagged)	0.0355	0.0260	1.36	0.174
Change in parent county rate (contemporaneous)	-0.0034	0.0090	0.38	0.705
Change in parent county rate (3 year lagged)	-0.0148	0.0050	2.96**	0.003
Kansas Border	-0.0085	0.0032	2.62**	0.009
Texas Border	-0.0084	0.0032	2.64**	0.008
Arkansas Border	-0.0043	0.0035	1.22	0.223
Number of Observations: 17204 (506 jurisdictions, 34 years)		Joint F-statistic: 13.43		
R-squared: 0.02				

* Significant at a 5 percent level. ** Significant at a 1 percent level.
Standard errors are clustered at the municipal level. Year dummies included in estimation but not reported. (Full results available upon request.)

Table 5: Panel OLS regression 4b results: follower sample

Dependent Variable: Change in tax rate (Δ τ)

	Coefficient	Robust standard error	t-stat
Change in regional leaders (contemporaneous)	0.0002	0.0112	0.01
Change in regional leaders (3 year lagged)	0.0116	0.0051	2.26*
Change in other regional followers (contemporaneous)	0.1050	0.0308	3.41**
Change in other regional followers (3 year lagged)	0.0187	0.0191	0.98
Change in parent county rate (contemporaneous)	-0.0023	0.0093	-0.24
Change in parent county rate (3 year lagged)	-0.0131	0.0053	-2.49*
Kansas Border	-0.0078	0.0035	-2.22*
Texas Border	-0.0102	0.0033	-3.04**
Arkansas Border	-0.0046	0.0037	-1.24

Number of Observations: 15964 (469 jurisdictions, 34 years) Joint F-statistic: 12.58 R-squared:

* Significant at a 5 percent level. ** Significant at a 1 percent level.
Standard errors are clustered at the municipal level. Year dummies included in estimation but not reported. (Full results available upon request.)

Table 6: Panel OLS regression 4c results: leader sample

Dependent Variable: Change in tax rate (Δ τ)

	Coefficient	Robust standard error	t-stat	P-value
Change in other regional leaders (contemporaneous)	0.0904	0.0437	2.07*	0.046
Change in other regional leaders (3 year lagged)	0.0034	0.0149	0.23	0.819
Change in regional followers (contemporaneous)	0.0427	0.0793	0.54	0.594
Change in regional followers (3 year lagged)	-0.0973	0.0451	-2.16*	0.038
Change in parent county (contemporaneous)	-0.0142	0.0411	-0.34	0.732
Change in parent county (3 year lagged)	-0.0232	0.0150	-1.55	0.130
Kansas Border	-0.0061	0.0158	-0.39	0.700
Texas Border	-0.0153	0.0065	-2.37*	0.023
Arkansas Border	-0.0217	0.0054	-4.03**	0.000

Number of Observations: 1258 (37 jurisdictions, 34 years) Joint F-statistic: 136.77
R-squared: 0.04

* Significant at a 5 percent level. ** Significant at a 1 percent level.
Standard errors are clustered at the municipal level. Year dummies included in estimation but not reported. (Full results available upon request)