Does Competition Tame the Leviathan? A Case of Earmarked Spending for Transportation

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ABSTRACT

Extant studies have explored the Leviathan hypothesis whether competition across governments enhances efficiency. This study empirically estimates the Leviathan hypothesis in the context of earmarked spending on transportation and competition in California. This study first obtains an efficiency score for empirical procedures employing the Malmquist productivity index and further the Tobit regression model to examine the Leviathan hypothesis. The findings provide evidence that competition of local (option) sales tax improves efficiency in transportation spending. The findings verify that efficiency becomes lower in a county that levies local (option) sales tax earmarked for transportation because transportation spending increases.

Keyword: Leviathan hypothesis, Government efficiency, Efficiency of earmarked spending, Local (option) sales tax

JEL code: H70, H72, H87

1. INTRODUCTION

In the Brennan and Buchanan's Leviathan hypothesis (1980), tax competition as a result of fiscal decentralization restricts the growth of government spending as a constraint on the bureaucrats behavior of revenue-maximization. Tax competition enhances government efficiency as an inverse relationship. Since the tax revolts in the late 1970s, local (option) sales taxes (hereafter, LOSTs) have been a replacement fiscal instrument for the US local governments to expand their revenue capacity and to finance capital infrastructure, which results in the devolution of taxing power. LOST has more dynamic effects in local governments because the short distance between local governments intensifies competition. Competition leads to a greater likelihood of cross-border shoppers to benefit from lower sales taxing areas, which affects the government fiscal policy.

Compared with federal and state governments, local governments have more responsibilities for road maintenance, operation and expansion, and for the growing demands of public transit. Among the various public services, local governments are greatly concerned with transportation and road systems because greater spending for a new transportation project rather than other capital projects is a prerequisite, sometimes greater than their fiscal capacity. Transportation and road systems result from a public-private partnership in the sense that most vehicles are private property, and private interests (i.e., corporations and individuals) are also engaged in transportation projects, while governments construct, own, and maintain roads. Because the amount of money required to construct and maintain roads is greater, governments still play a leading role in financing road maintenance and transportation systems.

Regarding the leading role, some states such as California, Colorado, Georgia, and Illinois in the United States, have allowed their local governments to adopt LOSTs earmarked for

the investments of transportation projects (LOST-Ts) as an alternative source of revenue. Some studies have also explored the effects of LOSTs on specific infrastructure projects (Afonso, 2015; Craft, 2002; Gordon, 2005). Although the extant studies consider the interdependence of governments when examining competition, this study has paid less attention to tax competition and efficiency in earmarked expenditure, transportation spending.

To contribute to the extant research, this study visits the Leviathan hypothesis to explore the association of LOST competition and efficiency in earmarked spending on the purpose of transportation in California counties in the period from 2003 through 2015. The empirical analysis depends on a two-step empirical procedure of the Malmquist productivity index to measure the efficiency in transportation spending and of the Tobit regression model to examine the Leviathan hypothesis. The empirical estimates provide evidence that LOST competition across county governments enhances the efficiency of transportation spending. However, the earmarks of LOST-Ts are more likely to decrease the efficiency of transportation spending. This is because an earmark expands the spending as input, given that the output is consistent. The findings indicate that a higher-taxing county is more likely to lose shoppers to its neighboring counties with lower sales tax rates, and that the revenue of the higher-taxing county will be smaller. Transportation spending will decrease in a county that levies LOST-Ts and sets the higher LOST-T rate followed by the lower LOST-T revenue, which results in the higher efficiency.

This study begins with an overview of the Leviathan hypothesis for government competition and efficiency. The study further discusses LOST for the Leviathan hypothesis and introduces LOST-Ts in California. An estimation strategy and variables are then addressed, and empirical results provided. Lastly, this study concludes by discussing the findings.

2. LOST AND THE LEVIATHAN HYPOTHESIS

The heterogeneity of the U.S. fiscal federalism raises inter- and intra-jurisdictional competition because they rival each other in an attempt to obtain more benefits and to avoid cost wastes. Competition across governments depends on the scarcity of resources from diverse policy tools such as tax, regulation, welfare, expenditure and other government policy initiatives.

Among the competition theories, the Leviathan hypothesis predicts an inverse relationship that governments constitutionally grow in power and size, but competition reduces their rent-seeking behavior. Brennan and Buchanan (1980) regarded bureaucrats as a monolithic Leviathan that seeks to maximize their revenues from all the constitutional tax sources for their own interests rather than of the voters who pay taxes. Theoretical propositions have suggested that competition through mobile taxpayers indirectly constrains the fiscal exploitation of the Leviathan. Contrastingly, Oates (1985) provided a counter argument that fiscal decentralization expands government spending, as well as results in a loss of some economies of scale and an increase in administrative costs. Followed by a suggestion which is contrary to the Leviathan hypothesis, Oates and Wallis (1988) argue that local governments become larger as the fiscal decision-making process becomes decentralized with greater control over public decisions. However, the two theoretical viewpoints of the Leviathan hypothesis do not necessarily contradict each other because fiscal decentralization might increase the expenditure of local governments while decreasing the overall government spending, especially the federal government (Shadbegian, 1999).

Among the two theoretical viewpoints of the Leviathan hypothesis, many studies have supported the Leviathan hypothesis. An examination on whether the competition for mobile

residents certifies the efficient delivery of public services confirmed that competition does not prevent governments from pursuing policies for the residents in spite of the increase in the number of jurisdictions that might diminish government power to tax in excess expenditure (Epple & Zelenitz, 1981). Assuming that bureaucrats are neither fully benevolent nor fully self-interested, Edwards and Keen (1996) verified that tax revenue is partially beneficial to both jurisdiction welfare and bureaucrats, and that competition for mobile capital might fail the efficient allocation of resources between public and private sectors. Rauscher (1998) pointed out that governments use immobile factors (i.e. infrastructure and institutional capital) to attract mobile private capital by maximizing rent from tax revenue, so that the government can savor the benefits. Therefore, competition is not inevitably harmful because the gains in efficiency could be sufficient in cancelling out the losses from bureaucratic waste. When governments levy benefit taxes to expand the rent, competition results in lower tax rates and improves the welfare of the society as governments are forced to redistribute the rent to the society.

Several studies on the Leviathan hypothesis, stated by Brennan and Buchanan (1980), have measured and regarded competition as taxes and expenditures resulting from mobile residents. They further assert that competition raises government efficiency and restricts the growth of government in size and power. Hughes and Edwards (2000) obtained both relative and absolute efficiency scores in the Minnesota counties. Their findings supported the Leviathan hypothesis that stated that the efficiency scores were greater in a county under competitive pressure from decentralization, while a larger jurisdiction land area caused inefficiency as diseconomies of scale. Apolte (2001) examined whether competition prevents the Leviathan governments from freely selecting tax instruments. The examination suggested that competition alone is not a sufficient constraint on the Leviathan behavior of governments and cannot

perfectly substitute efficiency. Dowding and Mergoupis (2003) failed to find evidence that shows that a more greatly fragmented government structure expands efficiency. Fiscal mobility in a fragmented structure might expand competition among governments; however, there was no evidence to confirm this assertion. Bates and Santerre (2006) suggested that competition helps governments to allocate resources with greater efficiency and that efficiency increases in market areas with more non-public schools. Barankay and Lockwood (2007) emphasized the association between competition among local governments and productive efficiency in providing education. They found that decentralization in the expenditure of education enhances competition and increases efficiency in educational attainment. The benefits of efficiency become greater when central governments are less competent.

This study turns the research focus to LOST[1] as a local power to tax for fiscal decentralization to test the Leviathan hypothesis on whether competition for a mobile tax base enhances technical efficiency in public service. LOST revenue has two purposes that expand the local revenue capacity and raise earmarked funds for specific local capital projects. An earmark is a tool used to check the Leviathan behavior of governments and earmarked tax revenue is a benefit tax (Brennan & Buchanan, 1980). However, the effects of earmarked revenue on efficiency are partial. Further, expenditure cannot achieve the goals for any specific project because the earmarked revenue becomes a portion of the unified budget (Oakland, 1984). Earmarked revenue should be administered in a separate budget so as to necessarily coordinate

[1] As of 2015, 38 states allow their local governments to levy LOSTs, aiming to raise local revenue capacity and to expand funding specific projects. More than 10,000 local governments in the U.S. have adopted LOSTs (Walczak & Drenkard, 2017), which has expanded competition across states and local governments due to the ease of cross-border movement.

all agencies that spend the earmarked revenue (e.g., moving gasoline tax from the general fund category).

Earmarked revenue has been considered to provide greater benefits for popular capital projects funding out of the general fund (Bowman, MacManus, & Mikesell, 1992). Some studies provide evidence for the effects of earmarked taxes on the Leviathan hypothesis. Practitioners prefer earmarking in the fiscal decision-making process because they anticipate a funds in exchange for a specific program (Goetz, 1977). Dye and McGuire (1992) further showed that earmarked revenues neither increase specific expenditures nor expand the entire spending. An earmark arranges budget items and leads a representative to certify a certain level of public service through specific budgetary items; furthermore, earmarked budgetary items constrain fiscal problems in a particular item from spreading to other budgetary items (Hsiung, 2001). An examination of the accommodation tax earmarked on tourism promotion showed that all the earmarked revenue failed to substitute for spending on tourism programs without monitoring (Blackwell, Crotts, Litvin, & Styles, 2006). The findings suggested that governments should create an agency that monitors the process of compliance. In addition to vehicle registration fees, the revenue from gasoline tax is designated to be spent on highway construction and maintenance. However, it does not have actual effects (Crowley & Hoffer, 2012); furthermore, they did not find any significant effects of earmarked revenue on education spending. The Leviathan governments prefer grants to earmarking (Liberati, 2011); however, competition between the central government and its lower-level governments impels the assigning of earmarks to local taxes. Earmarked tax revenue will decrease general funds spent on earmarked programs, but increase the spending elsewhere, which also expands the government.

Contrastingly, a meta-analysis (Sobel & Crowley, 2010) shows that approximately 45 cents from one earmarked dollar is spent on the intended program, while a state government spends between 22 and 78 cents of one earmarked grant dollar on an intended program (Novarro, 2002). Jung (2002) revealed that earmarked LOST revenue expands capital spending more than the revenue itself. Therefore, the fiscal decision-makers in local governments find it more difficult to shift the earmarked revenue to other fiscal functions. Afonso (2015) estimated that one-dollar generated by LOST earmarked on transportation expands more than one-dollar (about $1.76) on the transportation expenditure, while decreasing the spending on other functions less than one-dollar (about $0.73).

Studies on the Leviathan hypothesis have focused on the earmarked spending from government grants; however, the grantees (local governments, here) are not certain how much they receive due to their limited fiscal capacity to the grantors such as the federal and state governments. In spite of the mounting importance of LOST as an expansion of fiscal autonomy in local governments, few studies have focused on the LOST revenue to test the Leviathan hypothesis. To fill this gap, this study aims to explore the effects of the earmarked spending from LOST revenue on the efficiency in California local spending.

3. CALIFORNIA LOST EARMARKED ON TRANSPORTATION

California legislated LOST in 1955. All Californian counties have adopted ordinances for the board of equalization to collect LOST since 1965. California collects both state and LOST revenues. The collected revenues are allocated to local governments that have adopted LOST. LOST in California is mostly earmarked for specific projects in addition to revenue capacity

(Yee et al., 2013).[2] The State of California has attached some strings to the increase of LOST rates. However, major voters approve any changes in LOSTs. Moreover, local voters determine an earmark before actually imposing it. Further, the approval of local voters is a legal step to constraining expansions in local spending.[3]

There is a growing tendency of local governments to finance their transportation projects and investments with LOST-Ts instead of user fees (Bishop-Henchman, 2013). As a result of government efforts to explore funding options for transportation, LOST-Ts have gradually shifted the financial base for transportation projects from user fees toward broader-based taxes (Adams et al., 2001; Hannay & Wachs, 2007).[4] In California, only fuel taxes failed to generate the necessary revenue to finance transportation projects (Crabbe, Hiatt, Poliwka, & Wachs, 2005). Therefore, LOST-T revenue, in addition to developer and impact fees and transit fares should be spent on the maintenance of highways, streets and roads, and the development of transportation systems and public transit.

Operations and maintenance of existing transportation facilities receive funds from LOST-T revenue; this is a consistent trend in expenditures through LOST-Ts. However, the transportation facilities receive less than new capital transportation projects. Due to their unique advantages for transportation projects compared with other tax instruments,[5] LOST-Ts gained

[2] The specific projects are transportation, public health, education, public safety, environment and earthquake recovery. Earmarks for transportation purposes include rail-rapid transit district, community transportation authority and improvement, and street improvement. Public health purposes include community health, healthcare, and emergency medical service. Education purposes focus on public libraries, parks and recreation, open spaces and zoos.
[3] The maximum rate of all the LOST in any jurisdiction cannot exceed 2% except for the counties of Alameda, Contra Costa, and Los Angeles (Institute for Local Government, 2016).
[4] Historically, fuel taxes have been a critical means to fund the infrastructure for highway and roadway. In the sense of earmark, the revenue from fuel taxes has been earmarked exclusively on transportation funding (Hannay & Wachs, 2007).
[5] Please see the details for the four advantages in Crabbe et al. (2005).

nation-wide popularity as a primary funding source for transportation projects. Moreover, LOST-Ts expand fiscal autonomy in Californian local governments. Transportation investments and projects are the most popular sectors for which a local government has an earmark in place in California. Seventeen counties adopted LOST-Ts in the 1980s when they were first available. Further, LOST-Ts have since become a critical funding source for transportation projects in California (Afonso, 2015; Hannay & Wachs, 2007; Wachs, 2003). Californian counties are authorized to collect and administer LOST-T revenue and oversee the use of the funds.

[Figure 1 here]

As of 2015, 21 Californian counties levy their own sales tax earmarked on transportation spending. Figure 1 compares the LOST-Ts in 2015 with the first year 2003 of the empirical analysis in this study. The choropleth map shows that LOST rates in California counties have increased in 12 years and that the highest sales taxing areas are the largest counties, such as Alameda, Los Angeles, and San Francisco. Furthermore, the counties closest to the largest counties are shown to set their LOST at a high rate; LOST-Ts have also expanded.

4. EMPIRICAL STRATEGY AND VARIABLES

To examine the association of LOST competition and local government efficiency as the Leviathan behavior, it is necessary to have inputs and outputs to measure government efficiency. However, the unavailability of fully reasonable data on inputs and outputs at the local level leads to a focus on financial measures. Extant literature on the above mentioned Leviathan hypothesis has explored competition in terms of technical efficiency. Furthermore, competition is measured by levels of revenue and expenditures. Government efficiency is important in evaluating government performance; technical efficiency refers to the ability to maximize possible outputs

by avoiding cost wastes (Dollery, Wallis, & Worthington, 2001; Nathan, 2006; Oum, Yan, & Yu, 2008). Citizen mobility increases technical efficiency in government productivity and reduces waste. This study tests the effects of competition on the technical efficiency of transportation spending in Californian county governments to through a two-step procedure.

4.1 First Step: Measuring Efficiency

Multiple empirical techniques have been employed to measure technical efficiency. The techniques can be summarized as parametric and non-parametric methods.[6] This study estimates the technical efficiency in spending on transportation including LOST-Ts. The data envelopment analysis (DEA) approach in the measurement of productivity and performance is a widespread useful tool. The DEA constructs the best frontier over a set of decision-making units (DMU) and measures the distance of each DMU from the frontier. The distance indicates relative efficiency by comparing the efficiency scores among the DMUs. The DEA combines all input and output quantities and estimates the technical efficiency score of each DMU from zero to unity. The DEA decomposes total technical efficiency into pure and scale efficiency without considering functional forms and distributional assumptions (Charnes, Cooper, & Rhodes, 1978; Cooper, Seiford, & Zhu, 2011; Hughes & Edwards, 2000; Ji & Lee, 2010). In spite of its prevalence, the DEA cannot fully control for time variations in the measurement of efficiency. Caves et al.

[6] The methods classified as parametric are Stochastic Frontier Analysis, Deterministic Frontier Analysis, and Corrected Ordinary Least Squares. The non-parametric methods are Total Factor Productivity, Free Disposal Hull, and Data Envelopment Analysis (Färe, Grosskopf, & Lovell, 1985; Sheskin, 2003).

(1982) introduced the Malmquist productivity index (MPI) that calculates the relative efficiency of performance in each DMU (a county, here) at different time periods.[7]

Based on a panel dataset, this study employs the MPI to measure technical efficiency in transportation expenditures. The MPI approach requires the proper selections of input and output quantities of DMUs in the time span. The identification of inputs and outputs to assess relative/comparative efficiency is the most important step in utilizing the MPI (Fuentes, Grifell-Tatjé, & Perelman, 2001). Most LOST-T revenue is used to fund capital projects such as the construction and maintenance of highways, local roads, and transits. Local governments provide financial support for public transit services in addition to their general funds. Both funds are spent to maintain local roads in California (Watts, 2003).

To measure technical efficiency in transportation spending, this study selects the mileage of maintained public roads in each county according to the road performance monitoring system as the output (California Department of Transportation, 2017). As the inputs, this study considers the money spent on transportation purposes such as capital outlays and operating spending on roads, and transportation systems and terminals (Afonso & Fernandes, 2006). Additional inputs include population and area size because they are proxies for the demands of road service.

The non-parametric frontier in MPI is constructed as the piecewise linear combination in a sample like DEA. The frontier is measured in two ways: constant returns to scale (CRS) and variable returns to scale (VRS). The CRS obtains technical efficiency without considering the size, while the VRS compares DMUs within a similar scale. The CRS generates an overall

[7] In addition to the measures of technical efficiency along with time variations, the MPI decomposes technical efficiency into the two components of changes in efficiency and technology between two years by using a contemporaneous data and time variants of technology in the period. Therefore, MPI using DEA is more appropriate for a panel data format due to time-variant effects (Lee, Leem, Lee, Thales, & Lee; Pastor & Lovell, 2005; Tone, 2011).

technical efficiency score by combining pure and scale technical efficiency, while the VRS corrects for scale influences to obtain pure technical efficiency. The CRS is appropriate when all DMUs operate at an optimal scale. Furthermore, pure technical efficiency is better to examine the arguments of competition (Barros, 2008; Fuentes et al., 2001; Growitsch & Wetzel, 2009; Hughes & Edwards, 2000; Tone, 2011; Worthington & Dollery, 2000).[8] This study employs the VRS approach to attain the efficiency scores of the maintained roads in Californian counties because it can identify optimal scale and pure technical efficiency regardless of the fact that a Californian county does not operate at an optimal scale.[9] Table 1 describes the average miles of maintained roads and VRS efficiency score rankings in the sample period.

[Table 1 here]

4.2 Second Step: Tobit Regression Analysis

The efficiency scores from the VRS approach of the MPI model are used as the dependent variables in the regression analysis. The efficiency scores are bounded below by unity. Therefore, selecting a regression model that can recognize the distribution of the dependent variable of the technical efficiency scores and account for the differences in the scores among county governments is necessary. This study employs a Tobit regression model because

[8] A significant difference between the CRS and the VRS is whether scale efficiency exists. The CRS approach generates an overall technical efficiency score by combining pure and scale technical efficiency. The CRS approach considers the long-term perspective with the increase in competition. The VRS approach assumes that output levels are not proportionately reduced with input levels. This assumption renders the VRS approach a better way of obtaining efficiency scores by correcting for scale influences to obtain pure technical efficiency. Hence, the VRS approach is more appropriate for calculating the efficiency scores here.

[9] The Californian department of transportation defines the maintained roads in San Francisco as city roads because San Francisco is a consolidated government form. Therefore, the empirical analysis excludes San Francisco.

the MPI efficiency scores violate the normal distribution assumption of the ordinary least squares (OLS) regression model.

The Tobit regression model censors the observations out of the bounded areas (right-censoring in this study) to resolve the skewness in the distribution of the dependent variable. The Tobit regression model uses a latent variable for the censoring mechanism of a limited dependent variable (De Borger & Kerstens, 1996). The latent variable of the technical efficiency scores cannot be directly observed. However, it is obtained by censoring a limit level of unity and partially masking the actual values of the efficiency scores that are positively associated with the latent variable (Simar & Wilson, 2007). Consequently, actual technical efficiency scores are observed when the latent variable is greater than the unity, while actual scores are equal to the unity when the latent variable is the same as or smaller than the unity. Based on the two-step empirical strategy, the Tobit regression model is specified as follows:

$$TE_{it}^{*} = \alpha + \rho \boldsymbol{W} TE_{ijt} + \gamma STR_{it} + \sigma \boldsymbol{W} STR_{ijt} + \delta TRANS_{it} + \tau CON_{it} + \varepsilon_{it} \quad (1)$$

This model supposes a latent variable TE_{it}^{*}. This latent variable linearly depends on the explanatory variables. In the Tobit regression model above, the latent variable is observed only when it is smaller than the unity of 1:

$$TE_{it}^{*} = \begin{cases} TE_{it} & if\ TE_{it} < 1 \\ 1 & otherwise \end{cases} \quad (2)$$

where the dependent variable (TE_{it}) indicates the efficiency scores for expenditure on the transportation services in a county i in a fiscal year t, obtained by the VRS approach of the MPI. Regarding the efficiency scores, the output is the mileage of maintained public roads in each county (California Department of Transportation, 2017), while the inputs are the expenditures on roads and transportation (California State Controller's Office, 2017). The right side of the Tobit regression model includes a spatially lagged dependent variable that indicates competition with

the contiguous counties j using geospatial matrix $\boldsymbol{\mathcal{W}}$ in Equation (1).[10] The term ($\boldsymbol{\mathcal{W}}$) is a spatial lag term, normalized by rows to indicate whether a county shares a border with its neighbors. According to the Leviathan hypothesis, the spatial lag term generates the average technical efficiency of the neighbors, while the spatially lagged dependent variable accounts for competition.[11] Furthermore, the geospatial matrix is used to obtain the average LOST rate of the neighboring counties to control for LOST competition; additionally, the sales tax rate (STR) in a county includes the average LOST rate of the sub-county governments (municipalities) within the county to consider a potential vertical LOST competition. That is, the empirical model adds the sales tax rate (STR) of a county i, its municipalities, and its neighboring counties and municipalities j in a fiscal year t. These two variables account for the two forms of tax competition across counties and municipalities both horizontally and vertically, which affect the LOST-T revenue. These four variables are used to capture the competition that tests the effects of the Leviathan hypothesis on technical efficiency (Janeba & Osterloh, 2013). The empirical model ($TRANS_{it}$) includes a dummy variable indicating whether a county levies LOST-Ts and

[10] In a decentralized government system, the spatial dimension is important in the decision on spending performance that relies on spillover effects to explain the existence of competition among neighboring jurisdictions (Baicker, 2005; Costa, Veiga, & Portela, 2015; Ermini & Santolini, 2010). Furthermore, the spending decision of each jurisdiction is made by both its own characteristics and policies chosen elsewhere. Therefore, spillover effects associate any spending decision of a jurisdiction with the neighbors in complementary and/or substitute ways; the decision either positively or negatively affects the expenditure levels among jurisdictions; additionally, spillover effects raise free-ride in road and transportation services (Afonso & Fernandes, 2008; Prieto & ZofIo, 2001).

[11] The extant studies on the association between competition and technical efficiency considered the numbers of contiguous governments and general/special purposes of governments as absolute values and population-normalized values to measure the degree of technical efficiency (Grossman, Mavros, & Wassmer, 1999; Hayes, Razzolini, & Ross, 1998; Hughes & Edwards, 2000). However, this measurement is not appropriate for a panel data analysis because the numbers were not variant. Therefore, this study considers the technical efficiency score as an average value of the contiguous counties for empirical analysis.

the other revenues, collected from road projects, road service, road permits, and grants from the state as the LOST-T revenue can be only spent on transportation infrastructure projects. To resolve any potential endogeneity, the fiscal variables relevant to LOST and revenue were included as one-year lagged values.

In conclusion, the variables (CON_{it}) control for political, economic, and socio-demographic conditions that determine the demands of transportation and road services as well as the budget of the government. The ratio of voters to the Republican candidates from the four sets of election results measure the political condition (CQ Press, 2017). This study considers income level (U.S. Bureau of Economic Analysis, 2017), poverty (U.S. Bureau of Census, 2017b) and unemployment rates (U.S. Bureau of Labor Statistics, 2017) as economic conditions that capture the business cycle, as well. Socio-demographics is composed of population density and the ratios of female, white, black, Hispanic, young (under 20 years old) and senior (more than 65 years old) populations (U.S. Bureau of Census, 2017a). In conclusion, the Tobit regression model includes two sets of dummy variables for counties and years to specify the fixed-effects with clustering the robust standard errors by counties. Table 2 summarizes the variables for the empirical analysis.

[Table 2 here]

5. RESULT

Table 3 reports the results of the Tobit regression model that indicates the effects of competition on technical efficiency for the Leviathan hypothesis.[12] The Tobit regression result

[12] This study uses a two-step approach in that the input-oriented MPI–VRS approach calculates pure technical efficiency scores of 57 Californian counties in the period of 13 years in the first step. The efficiency scores are further regressed with the right-censoring.

provides convincing evidence that supports the beneficial views of the Leviathan hypothesis. The efficiency in each county is positively and significantly affected by the efficiency of neighboring counties. As a result of competition in the Leviathan hypothesis, a 1% increase in the efficiency score in neighboring counties is more likely to raise the score of a county by 0.29% points. Competition enhances the technical efficiency in transportation spending across counties as a reduction of government waste or rent-seeking behavior.

[Table 3 here]

Additionally, another form of competition considered in this study is tax competition that affects the efficiency. A higher LOST rate set by a county is likely to increase its efficiency score. A 1% increase in the LOST rate in a county is likely to raise the efficiency score by 0.152. When a county increases its LOST rate, the shoppers are more likely to cross the borders to shop in their neighboring jurisdictions where sales taxes are lower. Furthermore, the cross-border shoppers reduce government spending earmarked on transportation as well as reduce sales tax revenue. On the efficiency side, the input measured as the size of expenditures on roads and transportation becomes smaller in the efficiency score. Contrastingly, the LOST rate in neighboring counties is negatively associated with the efficiency score of a county. When the average LOST rate rises in neighboring counties, the likelihood that more shoppers come to the county becomes greater, which drives the county to collect more revenue and expand its expenditures earmarked on transportation, given that it has LOST-Ts. Therefore, the efficiency score is more likely to decrease in a county when its neighboring counties raise their LOST rates.

The efficiency score is likely to decrease in a county that collects sales tax revenue earmarked for transportation, following the Afonso's estimates (2015). This is consistent with the negative association of LOST rate and efficiency score. The revenue generated by LOST-Ts

expands the spending on transportation purposes, which results in a greater input for the efficiency score. Therefore, the adoption of LOST-Ts in a county government increases the expenditures on transportation, especially on new transportation capital projects financed by LOST-Ts; however, the efficiency in spending on transportation becomes lower as a result of the greater input for the efficiency score. The revenue from roads is spent on road maintenance and transportation. Therefore, its negative effects are consistent with the earmarked revenue on transportation.

Furthermore, heterogeneous trends are quite possibly correlated with the changes in the LOST rate within and across jurisdictions. For instance, the LOST rate of a county might have been a significant determinant on the adoption of LOST-T and/or LOST rate changes in the county and its neighboring counties which enables them to expand their expenditures on transportation. If so, the estimates of the Tobit regression are unlikely to capture the causal impact of tax competition, resulted from any changes in the LOST policy, on the efficiency of government transportation spending. The baseline model with the specifications of counties and year fixed-effects estimates the effects of LOST change on the efficiency in transportation spending with the neighboring counties. As a robustness check, a modified model is considered, including two interaction terms of LOST-T with the LOST rate in a county and its municipalities because the higher LOST rate quite possibly prevents counties from adopting LOST-T and/or raising LOST-T rate. Table 3 provides the estimates with the two interaction terms. Furthermore, the estimates are quite consistent with the estimates without the interaction terms. When the interaction terms are included, the estimates provide a significant effect of vertical tax competition measured by the average LOST rate in the municipalities of a county. These findings support the extant research that tax competition for mobile factors of production helps

jurisdictions to raise their efficiency (Keen & Kotsogiannis, 2003; Rauscher, 1998; Yamaguchi, 2004).

Focusing on control variables, the economic conditions in a county provide consistent estimates that raise the efficiency scores in its transportation spending. Among the three variables of economic conditions, income level has a greater effect on the efficiency score because poverty and unemployment have longer consistent effects on the business cycle compared with income level. A county supportive to the Republican Party is more likely to generate a higher efficiency score. However, a denser county is less efficient in transportation spending.

6. CONCLUSION

This study examines the Leviathan hypothesis whether competition enhances efficiency in the delivery of public services. The examination focuses on the cost efficiency of transportation spending in a sample of county governments in California, United States in the period from 2003 through 2015. The input is defined by the current spending of county governments on transportation and roads; the output is the mileage of maintained public roads in each county. Regarding the empirical analysis, this study focuses on transportation services in California county governments. To capture competition across county governments, this study obtained the average value of efficiency scores in the neighboring counties through the geospatial matrix. Furthermore, tax competition is considered to control for another form of competition because the California local governments rely heavily on LOST earmarked for transportation spending. This study recognizes tax competition both vertically, measured by the

average STR in the municipalities within a county, and horizontally through the geospatial matrix for counties and municipalities.

The empirical strategy is based on two steps. The first step is the MPI which is used to generate an efficiency score for transportation spending of the California county governments. The second step employs the Tobit regression model because the efficiency scores are bounded below by unity. The two-step empirical analysis provides robust evidence that competition improves the efficiency in transportation spending across county governments.

Additionally, the result revealed that a high STR levied by a county positively influences the efficiency in transportation spending because the higher rate increases the likelihood that a shopper will cross borders to a neighboring county in a lower-taxing area, hence decreasing sales tax revenues in a higher-taxing county. Following this finding, a county with LOST-Ts is less likely to generate a higher efficiency score because transportation spending will expand given that the outcomes as well as the size of the budget item of revenue from roads are constant. The LOST rate in the neighboring counties is negatively associated with the efficiency score because a county is more likely to have shoppers from the neighboring counties in the higher-taxing areas. Furthermore, the decrease in efficiency score results from the expansion in transportation spending of the county. Therefore, this study implies that competition across local governments tames the Leviathan hypothesis and develops the efficient delivery of public services.

However, this study has a limitation that the data in this study is not sufficient to generalize the findings to other types of public services. However, transportation is a policy area that needs more investments for capital projects including maintenance of the extant infrastructure than other services. Thus, future research needs to consider other policy areas financed by earmarking LOST revenue. For example, education services are financed with

earmarked LOSTs in some states such as Georgia and North Carolina. This policy area can, therefore, be an interesting possibility for future study. Another direction for future research is to explore the interactions of each earmarked fund collected by LOSTs to government efficiency.

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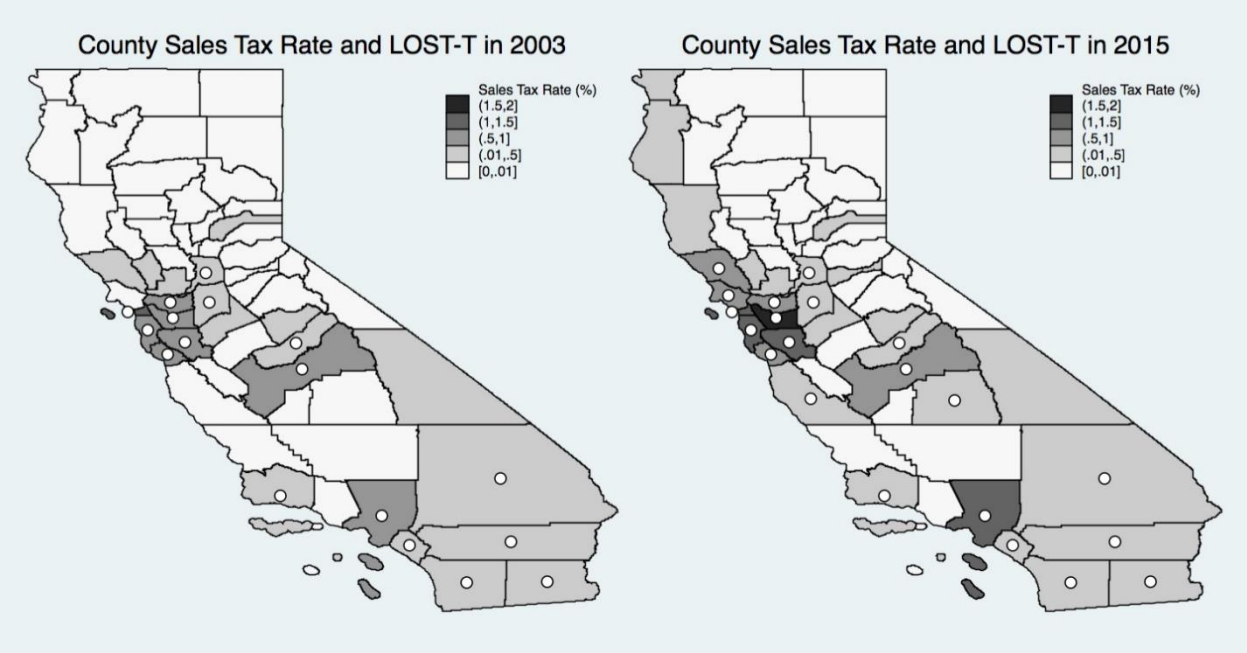
Figure 1: Comparison of Local Sales Tax Rates and LOST-T



Note: The rate is the total local sales tax rate that a county levies. The white circle in a county indicates that the county levies LOST-Ts. The 21 counties are Alameda, Contra Costa, Fresno, Imperial, Los Angeles, Madera, Marin, Monterey, Orange, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, San Joaquin, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Sonoma and Tulare.

Table 1: Average Miles of Maintained Roads, Efficiency Score and Ranks in California Counties (2003-2015)

No	County	Avg. miles	VRS score	Rank	No	County	Avg. miles	VRS score	Rank
1	Alameda	470.10	0.072	55	30	Orange	307.14	1.000	1
2	Alpine	133.49	1.000	1	31	Placer	1043.23	0.154	47
3	Amador	411.69	0.776	10	32	Plumas	674.08	0.337	33
4	Butte	1355.42	0.394	28	33	Riverside	2611.99	0.112	49
5	Calaveras	689.03	0.769	11	34	Sacramento	2353.59	0.092	50
6	Colusa	716.75	0.545	20	35	San Benito	384.84	0.302	35
7	Contra Costa	657.48	0.042	56	36	San Bernardino	2842.59	0.377	30
8	Del Norte	303.65	0.545	21	37	San Diego	1904.62	0.082	52
9	El Dorado	1063.69	0.166	45	38	San Joaquin	1656.49	0.168	44
10	Fresno	3614.82	1.000	1	39	San Luis Obispo	1293.62	0.260	39
11	Glenn	860.96	0.685	14	40	San Mateo	316.09	0.081	54
12	Humboldt	1204.94	0.320	34	41	Santa Barbara	902.34	0.118	48
13	Imperial	2552.91	1.000	1	42	Santa Clara	685.08	0.014	57
14	Inyo	1133.10	0.740	12	43	Santa Cruz	599.44	0.209	42
15	Kern	3298.66	1.000	1	44	Shasta	1187.91	0.222	41
16	Kings	955.65	0.876	8	45	Sierra	390.17	0.473	26
17	Lake	612.95	0.509	23	46	Siskiyou	1361.74	0.478	25
18	Lassen	905.14	0.598	18	47	Solano	600.17	0.252	40
19	Los Angeles	3102.76	0.081	53	48	Sonoma	1387.40	0.156	46
20	Madera	1548.50	0.697	13	49	Stanislaus	1546.48	0.292	37
21	Marin	419.97	0.267	38	50	Sutter	825.37	0.601	16
22	Mariposa	560.41	0.575	19	51	Tehama	1091.12	0.637	15
23	Mendocino	1018.95	0.536	22	52	Trinity	699.92	0.384	29
24	Merced	1726.96	0.404	27	53	Tulare	3064.85	1.000	1
25	Modoc	987.40	0.787	9	54	Tuolumne	604.09	0.507	24
26	Mono	685.07	0.944	7	55	Ventura	543.29	0.085	51
27	Monterey	1242.22	0.188	43	56	Yolo	804.15	0.361	31
28	Napa	445.76	0.361	32	57	Yuba	589.02	0.598	17
29	Nevada	564.53	0.299	36	**TOTAL**		**1173.26**	**0.415**	

Table 2: Summary Statistics of Variables (n=741)

Variables	Mean	S.D.	Min	Max
VRS efficiency score	0.415	0.292	0.014	1.000
VRS efficiency score (spatial lag)	0.413	0.169	0.062	0.923
County local sales tax rate (%)	0.274	0.384	0.000	2.000
Municipal sales tax rate (%)	0.114	0.183	0.000	0.918
County local sales tax rate (%; spatial lag)	0.275	0.265	0.000	1.313
Municipal sales tax rate (%; spatial lag)	0.113	0.100	0.000	0.504
LOST-T	0.321	0.467	0.000	1.000
Per capita revenue from road (logged)	3.497	1.264	-2.173	7.410
Per capita income (logged)	10.552	0.263	10.052	11.509
Poverty rate (%)	15.135	4.874	5.600	29.700
Unemployment rate (%)	9.512	4.014	3.394	28.965
Voters to Republican (%)	50.383	12.941	16.701	71.313
Population density (persons/sq. miles; logged)	4.448	1.883	0.395	8.302
White population (%)	83.422	9.267	51.281	96.063
Black population (%)	3.512	3.425	0.000	15.494
Hispanic population (%)	28.003	17.051	4.981	82.673
Young population (%)	26.817	4.397	16.986	37.032
Senior population (%)	13.922	4.156	6.475	27.671
Female population (%)	49.389	2.366	35.058	51.969

Table 3: Tobit Regression Result

VARIABLES	Coef.	S.E.	Coef.	S.E.
$\boldsymbol{W}$ × Efficiency score	0.292***	(0.094)	0.289***	(0.094)
Local sales tax rate (lagged)	0.152***	(0.046)	0.134*	(0.075)
Municipal sales tax rate (lagged)	-0.057	(0.052)	-0.104	(0.083)
$\boldsymbol{W}$ × Local sales tax rate (lagged)	0.111**	(0.049)	0.072*	(0.043)
$\boldsymbol{W}$ × Municipal sales tax rate (lagged)	0.443***	(0.115)	0.354***	(0.118)
LOST-T (lagged)	-0.108***	(0.033)	-0.157***	(0.042)
Interaction of LOST-T and county rate (lagged)			-0.016	(0.087)
Interaction of LOST-T and municipal rate (lagged)			0.625***	(0.151)
Per capita revenue from road (lagged)	0.011	(0.010)	0.011	(0.010)
Per capita income	0.510***	(0.065)	0.510***	(0.065)
Poverty rate	0.037***	(0.003)	0.036***	(0.003)
Unemployment rate	0.011**	(0.004)	0.007	(0.005)
Voters to Republican	0.008***	(0.001)	0.008***	(0.001)
Population density	-0.098***	(0.010)	-0.099***	(0.010)
White population	-0.000	(0.002)	-0.003	(0.002)
Black population	0.005	(0.004)	0.005	(0.004)
Hispanic population	0.006***	(0.001)	0.007***	(0.001)
Young population	-0.000	(0.006)	-0.005	(0.006)
Senior population	0.005	(0.005)	0.006	(0.005)
Female population	-0.010*	(0.006)	-0.007	(0.006)
Constant	-5.149***	(0.791)	-4.954***	(0.785)
Observations	684		684	
Number of counties	57		57	
Log likelihood	432.511		432.816	
Pseudo R-square	2.6002		2.601	
LR Chi-square	1405.59***		1406.20***	
Left-censored observations	0		0	
Uncensored observations	613		613	
Right-censored observations	71		71	

Note: Robust standard errors in parentheses, and clustered by counties. The two sets of dummy variables for counties and years were included for the specifications of fixed-effects in the analysis, but not reported here. Statistical significances are *** p<0.01, ** p<0.05, * p<0.1.