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LOCAL SALES TAX, CROSS-BORDER SHOPPING, AND DISTANCE

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This paper, using Nebraska sales tax data, estimates the magnitude of cross-border shopping in response to distance when a local sales tax changes. First, I test the hypothesis that consumers do not have an incentive to cross a city border to shop when a tax changes. Then, I specify the elasticity of a local sales tax as the function of distance. The results demonstrate that a one percent point increase in a local sales tax would create cross-border shopping at the border by 10-14 %; 3-5% in a city that is 20 miles away from other cities (i.e. shopping areas). The results also suggest that the influence of cross-border shopping would virtually disappear in a city that is more than 31 - 38 miles away from other cities.

Keywords: sales tax, cross-border shopping, distance, local taxes

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The views and opinions expressed herein are those of the author and do not necessarily represent the views of the Nebraska Department of Revenue. All errors and omissions are my own.

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I. INTRODUCTION

In the standard framework, imposing a sales tax has the same effect as increasing the price of a taxable good.[1] If we identify price elasticities of taxable goods, then we could estimate the demand of goods and economic consequences when a tax changes. If consumers have alternatives, however, they would shift their purchasing to avoid sales taxes, and a policymaker would face unexpected economic consequences. For example, the recent internet shopping has been one of the major sources of avoiding state and local sales tax. Under the current U.S. Supreme Court ruling, online sellers must to be physically located in a particular state before that state collects sales tax on in-state sales (Rothenburg, 2007). Therefore, states cannot compel out-of-state sellers to collect the tax on sales to state residents. Instead, resident consumers are obligated to pay an equivalent use tax, but enforcement is sufficiently lax and cross-state internet sales generally go untaxed (Einav et al., 2014).

Another well-known phenomenon is cross-border shopping. The imposition or increase of a sales tax by one jurisdiction in a region will create an incentive for consumers to substitute purchases in the jurisdiction with the higher sales tax for purchases in the jurisdiction with the lower sales tax (Fisher, 1980). This cross-border problem has been recognized in studies for several decades[2] (McAllister, 1961; Mikesell, 1970; Mikesell, 1971), and they have found evidence that a sales tax differential between adjacent jurisdictions creates substantial cross-

[1] Recent empirical studies suggest that consumers pay less attention to taxes that are not salient. Because sales taxes are not displayed in posted prices, shoppers often underreact to tax changes than general price changes with striking consumer's welfare consequences (Chetty, Looney, and Kroft, 2009; Goldin and Homonoff, 2013)

[2] To distinguish the effect of cross-border shopping from 'border effect' that is defined as home bias phenomena in international trade (McCollum, 1995), I use the term 'cross-border shopping' and 'cross-border problem' throughout the paper.

border shopping and leads to decrease in tax revenue (Fox 1986; Tosun and Skidmore, 2007; Wooster and Lehner, 2010). Recent empirical work also suggests that the cross-border problem influence not only fiscal responsibility but also affects the decision of a local policy maker (Agrawal, 2013), and labor markets in a region (Thompson and Rohlin, 2012). While the most influential factor determining cross-border shopping is the travel distance between jurisdictions, previous studies do not explicitly address distance as a major explanatory variable and remain rather limited when understanding the consumer behavior of cross-border shopping.

This paper, using Nebraska state and local sales tax data, estimates the magnitude of cross-border shopping in response to distance when the sales tax rate changes.[3] In Nebraska, many cities levy local sales taxes, but counties do not impose local sales taxes.[4] Therefore, while a county that covers most of the geographical area can only impose the state sales tax, a center city within a county may have a higher sales tax rate, which is a combination of state sales tax rate and local sales tax rate, and remote from other cities (i.e. alternative shopping area) that may have different sales tax rates. This fact enables this study to measure a point-to-point distance between two jurisdictions (i.e. cities), who have differential sale tax rates, and eliminates the ambiguity related to distance between study areas such as "along borders", "border county vs inner county", or "neighboring jurisdiction" in previous studies. This measurement, therefore, provides a decent opportunity to access the sensitivity of the distance to cross-border shopping in response to sales tax changes.

[3] Many studies, especially in theoretical setting, used a variable 'travel cost' as a distance factor in order to optimize consumer behavior. In this empirical paper, travel cost is assumed to be linearly related to the road distance between cities. This study measures the road distance and uses it as a distance variable in the model directly.

[4] Only exception is Dakota County, which has South Sioux City among the sample cities, had been levied 0.5% local sales tax on January 2005, but terminated on January 2014. This fact should not impact on the results in the paper.

First, a standard demand model was built in response to change in sales taxes, specifically separating a state sales tax change from a local sale tax change. It enables this study to differentiate the effect of cross-border shopping from the general effects of a sales tax change on the demand of taxable goods. Then, three different geographical areas were grouped along with distance to a neighboring city to examine how geographical location affects an incentive to cross-border shop.

The finding is that the overall tax elasticity with respect to the local sales tax is approximately -8.5 percent, and the elasticity with respect to the state sales tax is approximately -4.3 percent. Consequently, a substantial difference exists, which can be interpreted as the effect of cross-border shopping. In regression with subgroups, I test the hypothesis that consumers do not have an incentive to cross a city border to shop when a local sales tax changes. Consequently, consumers are responding to the local sales tax the same way they respond to the state sales tax. I reject the null hypothesis at the 1 percent level in the examination of the group of clustered cities, and reject it at the 10 percent level in the group of mid-range cities, and however, I cannot reject it for the group of remote cities. The results imply that the closer a city is to a neighboring city, the larger the incentive for consumers to cross a city border to shop, and the incentive disappears in remote city, which is more than 40 miles away from a neighboring city.

Later, I expanded the model to incorporate a flexible second-order polynomial as the function of distance. Using the model's estimations, I illustrate the effect of a hypothetical 1 percent point increase in a local sales tax. The results suggest that 1) the demand of taxable goods would be reduced 10-14 percent by cross border shopping where the city is adjacent to a neighboring city, 2) in the city that is 20 miles away from a neighboring city, the demand of taxable goods would

be reduced by 3-5 percent point, 3) the consumers that live in remote city, which is more than 31 - 38 miles away from another city, may not have incentives to travel to avoid sales taxes.

The remainder of this paper is organized as follows. The second section provides a brief review of the previous studies. The third section provides a description of the data used throughout the analysis. The forth section is divided into two subsections. The first subsection presents a basic demand model and examines the model with different geographic subgroups. The second subsection incorporates distance in the demand model, and illustrates the influence of cross-border shopping. The fifth section provides concluding remarks.

II. PREVIOUS WORK

In a survey paper, when Leal, Lopez-Laborda, and Rodrigo, (2010) restricted their review only to the general tax on sales and the taxation on food and clothing in the United States, they found that a 1 percentage point increase in the rate of tax reduced sales in the affected territory by approximately 6 percent. The relationship was found to be robust, and the study concluded that the extent of cross-border shopping is significant, which justifies the emphasis economists place on the cross-border problem over the last several decades.

Mikesell (1970), using cross-sectional data for the cities of 173 Standard Metropolitan Statistical Areas, found with 95 percent confidence that a 1 percent point increase in the central-city sales tax relative to suburban tax rate would reduce per capita sale in the central-city between 1.69 to 10.97 percent. Fisher (1980) reviewed theoretical issues on local sales tax rate differentials, and examined the effect of tax rate differences between the District of Columbia and the surrounding area. He found that food sales in D.C. reduced 7 percent in response to a 1

percent point increase in the sales tax rate in D.C., but the effect on general sales was not statistically significant. Fox (1986) examined three metropolitan areas along the Tennessee border, and estimated about a 1 to 4 percent reduction in sales in the high-tax rate jurisdictions in response to 1 percent point increase in the sales tax rate. He incorporated a travel cost variable into the model, but it is not statistically significant.

Walsh and Jones (1988) examined food sales in West Virginia during its phase out of the sales tax on food between 1980 and 1982. Using a pooled multivariate model for all West Virginia counties, Walsh and Jones found that a 1 percent point drop in the sales tax rate resulted in an increase in grocery store sales by 5.9 percent and a statistically significant increase in grocery store sales in the border counties, while no such effect was seen in the interior counties. Tosun and Skidmore (2007) reexamined food sales in West Virginia as the state reintroduced the food sales tax in 1989 at the rate of 6%. Controlling for fixed effects, they estimated that a 1 percent increase in the county relative price ratio due to the sales tax change resulted in a decrease in per capita food sales by 1.38 percent, which is significantly lower than the results from Walsh and Jones (1988). Wooster and Lehner (2010) examined the cross-border shopping problem in Washington State, which has a high sales tax rate relative to its surrounding states. Controlling for unobservable county-specific characteristics and spatial autocorrelation, they found that the price elasticity generated by the sales tax discrepancy between the years 1992 and 2006 was −3.11 in border counties in Washington.

Although the several studies mentioned above have tested the existence of cross-border shopping in response to a general sales tax, much of research on cross-border shopping has been concentrated on the analysis of specific goods such as alcoholic beverages, cigarette, gasoline, and lottery because such goods relate not only fiscal responsibility and consumer welfare but

also legitimation and even health issues. Among the research examining the cross-border shopping problem, the following two papers explicitly addressed distance as a significant variable to determine cross-border shopping.

Lovenheim (2008) estimated cigarette demand when smuggling incentives exist.[5] The demand model incorporated the decision of whether to smuggle cigarettes across a lower-price border. Lovenheim set up the smuggling cost function using a log distance measure, and estimated the demand model. Using estimated parameters, Lovenheim simulated the effect of distance on the likelihood to smuggle. Asplund, Friberg, and Wilander (2007), using data from Swedish municipalities, estimated how responsive alcohol sales are to foreign prices and related the sensitivity to the location's distance to the border. They utilized a flexible third-order polynomial as the function of distance, and using estimations from the model, they illustrated alcohol sales elasticity in terms of distance from the border. This paper follows their empirical framework, which is parsimonious but effective in demonstrating the influence of distance on incentives to cross-border shopping.

III. DATA

For this study, I selected 44 mid-sized cities in Nebraska, where the population ranged from 2,000 to 50,000, and categorized each city into one of three groups, which was determined by the distance between cities.[6] The first group consists of the clustered cities. A clustered city is

[5] Smuggling in the paper means a casual smuggling which is when an individual consumer purchases cigarettes in a nearby lower-price locality and generally does not issue a legal problem.

[6] Since 1994, The Nebraska Department of Revenue has been providing sales tax data for 47 cities. Concerning statistical bias, three cities are excluded among them. First, I exclude two biggest cities, Omaha and Lincoln, in Nebraska because they are far bigger than other cities (In 2010 Census, Population in each city is 408,958 and 258,379, respectively), and they did not change their local sales tax rates during the sample period. Another city I dropped from the analysis is McCook city, which is a mid-sized south-west located city. When McCook imposed a 1

defined as any city that has a neighboring city within a 10 mile radius. A neighboring city in this paper defines the closest city from an origin city with a relevant shopping opportunity. A neighboring city must be bigger than the origin city, or has a population greater than 20,000 to provide comparable shopping opportunities for consumers. The second group consists of the mid-range cities. A mid-range city is defined as having a neighboring city within a 10 - 40 mile radius. The final group consists of all the remote cities. A remote city is defined as any city whose consumers must travel more than 40 miles to find a relevant shopping opportunity. Figure 1 displays the location of the 44 selected cities. Most cities are located in the southeastern region of Nebraska or along the I-80 highway. Using Google Maps, distance data were obtained by measuring central business districts between cities. Table 1 presents profiles of the 44 cities which include the city's current population, the name of its neighboring city, the distance to the neighboring city, and the changes in local sales tax rates that have occurred during the sample period.

Net taxable sales that do not include sales tax amount are available from the Nebraska Department of Revenue over the 1994-2010 period. Nebraska has imposed a state sales and use tax since 1967, and the current state sales tax rate is 5.5%.[7] During the sample period, Nebraska had changed state sales tax rates three times: 5% to 4.5% in July, 1998; 4.5% to 5% in July, 1999; and 5% to 5.5% in October, 2002.

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percentage point local sales tax first time on October, 2000, coincidently the headquarter of a big utility company had relocated outside of the city. Consequently, the taxable sales in McCook sharply dropped (more than 20 percent comparing with previous years). The decrease is most likely attributed to the relocation of the company. As a result, this city is dropped from the analysis to avoid a possible measurement error. However, the regression results including all three cities do not have any significant differences from the results in the paper.

[7] The formal name of the sales tax system in Nebraska is a sales and use tax, in which use tax is applied to goods bought outside the state. However, this paper focuses only on sales within the state and on interactions among Nebraska cities. Therefore, the term 'sales tax' is used instead of 'sales and use tax' throughout the paper.

Nebraska law allows local government to impose its own local sales tax. These local sales tax rates have ranged from 0.5% to 1.5 % during the sample period.[8] Between 1994 and 2010, the selected cities have exercised their ability to change local sales tax rates 63 times. Table 2 presents the number of local sales tax rate changes by groups. The Nebraska sales tax is levied on retail sales of tangible goods and some services, but is not levied on food for home consumption (groceries). The number of sales tax filing is also available from the Nebraska Department of Revenue. Note that the number of filings is not the same as the number of establishments because Nebraska regulates a filing frequency based on an estimated annual state sales tax liability.[9]

Based on the Consumer Price Index (CPI) of a Midwest class D city from the Bureau of Labor Statistics, I estimated two price indexes for taxable goods in Nebraska; one for cities in the Omaha metropolitan area and another for all other cities. The Nebraska Department of Revenue provides annual taxable sales by business class at the county level. I aggregated county level data into two groups, and then calculated a weighted price index by matching businesses into the appropriate CPI.

I obtained two control variables at the county level because city level data is not available, and then match each city into the appropriate county. Each county's annual personal income data is available from the Bureau of Economic Analysis. The county's quarterly personal income data was estimated based on quarterly state personal income data which is also available from the Bureau of Economic Analysis. Finally, I obtained data on the monthly unemployment rate by

[8] In 2013, Nebraska amended legislation allowing for local governments except in cities of metropolitan class, which are continuously limited to 1.5 percentage points, to increase its local sale tax rate up to 2 percentage point. But it is out of the sample period.

[9] Nebraska law regulates the filing frequency by the expected tax liability. Annual returns are required if the retailer's yearly tax liability is less than $900, quarterly returns are required if the yearly liability is $900 or more and less than %3,000, and monthly returns are required if the yearly tax liability is $3,000 or more.

county from the Bureau of Labor Statistics. Monthly data was then converted to quarterly data by averaging the three month rates.

Table 2 presents summary statistics for the pooled dataset. Six cities fall in the clustered city group, 19 fall in the mid-range city group, and 19 fall in the remote city group. Local tax rate changes occurred 4, 34, and 25 times in the clustered city, mid-range city, and remote city groups, respectively. As expected, the mean distance from the neighboring city was greatest for the remote city group at 58.49 miles, while the mid-range city group had a mean distance of 26.20 miles, and the clustered city group had a mean distance of 6.07 miles. Average net taxable sales were the greatest for the remote city group at $45,889,000, followed by the clustered city group at $32,210,000, and the mid-range city group had the lowest average net taxable sales at $16,816,000.

IV. EMPIRICAL ANALYSIS AND RESULTS

A. Simple Demand Function

Since most cities in Nebraska are geographically remote from cities in other states,[10] I assume that the changes in a state sales tax do not create an incentive to cross the state border to shop. However, the changes in a local sales tax may provide an incentive for consumers to cross a city border to shop at a city with a lower local sales tax rate. To empirically estimate the difference between the effects of a state sales tax and a local sales tax, I set up a simple demand function

[10] Exceptions are South Sioux City, which is adjacent to Sioux City in Iowa, and four cities in the Omaha metropolitan area that are close to Council Bluffs in Iowa. Sioux City is big enough to influence behavior of residents in South Sioux City. Meanwhile, the influence of Council Bluffs would be limited because Omaha is bigger than Council Bluffs, and the sales tax rate in Iowa is higher than in Nebraska. In addition, Omaha itself is out of the sample cities. However, the regression results excluding these five cities were not significantly different from the results in the paper.

that follows the framework introduced by Chetty, Looney, and Kroft (2009). The framework of the demand function, assumptions and the specification of the model are described below.

Consider an economy with two goods, *x* and *y*. First, assume that the supply of good is perfectly elastic, which places the burden from a change in a sales tax fully on consumers (Poterba, 1996; Besley and Harvey, 1999). Next, normalize the price of y to one and let p denote the pretax price of x, and assume that y is untaxed and x is subject to ad valorem sales taxes: a state sales tax τ^s , and a local sales tax τ^l. Then, the final price of x that the consumer has to pay is $q = (1 + \tau^s)(1 + \tau^l)p$.

Let $x(p, \tau^s, \tau^l)$ denote demand as a function of the price, a state sales tax, and a local sales tax. Both sales taxes have the same characteristics except for who levies the taxes and where the taxes are applied. Assume that a policy maker independently decides the rate of sales tax in such a manner that the sales tax rates are not statistically related each other.[11] This assumption allows the hypothesis that the local sales tax of a city that has a neighboring city close enough creates an incentive for consumers to cross-border shop, which then would affect the demand of good *x* in the city. To test this hypothesis, I specify a log-linear demand function $x(p, \tau^s, \tau^l)$:

$$(1) \qquad \ln x(\tau^s, \tau^l, p) = \alpha + \beta\, ln(1 + \tau^s) + \theta_c\, \beta ln\,(1 + \tau^l) + \gamma \ln p.$$

In this equation, the parameter θ_c measures the degree to which consumers cross a city border to shop as the ratio of the local sales tax elasticity of demand ($\varepsilon_{x,1+\tau^l} = -\theta_c\, \beta$) to the state sales tax elasticity of demand ($\varepsilon_{x,1+\tau^s} = -\beta$) :

[11] Recently, Agrawal (2013) investigated the hypothesis that the rate of local sales tax would depend on the state sales tax rates in response to driving time from the state border. Using comprehensive local sales tax rates data in the U.S., he found that local sales tax rates on the low-tax side of the border tended to be higher than on the high-tax side.

$$(2) \qquad \theta_c = \frac{\frac{\partial \ln x}{\partial\, ln\,(1+\tau^l)}}{\frac{\partial \ln x}{\partial \ln\,(1+\tau^s)}} = \frac{\varepsilon_{x,1+\tau^l}}{\varepsilon_{x,1+\tau^s}}$$

The null hypothesis of cross-border shopping implies $\theta_c = 1$. I specify an estimating equation for the demand function (1) with *j* as the index for a city and *t* as the index for time:

$$(3) \qquad \ln x_{jt} = \alpha_j + \beta\, ln(1+\ \tau_t^s) + \theta_c\, \beta ln\left(1+\ \tau_{jt}^l\right) + \gamma \ln p_t + \delta \chi_{jt} + \ \varepsilon_{jt}$$

I examine two dependent variables x_{jt} ; gross taxable sales, and taxable sales per filing from city *j* at time *t*. Taxable sales per filing is the proxy measure of taxable sales per store, and might mitigate heteroskedasticity. α_j are the fixed effect coefficients. χ_{jt} are a vector of control variables; personal income, personal income per filing, and unemployment rates, and ε_{jt} is the standard error term. I estimate (3) using OLS with fixed effects and test the hypothesis $\theta_c = 1$. Note that the state sales tax rates are invariant throughout cities, but the local sales tax rates vary by cities.

Two options are examined for local sales taxes. One is a city's own local sales tax rate, and the other is the tax difference between an origin city and a neighboring city. More specifically, I use the ratio of two local sales tax rates between two cities. The latter corresponds to the influence of tax policy of a neighboring city. However, the influence of local sale tax changes in a neighboring city would be underestimated compared to the influence of local sales tax changes in an origin city. First, when the origin city changes local sales tax, it would affect the demand of

taxable goods by not only the effect of cross-border shopping but also by the price effects and the income effect. However, the tax changes in a neighboring city would incur the effect of cross-border shopping (i.e. opposite direction), but would not incur the price effect and the income effect at an origin city. Second, the neighboring city, on paper, is defined as the city that is either bigger than an origin city or has a population of over 20,000. It means that a market in an origin city may not absorb all shoppers who intend to cross a city border from the neighboring city because the market may not big enough to lure all shoppers.

Table 3 presents the baseline estimation of the demand function (3) with all sample cities using two dependent variables; taxable sales per filing for column (1) and (2), and gross taxable sales for column (3) and (4). Two regressions were conducted for each case, and columns (1) and (3) show the results of the case using a city's own local sales tax, while columns (2) and (4) present the results of the case using tax differences between an origin city and a neighboring city. The estimated elasticity of local sales tax on demand is consistent with two dependent variables. The overall local sales tax elasticity on demand for the case of the city's own tax is -8.54, and for the case of the tax difference is -5.85.

The estimated elasticity of state sales tax on demand is -4.48 for the case of sales per filing, and -4.05 for the case of gross sales. Therefore, the overall elasticity with respect to the state sales tax is approximately -4.3, which is significantly different from the price elasticity of demand in this analysis, which was found to be around -0.12 to - 0.36. Despite the coarseness of the price index in the paper, which may lead to an inaccurate estimation, the estimation of the tax price elasticity is substantially higher than the price elasticity of taxable goods in previous studies (Tellis, 1988; Clements, 2008). One plausible concern is online shopping alternatives. Einav et al. (2014), by using eBay data, estimated that a one percent point increases in a state's

sales tax increases online purchases by state residents by approximately 2 percent and decreases their online purchases from state retailers by 3-4 percent. Baugh, Ben-David, and Park (2014) also found similar results from Amazon.com data.

In the first and third columns, the elasticities of a state sales tax are -4.48 and -4.05, and the elasticities of a local sales tax are -8.53 and -8.55. Therefore, the calculated θ_c are 1.90 and 2.11, respectively, and using the Wald test, I reject $\theta_c = 1$ at the 1 percent significance level. I reject the null hypothesis that consumers do not have an incentive to cross a city border to shop. Meanwhile, in the columns (2) and (4), the Wald test cannot reject the null hypothesis. While there is a possibility of underestimating elasticity in the case of the tax difference, the overall results imply that there exists cross-border shopping between cities that have different tax rates. The income elasticities of demand are 0.63 for the case of income per filing, and 0.55 for the case of income, and they are consistent with previous studies. The coefficients of the unemployment rate are also statistically significant, and are robust throughout all regressions.

In order to investigate the influence of distance to cross-border shopping, I set all cities into three groups according to distance between the city and its neighboring city, as I mentioned above, and estimated the response of sales tax changes in each group. Table 4 presents the estimations from the three sets of geographical groups. Panel A in the table 4 demonstrates the results using a city's own local sales tax rates, and Panel B demonstrates the results using the tax differences between an origin city and a neighboring city. Columns (1), (2), and (3) show the results from the groups; clustered city, mid-range city, and remote city, respectively. Column (1) presents the results from clustered city. In both cases for local sales tax options, I reject the null hypothesis since a significant difference exists between the coefficients of state and local sales taxes. In column (2) for mid-range city, the null hypothesis is rejected at the 10 percent

significance level, and in column (3) for remote city, the null hypothesis cannot be rejected.[12] Therefore, the results of the Wald test indicate that the closer a city is to a neighboring city, the larger the incentive for consumers to cross a city border to shop, and the incentive may disappear in a remote city, which is defined as being more than 40 miles away from a neighboring city.

B. Travel Distance Function

The results from the previous section imply that the distance between jurisdictions (i.e. shopping area) that have different sales tax rates is a critical factor in determining cross-border shopping. Following Asplund, Friberg, and Wilander (2007), I adapted a travel distance function $g(\,d, D_j)$ that presents how distance affects cross-border shopping. **[13]** From the demand function (3), the demand of taxable goods in city *j* at time *t* is assumed to be given by:

$$(4) \qquad \ln x_{jt} = \alpha + \beta\, ln(1 + \tau_{jt}^{s}) + g\big(d, D_j\big) ln\left(1 + \tau_{jt}^{l}\right) + \gamma \ln p_t + \delta X_{jt} + \epsilon_{jt}$$

where D_j is the distance between two jurisdictions that have different tax rates. The elasticity with respect to the state sales tax is β, and the responsiveness with respect to the local sales tax is $g(d\,, D_j)$ and thus, depends on the distance between two jurisdictions. While Asplund, Friberg, and Wilander (2007) acknowledged that the specification is parsimonious, but the model effectively presents the influence of distance in cross-border shopping. I specify the function $g(d\,, D_j)$ as a flexible second-order polynomial:

[12] In the case of regression of the tax differences (the column (3) in the panel B) the test value is 0.022, but the coefficient of a state sales tax is higher than the coefficient of a local sales tax. It is not a case that I intend to test. In addition, if the implication that the incentive is disappeared in remote city is valid, the test with the case of tax difference for remote city is mis-specified.

[13] To distinguish from the term "distance function" in Mathematics, I refer to the function of distance between cities in this paper as "travel distance function" throughout the paper.

$$(5) \qquad g(d, D_j) = d_0 + d_1 * D_j + d_2 * D_j^2 .$$

The prior is that the influence of the local sales tax changes is decreasing in the distance between cities, such that $g' = (d, D_j) > 0$ and $g'' = (d, D_j) < 0$; at the border, the elasticity is d_0. Using OLS with fixed effects, I estimate the following equation for four cases; two dependent variables, and two local sale tax rate options.

$$(6) \quad \ln x_{jt} = \alpha + \beta \, ln(1 + \tau_{jt}^{s}) + d_0 \ln(1 + \tau_{jt}^{l}) + d_1 D_j * \ln(1 + \tau_{jt}^{l}) + d_2 D_j^2 *$$

$$ln(1 + \tau_{jt}^{l}) + \gamma \ln p_t + \delta X_{jt} + \epsilon_{jt}.$$

Table 5 presents the results from the equation (6). Overall, the coefficients are significant at the 1 percent significance level with the expected signs, and are plausible in magnitude. The hypothesis for the Wald test is that $d_1 * D_j = d_2 * D_j^2 = 0$, and all tests in the four cases reject the hypothesis at the 1 percent significance level, which presents the influence of distance on cross-border shopping. I conduct robustness tests on the two dependent variables, which do not produce any significant difference on the coefficients. This result was particularly apparent, when using the same local sales tax rate option, the coefficients of $g(d, D_j)$ are almost identical in both cases.

In the case of the city's own sales tax rate with sales per filing as dependent variable (column (1)), the elasticity of a local sales tax is -18.65 at the border, and the elasticity of a state sales tax rate is -4.39. Therefore, I interpret the differences of the two elasticities as the incentive for

consumers to cross-border shop, -14.26. In other word, the elasticity with respect to cross-border shopping is -14.26 at the border, and the elasticity would decrease as the distance increases. In the case of the city's own sales tax rate with gross sales as the dependent variable (column (2)), the elasticity with respect to cross-border shopping is -14.46 at the border. In the case of the tax differences with two dependent variables (column (2), and (4)), the elasticity of a local sales tax is -13.97, and -13.78, and the elasticity of a state sales tax rate is -3.94, and -3.51, respectively. Consequently, the incentive to cross-border shop is -10.03, and -10.26 at the border.

To illustrate how the elasticity of a local sales tax varies with the distance from an origin city to a neighboring city, I calculate $g(d, D_j)$ with a hypothetical 1 percent point increase in a local sales tax. Panel A in Figure 2 illustrates the case of sales per filing, and Panel B in Figure 2 presents the case of gross sales. As mentioned above, the elasticity of cross-border shopping at the border is about -14.4 percent for city's own tax, and about -10.2 percent in tax difference. The influence gradually diminishes as the distance to a neighboring city increases. At a city located 20 miles away from a neighboring city, the demand of taxable goods decrease by cross-border shopping about -5.32 percent in the case of city's own tax, and -2.84 percent in the case of tax difference, respectively. The incentive of cross-border shopping may disappear when a city is located 31 - 38 miles away from a neighboring city.

V. CONCLUSION

Previous studies on consumers' propensity to cross-border shopping in response to local sales tax changes have been mainly focused on specific regions such as metropolitan areas or states with high sales tax rates. However, cross-border shopping can result in the presence of tax

differences between any jurisdictions that are close enough for consumers to take advantage of tax avoidance. This fact requests general implications on cross-border shopping response to local sales tax changes.

Using Nebraska state and local sales tax data, I estimated the magnitude of cross-border shopping in response to distance when a sales tax changes. This paper exploits the fact that, in Nebraska, only cities levy local sales taxes, which enables this study to measure a point-to-point distance between two jurisdictions (i.e. cities), who may have different sale tax rates. First, I tested the hypothesis that consumers do not have an incentive to cross a city border to shop when a local sales tax changes. Consequently, consumers are responding to local sales tax changes the same way they respond to the state sales tax that is assumed to not create incentive to cross a state border to shop. Then, three different geographical areas were grouped along with distance to a neighboring city to examine how geographical location affects a consumer's incentive to cross-border shop. The results suggest that the closer a city is to a neighboring city, the larger the incentive for consumers to cross a city border to shop.

Finally, I manipulated the elasticity of a local sales tax into a travel distance function. Using estimations from the travel distance function, I illustrated the influence of cross-border shopping with a hypothetical 1 percent point increase in a local sales tax. The finding is that the elasticity of cross-border shopping is approximately between -10 and -14 percent at the border. The result demonstrates that, in the presence of a neighboring city close enough that traveling costs are minimal, increasing the local sales tax by 1 percent could reduce the demand of taxable goods in the city as much as 14 percent due to cross-border shopping. It suggests significant implication to jurisdictions which have alternatives for shopping nearby. The influence of cross-border

shopping gradually diminishes as the distance to a neighboring city increases, and virtually disappears when a city is located 31 - 38 miles away from a neighboring city.

This paper also estimates the elasticity with respect to a Nebraska state sales tax, which is around -4.0 and -4.5 percent. These results seem to be substantially higher than the previous study's estimates of price elasticity on demand. One plausible concern is online shopping alternatives. As mentioned, recent studies estimate that a one percent point increase in a state's sales tax increases online purchases by state residents by approximately 2 percent. Consequently, not accounting for online shopping may bias elasticity estimates upward.

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Table 1
City Profile

City	Population	Distance	Neighboring City	Tax Rate Changes
Bellevue	50,137	9.4	Omaha	1.5
Grand Island	48,520	25.7	Hastings	1 to 1.5, 10/04
Kearney	30,787	50.5	Grand Island	1 to 1.5, 04/06
Fremont	26,397	33.3	Omaha	0 to 0.5, 04/95; 0.5 to 1, 07/97; 1 to 1.5, 10/99
Hastings	24,907	25.7	Grand Island	1 to 1.5, 04/99; 1.5 to 1, 10/02; 1 to 1.5, 04/03; 1.5 to 1, 04/07; 1 to 1.5, 04/11
North Platte	24,733	99	Kearney	1.5
Norfolk	24,210	46.4	Columbus	1 to 1.5, 01/03
Columbus	22,111	46.7	Fremont	0 to 1, 04/95; 1 to 1.5, 04/01; 1.5 to 1, 04/03; 1 to 1.5, 04/05
Papillion	18,894	9.2	Omaha	1.5
La Vista	15,758	6.6	Omaha	1.5
Scottsbluff	15,039	57.5	Alliance	1 to 1.5, 10/95
South Sioux City	13,353	3	Sioux city	0 to 1, 04/00; 1 to 1.5, 01/05
Beatrice	12,459	40.7	Lincoln	1.5
Lexington	10,230	40.7	Kearney	1 to 1.5, 04/95
Gering	8,500	3	Scottsbluff	1 to 1.5, 04/03
Alliance	8,491	57.5	Scottsbluff	1 to 0, 07/00; 0 to 1.5, 04/02
Blair	7,990	24.6	Omaha	0.5 to 0, 04/96; 0 to 1, 10/98; 1 to 1.5, 04/03
York	7,766	51.6	Lincoln	0 to 1.5, 04/99
Nebraska City	7,289	45.1	Omaha	1 to 1.5, 04/95
Seward	6,964	26.5	Lincoln	0 to 1, 04/03
Crete	6,960	26.5	Lincoln	1 to 1.5, 04/11
Sidney	6,757	76.4	Scottsbluff	1.5
Plattsmouth	6,502	21	Omaha	0 to 1, 10/02; 1 to 1.5, 04/10
Schuyler	6,211	16.9	Columbus	0 to 1, 04/97; 1 to 1.5, 10/07
Ralston	5,943	5.2	Omaha	0 to 1.5, 10/06
Chadron	5,851	55.3	Alliance	1 to 1.5, 10/98; 1.5 to 1, 04/01; 1 to 1.5, 04/04
Wayne	5,660	31.3	Norfolk	0 to 1, 10/94; 1 to 0, 10/99; 0 to 1, 10/00
Holdrege	5,495	30.6	Kearney	1 to 1.5, 07/02
Ogallala	4,737	53.5	North Platte	1.5
Wahoo	4,508	30.3	Lincoln	0 to 1, 04/99; 1 to 1.5, 04/05
Aurora	4,479	21.4	Grand Island	0 to 1, 10/08; 1 to 0, 10/12
Falls City	4,325	55.6	Nebraska	0 to 1, 10/97; 1 to 1.5, 10/04

			City	
Cozad	3,977	14.4	Lexington	1 to 1.5, 10/99
Fairbury	3,942	27.5	Beatrice	1 to 1.5, 04/99
O'Neill	3,705	75.3	Norfolk	1 to 1.5, 10/12
Gothenburg	3,574	24.7	Lexington	1 to 1.5, 01/98
Broken Bow	3,559	46.3	Lexington	0 to 1, 01/96; 1 to 1.5, 01/07
Auburn	3,460	20.3	Nebraska City	1 to 1.5, 10/98; 1.5 to 1, 10/00
West Point	3,364	34.3	Fremont	0 to 1, 04/09; 1 to 1.5, 10/12
Central City	2,934	22.3	Grand Island	0 to 1, 10/97
Minden	2,923	21.1	Kearney	1
Valentine	2,737	130	North Platte	0 to 1.5, 01/07
Kimball	2,496	45.1	Scottsbluff	1 to 1.5, 10/98
Superior	1,957	57.5	Hastings	0 to 1, 04/95

Table 2
Summary Statistics

	Base Line		Clustered		Mid-range		Remote	
Number of Cities	44		6		19		19	
Observations	2,992		408		1,292		1,292	
Tax Rate Changes	61		4		34		23	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Sales	31,469	(37,140)	32,210	(24,945)	16,816	(20,075)	45,889	(46,621)
Sales/filing	27.94	(11.25)	36.27	(17.44)	22.74	(7.33)	30.50	(9.37)
Income	288.98	(706.46)	1,312.14	(1,549.10)	115.95	(74.47)	138.92	(104.17)
Filing	973.08	(869.22)	918.47	(623.96)	653.50	(536.84)	1,309.91	(1,059.63)
Unemployment	3.24	(1.04)	3.50	(1.13)	3.06	(0.99)	3.34	(1.04)
Distance	37.40	(25.00)	6.07	(2.61)	26.20	(6.86)	58.49	(22.76)

Notes: The value of sales is in thousands of dollars; personal income is in millions of dollars; unemployment is the unemployment rate; and distance is in miles.

Table 3
Effect of Sales Taxes on the Demand of Taxable Goods

	Sales per filing		Gross sales	
	City Own Tax	Tax Difference	City Own Tax	Tax Difference
	(1)	(2)	(3)	(4)
Ln(1+State sales tax)	-4.479***	-4.485***	-4.049***	-4.077***
	(1.074)	(1.081)	(1.080)	(1.088)
Ln(1+Local sales taxes)	-8.529***	-5.861***	-8.545***	-5.849***
	(0.677)	(0.541)	(0.675)	(0.540)
Ln(Price)	-0.267***	-0.357***	-0.120**	-0.219***
	(0.028)	(0.026)	(0.053)	(0.052)
Ln(Income)	-	-	0.548***	0.552***
			(0.032)	(0.032)
Ln(Filing)	-	-	0.360***	0.360***
			(0.020)	(0.021)
Ln(Income/filing)	0.628***	0.629***	-	-
	(0.020)	(0.020)		
Ln(Unemployment)	-0.063***	-0.064***	-0.057***	-0.059***
	(0.009)	(0.009)	(0.009)	(0.009)
Constant	68.510***	29.614***	66.854***	27.975***
	(5.822)	(4.952)	(5.835)	(4.974)
Regional Fixed Effect	Yes	Yes	Yes	Yes
Quarterly Dummies	Yes	Yes	Yes	Yes
Wald Test	0.001	0.253	0.000	0.143
Adjusted R^2	0.921	0.920	0.988	0.988
Observations	2,992	2,992	2,992	2,992

Notes: This table shows the OLS results in equation (3) with fixed effects. Standard errors are reported in parentheses. Asterisks denote significance at the 1%(***), 5%(**), and 10%(*) levels. Wald test is the probability of Ln(1+state sales tax) = Ln(1+local sales taxes).

Table 4A
Effect of Sales Taxes at Three Geographical Groups
: The Case of City's Own Local Sales Tax

	Clustered	Mid-range	Remote
	(1)	(2)	(3)
Ln(1+State sales tax)	0.309	-2.171	-6.328***
	(4.785)	(1.365)	(1.347)
Ln(1+Local sales taxes)	-24.190***	-5.039***	-5.457***
	(2.613)	(0.853)	(0.889)
Ln(Price)	0.108	-0.486***	-0.191***
	(0.112)	(0.038)	(0.037)
Ln(Income/filing)	0.839***	0.639***	0.576***
	(0.066)	(0.026)	(0.030)
Ln(Unemployment)	-0.016	-0.121***	-0.017
	(0.042)	(0.012)	(0.011)
Constant	114.368***	42.596***	63.155***
	(23.660)	(7.390)	(7.542)
Regional Fixed Effect	Yes	Yes	Yes
Quarterly Dummies	Yes	Yes	Yes
Wald Test	0.000	0.074	0.589
Adjusted R^2	0.848	0.928	0.928
Observations	408	1,292	1,292

Notes: This table shows the OLS results in equation (3) with fixed effects. The dependent variable is taxable sales per filing. Standard errors are reported in parentheses. Asterisks denote significance at the 1%(***), 5%(**), and 10%(*) levels. Wald test is the probability of Ln(1+state sales tax) = Ln(1+local sales taxes).

Table 4B
Effect of Sales Taxes at Three Geographical Groups
: The Case of Tax Differences between cities

	Clustered	Mid-range	Remote
	(1)	(2)	(3)
Ln(1+State sales tax)	3.937	-2.133	-6.365***
	(4.972)	(1.359)	(1.360)
Ln(1+Local sales taxes)	-18.359***	-4.732***	-3.002***
	(2.251)	(0.691)	(0.687)
Ln(Price)	-0.070	-0.543***	-0.258***
	(0.109)	(0.035)	(0.035)
Ln(Income/filing)	0.826***	0.639***	0.591***
	(0.067)	(0.026)	(0.030)
Ln(Unemployment)	-0.019	-0.117***	-0.020*
	(0.043)	(0.012)	(0.011)
Constant	-13.243	19.429***	38.403***
	(22.967)	(6.230)	(6.208)
Regional Fixed Effect	Yes	Yes	Yes
Quarterly Dummies	Yes	Yes	Yes
Wald Test	0.000	0.088	0.022
Adjusted R^2	0.842	0.928	0.927
Observations	408	1,292	1,292

Notes: This table shows the OLS results in equation (3) with fixed effects. The dependent variable is taxable sales per filing. Standard errors are reported in parentheses. Asterisks denote significance at the 1%(***), 5%(**), and 10%(*) levels. Wald test is the probability of Ln(1+state sales tax) = Ln(1+local sales taxes).

Table 5
Parameter Estimates of the Travel Distance Function

	Sales per filing		Gross sales	
	City Own Tax	Tax Difference	City Own Tax	Tax Difference
	(1)	(2)	(3)	(4)
Ln(1+Local sales taxes)	-18.648***	-13.972***	-18.434***	-13.776***
	(1.337)	(1.201)	(1.337)	(1.200)
Ln(1+Local sales taxes)*Distance	0.539***	0.441***	0.533***	0.438***
	(0.053)	(0.048)	(0.053)	(0.048)
Ln(1+Local sales taxes)*Distance^2	-0.004***	-0.004***	-0.004***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(1+State sales tax)	-4.391***	-3.939***	-3.967***	-3.510***
	(1.053)	(1.066)	(1.059)	(1.072)
Ln(Price)	-0.274***	-0.343***	-0.129**	-0.192***
	(0.027)	(0.026)	(0.052)	(0.052)
Ln(Income)			0.540***	0.540***
			(0.031)	(0.032)
Ln(Filing)	-	-	0.368***	0.364***
			(0.020)	(0.020)
Ln(Income/filing)	0.620***	0.624***	-	-
	(0.020)	(0.020)		
Ln(Unemployment)	-0.066***	-0.070***	-0.061***	-0.065***
	(0.009)	(0.009)	(0.009)	(0.009)
Constant	61.109***	27.034***	59.449***	25.317***
	(5.752)	(4.884)	(5.764)	(4.901)
Regional Fixed Effect	Yes	Yes	Yes	Yes
Quarterly Dummies	Yes	Yes	Yes	Yes
Wald Test	0.000	0.000	0.000	0.000
Adjusted R^2	0.924	0.923	0.988	0.988
Observations	2,992	2,992	2,992	2,992

Notes: This table shows the OLS results in equation (6) with fixed effects. Standard errors are reported in parentheses. Asterisks denotes significance at the 1%(***), 5%(**), and 10%(*) levels. Wald test is the probability of (1+local sales taxes)*distance = Ln(1+Local sales taxes)*Distance^2 = 0.

Figure1
The Three Groups of the Selected Cities.

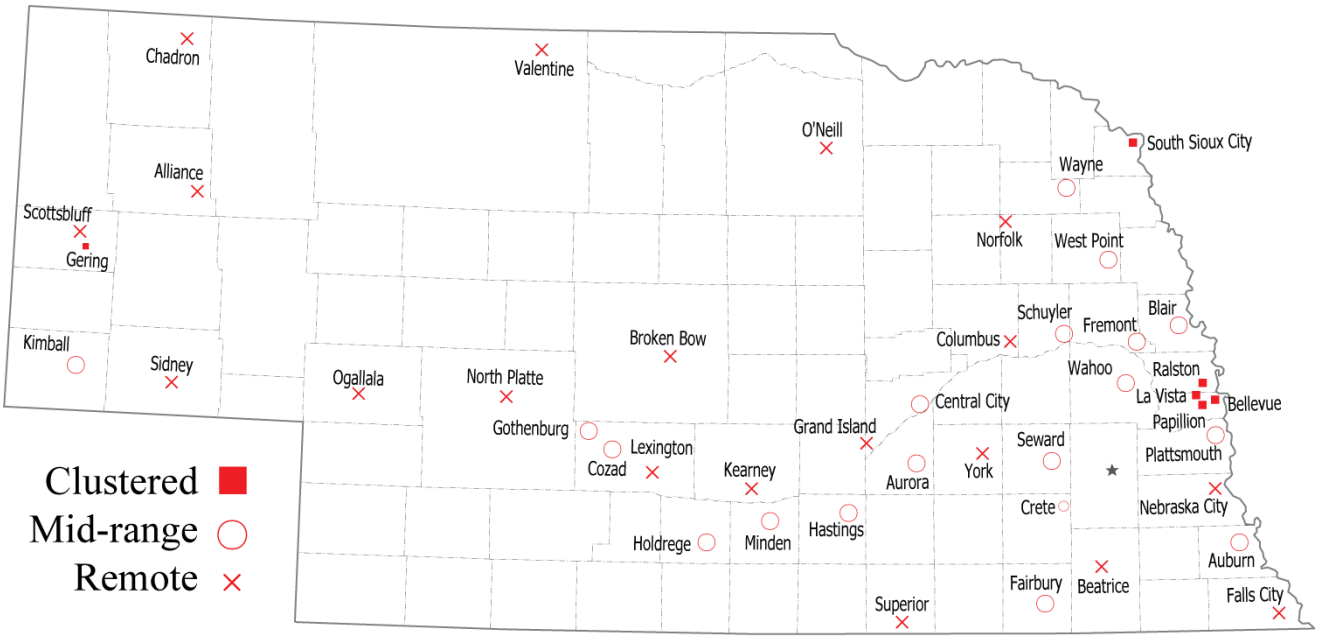
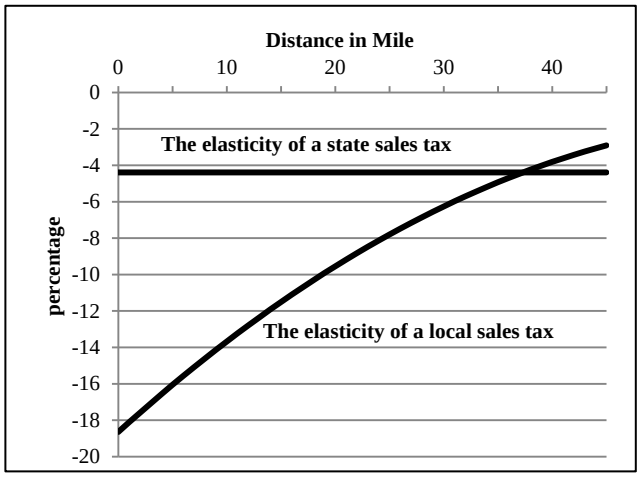
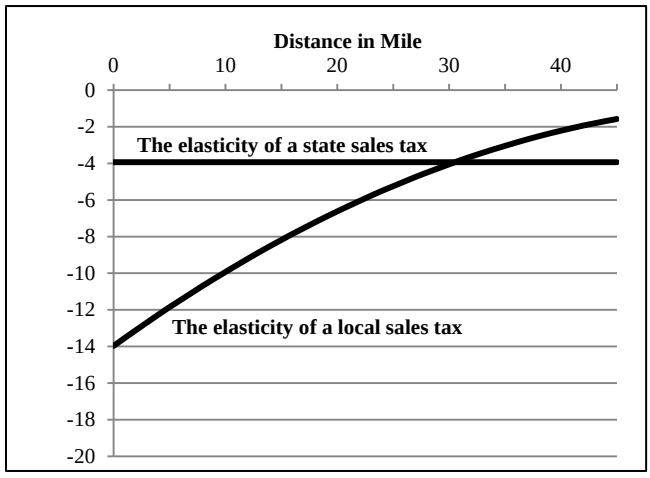


Figure 2
Estimated Effect of Sales Taxes on the Demand of Taxable Goods

Panel A: Sales per filing as dependent variable

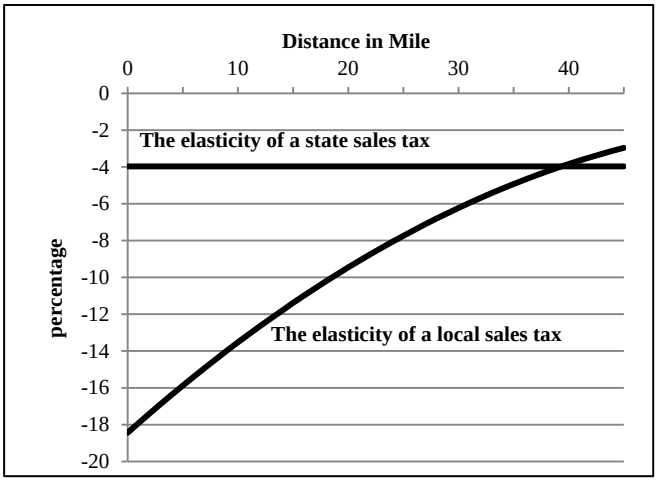


(1) City own tax

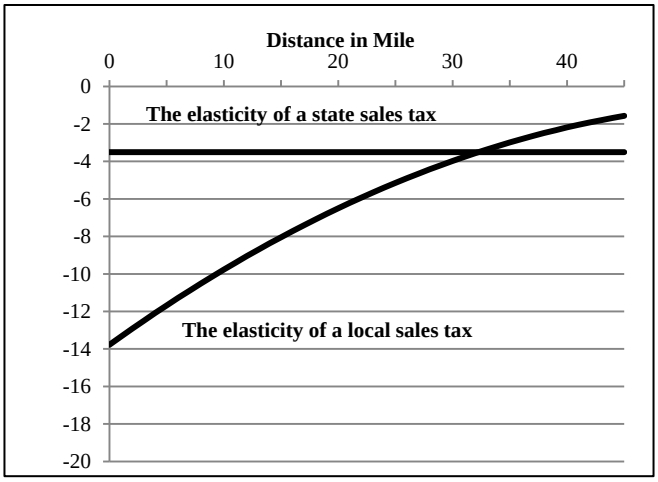


(2) Tax difference

Panel B: Gross sales as dependent variable



(3) City own tax



(4) Tax difference

Notes: It is the locus of point estimations when a hypothetical 1 percent point increase in sales tax options in Nebraska.