DIFFERENCE IN STATE CIGARETTE EXCISE TAX RATES: A LOOK INTO THE PROMINENCE OF TAX AVOIDANCE BEHAVIOR

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Abstract

I analyze the impact of differences in the cigarette excise tax rates of bordering states on the price elasticity of demand for cigarettes in the home state. Using unique county-level data on the sales tax revenues collected from Kansas tobacco sellers by industry type provided by the Kansas Department of Revenue, as well as data on cigarette excise tax rates, distance to Kansas' borders, and the combined state and county sales tax rate, I examine the determinants of tobacco sales tax revenue using a fixed effects model. The analysis allows me to infer cigarette demand effects, and I find that the price elasticity of demand for cigarettes in Kansas becomes significantly more elastic closer to a low tax border. Model estimates for gas stations with convenience stores and tobacco retailers suggest that a Kansas cigarette excise tax decrease would result in more sales tax revenue on average for counties within 50 miles of a low tax Kansas border, ceteris paribus.

Table of Contents

List of Figures

List of Tables

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Dedication

I dedicate my master's thesis to Robert Nicholson, my grandfather, who passed too early in October of 2011. He was a great man and my inspiration for furthering my education. I wish he was around for this, but I know he would be proud of me.

1. Introduction

State cigarette excise taxes have long been marketed in the United States as a means to raise state revenues or decrease cigarette consumption depending on the favored objective. Most states have raised their cigarette tax rates since 2000 and there is considerable variation across states. Currently, state cigarette excise taxes are as high as $4.35 per pack (New York) and as low as $0.17 per pack (Missouri). The combined local and state excise taxes in fact make the tax rate in New York City at $5.85 per pack (Campaign for Tobacco-Free Kids, 2012). However, several factors have brought into question the effectiveness of such taxation to its desired end. Low tax borders, in-state low tax venues, and the rising prevalence of the internet are all possible avenues for tax avoidance. Of these three, cross-border cigarette purchases are thought by some to be the most prevalent form of tax avoidance in the presence of a manageably close low tax border. For example, in 1997, almost all US states faced a low excise tax border and, on average, the real difference between the states' rates and their respective low tax neighbor's rate was 21.9 cents. By 2003, this mean difference increased to 39 cents per pack (Chiou and Muehlegger, p. 1, 2008), which suggests an increasing tax disparity among bordering states. It is possible this trend has resulted in the adaptation of tax avoidance strategies by cigarette consumers.

Also in the forefront of this conversation is the increasing level of internet penetration, measured as the percentage of households using the internet. Computers becoming more affordable over the past two decades has resulted in dramatic increases in national internet penetration since 1990 (Internet World Stats, 2012). We can see from Figure 1, national internet penetration has increased from 49.18% at the start of 2001 to 71.96% by the end of 2008. State internet penetration data for Kansas mirrors this trend.[1] Paired with these rising levels of internet penetration is the opportunity for a newer option in cigarette tax avoidance. As noted in Goolsbee et al. (2010), numerous online venders offer tax free cigarettes through their websites. This allows residents of relatively high cigarette taxation states to bypass their local high tax venues in favor of online venders. Although online venders are supposed to tax customers according to their state of residency and report this tax to the state, it is believed that only 5% do so (Emery et al., p132, 2002).

Another option for high cigarette tax avoidance is within the state itself. On military bases, cigarette purchases are exempt from state excise taxes and therefore offer an alternative to other cigarette merchants in the area. Indian reservations historically have offered lower tax cigarettes relative to the surrounding area within a state. However, recently states have begun to enforce the state excise taxes on Indian reservation purchases. In the case of Kansas, Notice 00-07 was passed on July 25, 2000 applying all state cigarette taxes to purchases on Indian reservations (KDOR). This legislation eliminated the tax break that previously could be found on Indian reservations in Kansas.

[1] http://www.ntia.doc.gov/legacy/data/index.html provides a compilation of links to several surveys in different years for state-level internet penetration. These data suggests that Kansas does indeed follow the trend of national internet penetration and in fact has slightly higher internet penetration than the national average.

Kansas and its bordering states went through a series of cigarette tax increases from the years 2002 to 2005. Cigarette tax rates for Kansas and its surrounding states are displayed in Table 1. Notice that there is significant with-in and state variation in cigarette tax rates from 2001 to 2005. During this time period, Kansas was the high tax state only in 2003 and 2004. Except for Nebraska, Kansas was the high tax state at 24 cents per pack in 2001. In 2002, Nebraska and Kansas increased tax rates, but Kansas increased by more and passed Nebraska as the high tax state at 70 cents per pack. In 2003, the cigarette tax increase in Kansas made it the highest tax state, but, by 2005, the Kansas tax rate was surpassed by tax increases in both Colorado and Oklahoma. The trends in the real excise tax rate by state can be seen in Figure 2. The figure shows that absent a tax hike, the real excise tax rate is falling over time. Figure 3 shows that the real national wholesale price of cigarettes is falling over time. This is also the case for real retail prices in Kansas, as depicted in Figure 3, except in the years of tax hikes.[2]

In the presence of tax avoidance opportunities the probability of desired results from cigarette excise tax increases becomes highly questionable. If such opportunities exists then an excise tax increase in a state such as Kansas which borders Missouri, a very low excise tax state, has a possibility to obtain neither policy goal. Revenue may be lost to the low tax border state and in the process consumption would not be curbed by the excise tax either. Consumption may in fact increase due to consumers stockpiling from low tax venues. This paper will

[2] Data on the national wholesale and Kansas retail prices of cigarettes are obtained for 2001 to 2008 from The Campaign for Tobacco-Free Kids and The Tobacco Merchants Association, respectively.

focus on the revenue implications of low tax venues and the extent of border crossing behavior.

Using tax data from retail establishments for all 105 counties in Kansas supplied by the Kansas Department of Revenue (KDOR), I examine the extent to which higher cigarette taxes cause smokers to travel to lower tax borders to purchase cigarettes. I do this by examining the extent to which the quantity effects of higher cigarette taxes are stronger closer to a low tax border. One complication is that, in Kansas, there are no data on direct quantities sold by proximity to a border. This is because the cigarette tax is levied at the level of the wholesaler, and KDOR does not track the wholesalers' distribution of cigarettes after the tax is levied. However, I can get at the quantity effect using the sales tax revenue of tobacco retailers by county. This is because buyers of cigarettes have to pay sales taxes at the time of purchase. I can thus use the data on sales tax revenue collected from tobacco sellers to infer the demand effects of a change in cigarette taxes. If the demand for cigarettes is price inelastic, the lack of reduction in quantity demanded of cigarettes combined with a higher tax-inclusive retailer price will show up as an increase in sales taxes remitted by the sellers of cigarettes.

To see why this is so, let t equal the tax rate per pack of cigarettes, t^s be the sales tax rate, P_0 be the pre-tax price of cigarettes and Q_1 be the post-tax quantity of cigarettes sold. For simplicity, consider the case of a retailer that only sells cigarettes. Then if demand is perfectly inelastic, the post-tax price of cigarettes equals $P_0 + t$. The sales tax revenue equals:

$$Pre - tax\ sales\ revenue = t_0^s * P_0 * Q_0 \ ,$$

$$Post - tax\ sales\ revenue\ (inelastic\ demand) = t_0^s * (P_0 + t) * Q_0 \ .$$

As can be seen, with inelastic cigarette demand a cigarette tax will increase sales tax revenue by $t_0^s * t * Q_0$.

In the case of more elastic demand, notice that the positive revenue effects of a higher post-tax cigarette price will be offset from a declining quantity sold, thus sales tax revenue collected may not increase and with perfectly elastic demand will fall as low tax borders come within a manageable distance. In sum, I am testing the cross-border effects of a changing relative cigarette tax rate in Kansas using variation in retail establishments' sales tax revenue collections by border proximity to infer quantity effects. This is the first paper to infer demand and revenue effects using retailer data over time. Using these data combined with distance measures to the low-tax border allows me to uniquely identify the responsiveness of demand to changes in the relative tax rate, accounting for distance effects.

2. Literature Review

The effectiveness of cigarette excise taxes has been a topic of research for decades. Whether an increase in such taxation will actually correspond to higher state revenues and decreased consumption, as generally predicted, has become questioned. In this section, I review seven key studies examining the tax avoidance behavior of smokers. Five of these studies use national data to detect possible effects. Two use local data for Chicago and California. All of the studies detect some degree of tax avoidance behavior with the strongest source coming from the increasing levels of internet penetration.

Goolsbee et al. (2010) suggest that increasing Internet penetration within the United States has led to significantly more responsive tax elasticities for cigarette consumers. The authors examine the responsiveness of cigarette demand using U.S. state level data from 1990 to 2005, from the Current Population Survey as well as a 2002 consumer survey from Forrester Research for their study. Both of these report Internet usage in the United States. The authors also use data from the Tobacco Institute. Specifically, they use data on cigarette price, sales and excise taxes from this publication. Their regression uses the log of quantity of cigarette packs sold per capita as the dependent variable against such independent variables as real per-capita income, the price of cigarettes, the real excise tax, and neighboring states' tax inclusive price as well as an interaction of Internet penetration with home state tax. They conclude that the price sensitivity of cigarette consumers has significantly increased due to tax-free cigarettes being more widely available through the higher levels of

Internet usage. The authors make a very significant statement on tax rate elasticities, reporting that, "The results suggest that sales can be quite elastic with respect to state cigarette taxes in the presence of Internet smuggling: the tax rate elasticities range from -0.186 to -0.267. If no Internet smuggling occurred, sales are less elastic with respect to tax changes. The estimate in column (2) is indicative at -0.112" (Goolsbee et al, p 146, 2010). The authors note that the price elasticities can be obtained by multiplying the given tax rate elasticities by 7.43, which equals (p + t)/t. Doing the simple math this gives an inelastic price elasticity of -0.832 without Internet smuggling, but when Internet smuggling is present the price elasticity becomes notably elastic ranging from -1.38 to -1.98. As a result the effectiveness of higher excise taxes, as both a revenue generating policy and consumption deterrent, has been lessened in their opinion.

Merriman (2010) uses a sample of littered cigarette packs to investigate tax avoidance among Chicago residents as a result of its extreme tax disparity with neighboring areas. Merriman reports large differences in tax rates across neighboring counties: total taxes vary from $4.05 per pack in Chicago to $1.37 in DuPage, Lake, and Will counties in Illinois and a low of 94.5 cents in nearby Indiana. Collectors employed by Merriman were sent along predetermined paths within Chicago and surrounding low tax counties in order to collect littered cigarette packs. Origin identifying tax stamps were recorded from collected packs and then used to estimate the prevalence of tax avoidance in the population. The study also employs data from the US Census in the regression of several linear models of the probability that a littered pack is from a legal local vendor. Based on the results the author concludes tax avoidance, in regard to cigarettes, is pursued by a significant portion of Chicago residents. Of the packs collected strictly in the city of Chicago, 59 percent had identification of being purchased in the state of Illinois, 36 percent were purchased in Cook County, and only 25 percent had the identification mark for purchase in the city of Chicago. If the sample statistic of only 25 percent being purchased in Chicago, where this portion of the discarded packs was collected, is accurate to the population, then it is fairly easy to imply the high tax rate is not optimally set. More revenue could be raised in Chicago by lowering the tax rate in Chicago. The authors also find that tax compliance quickly degenerates as you approach low tax borders.

Lovenheim (2008) uses a cigarette demand model including cross-border purchases to determine the significance of cigarette smuggling and its effect on state revenue. The main source of data the authors use is the Current Population Survey sections on cigarette consumption. Lovenheim regresses upon cigarette demand the log of the real home state price, difference in the log of prices, difference in the log of prices squared, log of distance, log of distance multiplied by the difference in the log of prices, and the year. Table 8, in Lovenheim (2008), displays the authors' estimates for the percent of consumers engaging in smuggling activities. On a national scale between 13 and 25 percent of consumers engage in smuggling activities when facing a low cost border or tax reduced establishment according to the authors. More specifically the author estimates that approximately 21 percent of Kansas customers participate in such behavior. Based on this finding he concludes that it would be more efficient for states to pursue smuggling prevention policies as a means to raise state revenue and reduce consumption rather than continuing to increase tax disparities between states.

Hyland et al. (2005) analyze the impact of changing cigarette prices on the purchasing behavior of current smokers. For their study the authors employ the Community Intervention Trial for Smoking Cessation survey, COMMIT, consisting of US smoker characteristics in years 1988, 1993, and 2001. COMMIT was collected by the National Cancer Institute in the largest attempt by the institution to use methods to help people stop smoking. COMMIT consists of ten matched pairs of communities in the United States and one matched pair in Canada. Through the use of descriptive statistics the authors estimate that 59 percent of smokers in the 2001 COMMIT survey engaged in some activity to avoid recently elevated prices. A total of 34 percent reported using some form of low tax venue such as an Indian reservation or lower tax border. Furthermore 28 percent and 18 percent switched to discount brands and coupons respectively. These percentages are not exclusive, meaning that some of the smokers who switched to a discount brand may have also started using coupons. The authors note a common distance proposed to be a threshold for significant tax avoidance incentive: “The strongest predictors of purchasing less expensive cigarettes were living within 40 miles of a place with a lower cigarette excise tax” (Hyland et al, p 90, 2005).

Emery et al. (2002) focuses on the demand for cigarettes by California residents in the year following a 1999 $.50 per pack excise tax hike to examine the prevalence of tax avoidance in the area. The authors use the 1999 California Tobacco Surveys, consisting of 5,215 randomly dialed adult smokers, for their study. They use basic descriptive statistics to determine what percent of consumers change consumption behavior as a means of tax avoidance. Among the results: 5.1 percent of California smokers surveyed admitted to evasion of the new higher tax by means of some low tax venue amounting to an estimated revenue loss of $51 million. However, most surveyed individuals claimed to have continued to purchase at their typical most convenient location. Among the most prevalent purchase locations were convenience stores, drug stores, and supermarkets at 45, 16.4 and 8.8 percent respectively. Although there was an admitted tax evasion by 5.1 percent and an estimate revenue loss of $51 million, the authors conclude that tax evasion was not a serious issue in California overall following the 1999 excise tax increase. The authors do note however, "It is possible that smokers underreported internet cigarette purchases because of concerns about the legality of this form of tax avoidance." Also, in respect to the age of the study, internet penetration did not start significantly increasing until a few years after this data was collected. This could explain the insignificance of internet cigarette purchases in this study.

Stehr (2005) uses a simple regression to estimate tax avoidance in the states. The author's main data sources are the Tobacco Institute and the Behavioral Risk Factor Surveillance System, supported by the National Center for Chronic Disease Prevention and Health Promotion and the Centers for Disease Control and Prevention, from 1984 to 2001. Stehr concludes that border-crossing tax avoidance is not near as detrimental to the cigarette tax policy objectives as is the ability to purchase cigarettes from Internet vendors. It is estimated that 12.7 percent of cigarette purchases in the states were done so in tax avoidance. However, less than 1 percent was done so by crossing low tax borders. According to the author the increasing prevalence of tax free Internet cigarette vendors accounts for the vast majority of tax avoidance in cigarettes. Stehr does give an estimate of the price elasticities for both low and high tax states in Table 4 of his study. He estimates that price elasticity of demand in relatively low tax states is -0.600 while relatively high tax states are a more elastic -0.907.

Lesley Chiou and Erich Muehlegger (2008) employ a cross-section in 2003 of the Current Population Survey Tobacco Use Supplement, TUS, as their primary data source to undertake a household level study. These data allow Chiou and Muehlegger to identify the household quantity of cigarettes purchased, their purchase location, and their county of residence. Their final sample has roughly 9,700 smokers across the U.S. who report the location of their last cigarette purchase. They note 98% of their sample drove less than 40 miles to purchase their most recent pack of cigarettes. Using this individualized data the authors create a model of demand in which they are able to take into account consumer preferred purchase location and corresponding cigarette prices and excise taxes. Independent variable for the model include price of cigarettes plus excise tax at chosen location, an interaction between the previously listed variable and income, distance to chosen location, an interaction between the chosen location and income, distance to chosen location squared, and distance dummy variable for between 0 to 10, 10 to 20, 20 to 30, to 30 and 40 miles to preferred location. The distance measures are Euclidean measurements from the centroid of the county of residence for the consumer to the nearest county in the neighboring state, because the authors do not observe the actual location of purchase, only the state of purchase. Chiou and Muehlegger classify the results of their efforts as "between those by Lovenheim (2008) and Stehr (2005)" (p. 3). More specifically they find smuggling becomes prevalent as low tax borders come into manageable distances, but not quite to the extent put forth in Lovenheim (2008).

Although these studies might not come to a clear joint consensus on the primary source of tax avoidance or its prevalence, they do for the most part agree that it is present in some magnitude. All listed studies except for Emery et al. (2002) conclude that the tax avoidance identified in their research is significant and endangering to the effectiveness of cigarette excise taxes in terms of revenue raised and smoking cessation goals. Of these studies, Chiou and Muehlegger (2008) is the most similar to this research, but is limited in that the authors do not have longitudinal data and cannot control for unobservable factors that may contribute to choices made. The data I use do not suffer from this problem since I observe counties over time, before and after the tax chages.

3. Data and Empirical Model

I use Kansas county-level quarterly data from 2001 to 2008 to examine tax effects. The data are from a few sources. KDOR is the primary source I use for data. The sales tax revenue data are quarterly county-level aggregates from the years 2001 to 2008 by industry code (NAISC), which identifies retailer type. The three types of retailers I examine are gasoline stations with convenience stores, tobacco stores, and vending machines. Due to an industry code change, data on Gasoline Stations with Convenience Stores begins in January 2003 as opposed to 2001 like the other two retailer types. In the data there are 62 counties which have gas stations with convenience stores. Only three counties have tobacco sellers. 41 counties have vending machines.[3] Also obtained from KDOR are 2001 to 2008 data on county sales tax rates, Kansas sales tax rates, and Kansas cigarette excise tax rates. I also use 2001 to 2008 data on population and income, both measured at the county level in Kansas, from the US Bureau of Economic Analysis *(BEA, 2012)*. Data on the national wholesale and Kansas retail prices of cigarettes are obtained for 2001 to 2008 from The Campaign for Tobacco-Free Kids (2012) and The Tobacco Merchants Association (2012), respectively. GIS distance measurements are provided by Dr. Tracy Turner. County population and income are both annually reported so I use linear interpolation to generate quarterly figures for each variable.

[3] KDOR will only provide county aggregates if there are enough establishments of the type to ensure retailer anonymity.

To examine the implications of higher cigarette taxes for tax avoidance I estimate the following econometric model by retailer type using STATA version 12:

$$(1) \quad Y_{jt} = \alpha + \beta_1 t_{jt} + \beta_2 t_{jt} * distance_j + \beta_3 t_{jt}^s + X'_{jt}\gamma + \Phi_j + \varepsilon_{jt},$$

where Y_{jt} is the total sales tax revenue collected in county *j* at time *t*, t_{jt} is the relative cigarette tax rate in county *j* at time *t*, $distance_j$ is the distance from the center of county *j* via roadway to the nearest state border, and t_{jt}^s is the combined county and state sales tax rate in county *j* at time *t*. The vector *X* includes possible other county variables such as population. Φ_j is a county fixed effect to control for factors in a county that affect sales revenue, but do not vary over time. The county fixed effect controls for any unobserved heterogeneity that may affect the dependent variable (Baltagi BH, 1995). ε_{jt} is the error term.

The relative cigarette tax rate t_{jt} faced in a given county *j* is computed as the difference between the real Kansas excise tax and the real excise tax rate at the nearest Kansas border to that county at time *t*. Note that the combined effects of changes in Kansas and neighboring states' tax rates generate sizable variation in the Kansas relative tax rate within counties over time. This can be seen in Figure 4, where I graph the relative tax rate in each Kansas border-sample county over time. In essence, my econometric approach identifies cross-border tax effects using the variation in the neighboring states' excise tax rates relative to Kansas over time.

The main hypothesis being tested is the revenue boosting potential of cigarette taxes will fall short of expectations in the presence of low tax borders. Referring to equation (1), I expect β_1 to be negative and the coefficient on the interaction term, β_2, to be positive. This prediction is due to relative price elasticities with respect to substitutes. In my study the availability of substitutes is inversely related to the distance to a relatively low tax border. As you move closer to a low tax border the high tax state's price elasticity for cigarettes becomes increasingly elastic since substitutes become increasingly available due to reduced travel distance. I expect neighboring states' cigarettes to be a very strong substitute for Kansas cigarettes for households on the border resulting in overall elastic demand at the border. As you move away from the low tax border, the price elasticity will become more inelastic since the substitute sellers become unreasonably far away to be considered.

Note that, in equation (1) the marginal effect of a \$1.00 increase in the Kansas cigarette tax rate equals:

$$(2) \quad \frac{\partial Y_{jt}}{\partial t_{jt}} = \beta_1 + \beta_2 distance_j$$

We see that if $distance$ = 0, ie., the cigarette retailer is on the county border with a low tax neighbor, the sales tax revenue will fall according to β_1. To the extent that the retailer is farther away, distance will mitigate this effect, eventually moving toward a positive net effect of an increase in cigarette tax on sales tax revenue. Prior research suggests that somewhere around 40 miles to the nearest low tax border, the marginal effect of a $1.00 increase in the cigarette tax rate switches from negative to positive (Hyland et al.).

Referring to equation (1), I expect that more populated counties will on average have higher sales tax revenue. Other factors that might matter at the county level that are time invariant will be captured by the county fixed effect. Regarding β_3, it is unclear what sign it will take on. Because the sales tax rate is low at an average of 6.1% compared to the cigarette tax rate (for small purchases), on a non-durable purchase it may be that consumer behavior is not altered much by small changes in t_{ij}^{s}. In this case, I expect β_3 to be positive.

I estimate equation (1) by industry type: Gas stations with convenience stores, tobacco stores, and vending machines. I also consider three specifications for each industry type: Real sales tax revenue in thousands, log of real sales tax revenue, and per capita real sales tax revenue, to pick up population effects. These specifications give a linear model, a nonlinear model, and a model that corrects for what is an immense population disparity between counties.

4. Empirical Results

I estimate equation (1) separately for each of the three retailer types for the reporting counties within 50 miles of any border and for the reporting counties within 50 miles of the Missouri border.[4] I concentrate on the counties nearest to the borders since prior findings suggest little effect more than 40 miles from the border. Summary statistics are reported by industry and sample type in Tables 2, 3 and 4. The two sample subsets include counties within 50 miles of any border, and counties within 50 miles of the Missouri border. All dollar values are in 2012 dollars. Evident from these tables are the striking difference across Kansas counties in several variables. Referring to the convenience stores sample for all borders, in terms of population, Elk County has the least population of 2,939, while Johnson County has the highest population of 532,175, over 180 times the population of Elk County. County income levels also show remarkable variation. For example, Elk County has the lowest reported real county income of $87.6 million, while Johnson County has a staggering county income of $33.2 billion. This is mainly due to the large population Johnson County possesses. In per capita terms Johnson County is slightly more than twice as large as Elk County. The large differences in population and income across counties suggest it is important to control for county fixed effects.

Also notice from Table 2 that the difference in real excise tax rates between Kansas and its closest bordering states differs greatly between

[4] Except in the case of tobacco stores. There are only three counties in Kansas with Tobacco retailers. Two of these are within 50 miles of a border (in this case Missouri). The third is in Sedgwick County and is more than 50 miles away from the Oklahoma border. I include all three counties in the tobacco stores sample.

counties. Referring to the max and min values reported in Table 2 for the any-border sample the difference in real excise tax rates (Kansas excise tax minus nearest border excise tax) reaches a minimum value of -$0.29 between Kansas and Oklahoma, meaning Kansas was the low tax state in relation to Oklahoma by 29 cents, and a maximum value of $0.78 between Kansas and Missouri, meaning Kansas was the high tax state in relation to Missouri by 78 cents. Distance to the nearest border also varies significantly between Kansas counties. The longest distance to the nearest border observed from the data is 48.56 miles, while the shortest distance is only 11.62 miles. The combined state and county tax rate in Kansas has a minimum and maximum of 5.3% and 7.55%, respectively, in the sample.

Table 5 reports the empirical results for convenience stores with a gas station run on the two subsamples of Kansas counties. The results generally reflect expectations. Where statistically significant, we see the β_1 is negative and β_2 is positive. The data do not suggest a linear effect as in models (1) and (4) of Table 5. Referring to models (2) and (5), note that the marginal effects in these models are computed as follows:

$$\frac{\partial lnY}{\partial t} = \beta_1 + \beta_2 distance \,,$$

$$\frac{1}{Y} * \frac{\partial Y}{\partial t} = \beta_1 + \beta_2 distance \,,$$

$$\frac{\partial Y}{\partial t} = Y * (\beta_1 + \beta_2 distance) \,. \tag{3}$$

I use the sample means of *Y*, $141.74, and distance, 23.78, to compute the marginal effect of a $1.00 increase in the Kansas cigarette excise tax rate on sales tax revenue. Note that the average distance is the average distance to the border for counties within 50 miles to the border. This marginal effect for model (2) in Table 5 equals:

$$\frac{\partial Y}{\partial t} = (141.74) * (-0.108 + 0.0035 * 23.78)\,,$$

$$\frac{\partial Y}{\partial t} = -3.511\,.$$

This marginal effect implies that on average we expect a $1.00 increase in the Kansas cigarette excise tax will result in a $3,511 decrease in sales tax revenue collected from gas stations with a convenience store, ceteris paribus. Table 6 shows the average marginal effect for gas stations with convenience stores for models (2), (3), (5), and (6) as well as the marginal effects at specific distances for each model. Referring first to the log models, notice that the average revenue impacts are much larger for counties near the Missouri border. For model (5) the average marginal effect is -4.593. This means that on average we expect a $1.00 increase in the Kansas cigarette tax will result in a $4,593 decrease in convenience store quarterly sales tax revenue, ceteris paribus, which is almost twice the revenue loss from the larger sample. As a percent of the sample average revenue collected, for any border, model (2) indicates a quarterly revenue loss from a $1.00 increase in the cigarette tax of $\frac{3.511}{141.74}$, which equals 2.5% of revenue. For the Missouri border, the corresponding revenue loss is

$\frac{4.593}{213.638}$, which equals 2.15% of revenue. As can be seen from Table 6, both models (2) and (5) predict strong adverse revenue effects near the border with revenue losses at $14,811 or 10% (computed as $\frac{14.811}{171.74}$), of revenue and $47,469 or 22% (computed as $\frac{47.469}{213.63}$), of revenue on the border, respectively, and adverse effects persisting but weakening up to between 20 and 30 miles away from the border, consistent with expectations.

Referring to the per capita models marginal effects reported in Table 6, the marginal effects are strongest closest to the border, with a $1.00 increase in cigarette tax translating into a decrease in sales tax revenue of 82 cents per pack and 49.6 cents per pack for models (6) and (3), respectively. Interestingly, like the log models the negative effect is stronger in the Missouri sample up to 10 miles out, but, unlike the log models, the per capita marginal effects at the mean are not more negative in the Missouri sample. Translating the per capita models, we see that the average county population in the all border sample is approximately 38,420 and in the Missouri sample, the average county population is about 59,912. These population data translate the impacts in models (3) and (5), on the border, to $19,056, computed as $(.4957)(38{,}420)$, and $49,128, computed as $(.8236)(59{,}290)$, respectively, in lost revenue.

For counties within 50 miles of any border, for models (2) and (3), and counties within 50 miles of the Missouri border, for model (5), we see that the price elasticity of demand for cigarettes is in fact elastic on average, because the marginal effect is negative on average, resulting in a drop in sales revenue for convenience store retailers and sales tax revenue for the state government.

Model (6) shows an average marginal effect of 0.0324 for counties within 50 miles of the Missouri border. This suggests that on average we expect a $1.00 increase in the Kansas cigarette excise tax will result in a 3 cent per person increase in gas station with convenience store sales tax revenue. This model result implies that while the price elasticity is still inelastic on average, it is much more elastic than would be expected for cigarettes. Notice also the interval the marginal effect switches from negative to positive. For model (2) we observe this change in the marginal effect between 30 and 40 miles from any low tax Kansas border. Model (3) suggests a large distance of between 50 and 60 miles from any border. Models (5) and (6) portray the same range of between 20 and 30 miles. Again, these results overall are consistent with what I was expecting to see.

Table 7 reports the empirical results for tobacco store retailers. The results exactly reflect economic theory. All three models estimated are statistically significant with the expected signs, β_1 is negative and β_2 is positive. Table 8 shows the results of using the marginal effect equations previous listed. The average marginal effects of all three tobacco retailer models are negative. For model (1) we get an average marginal effect of -15.127 meaning that on average we expect a $1.00 increase in Kansas cigarette excise tax rates to result in a sizable $15,127 decrease in tobacco store sales tax revenue, ceteris paribus, constituting a roughly 21% (calculated as $\frac{15.127}{73.45}$) decrease in sales tax revenue. The average marginal effect for model (2) is -11.117. This implies that, on average, a $1.00 increase in the Kansas cigarette excise tax rates result in a

$11,117 decrease in tobacco store sales tax revenue. Finally, model (3) shows an average marginal effect of -0.0401. This means that we expect to see, on average, a $1.00 increase in the Kansas cigarette excise tax rate result in a decrease in tobacco store sales tax revenue of approximately 4 cents per person. The county population average for these three counties equals 348,528 which suggest a drop in total revenue of $13,948. Also shown in Table 8 are the marginal effects at specific distances for all three models. Notice that the adverse revenue effects are very large on the border in each of the three models at 88%, 66% and 72%, respectively, for models (1), (2) and (3) in Table 8.[5] Also interesting to note here is that all three models show the same interval at which the marginal effect switches from positive to negative. This switch happens between 40 and 50 miles, also consistent with what I was expecting to observe.

Table 9 reports the results for vending machines. The results are not consistent across samples. The results suggest for counties within 50 miles of any border demand is always inelastic even on the border. This is shown by, where significant, both β_1 and β_2 being positive. This means that even on the border, we see an increase in vending machine revenue of β_1. However, for counties within 50 miles of the Missouri border we get a result similar to what we observe for gas stations with convenience stores and tobacco stores. Where statistically significant, β_1 is negative and β_2 is positive. The Missouri sample implies, like the previous two retailers, that demand is elastic at the border and

[5] Note that I calculate 88% as follows: It equals the revenue loss at a distance of 1 mile from the border, $65.134, reported in model (1) if Table 6, divided by the sample average sales tax revenue for tobacco stores of $73.450. The 66% equals $-\frac{48.506}{73.45}$. The 72% is calculated using the revenue loss per capita at a distance of 1 mile from the border, -0.1567, divided by the sample average per capita sales tax revenue for tobacco stores of 0.2179.

becomes inelastic as you move away from the low tax border. It is unclear why this pattern is emerging in the results.

It is interesting to note that across models, the sales tax coefficient is negative (where significant) in the convenience store estimates. This is a surprising result, suggesting that the demand for convenience store goods is elastic with respect to the sales tax, and may be occurring because of cross-border effects are present here too. Another possibility is that since the sales tax revenue data for convenience stores includes all goods sold, the negative coefficient may be displaying consumer’s desire to substitute away from higher priced convenience store goods in favor of lower priced grocery store goods in the case of increasing sales tax rates.

5. Conclusion

In this paper I analyze the effects of the prominent cigarettes excise tax disparity between relatively high and low tax bordering states on the sales tax revenue of retailers in Kansas. I estimated a county fixed effects econometric model. As expected, I find that distance to a low tax bordering state has a significant impact on the price elasticity of demand for cigarettes. For convenience stores and tobacco stores the results for the border are strong and consistent across models. Interestingly, the strongest effect is on the revenues for tobacco retailers. This is likely because these retailers solely collect their sales tax revenue from cigarette purchases, while convenience stores sell a variety of goods. Also interesting, I do not detect a consistent effect for vending machines. The demand is always inelastic for the all borders sample. This result would be intuitive if vending machine purchases are an impulse, must-have, buy. But then on the Missouri border, results indicate elastic demand at the mean.

With the results noted above it's important to recognize that cigarette excise taxes are most likely not fulfilling their intended purpose, that being state revenue generation and curbing cigarette consumption. In fact, a cigarette excise tax increase could not only result in lost revenue near the border of a lower taxed state, but may also increase consumption for those who pursue tax avoidance. The reasoning behind this assertion is that the tax disparities shown in my paper may influence stockpiling behavior in consumers who participate in tax avoidance. The incentive for stockpiling is to reduce the number of trips across state borders, thus overall increasing the effectiveness of the consumer's tax avoidance. However, with the presence of large amounts of product, the consumer may be persuaded to increase consumption.

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TABLES

TABLE 1

Area Excise Tax History 2001 to 2008

	State Excise Tax Rates on Cigarettes				
Year	Kansas	Missouri	Colorado	Nebraska	Oklahoma
2001	$0.24	$0.17	$0.20	$0.34	$0.23
2002	$0.70	$0.17	$0.20	$0.64	$0.23
2003	$0.79	$0.17	$0.20	$0.64	$0.23
2004	$0.79	$0.17	$0.20	$0.64	$0.23
2005	$0.79	$0.17	$0.84	$0.64	$1.03
2006	$0.79	$0.17	$0.84	$0.64	$1.03
2007	$0.79	$0.17	$0.84	$0.64	$1.03
2008	$0.79	$0.17	$0.84	$0.64	$1.03
2009	$0.79	$0.17	$0.84	$0.64	$1.03
2010	$0.79	$0.17	$0.84	$0.64	$1.03
2011	$0.79	$0.17	$0.84	$0.64	$1.03
2012	$0.79	$0.17	$0.84	$0.64	$1.03

Data Source: KDOR

Table 2

Descriptive Statistics: Convenience Stores Quarterly Panel Data on Kansas Counties

Counties Within 50 Miles of Any Border 2003 to 2008						
Variable	Mean	Std. Dev.	Min	Max	N	n
Real Sales Tax Revenue Convenience Stores (Thousands)	141.749	287.852	11.0837	1863.61	792	33
Real Sales Tax Revenue Convenience Stores (Per Capita)	4.83749	1.938028	1.21331	16.2172	792	33
Combined State and County Sales Tax Rate in Kansas	0.06103	0.005034	0.053	0.0755	792	33
Difference in Excise Tax of Kansas and Missouri	0.71907	0.039101	0.64974	0.77854	792	33
Difference in Excise Tax of Kansas and Colorado	0.20505	0.369693	-0.05986	0.74087	792	33
Difference in Excise Tax of Kansas and Nebraska	0.17397	0.00946	0.1572	0.18836	792	33
Difference in Excise Tax of Kansas and Oklahoma	0.05045	0.452967	-0.28734	0.7032	792	33
Income (Thousands)	1630974	4963952	87625.3	3.32E+07	792	33
Income (Per Capita)	34642.8	19132.63	18480.8	62422	792	33
Distance to Closest Border	23.78	12.03942	11.625	48.5577	792	33
County Population	38419.8	88343.88	2939	532175	792	33
Counties Within 50 Miles of Missouri Border 2003 to 2005						
Real Sales Tax Revenue Convenience Stores (Thousands)	213.638	367.4452	20.4588	1776.63	216	18
Real Sales Tax Revenue Convenience Stores (Per Capita)	4.26216	1.442679	1.21331	7.65183	216	18
Combined State and County Sales Tax Rate in Kansas	0.0635	0.003113	0.053	0.068	216	18
Difference in Excise Tax of Kansas and Missouri	0.75285	0.019478	0.72005	0.77854	216	18
Income (Thousands)	2543610	6189170	207675	2.81E+07	216	18
Income (Per Capita)	32142.2	6381.942	18480.8	56593.1	216	18
Distance to Closest Border	25.1816	14.41603	11.625	49.4108	216	18
County Population	59911.7	111536.6	7868	504441	216	18

Data Sources: KDOR and BEA
Notes: Convenience Store data starts in 2003 due to Industry code change. N is the number of observations and n is the number of counties.

Table 3

Descriptive Statistics: Tobacco Stores Quarterly Panel Data on Kansas Counties

Counties Within 50 Miles of Any Border 2001 to 2005						
Variable	Mean	Std. Dev.	Min	Max	N	n
Real Sales Tax Revenue Tobacco Stores (Thousands)	73.4525	39.17867	13.18	139.021	60	3
Real Sales Tax Revenue Tobacco Stores (Per Capita)	0.21792	0.050567	0.12522	0.36372	60	3
Combined State and County Sales Tax Rate in Kansas	0.06224	0.002894	0.0575	0.073	60	3
Difference in Excise Tax of Kansas and Missouri	0.54621	0.302116	0.08945	0.77854	60	3
Difference in Excise Tax of Kansas and Colorado	0.35826	0.356854	-0.05986	0.74087	60	3
Difference in Excise Tax of Kansas and Nebraska	0.09719	0.163457	-0.13079	0.45806	60	3
Difference in Excise Tax of Kansas and Oklahoma	0.28329	0.406075	-0.28734	0.7032	60	3
Income (Thousands)	1.64E+07	9880498	3384443	2.81E+07	60	3
Income (Per Capita)	43428.8	9731.691	33589.8	58238.2	60	3
Distance to Closest Border	38.4338	19.82863	11.625	58.2333	60	3
County Population	348528	175374	100503	504441	60	3

Data Sources: KDOR and BEA
Notes: N is the number of observations and n is the number of counties. Tobacco stores sample includes Sedgwick County since there is a total of only three counties in Kansas with tobacco store revenue reported.

Table 4

Descriptive Statistics: Vending Machines Quarterly Panel Data on Kansas Counties

Counties Within 50 Miles of Any Border 2001 to 2008						
Variable	Mean	Std. Dev.	Min	Max	N	n
Real Sales Tax Revenue Vending Machines (Thousands)	13.4829	26.2619	0.05389	148.67	608	19
Real Sales Tax Revenue Vending Machines (Per Capita)	0.21233	0.1654	0.00634	0.7967	608	19
Combined State and County Sales Tax Rate in Kansas	0.0616	0.00471	0.049	0.068	608	19
Difference in Excise Tax of Kansas and Missouri	0.59836	0.24673	0.08945	0.77854	608	19
Difference in Excise Tax of Kansas and Colorado	0.20319	0.34429	-0.0599	0.74087	608	19
Difference in Excise Tax of Kansas and Nebraska	0.12292	0.13252	-0.1308	0.45806	608	19
Difference in Excise Tax of Kansas and Oklahoma	0.07758	0.41494	-0.2873	0.7032	608	19
Income (Thousands)	2566316	6235982	226051	3.32E+07	608	19
Income (Per Capita)	33687.6	6361.18	18480.8	62421.9	608	19
Distance to Closest Border	26.9774	13.774	11.625	49.0946	608	19
County Population	59431.7	109342	7681	532175	608	19
Counties Within 50 Miles of Missouri Border 2001 to 2005						
Real Sales Tax Revenue Vending Machines (Thousands)	17.8995	31.7764	0.19162	148.67	260	13
Real Sales Tax Revenue Vending Machines (Per Capita)	0.20573	0.15655	0.01244	0.75511	260	13
Combined State and County Sales Tax Rate in Kansas	0.06288	0.00299	0.049	0.068	260	13
Difference in Excise Tax of Kansas and Missouri	0.54621	0.30017	0.08945	0.77854	260	13
Income (Thousands)	3340804	7021262	253797	2.81E+07	260	13
Income (Per Capita)	33174.3	7312.8	18480.8	58238.2	260	13
Distance to Closest Border	24.08	13.8721	11.625	49.0946	260	13
County Population	77098.7	124037	10087	504441	260	13

Data Sources: KDOR and BEA
Notes: N is the number of observations and n is the number of counties.

Table 5

Convenience Stores: Determinants of County Sales Tax Revenue

	Counties within 50 miles of any border 2001 to 2008			Counties within 50 miles of Missouri 2001 to 2005		
	(1)	(2)	(3)	(4)	(5)	(6)
	Revenue in Thousands	Log of Revenue	Per Capita Revenue	Revenue in Thousands	Log of Revenue	Per Capita Revenue
Difference in excise tax with closest border	2.083 (8.206)	-0.108** (0.047)	-0.5048** (0.2462)	-26.87 (33.95)	-0.2305** (0.1144)	-0.859* (0.473)
Difference in excise tax with closest border X Distance to border	0.0299 (0.363)	0.0035* (0.0018)	0.0091 (0.0094)	1.014 (1.154)	0.0083** (0.0039)	0.0354** (0.0161)
Combined state and county sales tax rate in Kansas	-1101.73 (699.35)	-15.08*** (4.046)	-41.64** (20.98)	-1370.9 (3938.5)	-43.05*** (13.27)	-83.34 (54.9)
Observations	792	792	792	216	216	216
Number of Counties	33	33	33	18	18	18

Notes: All models include county fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Table 6

Convenience Stores: Marginal Effects

	Model Number			
Distance	(2)	(3)	(5)	(6)
1	-14.81183	-0.4957	-47.468586	-0.8236
10	-10.34702	-0.4138	-31.510425	-0.505
20	-5.38612	-0.3228	-13.779135	-0.151
30	-0.42522	-0.2318	3.952155	0.203
40	4.53568	-0.1408	21.683445	0.557
50	9.49658	-0.0498	39.414735	0.911
60	14.45748	0.0412	57.146025	1.265
70	19.41838	0.1322	74.877315	1.619
80	24.37928	0.2232	92.608605	1.973
90	29.34018	0.3142	110.3399	2.327
100	34.30108	0.4052	128.07119	2.681
Average	-3.511	-0.2884	-4.593	0.0324

Notes: Averages are calculated using the average distance to the border of counties within 50 miles of the border. Models (2) and (3) use average values from the any border subset while models (5) and (6) use average values from the Missouri border subset

Table 7

Tobacco Stores: Determinants of County Sales Tax Revenue

	All Tobacco Retailers 2001 to 2005		
	(1)	(2)	(3)
	Revenue in Thousands	Log of Revenue	Per Capita Revenue
Difference in excise tax with closest border	-66.47***	-0.674***	-0.1599***
	(16.87)	(0.229)	(0.0499)
Difference in excise tax with closest border X Distance to border	1.336***	0.0136***	0.0032***
	(0.341)	(0.0046)	(0.001)
Combined state and county sales tax rate in Kansas	-250	-1.03	-0.683
	(833.3)	(11.29)	(2.468)
Observations	60	60	60
Number of Counties	3	3	3

Notes: There are only three counties in Kansas with Tobacco retailers. Two of these are within 50 miles of a border (in this case Missouri). The third is in Sedgwick County and is more than 50 miles away from the Oklahoma border. I include all three counties. All models include county fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Table 8

Tobacco Stores: Marginal Effects

	Model Number		
Distance	(1)	(2)	(3)
1	-65.134	-48.50638	-0.1567
10	-53.11	-39.5161	-0.1279
20	-39.75	-29.5269	-0.0959
30	-26.39	-19.5377	-0.0639
40	-13.03	-9.5485	-0.0319
50	0.33	0.4407	0.0001
60	13.69	10.4299	0.0321
70	27.05	20.4191	0.0641
80	40.41	30.4083	0.0961
90	53.77	40.3975	0.1281
100	67.13	50.3867	0.1601
Average	-15.128	-11.117	-0.0401

Notes: Averages are calculated using the average distance to the border of counties within 50 miles of the border.
All three models use average values from the Missouri border subset

Table 9

Vending Machines: Determinants of County Sales Tax Revenue

	Counties within 50 miles of any border 2001 to 2008			Counties within 50 miles of Missouri 2001 to 2005		
	(1)	(2)	(3)	(4)	(5)	(6)
	Revenue in Thousands	Log of Revenue	Per Capita Revenue	Revenue in Thousands	Log of Revenue	Per Capita Revenue
Difference in excise tax with closest border	6.243***	0.2001*	0.008	-8.62**	-0.309*	-0.0363
	(1.697)	(0.108)	(0.015)	(4.03)	(0.184)	(0.0243)
Difference in excise tax with closest border X Distance to border	0.1457**	-0.0049	-0.0004	0.1978*	0.0089*	0.0007
	(0.065)	(0.0041)	(0.0006)	(0.103)	(0.0047)	(0.0007)
Combined state and county sales tax rate in Kansas	-393.14***	1.591	-2.733***	-447.98	19.804	-0.6602
	(87.16)	(5.55)	(0.7854)	(354.58)	(16.19)	(2.144)
Observations	608	608	608	260	260	260
Number of Counties	19	19	19	13	13	13

Notes: All models include county fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Figure 1

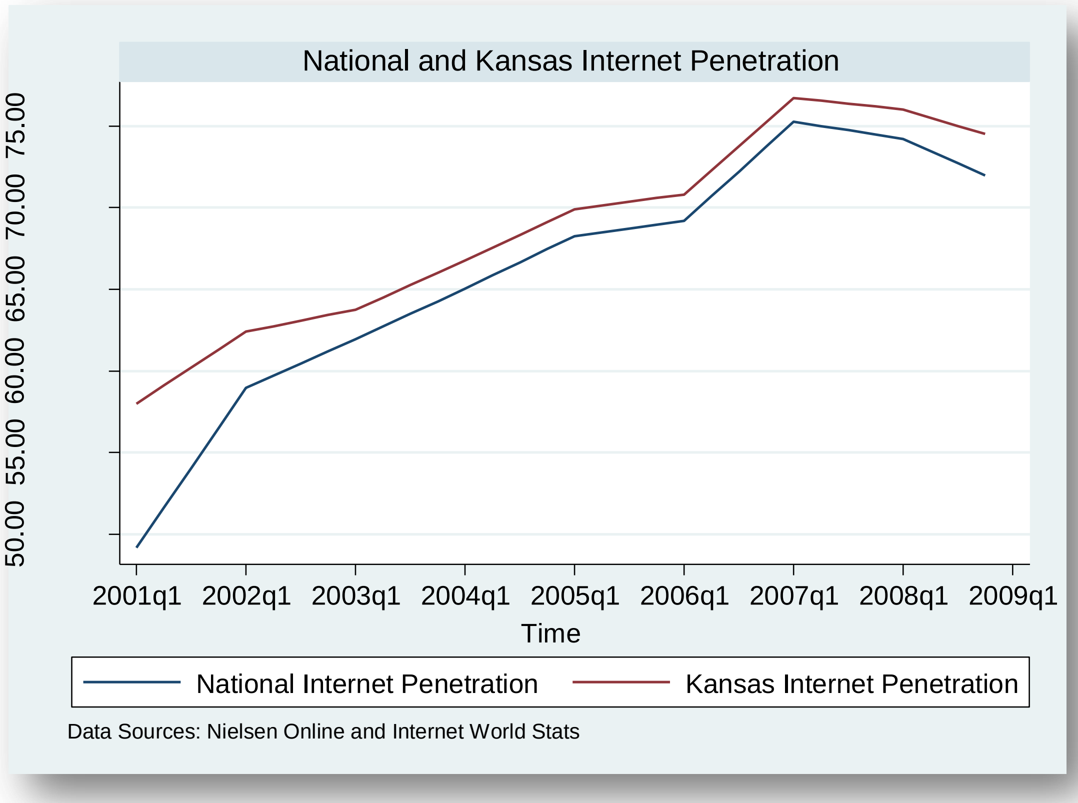

National and Kansas Internet Penetration
50.00
55.00
60.00
65.00
70.00
75.00
2001q1
2002q1
2003q1
2004q1
2005q1
2006q1
2007q1
2008q1
2009q1
Time
National Internet Penetration
Kansas Internet Penetration
Data Sources: Nielsen Online and Internet World Stats

Figure 2

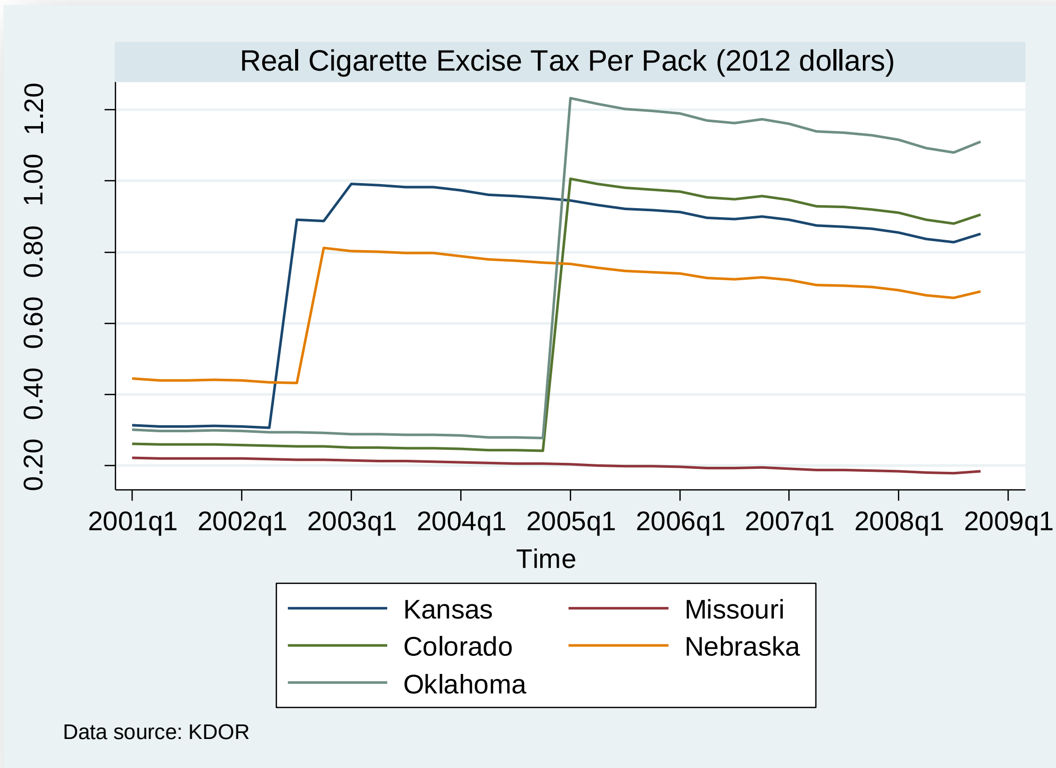

Real Cigarette Excise Tax Per Pack (2012 dollars)
0.20 0.40 0.60 0.80 1.00 1.20
2001q1 2002q1 2003q1 2004q1 2005q1 2006q1 2007q1 2008q1 2009q1
Time
Kansas
Missouri
Colorado
Nebraska
Oklahoma
Data source: KDOR

Figure 3

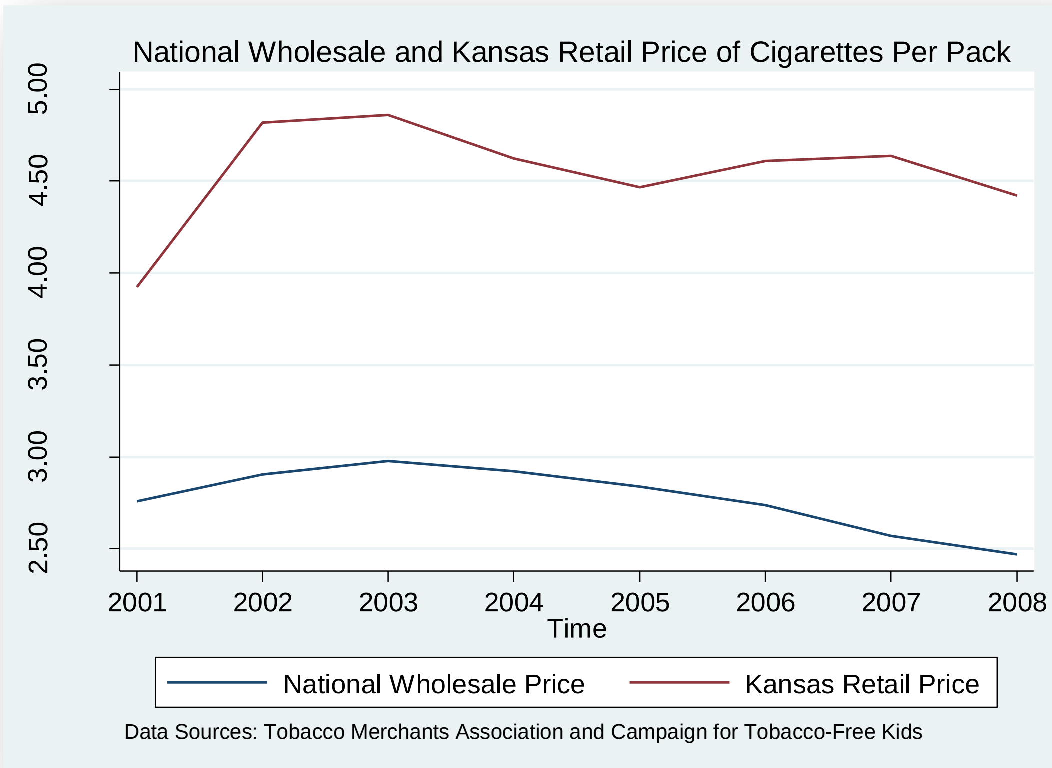
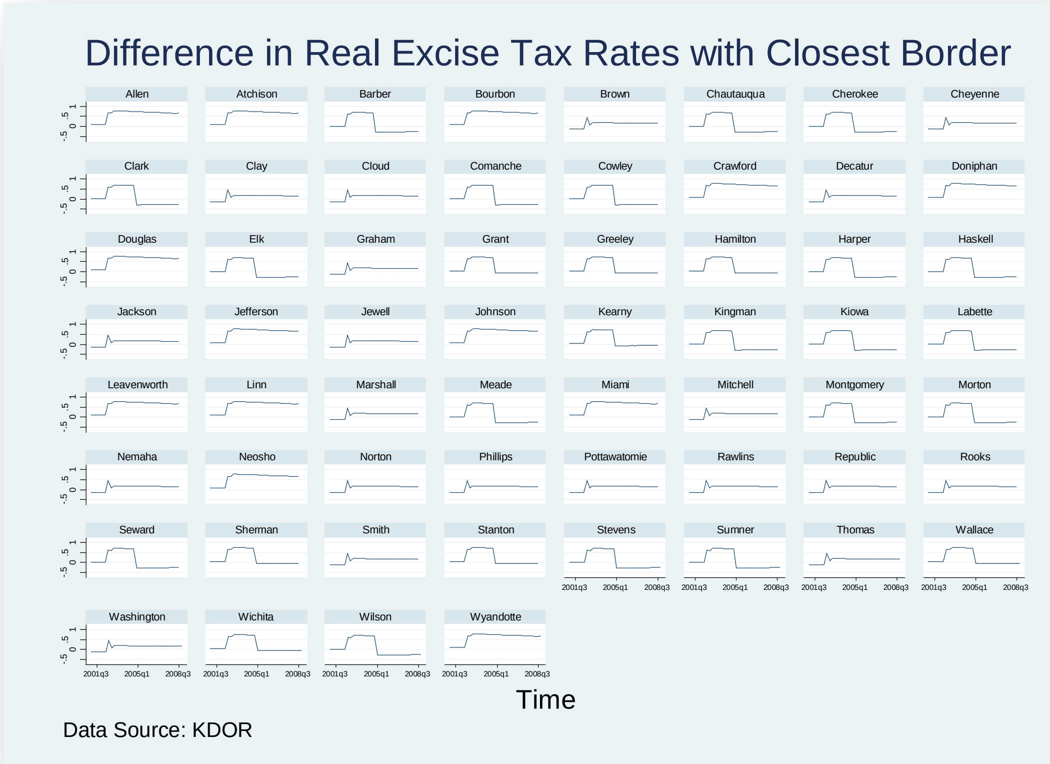

National Wholesale and Kansas Retail Price of Cigarettes Per Pack
5.00
4.50
4.00
3.50
3.00
2.50
2001
2002
2003
2004
2005
2006
2007
2008
Time
National Wholesale Price
Kansas Retail Price
Data Sources: Tobacco Merchants Association and Campaign for Tobacco-Free Kids

Figure 4


Difference in Real Excise Tax Rates with Closest Border
Allen
Atchison
Barber
Bourbon
Brown
Chautauqua
Cherokee
Cheyenne
Clark
Clay
Cloud
Comanche
Cowley
Crawford
Decatur
Doniphan
Douglas
Elk
Graham
Grant
Greeley
Hamilton
Harper
Haskell
Jackson
Jefferson
Jewell
Johnson
Kearny
Kingman
Kiowa
Labette
Leavenworth
Linn
Marshall
Meade
Miami
Mitchell
Montgomery
Morton
Nemaha
Neosho
Norton
Phillips
Pottawatomie
Rawlins
Republic
Rooks
Seward
Sherman
Smith
Stanton
Stevens
Sumner
Thomas
Wallace
Washington
Wichita
Wilson
Wyandotte
2001q3
2005q1
2008q3
Time
Data Source: KDOR