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Cross-Border Shopping and the Sales Tax: A Reexamination of Food Purchases in West Virginia

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Cross-Border Shopping and the Sales Tax: A Reexamination of Food Purchases in West Virginia

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Abstract: In this paper we present new evidence of cross-border shopping in response to sales taxation. While several instructive studies provide estimates of the cross-border shopping effect, we utilize a unique opportunity to evaluate the effect of a large discrete change in sales tax policy. Using county level data on food income and sales tax data for West Virginia over the 1982-2000 period we estimate that for every one-percentage point increase in the county relative price ratio due to sales tax change, the per capita food income decreases by about 0.7 percent. Our estimates indicate that food sales fell in West Virginia border counties by about 4 percent as a result of the imposition of the 6 percent sales tax on food in 1989.

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1. Introduction

In this paper we take advantage of a unique opportunity to reevaluate the role of sales taxation on cross-border shopping using county level food store data for West Virginia over the 1982-2000 period. During the 1980-82 period, West Virginia legislators eliminated the sales tax on food by cutting the rate on food from 3 percent by 1 percentage point per year. Then in 1989 legislators reintroduced the taxation of food, but at a rate of 6 percent. As illustrated in Figure 1, West Virginia's neighboring states (Kentucky, Maryland, Ohio, Pennsylvania, and Virginia) either exempt food from sales taxation, or in the case of Virginia tax food at a reduced rate. In total, there are currently 20 states that impose state and/or local sales tax on food products. Residents in West Virginia border counties experienced a significant shift in the after-tax price differential with neighboring states for food products. The reintroduction of the 6 percent sales tax on food in 1989 provides an opportunity to evaluate the impact of this large discrete change in sales tax policy on the food store industry in border counties relative to interior counties. This is relevant particularly due to recent proposals in West Virginia to eliminate or cut the sales tax on food purchases.

In recent years there has been a renewed interest in the role of sales taxation in consumption activity, and in particular the effect of sales taxation on shopping location decisions. At the state and local level, the proliferation of Internet shopping is eroding the tax base. State and local governments cannot require firms with no physical presence (or nexus) in the taxing jurisdiction to collect sales and use taxes. Thus, just as there is potential for consumers to avoid sales taxation by making purchases in a nearby lower tax jurisdiction, there is also potential for consumers to avoid sales taxation by making purchases online. Although the limited empirical evidence shows that Internet purchases are sensitive to sales taxation (Goolsbee, 2000), difficulty in obtaining location-specific data on Internet sales has hampered this line of research. At the federal level, there is some discussion of the possibility of replacing the income tax with a broad-based consumption tax. Also, in Europe policies that have increased both consumer and factor mobility have generated a new interest in tax harmonization in order to avoid distortions that may exist as a result of tax policy.[1] For all these reasons, policymakers at the federal, state and local levels in the United States as well as in Europe and elsewhere are looking to the literature for guidance. While several studies provide valuable empirical evidence on the degree of cross-border shopping in response to sales tax differentials,[2] our paper provides new evidence of the magnitude of the cross border shopping effect.

To preview the paper's results, our empirical analysis reveals a strong response to the application of the six percent sales tax on food: For every one percentage point increase in the county relative price ratio due to sales tax changes, the per capita food income decreases by about 0.7 percent. The remainder of this paper is organized as follows. The next section provides a brief review of the literature and outlines the theoretical construct used to guide our empirical analysis. In section 3, we present the data, our empirical methodology, and results. Section 4 concludes.

2. Literature Review and Theoretical Discussion

There are a number of studies from the U.S. that examine the relationship between state and local taxes and cross-border sales. However, given the integration efforts in the European Union, it is also important to cite research on cross-border

[1] See Tanzi (1995), Dhillon (2001), Peralta and van Ypersele (2002), and Neumann, Holman, and Alm (2002) for excellent discussions and an overview of the tax coordination literature.
[2] We provide a review of this literature in the next section.

shopping in Europe. Specifically, FitzGerald (1992) found evidence of tax-induced cross-border shopping between Ireland and the United Kingdom. Also, a study by Gordon and Nelson (1997) provided evidence of cross-border shopping in Denmark. Ohsawa (2003) contributed to the EU tax harmonization literature by showing in a theoretical model that narrowing the tax band across countries lowers the number of cross-border shoppers.

In North America excise taxation, lotteries and cross-border sales have been popular research topics in recent years. Ferris (2001) showed that heavy taxation of sin products in Canada played an important role in drastic changes in cross-border shopping between 1989 and 1994. Beard, Gant and Saba (1997) found that cross-border sales of beer and liquor are significant in at least some U.S. states. They argued that these cross-border sales might change the demand elasticities to the extent that the revenue generating capabilities of state governments are affected. Similarly, Nelson (2002) concluded that the size of potential cross-border markets is an important determinant of state excise tax policy in the U.S. Tosun and Skidmore (2004) and Garrett and Marsh (2002) analyzed the border effects of state lotteries. Garrett and Marsh (2002) provided evidence that cross-border lottery shopping had a significant net negative impact on state lottery revenues in Kansas, Similarly, Tosun and Skidmore (2004) showed that lottery and lottery game introductions in neighboring states have had a significant impact on lottery revenues in West Virginia border counties. In another paper, Skidmore and Tosun (2005) also provided evidence that cross-border effects from interstate lottery competition may have a significant impact on retail activity in counties that are at the border.

In the context of sales taxation and Internet shopping, Goolsbee (2000) evaluated the relationship between sales tax rates and Internet purchases, using data from Forrester Research (a marketing research company). He found that local sales taxation is an important determinant of Internet purchases. However, a limitation of his work is that he does not know precisely the city or county of residence for the consumer, and thus the tax rate variable used by Goolsbee may contain measurement error.

Most closely related to the present paper is the work of Walsh and Jones (1988) who examined the effect of the elimination of the 3 percent sales tax on food in West Virginia during the 1980-82 period.[3] In particular, they measured how West Virginia consumers in border counties who had been shopping outside of West Virginia to avoid the sales tax on food stopped shopping elsewhere as the tax was phased out. In contrast, in our analysis we measure the degree to which West Virginia consumers in border counties began shopping in neighboring states as the sales tax on food was reintroduced in West Virginia but at twice the rate.

While this previous work is useful in understanding the border tax issue, the work in the present paper makes several contributions. First, much of the previous work has relied on the cross-sectional variation in taxes and retail sales, whereas we evaluate the issue in a dynamic framework by utilizing a panel of West Virginia counties over a nineteen-year period. Second, the previous research that utilized panel data (as opposed to cross-sectional data) evaluated marginal changes in sales tax rates of, say, 1, 2, or 3 percent. Given the presence of travel costs, many consumers might not be responsive to these small changes. In contrast, we examine the response to a large and discrete 6

[3] Walsh and Jones (1988) provide an extensive review of the U.S. studies on sales taxation and cross border shopping.

percent increase in the sales tax rate, so that the tax savings are likely to outweigh travel costs for a larger number of consumers. Third, most studies have utilized data on general retail activity. We, just as Walsh and Jones (1988) did, focus on one industry—food purchased for home consumption. Lastly, none of the previous studies on taxation and cross border shopping address the potential bias that can be introduced from spatial lag or spatial error issues. Given the spatial nature of cross border shopping, this may potentially lead to bias, inefficiency, and/or inconsistency in the estimates.

The theoretical framework we use follows the simple model presented in Walsh and Jones (1988) and is similar to that which was used in earlier work of Fisher (1980) and Fox (1986). Per capita demand for grocery products in county i at time period t depends on per capita income (Y_{it}), the after-tax price of food items in the county relative to that available in other nearby locations (P_{it}), and the cost of travel associated with obtaining goods in other locations (C_{it}). This relationship is illustrated in the following multiplicative demand model:

$$S_{it} = A_i Y_{it}^a P_{it}^b C_i^c \qquad (1)$$

S_{it} is per capita sales of taxable food items demanded in county i at time t, Y_{it} is per capita income, and P_{it} is defined as, $\frac{p_{it}\left(1+T_{it}\right)}{p_{at}\left(1+T_{at}\right)}$ where T_{it} is the home state tax rate as applied to grocery food, T_{at} is the sales tax rate applied to grocery food sales in the nearest county in the adjacent state, and p_{it}, p_{at} are home and adjacent state pre-tax prices, which are assumed to be equal as in Walsh and Jones (1988). C_i and A_i represent costs of travel from county i to the nearest commercial center in the adjacent state and a multiplicative factor that is unique to each county. C_i and A_i are constant over time so that they will be controlled for with county fixed effects.

We expect an inverse relationship between food sales and the after-tax price differential because consumers may find it worthwhile to travel to the lower tax jurisdiction to make purchases. As highlighted in Walsh and Jones (1988), in order for us to attribute any changes in grocery sales with changes in sales taxation we must assume that input costs are similar on each side of the border, and that long-run supply curves are flat (i.e., constant cost structures); assumptions that are typical in this line of research. Nevertheless, we also control for several economic and demographic factors that may also determine food sales but are not explicitly modeled here—these variables are discussed in the next section.

The literature review and theoretical discussion presented above suggests that border county grocery sales are likely to decrease with the introduction of the sales tax on food. To set the stage for our more in-depth analysis, we present some *prima facia* evidence of a "border tax" effect. Using data on per capita food income[4] we conduct a difference-in-differences analysis. As shown in Table 1, average per capita food income in West Virginia interior counties was about $3.29 cents larger in the post-1989 period. But for West Virginia border counties the post 1989 period logged a reduction in per capita income of $6.97. The difference between the change in per capita food income for border counties versus interior counties is therefore ($10.26). Without controlling for other factors that determine changes in food sector income, this analysis suggests that the imposition of the sales tax on food in 1989 may have had a significant impact on the food

[4] Ideally, data on food sales would be the most appropriate measure. However, food sales data are not available annually by county for the period of analysis. We therefore proxy food sales with food income. As described in detail in the next section, food income is an excellent proxy for food sales.

industry in border counties. In the next section, we conduct a more thorough empirical analysis to determine that magnitude of the "border tax" effect.

3. Empirical Analysis

As outlined in Section II, the food sales (or income) variable is modeled to be a function of per capita income (Y_{it}), the after-tax price of food items in the county relative to that available in other nearby locations (P_{it}), and the cost of travel associated with obtaining goods in other locations (C_{it}). In this section we describe in detail the data we use, the empirical methodology and the estimation results. We begin with a detailed explanation of the data set we employ.

3.1 Data

Ideally, we would like to measure the effect of the sales tax on food sales, but to our knowledge annual county level data on food sales is not available over the entire period of analysis. However, data on food store income[5] is available on an annual basis. Is food store income an effective proxy for food store sales? To answer this question, we collected county level data from the United States Census Bureau on food store sales for years 1982, 1987, 1992, and 1997 and matched these data with data on food store income. The correlation between food store income and food store sales was 0.99. We also regressed food store income on food store sales. The estimated parameter values (with absolute value of t-statistics in parentheses) are reported in the equation below.

$$\underset{}{\textit{Food Store Income}} = -468.3 + \underset{(83.0)}{0.16}\ \textit{Food Store Sales}$$

$$\text{Adj. } R^2 = 0.97 \quad N = 193$$

[5] Food store income is defined as all income earned in the food stores (SIC code 623) within the retail sector as provided by the Bureau of Economic Analysis.

Figure 2 presents a simple plot of these two measures of food store activity, which shows an almost perfectly linear relationship between the two variables. From this analysis, we conclude that food store income is an excellent proxy for food store sales. Summary statistics for all variables used in the analysis are presented in Table 2. We now turn our attention to several important econometric issues.

3.2 Methodology

The data are a panel of 1045 observations[6] that include all counties for years 1982 through 2000. Given that our data have both time series and cross-sectional components, our analysis relies on changes in the status of the sales on tax on food in West Virginia. The analysis is simplified by the fact that West Virginia's contiguous states did not experience a change in the sales tax status during the period of analysis. Given the panel nature of our data, our analysis employs panel estimation techniques. Two conventional approaches for estimating panel data are the fixed-effects and random-effects procedures. In this case, if the individual county fixed-effects are correlated with other exogenous variables, the random-effects estimation procedure yields inconsistent estimates. We start with an *F*-test for the joint significance of the dummies that form the fixed effects. The null hypothesis, which says that fixed-effect dummies are "not significant", is resoundingly rejected.[7] In addition, a Hausman test shows that the fixed county-effects are correlated with the other exogenous variables, which suggests that the fixed-effects estimation procedure is more appropriate for this analysis. On a theoretical basis, a fixed-effects technique is more appropriate because the data are a panel of all counties in West

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[6] The panel is unbalanced due to 20 missing observations on food income from the Bureau of Economic Analyis.
[7] See Baltagi (2001: 14) for the specifics of this test.

Virginia and not a sampling of counties.[8] Therefore, for both theoretical and empirical reasons, we begin our econometric analyis by using the two way fixed-effects procedure as illustrated in equation (2). Denote $Food_{it}$ as the natural logarithm of deflated county per capita income earned in food industry (our proxy for food sales) in county i in period t. We assume that

$$Food_{it} = P_{it}\beta_1 + X_{it}\beta_2 + C_i + T_t + \varepsilon_{it}, \qquad (2)$$

where P_{it} is the after-tax price of food items in the county relative to that available in other nearby locations for county i in period t, X_{it} is an nxm vector control variables (m is the number of controls) and where β_2 represents an mx1 vector of coefficients. Included in X_{it} are the natural logarithm of real per capita income net of retail income (*Per Capita Non-Food Income*), the unemployment rate (*Unemployment Rate*), the proportion of the population that is over the age of 65 (*Elderly*), male (*Male*), and nonwhite (*Minority*). C_i represents the county specific effects which control for, among other things, travel costs, T_t is the set of time indicator variables, and ε_{it} is the residual which, as discussed below, we treat as either independently and normally distributed (OLS procedure), serially correlated (AR1 procedure), or spatially correlated (spatial error and spatial lag procedures) .

We estimate another specification in which we measure the effect of the after-tax-price ratio (P) on food income in each of the five bi-state regions (Kentucky, Maryland, Ohio, Pennsylvania, and Virginia) by interacting a series of indicator variables that equal one if the county borders a particular state and zero otherwise, with P. We also use a less specific measure of the effect of the introduction of the sales tax on food. In this

[8] Baltagi (2001) argues that random effects model is more appropriate when a random sample is chosen from a large population. Here, we have the entire set of counties.

specification we replace P with an interaction term between an indicator variable that is equal to one if the county is a border county and zero otherwise, and indicator variable that is equal to one for years 1989 and on (the years during which the 6 percent tax was imposed on food) and zero otherwise. In the last specification we examine the effects of the newly imposed sales tax on food with the indicator variable approach for each of the five bi-state regions.

Empirical analysis in a spatial context often focuses on factors such as distance, size of retail center, transportation routes, and the like. However, in this analysis, these variables change little over time so that fixed effects largely control for these factors. This allows us to focus on other variables that change over time such as income, demographic characteristics and, our primary interest, the changing tax environment. One approach to estimating the two-way fixed-effects model is to include a set of county and time indicator variables in the specification. The fixed-effects estimator uses a weighted average of the within county variation and the between county variation net of statewide trends to form the parameter estimates.

As we mentioned in the introduction, spatial autocorrelation can be a potential concern. With the exception of Case (1991, 1992), Case, et al. (1993), Ohsawa (1999), Garrett and Marsh (2002), and Tosun and Skidmore (2004), use of models of spatial dependence has been limited in the public finance arena. First introduced by Cliff and Ord (1981) and Anselin (1988), models of spatial dependence account for any direct influence of spatial neighbors, spillover effects, and externalities generated between cross-sectional observations (in this research the unit of observation is counties). Failing to address spatial dependence may lead to biased, inefficient, and/or inconsistent coefficient estimates.

Spatial dependence is caused by the existence of spillover effects between units of observation (counties) and the presence of a direct influence from activity in one county retail activity in neighboring counties. For example, changes in the number of retail establishments, changes in income, etc… in one county could affect retail activity in another county. The spatial relationship may affect the estimation in two ways. First, food retail activity in one county may affect food retail activity in a neighboring county; this is referred to as a spatial lag or spatial autoregressive relationship. Second, the error term for county (i) may be correlated with error term for county (j), where the degree of correlation depends on the distance between counties. In this study, we assume that adjacent county error terms are correlated but the error terms of counties not contiguous to one another are uncorrelated.

To control for the spatial lag issue, and additional term is added to equation (2). With the addition of the spatial lag term, equation (2) can be rewritten as

$$Food_{it} = \rho W_1 Food_{it-1} + P_{it}\beta_1 + X_{it}\beta_2 + C_i + T_t + \varepsilon_{it}, \qquad (3)$$

Where ρ indicates whether or not counties are contiguous to one another and therefore exhibit a spatial autoregressive relationship.

The degree of spatial autocorrelation depends on the potential correlation across counties in the error term. Any changes in the food retail market not captured by the regressors will be captured by the error term for each of the counties. We address this spatial correlation by using a spatial error model wherein the error term is written as

$$\varepsilon_{it} = \lambda W_2 \varepsilon_{it} + \mu_{it}$$

where

ε_{it} is the vector of errors for all counties

λ is the residual spatial autocorrelation coefficient,

W_2 is a symmetric spatial error weighting matrix,

and

μ_{it} is an independently and normally distributed error term with constant variance.

The spatial weighting matrix specifies the degree of correlation across counties. Here we assume that the error terms in adjacent counties are correlated so that a one is denoted in the those diagonals, and that the error terms in counties not contiguous to one another are uncorrelated so that a zero is denoted in all other diagonals.

For more detail on the econometric issues involved in addressing spatial dependence in panel data analysis, we refer readers to Elhorst (2003). Elhorst (2003) explains in detail both the fixed effects spatial error and spatial lag models.[9]

Garrett and Marsh (2002) use cross-sectional variation lottery sales to generate the parameter estimates, and thus spatial dependence is critical to their analysis. In our analysis, we use panel data so that the parameter estimates are generated primarily from the within county variation in food sales. In this context serial correlation of error is likely a more serious concern. In the next section, we report the OLS fixed effects estimation, a fixed effects estimation that corrects for serial correlation of the error, and a fixed effects estimation that corrects for spatial autocorrelation.

3.3 Results

[9] We used MATLAB routines of spatial error model (SEM) and spatial lag model (SAR) which can be downloaded from the web site www.spatial-econometrics.com.

Fixed Effects Estimates

Table 4 contains estimates using the fixed effects procedure without controlling for serial correlation of error—the same procedure used by Walsh and Jones (1988). However, to demonstrate the robustness of our results, in Table 5 we present another set of regressions in which we correct for serial correlation, and in Table 6 estimate a set of regression in which we correct for spatial autocorrelation.

In Table 4 we present four regressions that measure the effects of the West Virginia sales tax on food income in border counties. In column 1 we present a regression that includes our control variables and the interaction between the West Virginia border dummy variable and the post-1989 dummy variable. The coefficient on this interaction term is negative and significant. Per capita food income decreased by approximately 5 percent more in border counties (relative to interior counties) in the years following the imposition of the sales tax on food.[10] In column 2 we examine the effect in each of the five bi-state regions by including five interaction terms (the dummy variable for those counties that border particular neighbor state interacted with the post-1989 dummy variable). In three of the five bi-state regions (Ohio, Kentucky and Virginia borders) we observe reductions in food income in border counties relative to interior counties with the greatest reduction in counties that border Kentucky (16%). Surprisingly, the coefficient estimate for the Pennsylvania region is positive and statistically significant which indicates a 5.9% increase in per capita food income in the post-1989 period. One explanation to this could be the growing attractiveness of the Morgantown metro area for job opportunities in this period that may have led to more

[10] Here and in all other dummy variable coefficient interpretations, percentage change in per capita food income is calculated using the formula, $\left(e^{\gamma}-1\right)*100$, where γ is the coefficient of the dummy variable.

people from neighboring states (particularly bordering Pennsylvania) commuting to this area for day jobs. This could explain expanded food store activity despite the 6% sales tax on food purchases. Columns 3 and 4 present more precise estimates of the "border tax" effect. Column 3 includes the after-tax price of food items in the county relative to that available in other nearby locations. This variable is negative and significant at the 1 percent level, indicating that a 1 percentage point increase in the after tax price would reduce per capita food income by about 0.9%. This estimate indicates that a 6 percentage-point increase in the sales tax rate that occurred in 1989 reduced food income by about 5.4% in border counties, relative to interior counties. Column 4 shows again that in three of the five bi-state regions (again Ohio, Kentucky and Virginia borders) we observe negative effects of the sales tax on food income with the largest effect in counties that border Kentucky (2.9% decrease for a 1% increase in county relative price ratio). These border effects make sense when we consider the population base in these bi-state regions. For example, Huntington Metropolitan Statistical Area, which includes six border counties from West Virginia, Ohio and Kentucky, is the largest MSA in terms of population base in West Virginia.[11] In addition, the significant result for the Virginia border region is particularly important since Virginia is the only neighboring state that has taxed food purchases throughout our study period. West Virginia's imposition of sales tax on food purchases in 1989 decreased the tax difference between two states, which also diminished the tax incentives for Virginia residents at the West Virginia border to shop for food in West Virginia. The exceptions to the regions that we see significant border effects are the counties that border Maryland (a statistically insignificant coefficient) and Pennsylvania (again unexpectedly yields a positive and

[11] See Hammond (2001) for a comparison of West Virginia's MSAs.

significant coefficient). Generally, we find, just as Walsh and Jones did, strong border tax effects.

We also briefly report the coefficient estimates on the control variables. With the exception of per capita non-food personal income and the percentage of population over the age of 65, none of the control variables are statistically significant. The proportion of the population over the age of 65 is significant: A 10 point increase in the proportion of the population over the age of 65 reduces per capita food by between 0.2% and 0.3%. Given that the elderly population spends a greater portion of their income on services such as health care and that this demographic group is less likely to have children in the home, this result is not surprising. Somewhat surprisingly we obtain a negative and statistically significant coefficient estimate for the non-food personal income, although this coefficient loses its significance once we control for serial correlation.

Estimates with Correction for Serial Correlation of Errors

Given that the Durbin-Watson test indicated the existence of serial correlation of error, we also present for comparison fixed effects estimates with a correction for serial correlation using an AR1 procedure. As presented in Table 5, we see that the coefficient estimates become smaller in magnitude and statistical significance is lost for some of the variables. Two variables that show the overall border effects *WVBorder*Post-1989* and *County Relative Price Ratio* in columns (1) and (3) are still significant albeit with somewhat smaller coefficient estimates. However, with the exception of the Kentucky border region (*WVBorderKY*Post-1989*), the border effects variables for the bi-state regions lost their significance. As for the control variables, per capita non-food income is no longer significant whereas the proportion of population over 65 is still significant with roughly an unchanged coefficient estimate. Results in Table 5 show that while evidence of overall border effects is fairly robust, the correction for serial correlation weakens the results from the five bi-state region estimates.

Spatial Error Model Estimates

In a final set of regressions as reported in Table 6, we use the spatial error model. Note first that λ is not significant, indicating no evidence of correlation of errors across adjacent counties. While we present these estimates for comparison, given that we find no evidence of spatial autocorrelation we favor the results found in Tables 4 and 5. Even so the results in Table 6 are similar to the results in Tables 4 and 5, except that the overall measures of tax price becomes insignificant. However, the significance remains for two of the five bi-state regions (Kentucky and Virginia). Again, the tax price variables for the Pennsylvania bi-state region is unexpectedly positive and significant. We also estimated the same series of regressions using a spatial lag estimation procedure. However, we found no evidence of spatial autoregression and thus do not report them here.[12]

Based on this analysis, we believe the estimates found in Table 5 are most reliable. However, the alternative estimation techniques generally show that our findings are reasonably robust.

4. Policy Implications and Conclusions

In this paper we present new evidence of cross-border shopping in response to sales taxation. While several instructive studies provide estimates of the cross-border shopping effect, we add to this literature by utilizing a unique opportunity to evaluate the effect of a large discrete change in sales tax policy. Using county level data on food income and sales tax data for West Virginia over the 1982-2000 period we estimate that

[12] These estimates are available from the authors upon request.

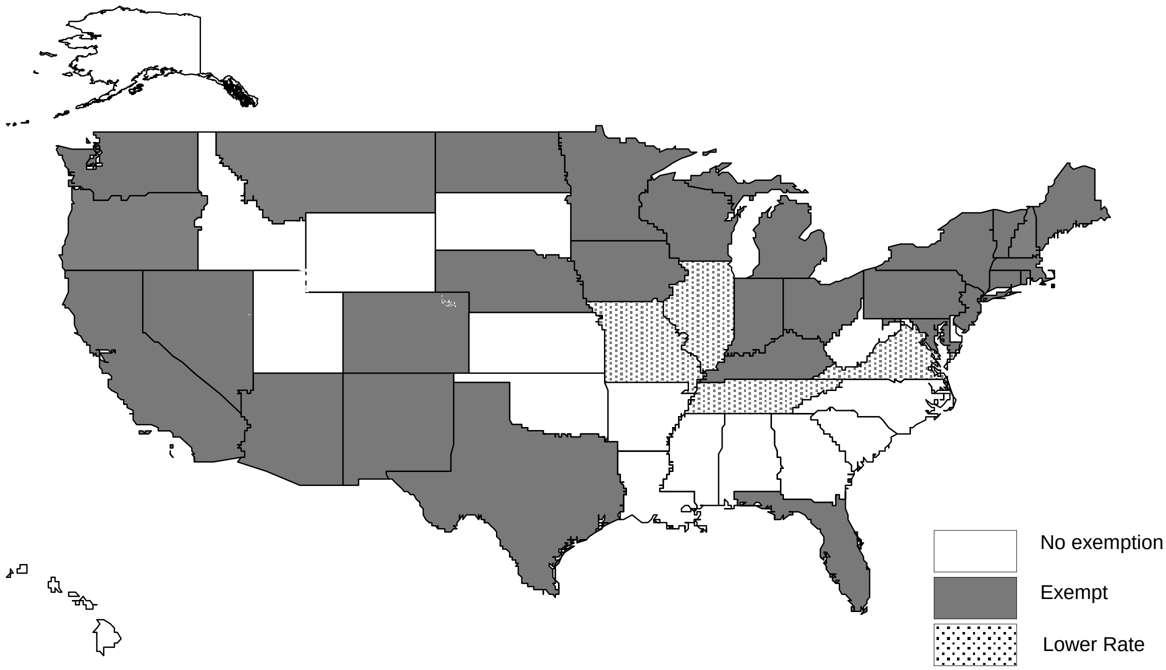
for every one-percentage point increase in the county relative price ratio due to sales tax change, the per capita food income decreases by about 0.7 percent. Our estimates indicate that food sales fell in West Virginia border counties by about 4 percent as a result of the imposition of the 6 percent sales tax on food in 1989. Hence, our results confirm those found in Walsh and Jones (1988).

Using the border effect estimate from column (3) of Table 5, our results indicate that, on average, the imposition of the 6 percent sales tax on food reduced food income in West Virginia border counties by about $69 million during the period 1990-2000 or $6.3 million annually after 1989. We also show that West Virginia counties at the Kentucky, Ohio and Virginia borders might have had significant negative cross-border sales impact from the sales tax on food with relatively weaker evidence for counties at the Ohio and Virginia borders. According to estimates in column (4) of Table 5, the annual economic impact after 1989 for the only bi-state region that exhibited statistically significant border effect was -$1.4 million for West Virginia counties bordering Kentucky. The total economic impact for these counties was -$15.8 million for the period 1990-2000. Our analysis suggests that one should approach the border effects results with caution: The correction for serial correlation of errors weakens the border effects estimates. More importantly, these effects are not borne out in most of the five bi-state border regions.

Generally, these results confirm the findings of previous work on taxation and border shopping. Our findings suggest that policymakers do well to consider carefully the tax structure in neighboring jurisdictions, and that tax harmonization efforts could lead to significant efficiency gains. In the case of West Virginia, the imposition of the sales tax on food resulted in a significant outflow of expenditures in border counties --

$6.3 million annually. It may be that in the end the benefits of imposing the sales tax on food outweighed the costs, but information presented here and in the previous literature helps decision makers to make that assessment.

Figure 1: Sales Tax Treatment of Food Products in the U.S. (as of January 1, 2005)



Source: Federation of Tax Administrators. http://www.taxadmin.org/fta/rate/sales.html

Figure 2: Plot of Retail Income and Retail Sales

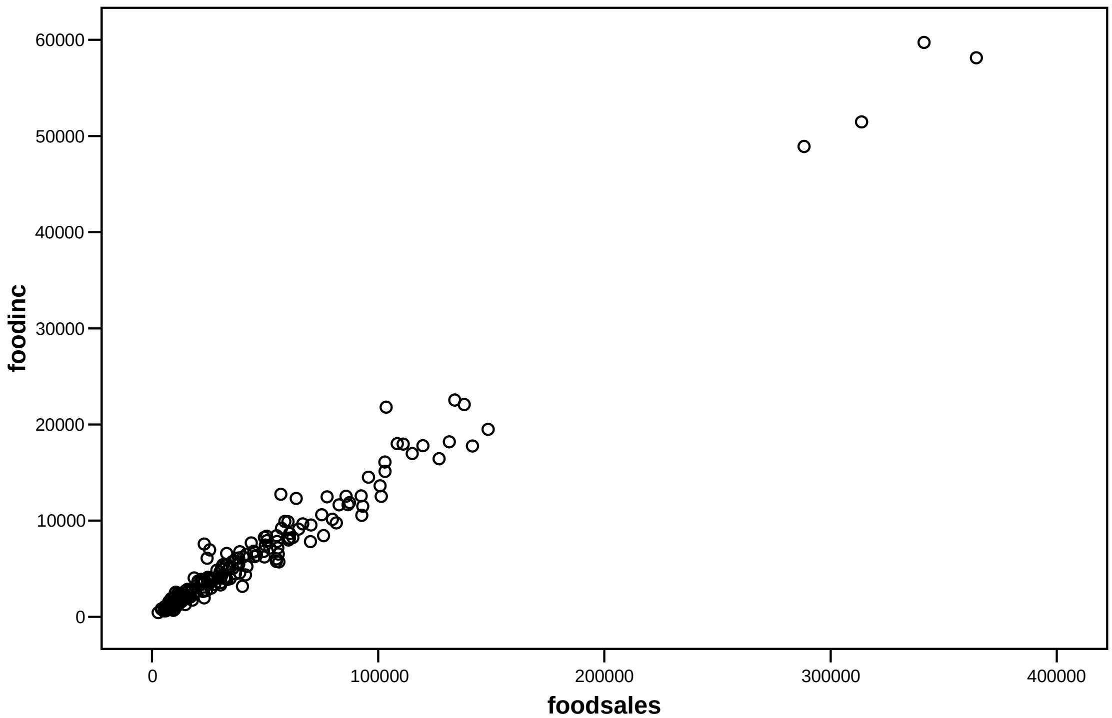


Table 1. Difference-in-Differences[a]

Real Per Capita Income in Food Stores Sector				
		Pre-1989	**Post-1989**	**Difference**
West Virginia County	Border Counties	200.29 (3.76)	193.32 (3.32)	-6.97 (5.04)
	Interior Counties	217.51 (4.21)	220.80 (4.86)	3.29 (6.86)
				-10.26 (8.33)

[a]Standard errors are shown in parentheses.

Table 2. Summary Statistics of Variables Used in the Analysis

	Observations	Mean	Standard Deviations
Per Capita Income of Food Stores	1025	206.586	66.193
WVBorder*Post-1989	1045	0.316	0.465
WVBorderOH*Post-1989	1045	0.126	0.332
WVBorderKY*Post-1989	1045	0.021	0.144
WVBorderVA*Post-1989	1045	0.137	0.344
WVBorderMD*Post-1989	1045	0.084	0.278
WVBorderPA*Post-1989	1045	0.074	0.261
County Relative Price Ratio	1045	1.012	0.027
PriceRatio* WVBorderOH	1045	0.226	0.428
PriceRatio* WVBorderKY	1045	0.037	0.192
PriceRatio* WVBorderVA	1045	0.236	0.425
PriceRatio* WVBorderMD	1045	0.149	0.361
PriceRatio* WVBorderPA	1045	0.132	0.345
Per Capita Non-Food Personal Income	1025	16,093.070	3,297.329
Unemployment Rate	1045	11.736	5.216
Proportion of Population Over the Age of 65	1045	14.642	2.147
Proportion of the Population That Is Male	1045	48.610	0.981
Proportion of the Population That is Nonwhite	1045	2.393	2.736
WV Border County	1045	0.545	0.498
Post-1989	1045	0.579	0.494

Table 3. Definitions and Sources of Variables

Variables	Definitions	Source
Per Capita Income of Food Stores	Real per capita private income in food stores sector	BEA
WVBorder*Post-1989	Indicator variable equal to 1 for a West Virginia border county and for the period 1990-2000 and 0 otherwise	TS
WVBorderOH*Post-1989	Indicator variable equal to 1 for a WV County at Ohio border and for the period 1990-2000 and 0 otherwise	TS
WVBorderKY*Post-1989	Indicator variable equal to 1 for a WV County at Kentucky border and for the period 1990-2000 and 0 otherwise	TS
WVBorderVA*Post-1989	Indicator variable equal to 1 for a WV County at Virginia border and for the period 1990-2000 and 0 otherwise	TS
WVBorderMD*Post-1989	Indicator variable equal to 1 for a WV County at Maryland border and for the period 1990-2000 and 0 otherwise	TS
WVBorderPA*Post-1989	Indicator variable equal to 1 for a WV County at Pennsylvania border and for the period 1990-2000 and 0 otherwise	TS
County Relative Price Ratio	Ratio of after-tax price in a West Virginia county to the after-tax price in a neighboring county	ACIR, CCH
PriceRatio* WVBorderOH	County Relative Price Ratio for a West Virginia County that borders Ohio	TS
PriceRatio* WVBorderKY	County Relative Price Ratio for a West Virginia County that borders Kentucky	TS
PriceRatio* WVBorderVA	County Relative Price Ratio for a West Virginia County that borders Virginia	TS
PriceRatio* WVBorderMD	County Relative Price Ratio for a West Virginia County that borders Maryland	TS
PriceRatio* WVBorderPA	County Relative Price Ratio for a West Virginia County that borders Pennsylvania	TS
Per Capita Non-Food Personal Income	Real per capita personal income net of non-food stores income	BEA
Unemployment Rate	Percentage county unemployment rate	WVBEP
Proportion of Population Over the Age of 65	Percentage Share of People Aged 65 and Over in Total County Population	CENSUS
Proportion of the Population That Is Male	Percentage Share of Male Population in Total County Population	CENSUS
Proportion of the Population That is Nonwhite	Percentage Share of Nonwhite Population in Total County Population	CENSUS
WV Border County	Indicator variable equal to 1 if it's a West Virginia border county and 0 otherwise	TS
Post-1989	Indicator variable equal to 1 for the period 1990-2000 and 0 otherwise	TS

Sources:
BEA: Bureau of Economic Analysis, Regional Accounts Data: http://www.bea.doc.gov/bea/regional/reis/
TS: Tosun and Skidmore – variables created by the authors.
ACIR: Advisory Commission on Intergovernmental Relations – Significant Features of Fiscal Federalism, various years.
CCH: Commerce Clearing House, Incorporated: http://tax.cchgroup.com
WVBEP: West Virginia Bureau of Employment Programs: http://www.wvbep.org/scripts/bep/lmi/cntydata.cfm
CENSUS: U.S. Census Bureau, County Population Estimates: http://eire.census.gov/popest/estimates.php

Table 4. Estimation Results[a]
(with county and year fixed effects)

Variable	(1)	(2)	(3)	(4)
WVBorder*Post-1989	-0.051*** (0.016)			
WVBorderOH*Post-1989		-0.041* (0.024)		
WVBorderKY*Post-1989		-0.175*** (0.048)		
WVBorderVA*Post-1989		-0.063*** (0.018)		
WVBorderMD*Post-1989		-0.008 (0.023)		
WVBorderPA*Post-1989		0.057** (0.023)		
County Relative Price Ratio			-0.896*** (0.277)	
PriceRatio* WVBorderOH				-0.691* (0.391)
PriceRatio* WVBorderKY				-2.895*** (0.818)
PriceRatio* WVBorderVA				-1.155*** (0.323)
PriceRatio* WVBorderMD				-0.157 (0.398)
PriceRatio* WVBorderPA				0.957** (0.392)
Per Capita Non-Food Personal Income	-0.293*** (0.105)	-0.259** (0.106)	-0.295*** (0.105)	-0.260** (0.106)
Unemployment Rate	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)
Proportion of Population Over the Age of 65	-0.022*** (0.008)	-0.029*** (0.009)	-0.022*** (0.008)	-0.029*** (0.009)
Proportion of the Population That Is Male	0.009 (0.020)	-0.004 (0.019)	-0.009 (0.020)	-0.004 (0.019)
Proportion of the Population That is Nonwhite	-0.002 (0.017)	-0.014 (0.017)	-0.001 (0.017)	-0.015 (0.017)
Constant	7.757*** (1.433)	8.189*** (1.382)	7.769*** (1.434)	8.183*** (1.383)
R^2:	0.88	0.89	0.89	0.89
Sample size:	1025	1025	1025	1025

[a] Standard errors are shown in parentheses.
*Indicate 10 percent significance level.
**Indicate 5 percent significance levels.
***Indicate 1 percent significance levels.

Table 5. Estimation Results[a]
(two-way fixed effects AR1 regression)

Variable	(1)	(2)	(3)	(4)
WVBorder*Post-1989	-0.039[*] (0.022)			
WVBorderOH*Post-1989		-0.024 (0.032)		
WVBorderKY*Post-1989		-0.145[**] (0.060)		
WVBorderVA*Post-1989		-0.018 (0.028)		
WVBorderMD*Post-1989		-0.046 (0.033)		
WVBorderPA*Post-1989		0.010 (0.037)		
County Relative Price Ratio			-0.664[*] (0.380)	
PriceRatio* WVBorderOH				-0.402 (0.526)
PriceRatio* WVBorderKY				-2.431[**] (1.002)
PriceRatio* WVBorderVA				-0.310 (0.479)
PriceRatio* WVBorderMD				-0.783 (0.549)
PriceRatio* WVBorderPA				0.173 (0.620)
Per Capita Non-Food Personal Income	-0.079 (0.132)	-0.093 (0.134)	-0.078 (0.132)	-0.093 (0.134)
Unemployment Rate	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
Proportion of Population Over the Age of 65	-0.024[**] (0.012)	-0.025[**] (0.012)	-0.024[**] (0.012)	-0.025[**] (0.012)
Proportion of the Population That Is Male	-0.017 (0.016)	-0.017 (0.016)	-0.016 (0.016)	-0.017 (0.016)
Proportion of the Population That is Nonwhite	-0.002 (0.016)	-0.002 (0.016)	-0.003 (0.016)	-0.002 (0.016)
Constant	1.621[***] (0.054)	1.601[***] (0.055)	1.616[***] (0.054)	1.945[***] (0.071)
R^2:	0.29	0.30	0.29	0.30
Sample size:	970	970	970	970

[a] Standard errors are shown in parentheses. Within R^2 is reported.
[*]Indicate 10 percent significance level.
[**]Indicate 5 percent significance levels.
[***]Indicate 1 percent significance levels.

Table 6. Estimation Results[a]
(spatial error model with county and year fixed effects)

Variable	(1)	(2)	(3)	(4)
WVBorder*Post-1989	-0.009 (0.693)			
WVBorderOH*Post-1989		-0.021 (0.997)		
WVBorderKY*Post-1989		-0.185*** (4.465)		
WVBorderVA*Post-1989		-0.035* (1.755)		
WVBorderMD*Post-1989		-0.019 (0.866)		
WVBorderPA*Post-1989		0.073*** (2.838)		
County Relative Price Ratio			-0.184 (0.760)	
PriceRatio* WVBorderOH				-0.358 (1.014)
PriceRatio* WVBorderKY				-3.067*** (4.355)
PriceRatio* WVBorderVA				-0.666* (1.897)
PriceRatio* WVBorderMD				0.296 (0.803)
PriceRatio* WVBorderPA				1.217*** (2.831)
Per Capita Non-Food Personal Income	-0.020 (0.365)	-0.016 (0.301)	-0.019 (0.339)	-0.019 (0.364)
Unemployment Rate	-0.001 (0.469)	-0.001 (0.576)	-0.001 (0.443)	-0.001 (0.523)
Proportion of Population Over the Age of 65	-0.014** (2.151)	-0.018** (2.883)	-0.014** (2.127)	-0.018*** (2.856)
Proportion of the Population That Is Male	-0.048*** (2.886)	-0.059*** (3.609)	-0.0048*** (2.882)	-0.058*** (3.548)
Proportion of the Population That is Nonwhite	-0.0020 (1.436)	-0.027* (1.853)	-0.020 (1.431)	-0.067* (1.877)
Spatial Autocorrelation	0.018 (0.421	-0.019 (0.441)	0.016 (0.374)	-0.019 (0.441)
R^2:	0.804	0.812	0.804	0.812
Sample size:	931	931	931	931

[a] Absolute value of t-statistics are shown in parentheses.
*Indicate 10 percent significance level.
**Indicate 5 percent significance levels.
***Indicate 1 percent significance levels.

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