

The Revenue Impacts of Cross-border Sales and Tourism: Wine and Liquor Taxation in West Virginia and Its Neighbors

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Abstract

This paper attempts to measure the revenue impacts of cross-border shopping and tourist purchases of wine and liquor in West Virginia. We find that cross-border shopping and tourism exert significant impacts on tax revenues from wine and liquor sales.

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1. Introduction

With most states currently experiencing budget crises and with the federal government's need to find revenues to pay for the new administration's health insurance mandate, support for new and increased excise taxes, particularly sin taxes, is quickly growing. Numerous states have openly considered increasing the taxation of sugared drinks, cigarettes, and alcohol. For example, California has proposed a roughly 25 cent increase in the wine tax and the House has recently approved a \$1.50 per pack hike in the cigarette tax. Illinois lawmakers have considered increases of 2.6 cents per six pack of beer, 13 cents per bottle of wine, and 80 cents per bottle of liquor to partially fund a new construction project. And, New York State Governor Patterson proposed an 18 percent tax on sugared sodas in order to raise additional revenues (and to reduce obesity rates).

Indeed, policymakers' interest in new and increased excise taxation seems to have been reinvigorated given the large revenue potentials and political advantages of such taxation. The burden can be shifted outside of the jurisdiction in three ways, all of which are commonly employed. The first involves the federal provision of the local public good or service, as described by Weingast, Shepsle, and Johnsen (1981). State representatives in the federal legislature trade votes with one-another in an attempt to secure localized benefits from federal expenditures. The result of such practices is that the federal government increases taxes by a small amount on constituents of all districts, raising a large pool of revenue that can be used to provide public goods or services in a particular district. The second method of tax exporting also involves exporting state and

local tax burdens to the federal level, in this case through the use of itemized deductions on the federal income tax return. As detailed by Ballard and Menchik (2004), taxpayers were able to export some \$75 billion of state and local tax liability through federal income tax deductions for state and local property taxes and income taxes.

The third method of exporting the financial burden of the provision of local public goods and services, and the topic of this paper, involves the use of excise taxation. Tax exporting of this type occurs when residents of one state travel into another state where they make purchases, contributing to that state's tax revenues. Since these revenues are used to provide public services for residents of that state, the visitor will not generally receive the direct benefits from the tax payments (unless spillovers are present). As such, cross-border sales and tourism create a potential for tax exporting. Tax revenues from tourist activities depend on the attractions present in the state, such as national and state parks, resorts, and college and professional sporting events. State revenues from cross-border sales, on the other hand, depend on the relative prices across state lines, locational convenience of shopping centers near state borders, and travel costs.

When prices across neighboring political jurisdictions differ by large amounts, many consumers will make purchases across the border to take advantage of the welfare gains arising from the lower prices in near-by, lower-cost regions. A primary, although not exhaustive, cause of interstate price differentials is the varying tax treatment of goods and services from one state to the next. Alcohol, cigarettes, and gasoline are the most prominent examples for which tax rates vary widely across states. Table 1 provides a comparison of state sales tax rates and excise taxes applied to beer, wine, and liquor sales as of January 1, 2011.

The tax treatment of all three types of alcoholic beverages varies substantially from state to state. Considering continental states only, per unit excise taxes range from \$0.02/gallon (WY) to \$1.07/gallon (AK) on beer; from \$0.11/gallon (LA) to \$2.50/gallon (AK) on wine; and from \$1.50/gallon (MD) to \$12.80/gallon (AK) on liquor in non-control states. “Control states” permit wine and liquor sales only through state-owned or state-licensed stores. The sale of wine and liquor in control states is subject to state ad valorem mark-ups at wholesale and/or retail. The highest implied excise tax, as estimated by the Distilled Spirits Council, on liquor in control states is \$26.03/gallon (WA). In addition to excise taxes, many states apply the state sales tax to the purchase of alcoholic beverages. Sales tax rates range from zero percent (DE, MT, NH, and OR) to 8.25 percent (CA). This variation in tax treatment of alcohol sales across states can lead to substantial interstate price differentials. These price differentials combined with the portability of alcoholic beverages suggests that cross-border sales may serve as an important determinant of state-level alcohol sales and tax revenue from those sales.

This paper measures the revenue impacts of cross-border sales and tourism in the market for wine and liquor using county-level data from the state of West Virginia. Wine and liquor sales (much like cigarette sales) make for interesting studies of cross-border sales because of its portability and because of the sizable variation in tax treatment as discussed above. West Virginia provides a unique and interesting testing ground for cross-border sales because of its unique geography. Twenty-eight of West Virginia’s fifty-five counties border at least one state. In fact, previous studies of cross-border shopping pertaining to West Virginia by both Walsh and Jones (1988) and Tosun and Skidmore (2007) reveal that differences in the state sales tax alter the pattern of food

Table 1: Sales and Selected Excise Tax Rates, January 1, 2011

	State Sales (%)	Beer Excise Tax (\$/gallon)	Wine Excise Tax (\$/gallon)	Liquor Excise Tax (\$/gallon)
Alabama	4.00	1.05	1.70	18.94 ^[2]
Alaska	0.00	1.07	2.50	12.80
Arizona	6.60	0.16	0.84	3.00
Arkansas	6.00	0.24	0.77	2.58
California	8.25	0.20	0.20	3.30
Colorado	2.90	0.08	0.32	2.28
Connecticut	6.00	0.19	0.60	4.50
Delaware	0.00	0.16	0.97	3.75
District of Columbia	6.00	0.09	0.30	1.50
Florida	6.00	0.48	2.25	6.50
Georgia	4.00	1.01	1.51	3.79
Hawaii	4.00	0.93	1.38	5.98
Idaho	6.00	0.15	0.45	10.57 ^[2]
Illinois	6.25	0.23	1.39	8.55
Indiana	7.00	0.12	0.47	2.68
Iowa	6.00	0.19	1.75	12.46
Kansas	6.30	0.18	0.30	2.50
Kentucky	6.00	0.08	0.50	6.85
Louisiana	4.00	0.32	0.11	2.50
Maine	5.00	0.35	0.60	5.21 ^[2]
Maryland	6.00	0.09	0.40	1.50
Massachusetts	6.25	0.11	0.55	4.05
Michigan	6.00	0.20	0.51	10.35 ^[2]
Minnesota	6.88	0.15	0.35	5.08
Mississippi	7.00	0.43	[1]	7.78 ^[2]
Missouri	4.23	0.06	0.42	2.00
Montana	0.00	0.14	1.06	8.72 ^[2]
Nebraska	5.50	0.31	0.95	3.75
Nevada	6.85	0.16	0.70	3.60
New Hampshire	0.00	0.30	[1]	0.00 ^[2]
New Jersey	7.00	0.12	0.88	5.50
New Mexico	5.13	0.41	1.70	6.06
New York	4.00	0.14	0.30	6.44
North Carolina	5.75	0.53	0.79	11.26 ^[2]
North Dakota	5.00	0.16	0.50	2.50
Ohio	5.50	0.18	0.32	9.14 ^[2]
Oklahoma	4.50	0.40	0.72	5.56
Oregon	0.00	0.08	0.67	22.38 ^[2]
Pennsylvania	6.00	0.08	[1]	6.65 ^[2]
Rhode Island	7.00	0.11	0.60	3.75
South Carolina	6.00	0.77	1.08	4.97 ^[2]
South Dakota	4.00	0.27	0.93	3.93
Tennessee	7.00	0.14	1.27	4.46
Texas	6.25	0.20	0.20	2.40
Utah	5.95	0.41	[1]	10.93 ^[2]
Vermont	6.00	0.27	0.55	0.67 ^[2]
Virginia	5.00	0.26	1.51	20.13 ^[2]
Washington	6.50	0.76	0.88	26.03 ^[2]
West Virginia	6.00	0.18	1.00	1.85 ^[2]
Wisconsin	5.00	0.06	0.25	3.25
Wyoming	4.00	0.02	[1]	0.00 ^[2]

Source: The Tax Foundation

[1] All wine sales are through state stores. Revenue in these states is generated from various taxes, fees, and net profits.

[2] In 18 states, the government directly controls the sales of distilled spirits. Revenue in these states is generated from various taxes, fees, and net liquor profits. Implied excise tax rates are computed by the Distilled Spirits Council.

sales in areas near the West Virginia state border. Additionally, since the mean income in the state is well below the national average, policy-makers face increased difficulty raising tax revenue from their constituents even though the demand for public assistance is substantial. Thus, given the demographics and geography of the state, tax exporting is an attractive solution for policy-makers in West Virginia.

Prior to expanding on the empirical analysis, a brief review of the related literature concerning alcohol consumption and cross-border sales is discussed in the next section. Section 3 discusses the tax rates in West Virginia and in each bordering state and the resulting expected flow of sales across West Virginia's state boundaries. Section 4 describes the data and presents the empirical model and results. Concluding remarks and policy implications are then offered in Section 5.

2. Literature Review

2.1 Alcohol Consumption Literature

Much of the literature studying alcohol markets centers around estimating the elasticity of demand. In a paper by Gallet (2007), the author conducts a meta-analysis of 132 studies estimating the elasticity of alcohol demand.¹ Overall the results of this study find that the demand for alcohol is inelastic, however, alcohol elasticity measures are sensitive to the various estimation methods used as well as the demand specification. More specifically, the author finds support for the widely held view that alcohol demand is more inelastic in the short-run than the long-run. Further, there is evidence that the demand for wine and spirits is more responsive to price than beer. Finally, the author

¹ The paper by Gallet (2007) also looks at income and advertising elasticities. The major findings for these two elasticities are that the short-run income elasticities are more inelastic than the long-run and that the advertising elasticity for spirits is more elastic than both wine and beer.

confirms earlier findings by Saffer and Grossman (1987) showing that younger individuals (less than 18 and 18-24) being less responsive to alcohol prices than older individuals (older than 24). Given these findings, policies designed to raise revenue through alcohol taxes need to take these differences into consideration.

2.2 Cross-border Literature

In addition to the areas of research discussed above, a large segment of the alcohol literature concerns cross-border sales. Before turning to the issue of cross-border sales of alcohol alone, it is worthwhile to discuss some of the other literature related to cross-border shopping and, more generally, smuggling. The literature on smuggling defines two different, although closely related, types of smuggling. The first is organized smuggling, also known as commercial smuggling or bootlegging. Smuggling of this type involves the purchase of a good in low-tax states or in foreign countries and the illegal resale of the good in high-tax states.² The second type of smuggling, and the concern of this paper, is cross-border shopping (or casual smuggling). Like commercial smuggling, cross-border shopping is often driven by interstate tax differentials. However, cross-border shopping is simply the retail purchase of goods for consumption in a near-by low-tax state, whereas commercial smuggling involves the illegal resale of goods in high-tax states.

Numerous theoretical models of cross-border shopping and the resulting tax competition between regions and levels of government exist in the literature. A survey by Leal, Lopez-Laborda, and Rodrigo (2010) points to the Kanbur and Keen (1993) analysis as being the standard theoretical framework from which many cross-border

² See Thursby and Thursby (2000) and Thursby et al. (1991) for more on commercial smuggling.

shopping papers have since built upon. Kanbur and Keen (1993) examine indirect tax competition in a partial equilibrium model in which there are two asymmetric regions (smaller country and larger country) behaving as Nash players.³ The results indicate that the tax rate will be lower and the per capita revenue will be greater in the smaller country than the larger country. Several studies have also shown that direct tax competition can cause the regions to reduce their tax rates below the socially efficient levels, leading to a general under-provision of public goods.⁴ Lee (2008) extends the theoretical models of cross-border shopping by assuming imperfect competition in a noncooperative tax competition game. The relevant conclusions of this study reveal that tax differences between two governments provide an incentive for cross-border shopping and tax competition.

Nelson (2002) empirically estimates a vote-maximizing model to determine how states set excise tax rates on cigarettes, alcoholic beverages, motor fuel and insurance.⁵ He reaches four main conclusions. First, state excise tax policies on cigarettes, motor fuel, and insurance are strongly influenced by the policies in neighboring states. Second, the size of the potential cross-border markets are important determinants of tax policy for cigarettes and distilled spirits only. Third, industry lobbying played a significant role in reducing taxes on cigarettes, liquor, and insurance. Lastly, the motivation behind excise taxation may go beyond user charges; rather, excise taxation may simply be a politically inexpensive method of raising government revenue.

³ Other variations of the Kanbur and Keen (1993) model can be found in Wang (1999) and Neilson (2001).

⁴ Trandel (1994), Ohsawa (1999), and Lucus (2004) each develop their own theoretic model of tax competition and provide more thorough discussions of the existing literature.

⁵ See Bowman and Mikesell (1983) for a discussion of state gasoline tax rate changes during the period 1963 to 1983.

Whereas Nelson (2002) empirically models how states determine excise tax policy, much of the empirical research take state taxes as exogenous and estimate by how much consumers respond to interstate tax differentials. Saba et al. (1995) developed the first microanalytic empirical analysis of cross-border shopping using cigarette market data, finding evidence that cross-border shopping affects sales in some states.⁶ Coats (1995) finds that about eighty percent of the sales response to cigarette excise tax changes is due to cross-border shopping. In a more recent report issued by the Mackinac Center, LaFaive et al. (2008) estimate that casual smuggling accounts for over 20 percent of state cigarette sales in Delaware, New Hampshire, and Virginia. Further, their results suggest that, at least in some circumstances, increases in cigarette tax rates lead to only modest increases in tax revenues due to casual and commercial smuggling.

Another strand of literature uses Internet sales as evidence of cross-border shopping. Ballard and Lee (2007) find that online shopping is less likely to occur amongst consumers who live adjacent to counties with lower sales tax rates. Similarly, Alm and Melnick (2005) find that consumers use Internet shopping to avoid taxation while Goolsbee (2000) finds that local sales taxation is a significant determinant of Internet purchases.

Overall, the existing literature suggests that the occurrence of cross-border shopping can play a significant role in determining sales and, therefore, the level of tax revenues collected in a state. As such, states face some revenue competition due to differences in tax rates, as well as other factors not generally controlled by policy-makers (such as retail prices and locational convenience of economic centers). If the state sets its tax rates below those of surrounding states, it will experience a net gain in cross-border

⁶ See also Beard et al (1997).

sales, leading to an increase in the share of the state's tax burden exported to out-of-state residents. However, this does not necessarily imply that overall tax revenues will rise. For example, as tax rates are reduced, more revenue may be generated due to an increase in cross-border shopping, but revenues raised from sales to in-state residents may decline. Thus, the total effect on tax revenues depends both on the change in cross-border shopping and the change in home-state consumption.

3. Exporting Taxes through Wine and Liquor Sales

3.1 Cross-border Sales and West Virginia

Before estimating the net revenue effect of cross-border shopping, it is worth-while to first compare the tax treatment of wine and liquor in West Virginia and its bordering states: Ohio, Pennsylvania, Maryland, Virginia, and Kentucky. The 2003 tax rates on wine and liquor were obtained from the state tax departments of Ohio, Kentucky, and Maryland, the West Virginia Alcohol Beverage Control Administration (WVABC), the Pennsylvania Liquor Control Board (PLCB), and the Virginia Department of Alcohol Beverage Control (VABC). Table 2 presents the tax rates on wine and liquor as of 2003 in each of these states. Consider first the differences in the tax treatment of wine. West Virginia, Ohio, Maryland, Virginia, and Kentucky all tax wine on a per gallon basis, although West Virginia also applies a five-percent ad valorem excise tax. West Virginia's unit tax rate exceeds that of Ohio, Maryland, and Kentucky. Virginia's per unit excise tax on wine is larger than the rate in West Virginia. In addition to the per unit excise tax in Virginia, there is also a county-imposed four-percent ad valorem excise tax on wine. The county tax is optional, but most counties, including all of those along the

West Virginia border, choose to enforce it. Pennsylvania places a half-cent (\$0.005) per-unit-proof per-gallon tax on wine, rather than the per gallon tax used in the other states mentioned. Depending on the proof of the purchased wine, an individual could pay a larger or smaller amount in taxes in Pennsylvania relative to the same purchase in West Virginia.

Now addressing the variations in the tax treatment of liquor, only Kentucky and Maryland (of the six states of interest here) allow liquor to be sold by private vendors at both wholesale and retail. The 2003 tax rates on liquor in Kentucky and Maryland are \$1.92 and \$1.50, respectively. The other four states (West Virginia, Ohio, Pennsylvania, and Virginia) allow the sale of liquor only at state-owned, state-operated, or state-licensed stores. The revenue in these states is generated from various taxes, fees, and net profits (earned on ad valorem mark-ups). The state mark-up in Virginia varies by volume and proof, ranging from 32 percent to 76 percent. Virginia also imposes an ad valorem excise tax of twenty percent applied to the after mark-up price. Similarly, Pennsylvania imposes an ad valorem tax rate of 18 percent in addition to the state mark-up. Ohio has a per unit tax on liquor of \$3.38 per gallon. Each of the six states of concern applies the state sales tax to wine and liquor sales. The treatment of liquor sales in West Virginia is discussed in greater detail below.

The West Virginia Alcohol Beverage Control Administration (WVABCA) operates as a monopoly, as it is the only legal supplier of liquor to retailers in the state. The WVABCA places a 28 percent ad valorem mark-up on all sales of liquor to retail outlets plus a \$1.25 delivery charge per case. Case sizes vary substantially, ranging from as small as one unit per case to 20 units or more per case. The average price (after mark-

Table 2: Effective Tax Rates for Wine and Liquor¹

State	Effective Tax Rates		Sales Tax
	Wine	Liquor	
West Virginia ²	\$1.00/gallon + 5% excise	28% wholesale mark-up + \$1.25 /case + 5% excise	6.0%
Ohio ²	\$0.32/gallon (<28 proof) \$1.00/gallon (28 to 41 proof)	\$3.38/gallon	6.0%
Pennsylvania ³	0.5 cents/unit proof per gallon	30% wholesale mark-up + 18% excise	6.0%
Maryland	\$0.40/gallon	\$1.50/gallon	5.0%
Virginia ²	\$1.51/ gallon + 4%	\$1/case + 32% to 76% wholesale mark-up + 20% excise	4.5%
Kentucky	\$0.50/gallon	\$1.52/gallon	6.0%

¹ Data obtained from various state tax departments, the WVABCA, the PLCB, and the VABC.
² The sale of liquor is permitted only at state-licensed stores and the effective tax rates are estimates.
³ The sale of wine and liquor is permitted only at state-owned stores and the effective tax rates are estimates.

up and delivery charge) of a case of liquor sold to retailers in 2004 was \$91.05. Retailers can then break the cases into individual units for sale. Liquor retailers must, at a minimum mark-up the final sale price by 10 percent, although it is common for retailers to use a mark-up of 30 percent, so this minimum does not appear binding. Revenue from the retail mark-up is retained by the (private) licensed retailer, not the state. The state also imposes a five-percent ad valorem excise tax and six-percent sales tax on the final sale price of liquor, inclusive of the earlier mark-ups.

The a priori expectations for the net effect of cross-border wine and liquor shopping for West Virginia follow. Those counties in West Virginia that border Virginia are expected to experience a net gain in cross-border sales. The tax rates on wine and liquor are both higher in Virginia, suggesting that proportionately more residents of Virginia will cross the border to purchase wine and liquor than vice-versa. The net effect of cross-border shopping in each of the other regions is not as straight-forward.

The region of West Virginia bordering Kentucky is likely to experience a negative net effect due to cross-border shopping. Both states impose per unit taxes on wine, but

Kentucky's is half the rate of West Virginia. While the tax rates on wine are directly comparable, this is not the case for liquor taxation. At the point of purchase, West Virginia applies a five percent excise plus the six percent sales tax to liquor sales while Kentucky imposes a \$1.52 per gallon excise plus the six percent sales tax. Thus, an average retail price of \$30.40 per gallon of liquor would make consumers indifferent of the place of purchase. An average price above \$30.40 would cause the total tax paid in West Virginia to exceed the \$1.52 per gallon unit tax in Kentucky. According to the American Chamber of Commerce Researchers Association (ACCRA), the average price of a 750 ml bottle of J&B Scotch in the Charleston, West Virginia MSA in 1998 was \$20.95. This equates to over \$105 per gallon. Thus, it is reasonable to expect a negative net effect of cross-border shopping in the region bordering Kentucky.

The region bordering Maryland should exhibit similar net effects as experienced by the Kentucky region. The Maryland region should observe a net decrease in wine sales due to cross-border shopping, since Maryland's tax is less than half of West Virginia's tax. The effect on liquor sales in this region again depends on the average retail price of liquor purchased. If the pre-tax purchase price of a gallon of liquor is greater than \$25, then the total tax paid per gallon in Maryland would be less than the tax paid in West Virginia. As indicated above, the average price according to ACCRA was over \$105. Similar to the Kentucky region, a negative net effect on liquor sales is expected in Maryland border-region of West Virginia.

Ohio imposes a smaller tax per unit of wine than does West Virginia. Thus, the region of West Virginia bordering Ohio is expected to experience a negative net effect on wine sales due to cross-border shopping. Following the method described above, and

equating the total tax paid on a gallon of liquor in the two states, the total tax becomes smaller in Ohio at a retail price of \$67.60 per gallon. The net effect of cross-border shopping for liquor is expected to be negative; relatively more residents of West Virginia should travel into Ohio to purchase liquor.

Pennsylvania allows the sale of wine and liquor only at state-owned stores. As such, the state earns revenue from wine and liquor sales both from taxes and mark-ups (net profits). Pennsylvania's wine tax is 0.5 cents per unit proof per gallon. If there were no mark-up on wine sales, then the tax would always be less than the West Virginia tax. If the mark-up is small, then the region bordering Pennsylvania will experience a net loss in wine sales due to cross-border sales. If the mark-up is large, the region should experience a net gain. Without knowledge of this mark-up, however, no expectation can be formed. Pennsylvania's wholesale mark-up and ad valorem excise rate applied to liquor sales are both greater than those in West Virginia. Indeed, the ad valorem excise is more than three times the rate of West Virginia. Given these comparisons, the region of West Virginia bordering Pennsylvania should observe a net increase in liquor sales due to cross-border shopping.

3.2 Tourism in West Virginia

In addition to cross-border sales, tax exporting can also result from tourism. The West Virginia Tourism website compiles a listing of all of the major tourist attractions in the state. There are four large gaming resorts (including dog tracks) in West Virginia. They are Wheeling Downs in Ohio County, Tri-State Casino in Kenawha County, Charles Town Races and Slots in Jefferson County, and Mountaineer Racetrack and Gaming

Resort in Hancock County. There are also four large ski resorts in the state: Canaan Valley and Timberline in Tucker County, Snowshoe in Pocahontas County, and Winterplace in Raleigh County. West Virginia also offers an assortment of upscale resorts located throughout the state. The most famous and largest of the resorts is The Greenbrier located in Greenbrier County. There are two major universities in West Virginia, West Virginia University in Monongalia County and Marshall University in Cabell County.

Counties with a tourist attraction or university are expected to exert upward pressure on wine and liquor sales. Thus, it is expected that tax revenues in counties with tourist attractions should be significantly higher relative to counties with no attractions. However, the type of consumer will likely differ depending on the tourist attraction. For example, those who attend an upscale resort may be less likely to consume large sums of liquor but prefer wines instead. Tailgaters at university sporting events, on the other hand, may consume more liquor than wine (although beer is probably the most common alcoholic beverage among this group). In summary, the impacts of gaming resorts, ski resorts, upscale resorts, and universities are all expected to positively influence the consumption of wine and liquor, although not necessarily by the same degree.

4. Methodology, Data, and Empirical Results

Data for each of the fifty-five counties in West Virginia from 1993 – 2002 are employed to quantify the cross-border sales for wine and liquor between West Virginia and its five bordering states. Spatial econometric modeling is employed herein and is motivated purely for econometric reasons, as first described by LeSage and Pace (2009). Omitted

variable bias almost certainly plagues all empirical studies as the world is too complex to capture all possible influences of the dependent variable. If some of these omitted variables vary systematically across space (counties in this case), then the estimated coefficients of the included variables may be biased. Employing a spatial econometric model corrects for this spatial bias and allows for more reliable estimates.⁷

The empirical model involves regressing per capita wine or liquor sales on a set of demographic variables, a set of dummy variables to control for travel and tourism, a set of border dummy variables, and a time trend. For robustness, a specification of the model is estimated with total per capita alcohol sales as the dependent variable where total per capita alcohol sales is the sum of per capita wine and liquor sales and per capita alcohol sales at private clubs. Demographic variables included in the model are per capita income and the unemployment rate in the county. An interstate dummy variable, equal to one if the county has a major interstate and zero otherwise, is used to proxy for ease of travel. Dummy variables indicating the presence of a resort, a gaming facility, and a university are also used to proxy for tourism. Finally, to measure the effects of cross-border shopping, a set of border dummy variables is included for each border state, equal to one if the county borders the state and zero otherwise.

To correct for spatial dependence in wine and liquor sales, the base model is modified to include a spatial weighting matrix.⁸ Spatial dependence can occur for numerous reasons; however, the most common explanation is to correct for the potential

⁷ Burkey (2005) also uses a spatial econometric model to explain many of the discrepancies found in the literature examining alcohol.

⁸ Garrett and Marsh (2002) use county level sales data in a spatial model to quantify the effect of cross-border shopping on lottery revenues in Kansas.

bias resulting from an omitted variable that varies over space.⁹ As such, the use of the spatial lag and spatial error models in this paper is motivated purely from an econometric basis. If the spatial dependence manifests in the dependent variable, the spatial lag model can be estimated:

$$y = \rho \cdot W \cdot y + X \cdot \beta + \varepsilon, \quad (1)$$

where y is the $N \times 1$ dependent variable, X is the $N \times K$ matrix of exogenous variables, W is the $N \times N$ weighting matrix, and ρ is the spatial autoregressive coefficient. If, instead, the spatial dependence appears in the error term, the spatial error lag model can be employed:

$$y = X \cdot \beta + \varepsilon, \varepsilon = (I - \lambda \cdot W)^{-1} \cdot v, \quad (2)$$

where λ is the unobserved spatial error correlation coefficient and v is the $N \times 1$ vector of IID random variables component of the error terms.

The results from the spatial lag and spatial error lag models can be found in Table 3 and Table 4, respectively. The signs of the coefficients in all specifications are consistent with the *a priori* expectations, although not all variables are significant. An increase in per capita personal income has a positive effect on both wine and liquor sales. A \$1000 increase in per capita income in county- i leads to an increase in total per capita sales by a little more than \$1.00. Although not always significant, the unemployment rate varies negatively with wine and liquor sales: a one percent increase in the unemployment rate of county i causes total sales to fall by about \$0.55 per person. The presence of an interstate in a county, which decreases travel costs, significantly increases total sales, leading to an increase of about \$14.00.

⁹ See LeSage and Pace (2009) for a more thorough explanation of how the use of a spatial weight matrix can correct for the bias caused by spatially correlated omitted variables.

Table 3: Spatial Autoregressive Model
Weighting Matrix: Geographic Neighbors

Per Capita County Wine and Liquor Sales in WV [2000 US\$] 1993-2002						
Variable	Total [1]	Total [2]	Wine [3]	Wine [4]	Liquor [5]	Liquor [6]
Virginia Border	28.318*** (8.60)	27.868*** (12.53)	9.484*** (7.15)	8.550*** (7.79)	15.822*** (9.58)	16.434*** (10.14)
Maryland Border	-32.753*** (9.38)	-31.669*** (10.25)	-8.149*** (5.26)	-9.297*** (7.23)	-19.665*** (9.98)	-17.456*** (9.12)
Pennsylvania Border	50.503*** (12.79)	33.169*** (9.06)	20.961*** (13.35)	11.272*** (8.24)	18.373*** (9.08)	14.914*** (7.21)
Ohio Border	-16.373*** (4.67)	-11.296*** (5.74)	-7.294*** (5.41)	-3.652*** (3.25)	-6.980*** (4.22)	-6.625*** (4.02)
Kentucky Border	-25.051*** (4.18)	-20.991*** (4.38)	-6.771*** (2.63)	-4.296** (2.06)	-12.978*** (3.98)	-12.273*** (3.96)
Rho	-0.286*** (5.16)	-0.159*** (3.09)	-0.263*** (7.40)	0.136*** (5.81)	-0.163*** (6.31)	-0.082*** (4.77)
Constant	29.308* (1.79)	23.132 (1.64)	3.993* (1.93)	5.740*** (2.61)	20.744*** (17.57)	13.840*** (5.78)
Per Capita Personal Income [2000 US\$1000]	1.799** (2.56)	1.020 (1.24)	0.701*** (7.02)	0.143** (2.34)	0.609*** (2.89)	0.605*** (3.86)
Unemployment Rate	-1.525*** (3.37)	-0.589* (1.84)	-0.560*** (3.28)	-0.172 (1.17)	-0.644*** (2.95)	-0.281 (1.28)
Interstate Dummy	22.646*** (9.78)	14.909*** (7.47)	8.597*** (8.60)	4.037*** (4.66)	11.455*** (9.09)	9.704*** (7.54)
Resort Dummy		12.874*** (5.16)		10.237*** (9.81)		-0.293 (0.19)
Gaming Dummy		18.790*** (9.10)		12.651*** (8.15)		1.110 (0.50)
University Dummy		69.057*** (12.91)		28.621*** (13.26)		27.708*** (8.58)
R-squared	0.479	0.631	0.392	0.623	0.400	0.472
Log Likelihood	-2347.41	-2258.87	-1900.82	-1778.63	-2031.37	-1997.37
Observations	550	550	550	550	550	550

Absolute T-values in parenthesis. Significance levels of 10%, 5%, and 1% are denoted by *, **, and ***, respectively. Regressions also include year dummies (not reported in table).

Table 4: Spatial Error Model
Weighting Matrix: Geographic Neighbors

Per Capita County Wine and Liquor Sales in WV [2000 US\$] 1993-2002						
Variable	Total [1]	Total [2]	Wine [3]	Wine [4]	Liquor [5]	Liquor [6]
Virginia Border	26.482*** (9.71)	27.134*** (10.92)	9.181*** (7.67)	8.332*** (8.00)	15.106*** (9.41)	16.179*** (10.12)
Maryland Border	-28.463*** (9.28)	-30.380*** (10.86)	-6.525** (4.83)	-8.863*** (7.60)	-18.710*** (9.91)	-17.202*** (9.31)
Pennsylvania Border	45.681*** (14.89)	31.946*** (10.37)	19.339*** (14.49)	10.982*** (8.58)	17.229*** (8.93)	14.722*** (7.38)
Ohio Border	-16.522*** (6.11)	-12.303*** (4.90)	-6.899*** (5.73)	-3.764*** (3.62)	-7.107*** (4.65)	-6.931*** (4.38)
Kentucky Border	-19.722*** (3.67)	-21.525*** (4.56)	-5.843** (2.50)	-5.172*** (2.62)	-11.508*** (3.66)	-12.068*** (3.96)
Lambda	-0.347*** (13.87)	-0.233*** (8.50)	-0.369*** (5.60)	-0.234*** (7.50)	-0.131*** (3.96)	-0.090*** (4.17)
Constant	20.332*** (3.47)	15.842*** (3.04)	2.437 (0.76)	3.893* (1.71)	17.299*** (9.66)	11.549*** (4.78)
Per Capita Personal Income [2000 US\$1000]	1.581*** (12.70)	1.077*** (10.05)	0.550*** (7.49)	0.146*** (8.79)	0.593*** (2.76)	0.638*** (4.24)
Unemployment Rate	-1.436*** (3.80)	-0.541 (1.59)	-0.483*** (2.85)	-0.132 (0.94)	-0.655*** (3.06)	-0.288 (1.33)
Interstate Dummy	22.039*** (10.24)	13.386*** (6.576)	8.954*** (9.57)	3.791*** (4.50)	11.169*** (9.08)	9.327*** (7.33)
Resort Dummy		12.196*** (5.02)		9.904*** (9.78)		-0.360 (0.23)
Gaming Dummy		18.388*** (4.62)		12.198*** (7.21)		0.779 (0.34)
University Dummy		72.101*** (13.68)		29.771*** (13.57)		28.231*** (8.67)
R-squared	0.513	0.645	0.452	0.638	0.402	0.474
Log Likelihood	-2349.40	-2258.03	-1896.22	-1776.56	-2033.74	-1997.72
Observations	550	550	550	550	550	550

Absolute T-values in parenthesis. Significance levels of 10%, 5%, and 1% are denoted by *, **, and ***, respectively. Regressions also include year dummies (not reported in table).

Tourism is found to increase wine and liquor sales, consistent with prior studies. The presence of an upscale resort increases wine sales by about \$10. However, liquor sales are not influenced by upscale resorts. Patrons of upscale resorts are arguably fairly wealthy, and wealthy individuals can be viewed as preferring wines to hard liquor. Surprisingly, the presence of a gaming resort has little impact on liquor sales while exerting a strong influence on wine sales, increasing wine sales by about \$12 per capita. The two counties (Monongalia and Cabell) with large universities experience about a \$28 increase in both per capita wine sales and per capita liquor sales.

Cross-border shopping for wine and liquor is also found to be significant for all regions, normally at the 1%-significance level. Counties in the Ohio, Maryland, and Kentucky regions were all expected to experience a net loss in per capita wine sales due to cross-border shopping. Indeed, this is what we observe from the data. Counties in the Ohio region lose about \$3.70 per capita in wine sales; those in the Maryland region lose about \$9.00 per capita; and the Kentucky region loses \$4.00 - \$5.00 per capita in annual wine sales. Counties bordering Virginia were expected to experience a net gain in cross-border shopping for wine; this too is supported by the results. Counties in the Virginia border region, even after controlling for tourism, observe a net increase in per capita wine sales of more than \$8.00. No *a priori* expectations for the net effect along the Pennsylvania border could be established without knowledge of the mark-up on wine in Pennsylvania. The results in Table 3 and 4 suggest that the mark-up is sizable since WV counties in this region experience an \$11.00 net increase in per capita wine sales.

The results for cross-border shopping for liquor are quite similar to those of wine. Again, the *a priori* expectations are supported. The Virginia and Pennsylvania regions

were expected to experience a net increase in liquor sales from cross-border shopping. The coefficient on the Virginia border dummy exceeds \$16 with the coefficient on the Pennsylvania border dummy slightly smaller at about \$14.80 per capita. The results for Ohio, Maryland, and Kentucky were said to depend on the mark-up on liquor sales in West Virginia, although the net effect in the Maryland and Kentucky region are likely negative since the per unit tax rates are fairly low in those states. The results suggest a net loss in liquor sales in all three regions. Furthermore, the effect is smallest for the Ohio region, which should be expected given that the tax rate in Ohio is over double the rates in Maryland and Kentucky.

Table 5 presents the estimated economic impacts of cross-border liquor sales based on the spatial lag model coefficients. An equivalent table of the estimated effects of cross-border wine sales is not possible without further knowledge on the quantity of wine sold, since the wine excise tax is per unit. While total liquor tax revenue due to cross-border shopping and tourism comprises only a small percentage (0.03 percent) of total state and local revenues, it appears that the cross-border effect is large relative to total liquor tax revenue. For instance, over fifty-percent of all revenues from the wholesale mark-up is generated in the Virginia and Pennsylvania regions. The other three state-regions reduce revenues by more than negative forty-five percent as a percent of total mark-up revenue, canceling out many of the gains from the Pennsylvania and Virginia regions. The presence of a university accounts for nearly twenty-percent of state revenues from the mark-up on liquor. This suggests that revenue from liquor taxation is highly dependent on interstate tax differentials and tourism.

5. Conclusion

Consistent with the empirical findings of Beard et al. (1997), the results of this paper indicate that cross-border shopping for wine and liquor are significant determinants of sales. Wine and liquor tax rate differentials encourage some consumers living on the border to save money by traveling across a state border to purchase alcohol. West Virginia counties along the Virginia and Pennsylvania borders, where home tax rates are relatively lower, are shown to experience a net increase in wine and liquor sales while those along the Kentucky, Ohio, and Maryland borders, where home tax rates are relatively higher, experience a net decrease in sales. It is estimated that over fifty percent of all government revenue collected from the mark-up on liquor sales is generated from the Pennsylvania and Virginia border regions, although much of that revenue is cancelled out by the other three border regions. Additionally, the presence of universities appears to account for twenty percent of this mark-up revenue.

Given these results, state politicians should take measures to encourage residents of neighboring states to cross-border shop and to encourage tourism. Politicians in West Virginia appear to be following this general rule. Much of the growth in the state is occurring in the Eastern and Northern Panhandles, where the potential for cross-border shopping is the greatest. For instance, the state recently encouraged much commercial development, starting with a large Cabela's store, in the Northern Pan-handle just off of a major interstate. It is expected that the majority of sales in this development area will go to cross-border shoppers residing in Ohio and Pennsylvania. Politicians also seem to have realized the potential revenue gains to be had from tourist activities as many states,

including West Virginia, running television commercials in nearby states informing viewers of all the attractions available in the state.

While the estimated revenue effects of cross-border shopping and tourism discussed here are significant, some caution should be taken when interpreting our results due to some empirical modeling issues. Of the six states included in this study, four (OH, PA, VA, and WV) are control states, making it difficult to accurately measure annual tax differentials along West Virginia's borders. The Distilled Spirits Council now provides estimated implied excise tax rates for all control states; unfortunately, these estimates are relatively new and do not exist for our sample period (which was dictated by the availability of data for our dependent variable). Given these difficulties, we resort to a pooled cross-section in which we measure the cross-border effects through the use of border dummy variables. If one were able to obtain more recent county-level sales data that could be matched with the Distilled Spirits Council's implied excise tax rates on liquor, an improved model taking advantage of tax changes and panel data could be estimated, generating more reliable estimates of the effects of cross-border shopping in the market for liquor.

**Table 5: Estimated Economic Impacts of Liquor Taxation¹
Based on Spatial Lag Estimates, Fiscal Year Ending 2002**

	Impact on Total Sales	Excise Tax Revenue	Sales Tax Revenue	Mark-up Revenue	Share of Mark-up Revenue	Sum of Revenue From Liquor	Share of State & Local Revenue
Resort Counties	-\$126,665	-\$6,333	-\$7,600	-\$76,121	-0.68%	-\$90,054	-0.0008%
Gaming Counties	\$354,169	\$17,708	\$21,250	\$212,842	1.90%	\$251,800	0.0023%
University Counties	\$3,414,429	\$170,721	\$204,866	\$2,051,941	18.29%	\$2,427,528	0.0224%
Total Tourist Effect	\$3,641,933	\$182,097	\$218,516	\$2,188,661	19.51%	\$2,589,274	0.0238%
VA Border Counties	\$6,192,019	\$309,601	\$371,521	\$3,721,165	33.17%	\$4,402,287	0.0405%
PA Border Counties	\$3,493,321	\$174,666	\$209,599	\$2,099,352	18.71%	\$2,483,617	0.0229%
MD Border Counties	-\$4,601,210	-\$230,060	-\$276,073	-\$2,765,150	-24.65%	-\$3,271,283	-0.0301%
OH Border Counties	-\$3,198,722	-\$159,936	-\$191,923	-\$1,922,309	-17.13%	-\$2,274,168	-0.0209%
KY Border Counties	-\$853,599	-\$42,680	-\$51,216	-\$512,980	-4.57%	-\$606,876	-0.0056%
Total Border Effect	\$1,031,809	\$51,590	\$61,909	\$620,077	5.53%	\$733,576	0.0068%
Total Effect	\$4,673,741	\$233,687	\$280,424	\$2,808,739	25.03%	\$3,322,850	0.0306%

¹Estimates based on a 30% retail mark-up.

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