

Liquor Sales in Pennsylvania: Does the Border Bleed?

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In Philadelphia we know that there are a few people – make that many people – who get in their cars and travel down [Interstate] 95 into Delaware or over into Jersey to buy their alcohol. I want a system that gives our people the flexibility to [make] purchases here. Selling alcohol is clearly not a core responsibility of government... I can tell you that we are losing millions of dollars a year in people purchasing their alcohol by going around the system. Pennsylvania Governor Tom Corbett as quoted in the *Philadelphia Inquirer*, 2/1/2013, pp. A1 and A4.

I. Introduction

In Pennsylvania, a state agency, the Pennsylvania Liquor Control Board (PLCB) has a monopoly in the wholesale and retail sales of wine and spirits which, for convenience, we will call “liquor.” Beer is sold through a separate system of private state-licensed distributors, and we do not include beer under the umbrella term “liquor.”

Pennsylvania’s system for the sale of liquor is unusual and controversial. Most states license private distributors at the retail and/or wholesale level.² Critics of the Pennsylvania (PA) system generally make three points. First, they argue that there is no theoretical rationale for a system of state-owned stores, i.e. why would the state own liquor stores when it does not own fast-food restaurants? Second, they argue that the convenience, selection, prices, and service at the monopolistic state-owned stores are inferior to what a competitive private state-licensed system would

¹ We thank Tim Kwilos and Zach Schmidt for excellent research assistance. Thanks to the Pennsylvania Liquor Control Board, and especially Kim Mankey, for providing us with the data used in this study and discussing the data with us. To ensure that we were not overlooking common-sense factors in parts of Pennsylvania with which we are not familiar, we informally surveyed economists at several PA colleges and universities for personal anecdotes on the border bleed in their regions. We are grateful to the many who responded, some quite humorously.

² For an up-to-date listing of state policies, see the U.S. National Institute of Health’s Alcohol Policy Information System website, <http://alcoholpolicy.niaaa.nih.gov/>.

provide. Third, they claim that PA loses a significant amount in liquor sales from residents who cross the border to buy liquor in surrounding states. This third point, known as the “border bleed,” is the subject of our paper.

In this paper, we attempt to measure the significance of this border bleed. We do not pass judgment on whether the state should monopolize liquor sales or privatize them. Some supporters of the state monopoly explicitly intend it to limit liquor consumption for health or moral reasons. Such considerations are beyond our focus. But for both advocates of privatization and opponents, the degree to which state residents avoid state-owned liquor stores and go out of state to buy wine and spirits is a relevant to their positions. Our goal therefore is to quantify this border bleed to better inform the public policy discussion.

Some critics of the PA system allege that the border bleed is significant. For example, in 2011 the PFM Group, a consulting firm hired by the administration of Governor Corbett to study the potential gains from privatizing the PA liquor system, stated in its report, "Much of this sales loss is due to consumers making purchases in surrounding states, including Delaware, Maryland and New Jersey. Multiple studies of this “border bleed” suggest that LCB's lost sales to other states may be in the range of 10 to 30 percent of total sales in the Commonwealth." (p. 9).³ If this is correct, this is a huge loss since the total annual sales (including the “Johnstown flood tax”) of the PLCB in the years that we analyzed was about \$1.75 billion dollars and the resulting annual revenue to the state was about \$500 million.⁴

In this paper, we use data from the PLCB to generate our own estimates. The PLCB generously provided us with store-level sales data for the over 600 retail stores across the state for 2009 through 2011. We aggregated these data at the county level and fit a regression model intended to predict per capita liquor sales at the county level. We included a “dummy” variable to indicate whether the county borders another state. We interpret the coefficient on the dummy variable as a measure of the border bleed.

Our model for estimating the border bleed is not intended to be causal, i.e., since our only goal is to predict liquor sales absent a border bleed, we put variables on the right hand side of the regressions that correlate with liquor sales, not necessarily those that cause such sales. But we note that there are significant differences across PA counties in per capita liquor sales and we briefly

³ The PFM Report (pp. 112-113) references two studies that focus on Pennsylvania. One is by a consulting firm and the other is by a liquor industry trade association. In June 2012, we contacted these two organizations to request copies of these studies but our emails were not answered.

⁴ In fiscal year 2010/11, the PLCB transferred \$105 million in profits, \$282 million from the 18% Johnstown flood tax, and \$117 million from the 6% sales tax to the PA state treasury (PLCB *Fiscal Year 10-11 Summary*).

discuss what might be driving such differences. For example, among Pennsylvania's 67 counties, the three counties with the three highest levels of per capita liquor sales averaged about \$150 in sales per year between 2009 and 2011. The three counties with the lowest levels of per capita liquor sales averaged about \$30 in sales over this time period.

In brief, we find that PA may lose about three to eight percent of liquor sales due to residents crossing state borders to buy wine and spirits out of state. Our estimates are well below those reported by many who support privatizing the PA liquor sales system. We re-emphasize, however, that the magnitude of the border bleed is just one element in discussions about the best state policy for liquor sales.

2. Overview of Previous Relevant Research

Julian L. Simon (1966) appears to have initiated the research on state-owned liquor store sales. At the time of his article, 16 states had state monopolies on liquor sales. The other states regulated private-sector retailers. His study examined cross-state comparisons of prices for popular brands. He found that, generally speaking, the prices in the monopoly states were somewhat lower than those in the private-sales states. He also compared state liquor revenues on a per capita basis across the categories of states. Per capita revenues tended to be higher in the monopoly states. Mean revenues per gallon consumed also tended to be higher in the monopoly states. Finally, he investigated levels of consumption across the states. He found that per capita incomes helped explain differences across the states as did the number of sales outlets. But he de-emphasized this latter variable since "...the number of outlets is more likely to respond to consumption, rather than be a cause of consumption." (p. 193). Whether or not the state was a monopoly state was a "negligible" influence.

T. J. Whalen, Jr. (1967) reexamined Simon's principle conclusions. He estimated that the lowest prices tend to prevail in the private-license states that do not have resale price maintenance regulations (i.e., "fair trade" laws). He also argued that consumers had a larger product mix in the non-fair-trade private-license states. He concluded, "...consumer welfare is higher in a private-license non-fair-trade state than a monopoly state." (p. 198)

Steve Swindler's (1986) study is closest in spirit to our own. At the time of his study, the Ohio Department of Liquor Control operated all retail stores that sold spirits and had at least one store in each county. Swindler surveyed prices for six popular liquor brands in Ohio and in the five neighboring states. He found that the prices tended to be lower in all of the neighboring states except Pennsylvania. Swindler ran cross-section regressions using 1980 per capita liquor sales in Ohio's 88 counties as the dependent variable, where this is measured as bottles sold per capita. His explanatory variables were: county per capita income, five dummy variables to indicate if the county borders one of the five surrounding states, a measure of total employment in the county, the number of state liquor stores per capita in the county, a dummy variable to indicate if

the adjacent county in a neighboring state is dry, and the percentage of the county's population that is non-white.⁵ He estimated negative and statistically significant coefficients on the dummy variables that signaled whether an Ohio county bordered West Virginia or Indiana. He obtained a positive and statistically significant coefficient on the Pennsylvania border dummy. The coefficients on the dummies for Kentucky and Michigan were not statistically significant.⁶

Katja Seim and Joel Waldfogel (2013) investigate the objective function of the PLCB. As part of this project, they estimate a model of liquor demand using PLCB sales data, such as we use in our project. They conclude that the PLCB has too many stores to be a profit-maximizing monopolist, but it has fewer stores than would exist under a licensing system with relatively free entry. Their paper does not examine the issues that are the focus of this paper.

3. Liquor Operations and Taxes in PA and Surrounding States

In PA, the state operates the wholesale and retail firms that sell wine and spirits. PA and Utah are the only two states that own and operate both wholesale and retail operations for wine and spirits. By population, PA is the largest such complete "control" state.

Below we discuss the regulations and pricing in PA and its surrounding states. Obviously, the pricing matters for cross-border sales but so too can regulations, such as whether wine, spirits, and beer can be sold in the same location or whether stores are open on Sundays. In addition, commuter travel patterns and differences in service and selection may create cross-border sales.

Regulations and Pricing in PA

Beer cannot be sold in the PLCB stores, which only sell wine and spirits. Beer is sold separately by private state-licensed locations that cannot sell wine or spirits.

⁵ In a footnote, Swindler notes that there is a causality problem between the number of outlets and the demand for liquor. He justifies including this variable, however, on the grounds that some previous studies (including Simon's) did so.

⁶ In 1980, Ohio state stores used uniform pricing but the average price of a bottle sold in one county could differ due to differences in the composition of sales. Swindler therefore estimated a second equation with the same right-hand-side variables, but using the average price of a bottle sold in the county as the dependent variable. He finds negative and statistically significant coefficients for Indiana and Kentucky, negative but statistically insignificant coefficients for Michigan and West Virginia, and a positive and statistically significant coefficient for Pennsylvania. He interprets this as suggesting that Ohio residents cross the borders for premium liquors, where their savings are likely to be the greatest. Pennsylvania residents cross into Ohio for the same reason.

Liquor prices in PA are uniform across the state. The PLCB does not offer volume discounts.⁷ Slightly over 25% of the stores are open on Sundays. Some stores, especially "Premium Collection" stores, have a broader selection than other stores, mainly in wine. About 12% of the stores are Premium Collection (PC) stores. Nearly all of these PC stores are open on Sunday afternoons and their annual sales volume is nearly three times that of a typical non-PC store.

The PLCB, as one of the largest single wholesale buyers of liquor in the country, should be able to negotiate the lowest prices available from producers. But, as noted in the PFM report (p. 96), this probably applies most strongly to less commonly carried products, such as the "Chairman's Selection" wines. In the case of a mass-market liquor product, the producer likely knows that the PLCB feels obligated to carry the product, so the PLCB may not be able to negotiate a price any lower than other large wholesalers. In the case of less-popular wines and spirits that the PLCB does not feel the need to carry, it likely has much more negotiating leverage.

Table 1 illustrates how the PLCB establishes the final sales price for a bottle of wine/spirits. The price the PLCB pays to producers is known as the cost of goods sold (COGS). This includes the freight costs which the producers bear. At the retail level, the shelf price includes three key mark-ups. First, the PLBC marks up the COGS by 1% to pass on a wholesale "prompt payment" discount.⁸ Second, the PLCB marks up the modified COGS by 30% on all products with a COGS under \$65. If the COGS is greater than \$65, the mark-up on that part that exceeds \$65 is 10% (PFM, p. 97). Third, the PLCB imposes a "logistics, transportation, and merchandising factor" (LTMF) mark-up which varies by product type and container size. Typically, this is about an additional 15.5 percent additional mark-up (Appendix 1, PFM report).⁹ In addition to these markups, the state imposes an 18% excise tax (the Johnstown Flood Tax introduced in 1963) which is built into the shelf price. Finally, the PLCB rounds the final retail shelf price to the nearest \$0.09 if the adjusted price ends in \$0.05 or below. If it ends in \$0.06 or above, the retail

⁷ But bars and restaurants receive a 10% discount off the retail price discussed below (PFM Report p. 98).

⁸ The PLCB's *2009-2010 Retail Year in Review Report* indicates (p. 40) that this is a 1% discount from the cost of goods. But the PFM report states, "...suppliers and manufactures used to give the Commonwealth a one percent invoice discount if they remitted payment to the vendor within ten business days. Since the mark-ups were computed from the invoice price of the product, the prompt-payment discount essentially represented an additional one percent profit. When vendors phased out this process, the PLCB instituted an additional one percent mark-up into the pricing structure to maintain the historical margins." (p. 97). In 2011 testimony before the PA Senate from a representative of the Wine Institute roughly supported the interpretation of the PFM report, indicating that the PLCB "...charges suppliers this 1% on EVERY transaction, but NEVER makes payments for 90 days." (<http://www.pasenategop.com/committees/law/2011/050411/beirne.pdf>)

⁹ The Wine Institute testimony cited in the previous footnote states that this is a \$1.30 flat fee for wine.

price is rounded up as much as \$0.19. For example, \$15.95 would be rounded to \$15.99 and \$15.96 would be rounded to \$16.09 (PFM, p. 97-98).¹⁰ At the point of sale, the state also collects a 6% sales tax.¹¹

Table 1
Representative Determination of the Final Sales Price for a Bottle of Wine/Spirits

	Price Adjustment	Price
Cost of Goods Sold		\$10.00
Prompt Payment Markup	1%	\$10.10
Standard Markup	30%	\$13.13
LTMF	15.5%	\$15.17
Johnstown Flood Tax	18%	\$17.89
Rounding	\$0.10	\$17.99
Retail Shelf Price		\$17.99
State Sales Tax	6%	\$19.06
Final Cost to Consumer		\$19.06

As of July 2011, the PLCB operated 610 retail stores in the state. PLCB policy requires that each county in PA have at least one store, regardless of the potential business in the county (PFM, p. 20).

As indicated in Figure 1, PLCB stores are heavily clustered in five urban regions: the Philadelphia metropolitan statistical area (MSA), the Pittsburg MSA, Harrisburg MSA, Allentown-Bethlehem-Easton MSA, and the Erie MSA. Nearly all of the border counties, except those of the Philadelphia MSA, are sparsely populated, especially in the regions near the borders. This suggests that any significant border bleed mostly likely occurs from the Philadelphia MSA. (Appendix A lists the PA counties, their populations, and what states they border.)

It is legal for a PA resident to bring up to one gallon of liquor across the state border for personal use.¹² In the case of wine, if a resident wants to import more than this from an out-of-state producer whose products are not carried in the state stores, he/she can do this as long as she has it delivered through a state store and he pays a \$4.50 handling fee, the 18% liquor tax and the 6%

¹⁰ The PLCB offers some items at a "sales" price. According to our communications with the PLCB, in such cases all of the markups remain the same. The price reduction is on the cost of goods sold, i.e. the vendor offers the price reduction.

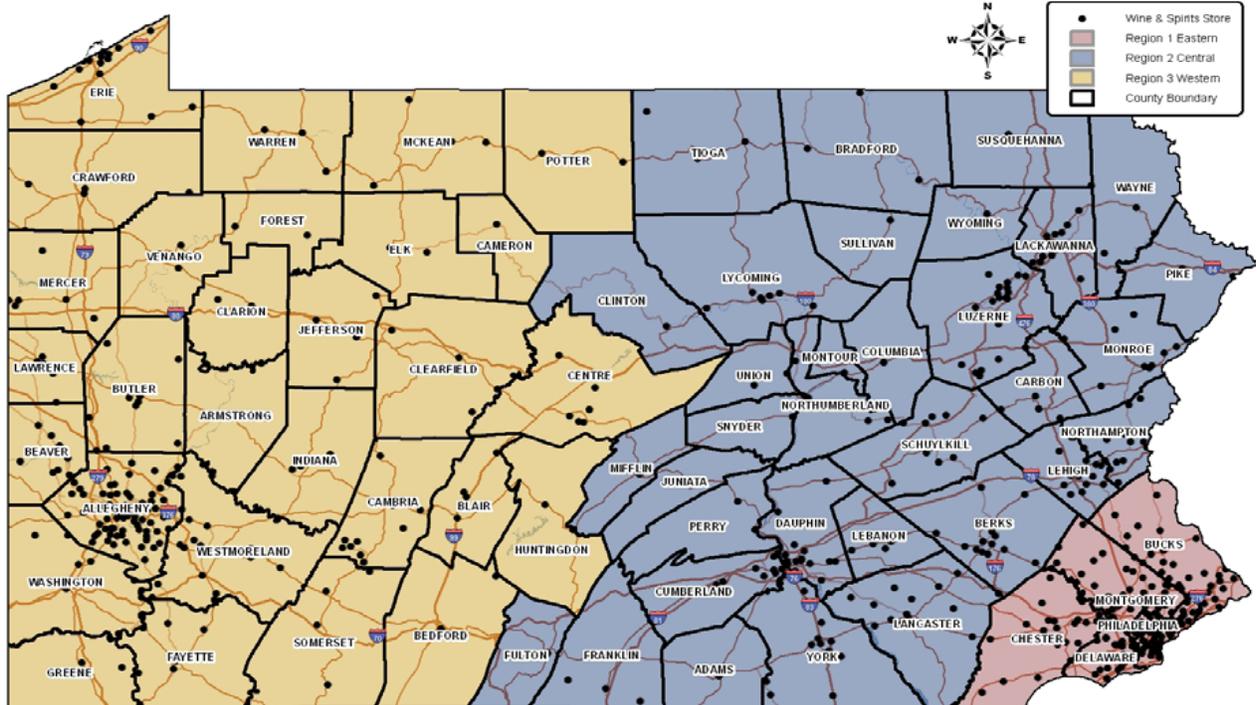
¹¹ As noted below, Philadelphia adds a 2% local sales tax and Allegheny County adds a 1% local sales tax.

¹² http://www.portal.state.pa.us/portal/server.pt/community/pennsylvania_liquor_code/1829

state sales tax. In the case of people who use their cars to transport liquor bought across the border for personal use, the state has little ability to enforce these laws.

Figure 1

PA Wine & Spirits Stores Map



Source: Pennsylvania Liquor Control Board, *Retail Year in Review, 2011/2012*

Regulations and Taxes in Surrounding States

The states that surround PA tax wine and spirits by the gallon, which has a greater percentage impact on lower-priced items than PA's excise tax. The excise tax also taxes wine relatively more heavily since a bottle of wine generally sells for less than a bottle of spirits of similar size. Table 2 summarizes liquor regulations in the states surrounding PA.

Table 2
State Liquor Laws and Taxes as of August 2012

State	Spirits Tax (per gallon)¹³	Wine Tax (per gallon)	Licensed or Control¹⁴	Sunday sales¹⁵	Beer and Liquor sold jointly?
DE ¹⁶	\$3.75	\$0.97	License for all alcoholic beverages	Yes	Yes
MD	\$1.50	\$0.40	License for all alcoholic beverages	Yes, except in some counties	Yes
NJ ¹⁷	\$5.50	\$0.875	License for all alcoholic beverages	Yes	Yes
NY	\$6.44	\$0.30	License for all alcoholic beverages	Yes	No
OH	\$9.04	\$0.32	The wholesale market for spirits is controlled by the state. Retail is by licensed private stores. Beer and wine sold via licensed distributors.	Yes	Yes
WV	\$1.85	\$1.00	Wholesale is controlled by the state. Private firms act as “agents” for the state, selling spirits at the retail level. Beer and wine sold by licensees.	Wine, yes. Spirits, no	Yes

¹³ Except where noted, these excise tax data are from The Tax Foundation. In the case of Ohio and West Virginia, where the states control the wholesale spirits operations, an implied excise tax is calculated using the methodology designed by the Distilled Spirits Council of the United States.

¹⁴ http://www.alcoholpolicy.niaaa.nih.gov/Alcohol_Control_Systems_Retail_Distribution_Systems_for_Spirits.html

¹⁵ http://www.alcoholpolicy.niaaa.nih.gov/Bans_on_Off-Premises_Sunday_Sales.html

¹⁶ finance.delaware.gov/publications/fiscal_notebook_05/.../abcc.pdf

¹⁷ On August 1, 2009, New Jersey increased its tax on wine and spirits by 25%. The taxes in this table reflect the newer rates.

A Shelf-Price Comparison

How do PA prices compare with those of surrounding states? We gathered the data in Table 3 during the week of June 18-22, 2012. In the case of the border states, we tried to call three stores in each state that were reasonably close to the PA border. The reported prices are an average across the three stores.¹⁸ We determined the top selling PLCB wine and spirits using data from retail year 2010/11.

Table 3
Price Comparison of Top-Selling Products in PA in FY 2010-11

Wine	(1) Sutter Home White Zinfandel (1.5L)	Cavit Pinot Grigio (1.5L)	Kendall-Jackson Vintner's Reserve CA Chardonnay (750 mL)	Woodbridge California Chardonnay (1.5L)	(5) Yellow Tail Chardonnay (1.5L)
Pennsylvania	\$9.99	\$14.99	\$14.99	\$13.99	\$14.99
Delaware	\$10.11	\$13.62	\$14.66	13.32	\$11.32
Maryland	\$8.89	\$12.65	\$13.15	\$11.65	\$11.66
New Jersey	\$8.12	\$13.75	\$12.38	\$11.62	\$11.85
New York	\$9.99	\$15.32	\$14.82	\$14.82	\$12.66
Ohio	\$9.16	\$13.99	\$14.99	\$13.16	\$13.16
West Virginia	\$10.49	\$12.99	\$17.99	\$13.99	\$15.99
Spirits (750 ml bottles)	(1) Jack Daniels Old #7 Black Label Whisky	Grey Goose Vodka	Captain Morgan's Spiced Rum	Jagermeister Herb Liqueur	(5) Crown Royal Canadian Whisky
Pennsylvania	22.99	30.99	17.49	19.99	26.99
Delaware	21.66	29.42	15.32	18.75	21.09
Maryland	19.66	29.99	15.32	19.16	23.99
New Jersey	25.02	31.69	22.82	21.69	29.36
New York	25.16	33.82	20.99	23.99	31.49
Ohio	23.15	32.03	16.67	23.10	25.15
West Virginia	22.99	30.99	15.99	19.99	25.99

Note: Ranked (1) to (5) from left to right.

¹⁸ We almost always succeeded in finding the prices from three border stores except in West Virginia. Several of the stores we reached in that state refused to give prices over the telephone.

Since private-sector stores in other states may have larger markups in low volume products, while the PLCB employs a constant markup formula, it is possible that Pennsylvania is more competitive on comparable low-volume products.

Customers may recognize that the final price they pay depends on the sales taxes that are added at the point of sale (POS). Table 4 compares sales taxes across the states. In addition, in Pennsylvania the City of Philadelphia adds a 2% sales tax and Allegheny County adds a 1% sales tax.

Table 4
Sales Taxes on Wine in Spirits in PA and Surrounding States

State	Sales Tax
Delaware	0%
Maryland	6% prior to July 1, 2012. 9% on and after that date
New Jersey	7%
New York	4%
Ohio	5.5%
Pennsylvania	6%
West Virginia	6%

Source: The Tax Foundation & website of the Comptroller of Maryland

These data gives us some notion, even prior to running regressions, about the likely magnitude of the border bleed. Clearly, the size of the border bleed will depend on which state a particular county borders. It may also vary by spirits versus wine. But the price differentials for the most popular products suggests that the border bleed may be relatively minor for many border counties of the state, and could even favor PA in some cases. There certainly could be a loss of wine and spirits sales to Delaware, Maryland, and New Jersey due to their competitive pricing, perceived better service and selection, and, in the case of Delaware, the absence of a sales tax. But, at least for the most popular items, the price differentials are small enough that it may not be worthwhile for typical consumers to cross the border. Certainly, for the most popular items, one might expect to find little or no border bleed relative to New York, Ohio, and West Virginia. This is due to small pricing differentials and sparse Pennsylvania populations within a convenient drive of the border. To the extent that there is a significant border bleed, it almost certainly comes from the five counties that make up the Philadelphia MSA, especially from those parts of these counties where the residents have easy access to the Delaware, New Jersey, and Maryland borders. To make a back-of-the-envelope calculation of its significance for the sales of the PLCB, consider that the population of Pennsylvania in 2011 was 12.7 million. The five counties that make up the Philadelphia MSA have about 4 million residents, or about 32 percent of the state's population. These five counties accounted for about 39% of PLCB's total retail sales in 2011. If we assume, somewhat arbitrarily, that sales in these five counties would be 15 percent higher were there no border bleed and that sales in other PA counties are largely unaffected, this

implies that PA state-wide liquor sales are depressed by about six percent, significantly short of some estimates of the border bleed.

4. The Data

The PLCB provided us with monthly retail sales data for all stores in the state for FY 2008/09, 2009/10, and 2010/11. Its retail year runs from July 1 to June 31. The data are broken down by quantity of bottles sold and by revenue earned. The PLCB also gave us data for the last six months of 2011. We converted these data to calendar year data for 2009, 2010, and 2011. We aggregated the store data by county. The PLCB also gave us sales data for kiosks, a short-lived unsuccessful PLCB 2010/11 initiative to place automated wine-bottle-dispensing machines in grocery stores. We include the kiosk sales in the total for county sales.¹⁹

In the case of data on the number of PLCB stores in a county, we adjusted the data for the amount of time a store was open. If, for example, a store was open just six months in the calendar year, we counted it as one-half of a store.

We should emphasize that our retail sales do not constitute a complete set of data on alcohol sales in a county. Individuals can, of course, buy liquor by the glass or a bottle of wine at a bar or "licensee" restaurant for consumption on the premises, and they can drink beer at home in place of wine or spirits. Thus, there is a theoretical possibility that low liquor sales in a county are due to high alcohol consumption through alternative means.

We added demographic descriptive data for each of the counties, using the U.S. Census Bureau's *QuickFacts*. In most cases these data are from the 2010 census but, in some cases, such as household income, the data were collected in the Census Bureau's American Community Survey. The Census Bureau is also the source for the annual esti

mated county population data. We obtained county unemployment rates and employment data from the U.S. Bureau of Labor Statistics using its Local Area Unemployment Statistics. Our data on voter registrations come from the PA Department of State and are accurate as of November

¹⁹ The kiosks, which sold wine, were initially installed in some grocery stores in the summer of 2010. In order to purchase wine from one of the kiosks, consumers had to insert a driver's license to prove that they were 21 or older and blow into a breathalyzer to prove that they were not already inebriated. The average kiosk operated for about 5 months and sold about 300 bottles a month. The PLCB removed all of the kiosks by September 2011 due to disappointing sales and persistent mechanical glitches. See "Pennsylvania's Wine Kiosk Experiment is Ending over Dispute with Contractor," September, 20, 2011, The Associated Press. Accessed at www.pennlive.com on June 22, 2012.

8, 2011.²⁰ When we refer to percentage Democratic or Republican voters, we mean as a percentage of registered voters in the county. The data on religious affiliation were downloaded from the Association of Religion Data Archives and are based on a survey conducted from 2009-2011. When we refer to the percentage “Main Line protestant” or some other religious affiliation, we mean as a percentage of the county population. Finally, in the regressions below, we classify the various Pennsylvania counties as being either border or non-border counties. The border counties are counties that border another state. But, since a significant share of the populations of Montgomery County and Lehigh County, which do not border other state boundaries, lives within 20 to 30 miles of Delaware or New Jersey, we also report whether our key results are sensitive to classifying these two counties as “border” counties.

Some Simple Descriptive Statistics

There is significant variation across PA counties in per capita liquor sales. This is illustrated in Table 5.

Table 5

Median County Based on Mean Per Capita Sales	Mean Liquor Sales Per Capita (2009-2011)	Persons Per Square Miles (2010)	Median Household Income (2010)	Number Liquor Stores in County (2010)
Crawford	\$62.01	88	\$38,924	5
Highest Three Counties				
Montgomery	\$165.16	1,656	\$76,380	40
Bucks	\$150.99	1,035	\$74,828	34
Chester	\$148.69	665	\$84,741	24
Lowest Three Counties				
Adams	\$34.68	63	\$44,276	1
Fulton	\$30.37	34	\$45,240	1
Juniata	\$23.92	196	\$56,529	1

Table 5 clearly suggests that per capita liquor sales are positively correlated with local household

²⁰ www.portal.state.pa.us/portal/server.pt/community/voter_registration_statistics/

incomes, population density, and convenience.²¹ Of course, the number of stores in a county (a proxy for "convenience") may be determined by per capita demand and population density. We address this issue in more detail later.²²

Finally, before presenting regression results, in Table 6 we provide some basic summary data for several of the variables we discuss below.

Table 6
Summary Data for 67 PA Counties in 2011

Variable	Mean (unweighted)	Min	Max
Liquor sales per Capita	\$79.34	\$24.26	\$170.13
Income per capita	\$23,645	\$14,325	\$41,251
Population	189,588	5,085	1,526,006
Employment	87,744	2,056	602,536
% population black	4.4%	0%	43%
% population Hispanic	3.4%	0%	19%
State liquor stores per 100 square miles	2.02	0.18	40.26
Population per square mile	467.3	12.8	11,379.5

²¹ The U.S. Bureau of Labor Statistic's Consumer Expenditure Survey shows a high correlation between household income and expenditures on alcoholic beverages. In 2010, household spending on alcoholic beverages by income quintile was:

Lowest Quintile	Second Quintile	Third Quintile	Fourth Quintile	Highest Quintile
\$153	\$211	\$359	\$466	\$869

²² A number of other factors may affect per capita liquor sales and the composition of such sales. We highlight a few of these in Appendix B.

5. What Explains Cross County Differences in Liquor Sales? Is There a Big Border Bleed?

What might we expect to find based on economic theory and eyeballing the data? *Ceteris paribus*,

- Higher income counties have higher sales per capita, i.e. liquor is a normal good.
- Counties with more liquor stores per 100 square miles should have higher sales per capita due to a convenience effect. Of course, the number of stores per square mile could also be driven by consumer demand. We address this issue below.
- Some demographic factors, such as race and ethnicity, religious affiliation, etc, may play a role, but we have no strong priors on the correlations.
- The border bleed will likely vary by the state that the county borders. Our suspicion, based on the analysis above, is that the border bleed will be most significant for counties that are easily accessible to Delaware, and perhaps New Jersey or Maryland.

The Simplest Model

We begin with a simple OLS linear regression model intended to capture the key factors driving cross-county differences in liquor sales. Our dependent variable is the annual per capita liquor sales in each of PA's 67 counties for 2009 through 2011. The explanatory variables in this first model are the county per capita income in thousands of dollars in 2010, the number of PLCB stores per 100 square miles for 2009 through 2011, a border dummy to indicate whether a county borders some other state or two states, and year dummies for 2010 and 2011. As shown in Table 7, we also run a second regression where the border dummies indicate which states the counties border.

Table 7
Dependent Variable: County per Capita Liquor Sales in 2009-11

Income per capita, 2010 (\$1,000)	5.09*** (0.27)	5.64*** (0.40)
PLCB stores per 100 square miles	1.44*** (0.16)	0.91*** (0.33)
County borders other state	-7.61** (3.47)	
County borders NY		1.87 (7.0)
County borders OH		-0.2 (2.9)
County borders MD		-27.0*** (4.5)
County borders WV		-11.9*** (3.3)
County borders NJ		15.4 (11.8)
County borders OH & WV		-1.4 (5.5)
County borders DE & MD		-5.0 (8.2)
County borders DE & NJ		-50.5*** (8.6)
County borders NY & OH		20.7*** (7.5)
County borders MD & WV		32.5*** (5.4)
County borders NY & NJ		-29.4** (13.3)
Year 2010	1.86 (3.98)	1.86 (3.62)
Year 2011	5.04 (4.07)	5.01 (3.75)
Constant	-45.8***	-57.6***
Number observations	201	201
R ²	0.56	0.65
F	86.7	1499

Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

The first regression in Table 7 implies that a \$1,000 increase in per capita income in a county would raise per capita liquor sales by about \$5.09, controlling for the other explanatory variables. An increase of one PLCB store per 100 square miles would raise sales by about \$1.45.²³

²³ We do not interpret this coefficient causally since it is possible that the PLCB opens more stores in counties where per capita demand is high. The basic data, however, suggest that this is not the case. Simple correlations using the 2011 data show that store density has a 0.99 correlation with population density and population density is unlikely to be caused by per capita liquor

If a county borders another state, sales are reduced by about \$7.61. All of these coefficients are statistically significant but the standard error on the border coefficient is fairly large, so we are uncertain about the precise magnitude of the estimated border bleed. But if we use the \$7.61 point estimate to increase per capita sales in all border counties by this amount, we calculate that total PLCB sales in 2011 would have increased by 3.6%. This is much less than the border bleed suggested by some others. If we increase and decrease the border bleed coefficient by one standard deviation, the estimated 2011 loss from cross border sales ranges from 2% to 5.3%.

The second regression in Table 7 decomposes the border effect by specific border states. The estimated coefficients for income and store density are similar to those in the first regression. In the case of the border coefficients, the counties with a statistically significant negative coefficient are those that border: Maryland; West Virginia; Delaware and New Jersey jointly; and New York and New Jersey jointly. The coefficients on the border dummies for the two counties that jointly border New York and Ohio and Maryland and West Virginia are positive and statistically significant. If we increase 2011 liquor sales in all of the counties where the coefficient point estimates indicate a border bleed (and ignore the cases where PA seems to benefit from cross-border sales) we calculate that PLCB sales in that year would have been 6.8% higher.²⁴ This is not a huge effect for the state, but the estimated border bleed for some counties is large. For example, without the estimated border bleed, 2011 sales in Delaware County, a county in the Philadelphia MSA which borders Delaware and New Jersey, would have been 48 percent higher.²⁵

A "Kitchen Sink" Model

Our second approach to estimating the magnitude of the border bleed is to put a large number of socioeconomic variables on the right-hand-side of the regression that could help predict county per capita liquor sales. We certainly do not interpret any estimated coefficient in these regressions, statistically significant or not, as reflecting causation. Table 8 presents the results from this exercise.

demand. Not surprisingly, when we repeated the regressions in Table 7 using population density as an instrument for store density, the results were nearly the same as those shown in Table 7.

²⁴ That is, we calculate the "gross" border bleed. If we were to estimate the state-wide "net" border bleed, including counties that seem to increase liquor sales on net due to border crossings, our estimate would be closer to the estimate with just a "border" dummy, i.e. closer to 4 percent.

²⁵ Some people argue that Montgomery County and Lehigh County should be classified as "border" counties since a large share of their populations are within a 30 minute drive of New Jersey. We did to check the effect on the regressions in Table 7. It had no notable effect on our estimates.

Table 8
Dependent Variable: County per Capita Liquor Sales, 2009-2011

Income per capita (\$1,000)	-2.49*** (0.86)	-2.44*** (1.14)
PLCB stores per 100 square miles	0.878* (0.48)	-0.86* (0.49)
Percent stores open Sunday	0.11 (0.07)	0.14** (0.07)
Percent "PC" stores	1.02*** (0.26)	1.00*** (0.25)
Percent population working	0.15 (0.44)	-0.24 (0.44)
Percent black	-0.47 (0.55)	0.84* (0.43)
Percent Hispanic	0.16 (0.32)	0.26 (0.34)
Percent college completion	3.54*** (0.52)	4.13*** (0.71)
Percent 18 to 64	-4.22*** (1.07)	-4.17*** (1.25)
Percent female	-3.06*** (0.77)	-1.54** (0.72)
Percent voters Democrat	0.57*** (0.18)	0.07 (0.23)
Percent voters Independent	2.57*** (0.64)	0.64 (0.72)
Percent evangelical	-0.85** (0.34)	-1.08*** (0.40)
Percent Main Line protestant	-0.73** (0.28)	-0.65** (0.29)
Percent Catholic	-0.02 (0.19)	0.08 (0.20)
County borders other state	-11.01*** (2.55)	
County borders NY		-6.09 (4.18)
County borders OH		-13.70*** (3.69)
County borders MD		-14.18*** (5.26)
County borders WV		-2.14 (5.42)
County borders NJ		10.70 (7.18)
County borders OH & WV		8.79 (6.41)
County borders DE & MD		-23.96*** (7.86)
County borders DE & NJ		-71.05*** (8.48)
County borders NY & OH		15.94*** (5.94)

County borders MD & WV		1.98 (6.30)
County borders NY & NJ		-28.37*** (6.86)
Year 2010	2.01 (2.41)	1.73 (2.14)
Year 2011	4.688* (2.61)	4.46* (2.343)
Constant	433.7***	398.4***
Number observations	201	201
R ²	0.84	0.88
F	85.0	482.1

Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

In terms of explaining the variation in per capita liquor sales across the counties over the three years, the models do quite well.²⁶ The R-squared is .84 in the first model and 0.88 in the second. In addition, several of the estimated coefficients do not surprise us. For example, the first regression suggests that holding the other variables constant, a 1% increase in the percentage of the county population with a college degree is associated with a \$3.54 increase in annual per capita liquor sales. Perhaps this is because college graduates are wealthier or have more stable employment prospects, and therefore are more willing to spend their incomes on wine and spirits. Some of the estimated coefficients are difficult to explain. Controlling for the other factors, for example, an increase in per capita county income is associated with a decrease in per capita liquor sales. But this simply points out the difficulty of explaining the rationale for some of the individual coefficients when so many other factors, which are often strongly correlated with each other, are on the right hand side.

Our caution about interpreting the estimated coefficients as reflecting causation is especially strong in the case of the PLCB policy variables. The PLCB decides how many stores to open in a county, which stores should be open on Sundays, and which stores should be designated Premium Collection (PC) stores, meaning that they offer a wider selection of wines. A quick glance at the locations of the PC stores indicates that they are disproportionately located in high-income urban areas, i.e. areas where there is likely to be high per capita liquor sales. For our purposes, however, this bi-directional causation is not a problem since we are only using data on the percentage of PC stores in a county to predict what liquor sales would be absent a border effect.

In Table 8, the key coefficients of interest are the estimated coefficients on the border effects. In the first regression, the point estimate for the border bleed is 11.01, indicating that average per

²⁶ We tried a number of variations with the variables on the right-hand-side of these regressions, including such things as the county poverty rate, unemployment rate, median home value, etc. Such inclusions or substitutions did little to the R-squares and did not change notably the estimates for the border dummies.

capita liquor sales in border counties is \$11 below what they would be without any border bleed. This is a larger effect than we estimated in the simpler model of Table 7, but given the standard errors associated with both estimates, we cannot rule out that the estimated border effects are the same in the two specifications. If we use the point estimate of the border effect in Table 8 to increase per capita sales in all border counties by this amount, we calculate that total PLCB sales in 2011 would have increased by 5.3%. If we increase and decrease the estimated border bleed coefficient by one standard deviation, the estimated range for the loss in PLCB sales lies between 4.0% and 6.5%.

The second regression in Table 8 breaks down the border effect by specific border states. The counties with a statistically significant negative coefficient are those that border: Ohio; Maryland; Delaware and Maryland jointly; Delaware and New Jersey jointly; and New York and New Jersey jointly. The coefficients for the border dummy for the county that jointly borders New York and Ohio is positive and statistically significant. Several of these estimates agree with those in the simplest model of Table 7, but not all. Here the estimate on the Ohio border bleed is statistically significant; it was not in Table 7. Here the estimate on the West Virginia border bleed is not statistically significant; it was in Table 7. Here the estimated border bleed for the county that jointly borders Delaware and Maryland is larger than it was in Table 7 and is statistically significant.²⁷ If we increase 2011 liquor sales in all of the counties where the coefficient point estimates indicate a border bleed (and ignore the cases where PA seems to benefit from cross-border sales) we calculate that PLCB sales in that year would have been 7.1% higher. For a few counties, such as those bordering Delaware, the estimated border bleed is quite large. Our estimates in this model indicate, for example, that 2011 sales in Delaware County, a county bordering Delaware and New Jersey, would have been 68 percent higher were it not for the border bleed.

6. Conclusions

One element in the discussion of PA liquor policy is the border bleed. Some politicians and studies have claimed that PA liquor sales may be depressed by 10 to 30 percent due to state residents buying liquor in surrounding states rather than their home state. Our estimates indicate that the border bleed is more likely in the range of three to eight percent, and certainly likely to be below ten percent. There may be good reasons to privatize the liquor distribution system in PA, but the emphasis given to the border bleed is probably misplaced. The border bleed is unlikely to be as significant as many people have claimed and, even under a privatized system, as long as PA taxes on wines and spirits are higher than those of some surrounding states, it is not likely to be completely eliminated.

²⁷ Reclassifying Montgomery and Lehigh counties as NJ "border" counties has little notable effect on the results in Table 8. The estimated coefficient on the NJ border in the second regression of Table 8 becomes negative, but is not statistically significant.

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Appendix A

County	Population, 2010	Per capita income (2010 dollars)	Persons per square mile, 2010	# PLCB stores in county	2011 Liquor sales per cap	Borders?
Adams	101,407	\$25,606	196	1	\$ 35.32	Maryland
Allegheny	1,223,348	\$29,549	1,676	76	\$ 148.61	
Armstrong	68,941	\$21,828	106	4	\$ 38.35	
Beaver	170,539	\$24,168	392	8	\$ 63.24	Ohio, W Virginia
Bedford	49,762	\$20,545	49	3	\$ 82.78	Maryland
Berks	411,442	\$25,518	480	13	\$ 85.36	
Blair	127,089	\$22,880	242	5	\$ 75.40	
Bradford	62,622	\$20,979	55	5	\$ 59.11	New York
Bucks	625,249	\$35,687	1,035	33	\$ 156.02	New Jersey
Butler	183,862	\$28,446	233	10	\$ 123.77	
Cambria	143,679	\$21,278	209	11	\$ 69.19	
Cameron	5,085	\$21,375	13	1	\$ 51.85	
Carbon	65,249	\$22,956	171	4	\$ 53.37	
Centre	153,990	\$23,744	139	6	\$ 118.07	
Chester	498,886	\$41,251	665	24	\$ 152.21	Delaware, Maryland
Clarion	39,988	\$20,259	67	4	\$ 62.75	
Clearfield	81,642	\$20,142	71	5	\$ 62.94	
Clinton	39,238	\$19,261	44	2	\$ 52.29	
Columbia	67,295	\$22,403	139	2	\$ 82.36	
Crawford	88,765	\$20,383	88	5	\$ 63.96	Ohio
Cumberland	235,406	\$30,119	432	10	\$ 134.33	
Dauphin	268,100	\$27,727	511	15	\$ 113.73	
Delaware	558,979	\$32,067	3,041	20	\$ 103.42	Delaware, New Jersey
Elk	31,946	\$22,729	39	2	\$ 54.14	
Erie	280,566	\$22,644	351	15	\$ 102.08	New York, Ohio
Fayette	136,606	\$19,209	173	8	\$ 50.29	Maryland, W Virginia
Forest	7,716	\$14,325	18	2	\$ 65.92	
Franklin	149,618	\$25,307	194	5	\$ 51.06	Maryland
Fulton	14,845	\$21,739	34	1	\$ 27.69	Maryland
Greene	38,686	\$20,258	67	2	\$ 43.10	West Virginia
Huntingdon	45,913	\$20,616	53	2	\$ 44.74	
Indiana	88,880	\$20,587	108	5	\$ 63.90	
Jefferson	45,200	\$20,305	69	4	\$ 40.76	
Juniata	24,636	\$20,682	63	1	\$ 24.26	
Lackawanna	214,437	\$24,152	467	13	\$ 126.55	
Lancaster	519,445	\$25,854	550	16	\$ 83.56	Maryland
Lawrence	91,108	\$21,467	254	5	\$ 62.30	Ohio
Lebanon	133,568	\$25,525	369	4	\$ 62.48	
Lehigh	349,497	\$27,301	1,013	15	\$ 138.66	
Luzerne	320,918	\$23,245	360	19	\$ 105.03	
Lycoming	116,111	\$21,802	95	7	\$ 94.81	
McKean	43,450	\$21,022	44	4	\$ 61.63	New York
Mercer	116,638	\$21,765	173	6	\$ 75.17	Ohio
Mifflin	46,682	\$19,085	114	1	\$ 47.34	
Monroe	169,842	\$24,824	279	9	\$ 149.44	New Jersey
Montgomery	799,874	\$40,076	1,656	39	\$ 170.13	
Montour	18,267	\$26,124	140	1	\$ 126.25	
Northampton	297,735	\$28,362	805	13	\$ 104.85	New Jersey
Northumberland	94,528	\$20,654	206	4	\$ 48.51	
Perry	45,969	\$23,701	83	2	\$ 36.96	
Philadelphia	1,526,006	\$21,117	11,380	54	\$ 108.95	New Jersey
Pike	57,369	\$27,564	105	2	\$ 91.82	New York, New Jersey
Potter	17,457	\$20,594	16	2	\$ 53.73	New York
Skuykill	148,289	\$21,408	190	10	\$ 62.31	
Snyder	39,702	\$21,072	121	1	\$ 49.03	
Somerset	77,742	\$19,903	72	4	\$ 39.45	Maryland
Sullivan	6,428	\$19,718	14	1	\$ 88.77	
Susquehanna	43,356	\$22,173	53	3	\$ 45.31	New York
Tioga	41,981	\$20,358	37	3	\$ 63.94	New York
Union	44,947	\$21,612	142	2	\$ 78.42	
Venango	54,984	\$20,522	82	3	\$ 54.45	
Warren	41,815	\$22,170	47	3	\$ 62.10	New York
Washington	207,820	\$26,045	243	11	\$ 89.56	West Virginia
Wayne	52,822	\$22,525	73	3	\$ 144.66	New York
Westmoreland	365,169	\$25,845	355	23	\$ 85.92	
Wyoming	28,276	\$22,899	71	1	\$ 63.22	
York	434,972	\$27,196	481	12	\$ 83.92	Maryland

Appendix B

It is not the focus of our paper, but we find it interesting that the composition of liquor sales also varies significantly across the counties and is also correlated with income. Table B1 reports the composition of liquor sales for a selection of counties.

Table B1

3 highest and lowest counties by wine sales percentage	Wine sales as a percentage of all revenue (FY 2010/2011)	Median Household Income (2010)
Chester	0.45	\$84,741
Montgomery	0.44	\$76,380
Bucks	0.42	\$74,828
Fulton	0.13	\$35,150
Greene	0.12	\$40,498
Forest	0.12	\$45,240

Source for data on wine sales: *PLCB, 2010-2011 Retail Year in Review*

In addition to cross-county comparisons of levels of liquor sales, it is interesting to make comparisons of changes in sales over time. Table B2 reports changes in liquor sales for a selection of counties. The data in the table suggest that changes in sales over time are related to changes in employment and changes in the convenience of stores.

Table B2

Four highest and lowest counties by growth in liquor sales	Percentage change in liquor sales, between 2009 and 2011	Percentage change in county employment, 2009 to 2011	Percentage change in number of PLCB stores
Bedford	145.3%	1.9%	33.3
Tioga	21.4	10.3	0
Bradford	19.8	11.8	0
Lycoming	14.2	3.4	0
Juniata	0.0	1.9	0
Westmoreland	-2.1	1.4	0
Beaver	-11.0	-0.1	-11.1
Fulton	-19.1	5.6	0

Table B2 indicates that Tioga, Bradford, and Lycoming are three of the top four counties in terms of gains in liquor sales. As indicated in Table B3, they are booming Marcellus Shale gas-drilling counties. But, among the bottom four counties in terms of growth in liquor sales is Westmoreland, which has also experienced significant drilling activity.

Table B3

	Number Oil and Gas Wells Drilled between 9/1/2008 and 9/1/2011
Bedford	1
Tioga	586
Bradford	818
Lycoming	352
Juniata	0
Westmoreland	433
Beaver	6
Fulton	0

Source: Pennsylvania Department of Environmental Protection.
Website accessed October, 2012.