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Do New Lottery Games Stimulate Retail Activity? Evidence from West Virginia Counties

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Abstract. In this study we examine the impact of lottery sales and the introduction of new lottery games on the retail activity using panel data on all West Virginia counties over the 1987-2001 period. We find that the introduction of video lottery spurred retail activity in those counties that have been granted the authority to offer video lottery. Empirical analysis also suggests that there is a positive relationship between lottery sales and retail activity, and that generally the introduction of new lotteries or lottery games in neighboring states reduced retail activity in West Virginia border counties.

1. Introduction

Although lotteries exist in 40 U.S. states and the District of Columbia, the use of lotteries as a public finance tool remains controversial.[1] Numerous studies examine issues such as regressivity (Clotfelter and Cook, 1990), lotteries as a component of a state's tax portfolio (Szakmary and Szakmary, 1995), enactment of lotteries across the states (Davis, Filer, and Moak, 1992; Alm, McKee, and Skidmore, 1993), competition with other forms of gambling (Clotfelter and Cook, 1990; Gulley and Scott, 1999; Elliot and Navin, 2002; Kearney 2005), and cross-border lottery shopping (Garret and Marsh, 2002; Tosun and Skidmore, 2004), but relatively little is known about the overall effects on state retail activity. Lotteries may play a larger role in the regional economy than when considered simply as a public finance issue. On the one hand, some research suggests that the effects on retail activity are, at best, neutral because lotteries compete with other forms of gambling and may reduce consumption of other goods and services (Gulley and Scott, 1989; Kearney, 2005). On the other hand, states that lead the way in the adoption of lotteries and new lottery games may generate positive economic benefits via cross-border shopping.[2] Similarly, states that lag behind may be compelled to adopt lotteries and new lottery games in order to avoid an outflow of funds to a neighboring state. In this applied study we add to this literature by examining the degree to which lottery activity generates retail activity.

West Virginia is a small state surrounded by states with higher incomes and larger populations. Given that West Virginia relies on tourism and frequent visits from consumers in neighboring states, erosion of its consumer base resulting from new competing lottery games in contiguous states stands as a threat not only to lottery revenues, but to its retail base.[3] Our empiri-

[1] Those opposed to the use of lotteries have based their objections on issue such as the regressivity of the "lottery tax" as well as moral considerations.

[2] Tosun and Skidmore (2004) demonstrate a significant cross-border shopping effect with regard to lottery sales in West Virginia. It is natural to consider whether there is a corresponding spillover to sales of goods and services complementary to lottery ticket sales.

[3] According to WV Division of Tourism 2001 Annual Report, tourism sector produced $3.9 billion of economic impact with $2.8 billion in direct spending from tourists in 2001. This 7.4% increase in West Virginia tourism over the previous year is relatively large as compared to the national increase of 2.4%. The same report lists all five neighboring states and Washington D.C. as the top state origins for overnight leisure travelers.

cal approach allows us to observe county-by-county lottery sales and retail income before and after new West Virginia lottery games are introduced. [4] Generally, our results present evidence that lottery sales lead to increased retail activity. In particular, we find that the introduction of video lottery appears to have spurred retail activity in the counties that have been granted the authority to offer video lottery. We also find that the introduction of new lotteries in neighboring states reduced retail activity in West Virginia. Somewhat surprisingly, however, the introduction of new lottery games like Big Game in neighboring states is actually positively associated with retail sales in West Virginia border counties.

2. Literature Review and Discussion

There are number of studies that examine the relationship between state lottery games and other forms of gambling.[5] The general conclusion of this research is that consumers view lottery play as a substitute to other forms of gambling. Two exceptions are studies by Kearney (2005) and Giacopassi, Nichols and Stitt (2006). Kearney (2005) uses data from national gambling surveys to do a difference-in-difference analysis of whether the introduction of state lotteries leads to a substitution away from other forms of gambling. Kearney finds that lottery spending tends to crowd out other household spending. Giacopassi, Nichols and Stitt (2006) find that casino gambling is a substitute for instant but not online games. Generally, the literature suggests that lotteries are unlikely to lead to increases in retail activity unless lottery activity serves to alter spending patterns away from other forms of gambling to lottery play and complementary retail activity. In a worst-case scenario (one in which state government failed to use lottery proceeds productively and the winners failed to spend proceeds within the state), lottery games could lead to a decline in overall retail activity. On the other hand, states might realize a net increase in retail activity via a reallocation of spending from non-retail spending (i.e., other forms of gambling) to the retail sector.

Studies by Davis, Filer and Moak (1992) and Alm, Mckee and Skidmore (1993) indicate that the decision to adopt lotteries was influenced, at least in part, by border competition.[6] Davis, Filer and Moak (1992) demonstrated that the presence of lottery programs in contiguous states is a significant factor in a state's adoption of lottery. In order to avoid an outflow of dollars, states that border a lottery state must adopt its own lottery. Alm, Mckee and Skidmore (1993) concluded that while fiscal stress was an important factor in early introduction of state lotteries, border competition became a dominant factor in later lottery enactments. In another study, Stover (1990) examined the substitution between lottery games in the context of contiguous state lotteries, and he shows that similar lottery games in bordering states are substitutes for each other.

Garrett and Marsh (2002) provide evidence on both cross-border lottery shopping and its impact on lottery revenues. Using cross-sectional data on 105 Kansas counties, they first show the presence of cross-border lottery shopping. They then estimate the revenue impact from the existence of lotteries in neighboring states, concluding that cross-border lottery shopping could account for substantial reductions in state lottery revenues. Similarly, Tosun and Skidmore (2004) evaluate the importance of border effects on lottery sales by examining the introduction of lottery and new lottery games within West Virginia and in nearby states using data on lottery sales for all 55 counties in West Virginia over the 1987-2000 period. In this dynamic framework, they also find evidence of cross-border shopping.

Clotfelter and Cook (1989) demonstrate that the introduction of state lotteries is a significant determinant of participation in gambling activity. In a multivariate probit analysis of participation in commercial gambling, which included variables such as gender, race, religion, frequency of church attendance, household income, age, education, and other explanatory variables, the presence of a lottery in the state of the respondent's residence was a statistically significant determinant of participation in gambling. This suggests that there is a latent demand for lottery play in states that do not have them. Thus, for a given market area there is a potential for this latent demand to be met by lottery games in adjacent states, especially along shared borders.[7] The potential effects on retail activity are, however, ambiguous. On the one hand, retail activity might be more responsive to lottery sales

[4] Ideally, we would like to use retail sales as the measure of retail activity. However, county level retail sales data are only available every five years. Later, we demonstrate that retail income is an excellent proxy for retail sales.

[5] Tosun and Skidmore (2004) provide a comprehensive review of this literature.

[6] Generally, the pressure point appears to have been on potential revenue loss for government, but forgone retail sales has also been a concern.

[7] As an illustration, several years ago one of the authors saw a billboard along the Illinois-Indiana border with following Illinois lottery advertisement, "Honey, I have to run to Illinois to get some milk."

due to the potential for cross-border shopping. On the other hand, residents in border counties have accessible to them the availability of attractive substitute lottery games in a neighboring state; this may lead to a weaker connection between lottery sales and retail activity in those counties. Clotfelter and Cook (1989) also show that lottery games are complements to other products. Thus, retail activity (and sales tax revenues) may be affected by the introduction of new lottery games. Generally, we hypothesize that retail activity is positively related to lottery activity. To our knowledge, no one has studied the effects of lottery games directly on retail activity.

3. Empirical Analysis

Given that lottery sales may be simultaneously determined with retail activity, we must examine the potential for endogeneity. To address this endogeneity issue, we reexamine the relationship between new neighboring state lottery game introductions and West Virginia lottery sales as in Tosun and Skidmore (2004). Next, we use this information to conduct a Hausman specification test, and then proceed to estimate the relationship between lottery sales and retail activity using appropriate econometric procedures.

3.1 Data

We estimate the effects of lottery sales on retail activity using data on retail income for all 55 West Virginia counties over the 1987-2001 period. Ideally, our key dependent variable would be some measure of retail sales. Unfortunately, county level data on retail sales is only available every five years. Data on retail income, however, is available on an annual basis.[8] Is retail income an effective proxy for retail sales? To answer this question, we collected county level data from the United States Census Bureau on retail sales for years 1987, 1992, and 1997 and matched these data with data on retail income. The correlation between retail income and retail sales was 0.995. Our conclusion is that retail income is an excellent proxy for retail sales, and thus turn our attention to several other important data issues.

Critical to our analysis is the location of significant retail centers in West Virginia. West Virginia and the bordering region with major cities and major highways are indicated on Figure 1. On the map we compare retail income per capita across counties in year 2001 with darker colors representing higher income. We see evidence of concentrations of retail activity in some interior counties as well as border counties, particularly in counties that are close to population centers like Pittsburgh and Washington D.C. It appears that there is the potential for sales location substitution, particularly in border counties.

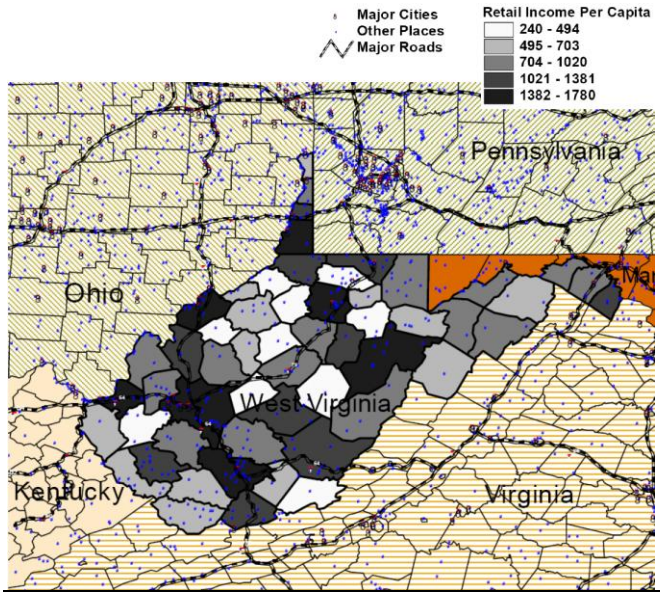

Figure 1. Retail income, West Virginia counties (2001)

Our primary objective is to examine the effects of the West Virginia lottery sales and the introduction of video lottery in 1994. Given that the method of analysis depends on whether lottery sales and retail activity are simultaneously determined we must first determine whether lottery sales are indeed endogenous. Critical to this portion of the analysis is whether we can identify appropriate instruments to conduct a Hausman test, and if needed, use a two-stage least squares estimation procedure. As discussed greater detail later, we identify several variables that measure lottery game status in bordering states as appropriate instruments. The information we provide in Table 1 shows that there are five new border state lottery or lottery game adoptions that occurred over the 1987-2001 period.[9] Both Virginia and Kentucky introduced lotteries following West Virginia's introduction in 1986. Also, Kentucky introduced Powerball in 1991, and Maryland and Virginia introduced Big Game in 1996 and 1997, respectively. In all, 17 of West Virginia's 29 border counties experienced the introduction of new lottery games in adjacent states. Data covering 55 counties over 15 years enable us to estimate the effects in border counties of lottery and lottery game introductions in West Virginia and neighboring states rela--

[8] Retail income is defined as all income earned in the retail sector (CA05 and CA25) as provided by the Bureau of Economic Analysis.

[9] Table 1 originally appears in Tosun and Skidmore (2004).

Table 1. Summary of New Lottery and Lottery Game Introductions in West Virginia and Neighboring States

State	Year Lottery Adopted	Instant	3-digit	4-digit	Lotto	Cash Lotto	Power Ball	Big Game	Video lottery
Kentucky	1989	✓	✓	✓	✓	✓	✓1991		
Maryland	1973	✓	✓	✓	✓	✓		✓1997	
Ohio	1974	✓	✓	✓	✓	✓			
Pennsylvania	1972	✓	✓	✓	✓	✓	✓2002		
Virginia	1988	✓	✓	✓	✓	✓		✓1996	
West Virginia	1986	✓	✓	✓		✓	✓1992		✓1994*

* Video lottery was introduced in racetracks in the following West Virginia counties: Ohio (1994), Hancock (1994), Kanawha (1994), and Jefferson (1997). Since late 2001, video lottery machines are also allowed in adult settings such as bars and clubs.

tive to interior counties and other border counties that did not experience new lottery game introductions. These results will then be used to test for the endogeneity of lottery sales.

To address the endogeniety issue, we create a series of dummy variables indicating new lottery and lottery game introductions in neighboring states. The first of these variables is a dummy variable that is equal to one if a border county experiences introduction of a lottery or a lottery game such as Powerball or Big Game in a contiguous state (*Border County*New Lottery or Lottery Game in Border State*). We also isolate the effects of each neighboring state's lottery game introduction with a series of five indicator variables. The first two variables characterize the introduction of a new lottery in a state that previously had no lottery: A dummy variable equal to one if a county borders Kentucky and Kentucky introduces a new lottery and zero otherwise (*Border County* New KY Lottery*); and a dummy variable equal to one if a county borders Virginia and Virginia introduces a new lottery and zero otherwise (*Border County* New VA Lottery*). The remaining three variables characterize the introduction of a new lottery game in states that had previously adopted the use of lotteries: A dummy variable equal to one if a county borders Kentucky and Kentucky introduces Powerball and zero otherwise (*Border County*New KY Powerball*); a dummy variable equal to one if a county borders Virginia and Virginia introduces a Big Game and zero otherwise (*Border County* New VA Big Game*); and a dummy variable equal to one if a county borders Maryland and Maryland introduces Big Game and zero otherwise (*Border County*New MD Big Game*). These variables reveal how new lottery game introductions affected lottery sales in each of the five bi-state regions. It should be noted that Ohio and Pennsylvania also offer lottery games, but we are not able to estimate their effects on West Virginia retail income because neither of these two states introduced new lottery games during the period of analysis.[10]

To estimate the effects of lottery sales on the real per capita retail income, we control for fixed county-effects as well as time-effects. Importantly, county fixed effects control for factors that are fixed over time such as major roads and highways that determine commuting patterns and traffic flow.[11] In addition, we control for changing economic and demographic conditions within the county by including county per capita personal income net of retail income, the unemployment rate, the proportion of the population over the age of 65, the proportion of the population that is male, and the proportion of the population that is nonwhite in the regression analysis. We expect the relationship between per capita income (net of retail income) and retail activity to be positive. Similarly, we also include the rate of unemployment as a control, and expect a negative relationship between retail activity and unemployment. We expect that a county with a growing elderly population will experience reduced retail activity, given that the elderly tend to spend a larger proportion of their resources on items such as health care and other services. We also include the proportion of males and minorities, but have no *a priori* expectations of how these demographic factors will affect retail activity. Summary statistics, de-

[10] Although, Pennsylvania started Powerball in June 2002, it is too soon to see its effect on West Virginia lottery sales.

[11] Data on commuting patterns is not available over the entire period of analysis.

finitions, sources of data for all variables used in the analysis are presented in Tables 2 and 3, respectively.

3.2 Method of Analysis

Before proceeding, several other econometric issues warrant discussion. The data are a panel of 825 observations that include all counties for years 1987 through 2001. Given that our data have both time-series and cross-sectional elements, our analysis relies on changes in the status in lottery games in West Virginia and contiguous states. Thus, we employ 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 conducted 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.[12] On a theoretical basis, a fixed-effects technique is more appropriate because the data are a panel of all counties in West Virginia and not a sampling of counties. Therefore, for both theoretical and empirical reasons, we use the fixed-effects procedure.

Empirical analysis of spatial models often focuses on factors such as distance, size of retail center, transportation routes, and the like. Given the spatial nature of retail activity, there is the potential for spatial dependence. 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. We therefore also use appropriate techniques to correct for spatial autocorrelation. Note that the tests we conduct for fixed effects and for endogeneity were completed in conjunction with the spatial econometric analysis.

We now present the empirical analysis, beginning with an assessment of the potential endogeneity of lottery sales. We then proceed with the core component of our analysis: estimating the determinants of retail income with an emphasis on the role of lottery sales, video lottery and lottery or lottery game introduction in neighboring states. This empirical approach allows us to examine the degree to which lottery sales affect retail activity, and importantly it allows us to test for the endogeneity of lottery sales.

3.3 Endogeneity of Lottery Sales

Given the potential for a two-way relationship between retail activity and lottery sales, it is important to examine in a systematic way whether we should treat lottery sales as an exogenous determinant of retail income. Improper treatment of lottery sales could lead to biased estimates. Thus, we examine the possible endogeneity of lottery sales using a Hausman specification test.[13] The Hausman test requires us to identify an instrument: a variable that determines lottery sales but does not directly determine retail income. Second, because we employ a fixed effects framework, our instrument(s) must vary over time and across counties.

The variables that characterize changes in border state lottery games meet these criteria.

In the first stage of the Hausman specification test we estimate the following regression that includes the spatial error autocorrelation structure:[14]

$$Lottery\ Sales_{it} = Intro_{it}\mu_1 + V_{it}\mu_2 + C_i + T_t + \varepsilon_{it},\ \varepsilon_{it} = \rho W\varepsilon_{it} + \omega_{it} \qquad (1)$$

for state i in period t. $Intro_{it}$ is an nx1 vector that indicates the status of lottery games in neighboring states interacted with the West Virginia border county indicator variable and μ_1 measures the effect of a new lottery or lottery game introduction in a neighboring state in a particular county-year. V_{it} is an nxk set of control variables (k is the number of controls) and μ_2 is a kx1 vector of parameters. C_i represents the county specific effects, T_t is the set of time indicator variables, and ε_{it} is the residual. We note again that summary statistics for these and all other variables used in the estimations are presented in Table 2, and detailed definitions and sources of all variables used in the analysis are shown in Table 3. Consistent with the findings in Tosun and Skidmore (2004), regressions presented in Appendix Table A show that several of the coeffi-

[12] See Baltagi (2001: 32) for the specifics of this test. We conducted this test within the spatial regression framework which is explained in the next paragraph. In addition, a Hausman test before the spatial considerations also 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.

[13] See Kennedy (1992) for a description of the Hausman specification test.

[14] See Elhorst (2003) for a detailed explanation of the fixed effects spatial error and spatial lag models. It is assumed in equation (1) that $E(\varepsilon_{it})=0$ *and* $E(\varepsilon_{it}\varepsilon_{it}')=\sigma^2 I_N$. Also note that the endogeneity test could alternatively be done using a spatially lagged dependent variable. This does not change the test results.

cients on the border effect variables are negative and statistically significant.[15] While we do not discuss these results in detail, the estimated effects of the lottery variables are presented for the interested reader.[16] Importantly several of the border variables have statistically significant and economically meaningful effects of lottery sales: West Virginia counties bordering states that introduced new lottery or lottery games experienced reduced lottery sales. Thus, we have identified several variables that may qualify as valid instruments.

Table 2. Summary Statistics of All Variables (n = 825)

	Mean	Standard Deviations
Per Capita Retail Income	884.167	414.846
Per Capita Non-retail Income	16,347.470	3,149.882
Per Capita Lottery Sales	64.680	36.711
Unemployment Rate	9.900	4.085
Population	33,007.750	32,650.490
Proportion of Population Over the Age of 65	15.105	2.006
Proportion of the Population That Is Male	48.597	1.006
Proportion of the Population That is Nonwhite	2.464	2.720
Video Lottery Dummy	0.035	0.184
Border Effect Variables		
(Border County)*(New WV Video Lottery)	0.025	0.158
(Border County)*(New WV Powerball)	0.364	0.481
(Border County)*(New Lottery or Lottery Game in Border State)	0.245	0.430
(Border County)*(New KY Lottery)	0.032	0.175
(Border County)*(New VA Lottery)	0.205	0.404
(Border County)*(New KY Powerball)	0.027	0.161
(Border County)*(New VA Big Game)	0.095	0.293
(Border County)*(New MD Big Game)	0.048	0.215

[15] A more detail discussion of these findings is presented in Tosun and Skidmore (2004).

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

To complete the Hausman specification test, the residual generated from equation (1) is included as an explanatory variable in the retail income equation. If lottery sales are endogenous, then the coefficient on this residual should be significantly different from zero. The Hausman test indicates that the null hypothesis that lottery sales are exogenous cannot be rejected. We therefore proceed with estimating the retail income equation without correcting for simultaneity. We note that the two-stage least squares estimates are similar to those presented in the paper, and do not alter our basic conclusions.[17]

3.4 Estimation Results

The econometric model is as follows. Denote $Retail_{it}$ as the natural logarithm of deflated county per capita retail income in county i in period t. We assume that

$$\mathrm{Re}tail_{it} = LotterySales_{it}\beta_1 + X_{it}\beta_2 + C_i + T_t + \varepsilon_{it},$$
$$\varepsilon_{it}=\rho W\varepsilon_{it}+\omega_{it} \qquad (2)$$

where *LotterySales* is the natural logarithm of real per capita lottery sales in county *i* in period *t*, X_{it} is an *n*x*m* vector control variables (*m* is the number of controls) and where β_2 represents an *m*x1 vector of coefficients. Included in X_{it} are the natural logarithm of real per capita income net of retail income (*Per Capita Non-Retail 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, T_t is the set of time indicator variables, and ε_{it} is the residual.

In addition to estimating the effects of West Virginia lottery sales (and indirectly any border effects) on retail income we also directly estimate the effect of a new lottery game introduction in West Virginia. The introduction of video lottery in four West Virginia counties (Ohio [1994], Hancock [1994], Kanawha [1994], and Jefferson [1997]) may have affected retail activity in those counties. Video lottery at racetracks has been very successful in these counties, garnishing about $546 million in total sales or 2.6 times more than total traditional lottery sales in 2002. Video lottery is clearly aimed at residents from Pennsylvania, Kentucky, Virginia, Maryland and Ohio. We are interested in evaluating the degree to which these visitors purchase other retail items in West Virginia. Note that video lottery revenues are not included in our measure of lottery sales. Rather, video lottery is considered separately. The issue is then whether the retail activity

[17] These results are available from the authors upon request.

Table 3. Definitions and Sources of Variables

Variables	Definitions	Source
Per Capita Retail Income	Real Per Capita County Retail Income (CA05 and CA25)	BEA
Per Capita Non-retail Income	Real Per Capita County Non-retail Income	BEA
Per Capita Lottery Sales	Real Per Capita County Lottery Sales	WVL
Unemployment Rate	County Unemployment Rate	BLS
Population	County Population	BEA
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
Video Lottery Dummy	Indicator Variable Equal to 1 for Introduction of Video lottery in County and 0 Otherwise	TS
Border Effect Variables		
(Border County)*(New WV Video Lottery)	Indicator Variable Equal to 1 for Introduction of Video lottery in a Border County and 0 Otherwise	TS
(Border County)*(New WV Powerball)	Indicator Variable Equal to 1 for a Border County Following the Introduction of Powerball in WV and 0 Otherwise	TS
(Border County*(New Lottery or Lottery Game in Border State)	Indicator Variable Equal to 1 if a County Borders a State That Introduces a New Lottery or New Lottery Game and 0 Otherwise	TS
(Border County)*(New KY Lottery)	Indicator Variable Equal to 1 if a County Borders Kentucky and Kentucky Introduces a New Lottery and 0 Otherwise	TS
(Border County)*(New VA Lottery)	Indicator Variable Equal to 1 if a County Borders Virginia and Virginia Introduces a New Lottery and 0 Otherwise	TS
(Border County)*(New KY Powerball)	Indicator Variable Equal to 1 if a County Borders Kentucky and Kentucky Introduces Big Game and 0 Otherwise	TS
(Border County)*(New VA Big Game)	Indicator Variable Equal to 1 if a County Borders Virginia and Virginia Introduces Big Game and 0 Otherwise	TS
(Border County)*(New MD Big Game)	Indicator Variable Equal to 1 if a County Borders Maryland and Maryland Introduces Big Game and 0 Otherwise	TS

Sources:

BEA: Bureau of Economic Analysis, Regional Accounts Data: http://www.bea.doc.gov/bea/regional/reis/

BLS: Bureau of Labor Statistics, Local Area Unemployment Statistics: http://www.bls.gov/lau/home.htm

CENSUS: U.S. Census Bureau, County Population Estimates: http://eire.census.gov/popest/estimates.php

WVL: State of West Virginia Lottery Commission: http://www.state.wv.us/lottery/

TS: Tosun and Skidmore – variables created by the authors.

Table 4. Retail Income Regressions

Dependent variable: Natural Logarithm of Real Per Capita Retail Income	(1)	(2)	(3)
Per Capita Non-retail Income	0.014	0.239***	0.260***
	(0.23)	(4.08)	(4.51)
Unemployment Rate	-0.007***	-0.008***	-0.006***
	(-4.76)	(-5.16)	(-3.98)
Proportion of Population Over the Age of 65	-0.022***	-0.028***	-0.021***
	(-3.64)	(-4.26)	(-3.27)
Proportion of the Population That Is Male	-0.012	-0.020*	-0.024**
	(-1.12)	(-1.85)	(-2.27)
Proportion of the Population That is Nonwhite	-0.015*	-0.026***	-0.029***
	(-1.68)	(-2.93)	(-3.28)
WV Video Lottery	**0.072****	**0.097*****	**0.079*****
	(2.56)	**(3.42)**	**(2.83)**
Per Capita Lottery Sales	**0.083*****		
	(6.70)		
(Border County)* (New WV Powerball)		**0.024****	**0.020***
		(1.95)	**(1.65)**
(Border County)*(New Lottery or Lottery Game in Border State)		**-0.030***	
		(-1.67)	
(Border County)*(New KY Lottery)			**-0.072**
			(-1.01)
(Border County)*(New VA Lottery)			**-0.091*****
			(-3.99)
(Border County)*(New KY Powerball)			**-0.093***
			(-1.66)
(Border County)*(New VA Big Game)			**0.040****
			(2.40)
(Border County)*(New MD Big Game)			**0.044****
			(2.16)
Spatial Autocorrelation	-0.046	-0.024	-0.044
	(-0.95)	(-0.50)	(-0.91)
Adjusted R^2	0.954	0.951	0.953

* Indicates significant at the 90% level of confidence for a two-tailed test.
** Indicates significant at the 95% level of confidence for a two-tailed test.
*** Indicates significant at the 99% level of confidence for a two-tailed test.
All regressions include a series of county and time indicator variables to control for fixed county and time effects. Also, a procedure is used to correct for spatial autocorrelation. The t-statistics are in parentheses.

has been affected by the introduction of video lottery. To address this question, we include an indicator variable equal to one if a county offers video lottery and zero otherwise (*WV Video Lottery*).[18]

In Table 4 we present the results for three regressions that measure the effects of West Virginia traditional lottery and video lottery sales on retail income. In column 1 we present a regression generated from data that include all West Virginia counties. In columns 2 and 3 we examine the effect of border state lottery and lottery game introductions directly on retail activity in West Virginia border counties. The estimates found in columns 2 and 3 are "reduced form" regressions in that they examine exogenous changes in neighboring states on West Virginia retail activity.

Consider first the results found in column 1. The coefficients on Video Lottery and Per Capita Lottery Sales are both positive and highly significant, indicating that the introduction of Video Lottery and increases in lottery sales appear to spur retail activity. According to these estimates, the introduction of video lottery increased retail activity by about seven percent, and a 10 percent increase in lottery sales increases retail activity by 8 percent (column 1).

As evidence of the border county effect, consider the results found in columns 2 and 3. In these regressions we omit the per capita lottery sales variable and include just the border county/neighboring state interaction terms to estimate the direct effect of changing lottery status in neighboring states on border state retail activity. In column 2 we see that a new neighboring state lottery or lottery game introduction reduces retail activity in West Virginian border counties by about 3 percent. Results in column 3 show that lottery introduction in Virginia in 1988 and PowerBall introduction in Kentucky in 1991 have strong negative effects on retail activity in West Virginia border counties. On the other hand, PowerBall introduction in West Virginia in 1992 has a relatively small positive effect countering these negative effects. Also, surprisingly, we see a positive effect from the introduction of Big Game in Maryland (1997) and Virginia (1996). These positive effects, however, are less than half of the negative effects from Virginia's lottery and Kentucky's PowerBall. Also, these positive effects could be pointing to possible complementarities between different gambling products similar to evidence provided by Giacopassi, Nichols and Stitt (2006).[19]

Finally, we briefly discuss the coefficient estimate on the control variables. The coefficient estimate on personal income net of retail income is positive but only significant in columns 2 and 3, the regressions that do not include per capita lottery sales as an explanatory variable. This is an indication of multicolinearity between per capita lottery sales and per capita income. Controlling for income, we find a significant negative coefficient on the unemployment rate, as we expected. Turning to the demographic variables, the coefficient on the proportion of the population over the age of 65 is also negative and significant, and in some regressions male and minority population variables are inversely related to retail sales. Given that our goal is to control for the unobservable characteristics with fixed effects so that we can obtain unbiased estimates of the lottery/retail relationship, we will not focus our discussion on these variables. It is reassuring, however, to see that the coefficients on these variables are largely consistent with our expectations.

4. Conclusion

The analysis presented in this study suggests that lottery games can have substantial effects on retail activity. In particular, the introduction of West Virginia video lottery had a notable impact on retail income in those counties that adopted the game. The retail bases in the counties with video lottery have increased substantially, but these economic benefits may be vulnerable to the introduction of similar games in neighboring states or in other West Virginia counties. In fact, Pennsylvania recently responded by issuing licenses for 61,000 video lottery slots throughout the state. This move could have significant effects on both lottery and retail activity in West Virginia, particularly in the video lottery counties.

Traditional lottery sales in West Virginia also have a positive effect on West Virginia retail activity and, importantly, new lottery and lottery game introductions in neighboring states appear to have also had an impact on border county retail activity. For rural states such as West Virginia, not only are lottery revenues at risk (Tosun and Skidmore, 2004) but new lottery and lottery game competition from neighboring

[18] In principle, the introduction of Video Lottery is also potentially endogenously determined. For example, one might argue that the state officials may approve Video Lottery in strong retail regions. However, it appears that Video lottery was introduced in economically distressed areas. Thus, if there is a bias, it is likely downward.

[19] This is particularly interesting given the fact that one of the largest video lottery operations in West Virginia is located in Jefferson County which is very close to both Maryland and Virginia borders. Hence, we may be seeing the complementarity between casino type gambling (video lottery) and online games (Big Game) which is consistent with similar evidence from Giacopassi, Nichols and Stitt (2006).

states may have significant negative retail impacts, particularly in border counties. This analysis also suggests that any economic benefits resulting from being a "first mover" in the introduction of new lottery games is likely to be short-lived: As neighbor states follow with introduction of their own new games, the benefits accruing to the leader will dissipate. Similarly, losses incurred by lagging states appear not to be permanent. Finally, we note that because lottery activity affects retail activity, by extension sales taxes are also affected. While it would be useful to estimate the affect of changing lottery sales on sales tax revenues, such a task is beyond the scope of this study, and thus a fruitful avenue for future research. In sum, the impacts of the changing lottery environment on state government revenues extend beyond simply the gains (or losses) in lottery revenues.

In this study we use panel data from 55 West Virginia counties over the period 1987 through 2001 to estimate the effects of the introduction of new lotteries and lottery games on retail income. The use of panel data allows us to examine how retail activity changes as new West Virginia lottery games are introduced. The panel data approach is a significant contribution in and of itself, given that much of the previous work has utilized cross-sectional data. Generally, our findings provide new evidence of significant retail effects from lottery activity and that the introduction of new games within a state and in neighboring states can have an impact on retail activity.

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Appendix Table A. Lottery Revenue Regressions

Dependent Variable: Natural Logarithm of Real Per Capita Lottery Sales	(1)	(2)
Constant	-0.948 (-0.33)	-1.624 (-0.58)
Per Capita Non-retail Income	0.339 (1.29)	0.445* (1.71)
Unemployment Rate	0.002 (0.55)	0.004 (0.94)
Proportion of Population Over the Age of 65	0.063*** (3.35)	0.062*** (3.27)
Proportion of the Population That Is Male	0.013 (0.43)	0.006 (0.20)
Proportion of the Population That is Nonwhite	0.013 (0.49)	0.011 (0.39)
WV Video Lottery	-0.196*** (-2.86)	-0.226*** (-3.12)
(Border County)*(New WV Video Lottery)	0.475*** (3.12)	0.529*** (3.71)
(Border County)*(New WV Powerball)	-0.114** (-2.30)	-0.069 (-1.24)
Neighbor State Border Effect Variables		
(Border County*(New Lottery or Lottery Game in Border State)	-0.084 (-1.23)	
(Border County)*(New KY Lottery)		-0.097 (-0.69)
(Border County)*(New VA Lottery)		-0.090 (-1.17)
(Border County)*(New KY Powerball)		-0.420*** (-3.17)
(Border County)*(New VA Big Game)		-0.135** (-2.02)
(Border County)*(New MD Big Game)		-0.067 (-1.19)
Adjusted R^2	0.902	0.903

* Indicates significant at the 90% level of confidence for a two-tailed test.
** Indicates significant at the 95% level of confidence for a two-tailed test.

cates significant at the 99% level of confidence for a two-tailed test.

All regressions include a series of county and time indicator variables to control for fixed county and time effects. Also, a procedure is used to correct for spatial autocorrelation. The z-statistics are reported in parentheses.