E C O N O M I C S   B U L L E T I N

The Importance of Self−Selection in Casino Cannibalization of State Lotteries

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Abstract

This note extends the work of Elliott and Navin (2002) on the substitutability of commercial casinos and state lotteries by controlling for a potential negative selection bias. We utilize a Heckman two−step selection correction in which our first stage probit involves whether or not a state has legalized commercial casinos. Results indicate that a $1 increase in state casino tax revenue will reduce net lottery proceeds by $0.56. This estimate is 33% smaller than what has been found in other studies, which is consistent with a negative selection bias.

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1. INTRODUCTION

The past thirty years have represented a large growth in the proliferation of legalized gaming within the US. As of 2001, there were 37 states with state-operated lotteries, 28 states with Indian gaming and 11 states with commercial casinos. This expansion has been met with significant growth in gaming revenue. For FY 2001, the nation's gross gambling revenue (wagers minus winnings) increased 3.1% to $63.3 billion. Of that amount, 28% was attributed to state-sponsored lotteries, whereas another 41% was due to commercial casinos.

The expansion of the nation's gaming industry provides states with additional sources of revenue. In FY 2001, states received slightly under $12.5 billion in net lottery revenue (sales minus winnings and administrative costs) and an additional $2.9 billion in tax receipts from commercial casinos. Since an individual's participation in gaming is voluntary, states view these revenue sources as a "painless" tax (Clotfelter and Cook 1989), which makes gaming taxation a particularly attractive source of state financing. Because of this, many lottery-only states facing financial shortfalls are discussing increasing their gaming base by legalizing commercial casinos[1], thereby tapping an unrealized revenue source. Given that lotteries and casinos are substitute forms of gaming, the potential exists that the legalization of casinos could cannibalize existing lottery revenues. If this is the case, states could find themselves on the short end of revenue projections.

Empirical research on the issue of commercial casino-lottery substitution[2] is limited to the work of Elliott and Navin (2002) who find that during the period 1989-1995, expenditures on riverboat gambling had a negative impact on gross state lottery revenues. They then use average tax rates to estimate that a dollar increase in riverboat gambling was met by an 83-cent decline in net lottery revenue.

We expand on this work in three important ways. First, given that the state is likely more concerned with the revenues it receives than gross revenues generated in the gaming industry, we use actual tax receipts from all forms of commercial casinos (not just riverboats) and net lottery revenue, rather than focus on gross revenues. Second, we expand the time frame to include 1988-2000. Doing so encompasses the legalization of all commercial casinos in the US with the exception of those in Nevada and New Jersey, where legalized commercial gaming has been in place since 1931 and 1976, respectively.

Most importantly, we address the issue of self-selection in a different manner. Elliott and Navin (2002) argue for the potential of sample-selection bias in lottery revenues. Hence, they perform a Heckman two-step selection correction, in which their first stage probit involved whether or not a state adopted a lottery. While there may be specific characteristics that determine whether or not a state adopts a lottery (Alm et al 1993, Erekson et al 1999), in discussing whether the addition of commercial casinos cannibalizes lottery revenue, the state must already have the lottery in place. Thus, we view the potential sample-selection bias to be in regards to having legalized commercial casinos, as states with low lottery revenues may be more likely to legalize commercial casinos. If this is so, OLS estimates using a full sample of lottery states will show that casino tax revenue is associated with low lottery revenue, although this may be -in part- due to the fact that low lottery revenue states are more likely to legalize casinos.

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[1] For example, within the past year, Governors Mitt Romney of Massachusetts and George Pataki of New York have been promoting the notion of allowing casino gaming in their states.

[2] Siegel and Anders (2001) have looked at the substitution between lottery revenues and Indian casino gaming in Arizona.

Since we are interested in how states respond to changes in casino tax revenues, we need to control for the self-selection into commercial casinos.

Our results indicate a strong cannibalization of state net lottery revenue by commercial casino tax revenue. Specifically, we find that a $1 increase in commercial casino tax revenue decreases net lottery revenue by $0.56, which is a 33% decline from the impact noted in Elliott and Navin (2002). This decrease is consistent with the negative selection bias outlined above.

2. DATA

The data used for the analysis covers the mainland 48 states for the years 1988 through 2000. This time span starts with the year the Indian Gaming Regulatory Act (IGRA) was passed and encompasses when the majority of states legalized commercial casinos. Annual state lottery revenue, including breakdowns on sales, winnings and administrative costs, was collected from issues of *State Government Finance*. Individual states' lottery make-up and structure was obtained through LaFleur's *2002 World Lottery Almanac*. We collected state commercial casino tax revenues by contacting state casino regulatory agencies. Data pertaining to Indian Gaming Compacts was obtained by contacting the Indian Gaming Management Staff in the Bureau of Indian Affairs, which is part of the Department of the Interior. Other state demographic information, including population, unemployment rates, educational attainment, and age breakdowns of the population were compiled from the *Statistical Abstract of the United States.* All dollar amounts are in real terms with 1996 as the base year. Moreover, all dollar values are measured in per capita terms for easy comparison with Elliott and Navin (2002).

3. MODEL

To examine the effects of commercial casinos on lotteries, our econometric specification is a hybrid model borrowing from the work of Gulley and Scott (1989), who studied the substitution between lotteries and pari-mutuel gaming, and Siegel and Anders (2001), who studied the substitution between Indian gaming and lotteries in Arizona:

$$\begin{aligned} LOTTERY_{it} = \beta_0 + \beta_1 CASINO_{it} + \beta_2 OTHER\ GAMES_{it} + \beta_3 STRUCTURE_{it} + \\ \beta_4 DEMOGRAPHICS_{it} + \delta_i + \tau_t + \varepsilon_{it} \end{aligned} \quad (1)$$

The LOTTERY variable is the amount of revenue generated by the lottery that is given to a state general fund or is directed towards other public programs. Using net lottery revenue (lottery sales minus winnings and administrative costs) is preferred to gross lottery revenue since the latter does not accurately depict how much revenue the lottery is contributing to state coffers.

CASINO is the amount of tax revenue generated by commercial casinos that is given to state general funds. This includes wagering taxes, which are applied to a casino's annual gross receipts (total wagers minus payouts) and admission fees, which apply solely to riverboat casinos.[3] We exclude gaming device fees since the revenue generated by this particular fee is used by the state to regulate the casino industry as opposed to being used on expenditures that service the population at large.

[3] See Madhudsudhan (1999) for more details on state casino taxation.

Following Siegel and Anders (2001), OTHER GAMES includes variables representing other gaming choices within a state. We include a variable measuring pari-mutuel tax revenues, which covers the taxation of animal racing, jai alai and the like. We also include a dummy variable for the existence of Indian gaming within a state. Because Indian casinos do not need to make their revenue reports public, we are limited to the use of indicator variables for Indian casinos. These two variables cover most remaining legal gaming options in a state, and hence should address most of the substitution possibilities for individuals.

Included under STRUCTURE is a series of dummy variables addressing the structural characteristics of a particular state's lottery. We include a variable indicating the number of years the lottery has been in existence, since it has been shown (e.g. Vasche 1985, Mikesell and Zorn 1987, Stover 1987) that the age of the lottery has an impact on lottery revenues, with increases over the first few years followed by a slow decline thereafter. Clotfelter and Cook (1989) and Stover (1990) also indicate that the existence of a 3 digit or 4 digit daily lotto game influences lottery revenues, thus a dummy variable conveying the existence of those games within a state is used. Finally, we include a variable measuring the percentage of neighboring states with lotteries. According to Alm et al (1993) and Erekson et al (1999), an increase in neighboring lotteries would reduce the attractiveness of a state's lottery to out-of-state residents, which would lead to a decline in sales and lower lottery revenues.

DEMOGRAPHICS contains four variables that describe the background of the state. We include the unemployment rate since Vasche (1985) and Mikesell (1994) have shown lottery play to increase with unemployment. Per capita income captures the amount of disposable income available to spend on the lottery. The percentage of states' constituents who are over the age of 65 is also used since the elderly are thought to spend more on lottery products. Finally, we have a variable measuring the percentage of people within a state that have at least a college degree.

State and year fixed effects, expressed in Equation 1 as δ_i and τ_t respectively, are also included. State fixed effects account for any unobservable political or demographic factors within a state over the study's time period that may influence lottery revenue, whereas year fixed effects account for any unspecified federal legislation or national business cycle fluctuations. Finally, ε_{it} is a mean-zero normal error term.

4. ECONOMETRIC CONCERNS

In estimating the impact of commercial casinos taxation on net lottery revenue, we are faced with two sample selection issues. The first involves the choice of observations. Because our interest is determining the impact of casino taxation on states with a pre-existing lottery, we limit our sample to those states that have a lottery in place. This provides us with a total of 416 observations during our twelve-year sample period.

Our second concern involves the issue of self-selection. The legalization of casino adoption is a purposeful reaction to conditions within a state, ranging from political pressure to fiscal strain. Of concern to us is the possibility that states with low lottery revenue may be more inclined to legalize commercial casinos in order to generate additional revenue. If this is true, OLS estimates using a full sample of lottery states will be biased. We therefore perform a Heckman two-step selection correction based on the estimated probability to legalize commercial casino gaming in a given year. The legalization equation is used to calculate the inverse Mills ratio, which is included into the regression as an explanatory variable.

Because to our knowledge there is no work examining the characteristics of state legalization of casinos, we model our first stage probit equation off the work of Alm et al (1993), who study the characteristics of state lottery adoption. The variables we use fall into three broad categories: gaming variables, fiscal variables, and political variables.

The gaming variables include a dummy variable indicating the presence of pari-mutuel gaming, a dummy variable indicating the presence of Indian gaming in the state, the number of Indian casinos in a state, and a measure of casino gaming in neighboring states. We include the first two measures because a state with existing gaming options may find it politically easier to legalize commercial casinos. We add the number of Indian casinos to measure the degree of competition a commercial casino would face in a state. If commercial casinos would not have sufficient market share to generate significant tax revenues, the state may decide against legalizing their presence. Our neighbor variable measures the percentage of neighboring states that have either a commercial or Indian casino. A state will likely look at neighboring states to see if external gaming options abroad are luring consumers to spend their money across state lines. Increased gaming in neighboring states will increase the probability of a state legalizing commercial casinos so that it can keep this potential revenue source in state.[4]

Our fiscal variables measure unemployment rates, per capita income levels, debt levels and federal transfers. States may view high unemployment rates as predictors of future revenue shortfalls, making them more likely to adopt a casino. Per capita income captures the amount of disposable income that would be available for gaming in the state. Since high per capita debt levels are often indicative of fiscal stress, states may be more inclined to legalize casinos in order to help alleviate their current financial difficulties. We include per capita federal transfers since federal money allows states to rely less heavily on in-state generated revenues, which would make revenue from casinos seem unnecessary. Finally, the percentages of youths (ages 5-17) and elderly (ages 65 and over) in the population are also included, since these groups tend to receive more in public services than they contribute in taxation. A state may therefore need the revenue from casino taxation to provide services to these two groups.

Lastly, we include dummy variables to indicate whether or not all branches of state government are of the same political party, since it may be easier for lawmakers to pass legislation regarding casinos if the braches are all the same party. We make the distinction between the branches being Democratic or Republican. A dummy variable indicating if it was a gubernatorial election year in the state is also included since the legalization of casinos could be an issue during an election.[5]

With this adoption specification, we generate an inverse Mills ratio. The inverse Mills ratio is then included in the regression described above as an additional explanatory variable in order to eliminate any potential selection bias.

5. RESULTS

Table 1 presents the results of our estimation. Column (1) shows ordinary least squares (OLS) estimates from our entire US sample without inclusion of the fixed effects, column (2) includes the fixed effects, column (3) provides estimations using a sub-sample of only lottery

[4] This argument is consistent with the work of Alm et al (1993), who found a positive relationship between the number of neighboring states with a lottery and a state's probability of adoption.

[5] For brevity we do not report the results of the first-stage probit, although the results are available from the authors upon request.

states, and column (4) controls for the selection issue by including the inverse Mills ratio in the estimation.

Examining columns (1) through (4), the coefficient on casino tax revenues is both negative and significant in all specifications.[6] This is consistent with the findings of Siegel and Anders (2001) as well as Elliott and Navin (2002). With these results being consistent across specifications, we are confident in saying that casino tax revenues unambiguously cannibalize lottery revenues to state funds. More importantly, as we refine our specification, the estimated negative effect increases while remaining statistically significant, which speaks to the robustness of our results. Examining column (4) in particular, the negative coefficient can be interpreted as a $1 increase in casino tax revenues is matched by a $0.56 decrease in lottery tax revenues. Figuring that roughly 35% of lottery revenues go to state funds, and assuming an average casino tax rate of 20%[7], this estimate suggests that consumers who spend $5 on casino games (thereby generating $1 in casino tax revenue) decide not to spend roughly $1.60 on lottery products. This calculation of a $1.60 decline in gross lottery sales is consistent with Elliott and Navin (2002), who had an estimated $1.38 decline.

Our other explanatory variables are consistent with the existing literature. As expected, the percentage of neighboring states with lottery programs negatively impacts net lottery revenue, as such an increase will decrease the likelihood of the state lottery attracting out-of-state participants. Consistent with Mikesell (1987), the unemployment rate is positively related to lottery revenues. Finally, the number of years a lottery has been in place also has a positive impact on revenues, indicating that a more established lottery generates higher revenue.

6. CONCLUSION

This study shows that for the period 1988-2000, state tax revenues from commercial casinos have had a negative impact on state revenues. Upon controlling for the self-selection issue surrounding the legalization of commercial casinos, we show that an additional dollar in casino tax revenue is offset by a $0.56 decline in net lottery proceeds to the state. Our estimation of cannibalization is smaller than the $0.83 decline estimated by Elliott and Navin (2002), indicating the presence of a negative sample selection bias when this selection issue is not controlled.

Despite the estimated negative effects associated with casinos, the losses reported here do not call for states to stop legalizing commercial casinos. The study does provide more information on the tax implications of casino gambling, and should be considered by politicians and voters when weighing the costs and benefits of this alternative taxation policy. On the whole, though, these results speak to the high degree of substitutability between gaming choices.

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[6] To check for sensitivity, the estimations were repeated with the dollar terms undergoing a natural logarithmic transformation, as done by Anders et al (1998) and Siegel and Anders (2001). In all cases 1 was added to the variables' value before the transformation, accounting for any zero values in the data. In almost all cases, the overall trends from Table 1 remained strong. In particular, casino tax revenues were shown to have a significant negative effect on lottery proceeds to the state.

[7] These two tax rates are estimations. The lottery rate, from Fink et al (2003) is calculated by dividing net lottery sales by total lottery sales for FY2000. The casino tax rate we used was calculated by taking the average wagering tax rate of all of the states during our sample. Moreover, this is also the rate used in Elliott and Navin (2002).

TABLE 1
OLS Results on Determinants of State Per Capita Lottery Revenue

	(1)		(2)		(3)		(4)	
	OLS		OLS		OLS		OLS	
Independent Variable								
Casino tax revenue	-0.182	**	-0.234	**	-0.474	***	-0.560	***
	(0.089)		(0.106)		(0.169)		(0.173)	
Pari-mutuel tax revenue	-0.892	*	0.781		0.841		0.900	
	(0.503)		(0.654)		(0.804)		(0.757)	
Indian gaming dummy (YES = 1)	-5.981	**	-3.152		-2.815		2.322	
	(2.798)		(3.889)		(5.584)		(5.139)	
Digits (Pick 3 & 4) gaming dummy (YES = 1)	12.483	***	1.565		-15.061	**	-12.700	**
	(3.472)		(4.883)		(6.696)		(6.449)	
Number of lotteries in US at year t	0.045		1.432		2.463	*	1.184	
	(0.491)		(1.573)		(1.359)		(1.325)	
Percentage of neighboring states with lotteries	-12.451	**	-23.913	**	-25.595		-27.015	*
	(5.028)		(12.084)		(17.36)		(16.032)	
Number of years with a state lottery	1.705	***	2.084	***	2.057	**	2.213	**
	(0.232)		(0.677)		(0.863)		(0.864)	
Percentage of population w/ at least college degree	-0.260		-1.337	*	-0.983		-0.421	
	(0.456)		(0.76)		(0.932)		(0.885)	
Percent of population 65 years or older	253.981	***	-72.107		-49.070		188.870	
	(83.066)		(197.233)		(281.454)		(269.897)	
State unemployment rate	0.073		1.628		2.815		5.451	***
	(0.97)		(1.511)		(2.078)		(2.074)	
State per capita income	0.002	***	0.002		0.000		-0.001	
	(0.001)		(0.002)		(0.003)		(0.003)	
Constant	-61.228	***	-45.383		-61.616		8.064	
	(23.423)		(38.546)		(62.313)		(57.306)	
State/year fixed effects	NO		YES		YES		YES	
Lottery states only	NO		NO		YES		YES	
Contol for Selection Issue	NO		NO		NO		YES	

standard errors in parentheses
*** significant at the 99th percent level, ** significant at the 95th percent level, and * significant at the 90th percent level

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