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Do Pennsylvania Casinos Cannibalize PA State Lottery Revenues?

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ABSTRACT

The first Pennsylvania casino opened its doors in 2006. Studies of other states, and nationally, indicate that casinos cannibalize lottery revenues as consumers substitute lottery spending for casino spending. Pennsylvania time-series data and cross-sectional data for each county suggests that higher casino wagering leads to lower lottery spending. Unlike the other studies, Pennsylvania's rate of cannibalization is relatively low where state lottery revenues decline by five to fifteen cents for each dollar of casino revenue gained. About half of the cannibalization takes place in the counties where the casino resided.

INTRODUCTION

On November 14, 2006, Pennsylvania officially became the 12th state in the country to legalize casino gambling[1]. In the first 24 months the Pennsylvania casinos had recorded a staggering $31.9 billion in total wagers from six casinos and by the end of 2009 Pennsylvania had added two more with plans to open additional casinos in the future.

Although the rapid growth of the casino industry signifies its popularity among the people and raises tax revenue for the state, the perceived tax benefits must be evaluated in light of potential losses in lottery tax revenues. Previous studies indicate that the introduction of casino gambling within a state had impact on lottery revenues; when casinos were introduced into states which already had a lottery, state lottery sales and revenues slowed. The degree of cannibalization has been estimated as high as 83% (Elliott and Navin, 2002) to a low of 10% (Walker and Jackson, 2008).

Walker and Jackson (2008) utilized both time series and cross sectional data in an attempt to show a relationship between the different forms of gambling. They broke the industry into four mains sections: casino gambling, lotteries, horse racing and dog racing. In order to assess the degree of cannibalization, they collected data prior to and after the introduction of a new game into each state. They controlled for education, income level and age. Walker and Jackson found that some games complimented each other and some were substitutes. In regards to their lottery model, they found that the lottery, dog and horse racing were compliments while the lottery and casinos were substitutes. They showed that as casino wagering increased, lottery sales decreased. Finally, they also found that the only demographic variables that were statistically significant and impacted lottery sales were the number of people less than 65 years old and tourism. Younger people tended to contribute more towards lottery sales and a decrease in tourism led to higher lottery sales.

The substitutability found by Walker and Jackson is borne out by three other studies: Siegle and Anders (2001), Elliott and Navin (2002, and Fink and Rork (2003). Siegel and Anders

(2001) found that a 10% increase in slot machines at Indian casinos in Arizona, led to a 3.8% decline in lottery revenues while the number of dog and horse tracks had a slightly positive influence on lottery revenues. Elliott and Navin (2002) examined whether or not legalizing riverboat gambling has reduced state lottery revenue. Like the previous two studies they found that for every additional dollar in revenue from state-licensed gambling casinos and pari-mutuel betting gross state lottery revenues were reduced by $.83. Fink and Rork (2003) recognize that casinos can cannibalize lottery revenues, but they believe that previous studies were flawed in that they did not fully control for the self-selection of states which allowed commercial casinos. Controlling for self-selection bias they found that for every dollar increase in casino revenues, states lottery revenues decline by $.56.

Finally, the Pennsylvania Budget and Finance Committee studied the impact of slots on Pennsylvania Lottery Sales.[2] After a strong period of growth, lottery sales started to slow after 2006 when the first casino entered the market. After a review of the data the Joint Committee contended that "no single factor, including the introduction of slots gaming can now be cited as the sole contributing factor in the leveling off and subsequent downturn that has occurred in lottery sales". (Joint Committee, p. s-4) This contention was not based on a statistical model but on casual observation of the data. They also site six possible reasons contributing to the downturn of the PA lottery (pp. 91-98):

1. Declining economic conditions and consumer confidence.
2. A slowdown in the growth of the lottery retailer network.
3. Declining Powerball sales due to low jackpots.
4. A decrease in the popularity of traditional numbers games.
5. Border state competition from Mega Millions jackpot game.
6. Higher than normal gas prices.

The Committee's observations were based on the first 28 months of casino operations with no details on how large of an impact the casinos had on lottery revenues. The questions that remain to be answered are: how much of an impact do casinos have on lotteries and will this impact benefit or harm the state's total tax revenue in the future?

GENERAL MODEL

In general, total lottery sales are a function of the expected return of the lottery, economic conditions, competition from neighboring games, and casino wagering. Since state tax revenue rather than sales is at issue lottery revenues are also examined. If operational expenses of the PA Lottery are stable, lottery revenues to the state would also be influenced by the same factors:
Total Lottery Revenues/Sales = f {Expected Return, Economic Conditions, Competition, Casinos}

If the PA Lottery is sales driven and reacts to market forces, revenues may be more responsive to some of these factors.

To examine this general model two distinctive data sets are used. The first data set examines the lottery at the state level. Monthly lottery revenues and sales are examined over several periods. The state level data not only enables us to evaluate cannibalization of lottery revenues, but also evaluate the other factors listed in the legislative report. The second data set will examine the cannibalization effect at the county level over four years.

State Level Model

At the state level two models are examined. The first model is called the "legislative model" since it examines the claims made by the legislative report. The second model is an "alternative model" which retains most of the variables from the legislative model but examines a different economic variable.

According to the PA Legislative Report (2008) total lottery sales are influenced by the Powerball Jackpot. In theory, the jackpot can be a measurement of the expected return of the lottery. A person is more likely to purchase lottery tickets as they expect the return to be higher. Oster (2004) has shown that that the higher the Powerball Jackpot (the expected return) for a given period, the higher the Powerball lottery sales will be.

The report also lists several economic conditions that may impact lottery sales: gas prices, the level of consumer sentiment, or unemployment. Since many lottery retail outlets are located in gas-type convenience businesses, lottery sales could be viewed as a complimentary good and higher gas prices would lead to lower lottery sales. As noted in the PA Legislature's report the consumer sentiment may have a positive impact on sales. Lower indexes suggest poorer economic conditions. This suggests that lottery tickets are a normal good. However, if individuals view the purchase as a means to improve their economic conditions they may choose to buy more tickets as suggest by Eadington (1976). Finally, like consumer sentiment, unemployment could have a positive or negative impact on lottery sales since it also indicates poor economic conditions. If the lottery is viewed as a normal good, we would expect a negative relationship, but if the good is an inferior good, we would expect a positive relationship. An alternative specification of the legislative model is also examined. The alternative model uses sales tax revenue in lieu of consumer sentiment and unemployment. Sales tax revenue would be a proxy for consumer spending which would embody both consumer sentiment and unemployment.

For a large portion of Pennsylvanians the lottery competes with neighboring states. The New Jersey and West Virginia casinos were in direct competition with the PA Lottery spending. Not only did the enactment of casino legislation entice gamblers back to Pennsylvania, but it also provided greater access to lottery spending at the casinos where lottery machines are placed by law near the payout windows. A proxy for lottery competition by out-of-state casinos is the number of charter buses visiting Atlantic City, N.J. Although one would expect that Atlantic City patrons come primarily from eastern Pennsylvania, it should reflect a pattern of casino activity across the state. Residents in western Pennsylvania were patrons of West Virginia, and New York casinos and we would expect a similar impact exodus and return in the western side of the state. We would expect that a drop in charters to New Jersey would increase PA lottery purchases.

County Level Model

The county level data, over a four year period, is used to examine if certain counties are more affected by casinos due to casino placement within the state. The general model for county level analysis differs slightly from the state-level model:

County Lottery Sales = f {Casinos, Economic, Competition, Demographics}

The county model is similar to the first in that the variables reflect the impact of the economy, competition and casinos on lottery sales. However, the model also includes demographic information as suggested by the literature. Fink and Rork (2003), Clotfelter and Cook (1990), Orster (2004), Walker and Jackson (2008) have typically included demographical control variables in their cross-sectional models. Among them were religious, educational and racial backgrounds, age of the population, and population. To capture the education level of each county, the % of people in each county who are 25 years or older and have at least a bachelors degree is used; the higher the education of the populace the lower the lottery sales. Different age groups have

different propensity to play the lottery. While the literature has found that older individuals are less likely to play, Pennsylvanians may be an exception. In Pennsylvania lottery revenues are dedicated to senior citizens. Seniors would be more likely to play the lottery since the net loss is much lower than for an individual who is not retired. Finally, we used the % of white people in each county to show if race played a role in lottery sales.[3]

In the county analysis new casinos are expected to compete for gambling dollars in the host county and neighboring counties. In addition to Pennsylvania casinos as a direct form of competition to the lottery, out-of-state casinos and lotteries also compete with the PA Lottery. Counties that border other states that have the Mega Million lottery or casinos are expected to lose lottery patrons compared to counties in the interior of the state.

The economic conditions of each county determined how high lottery sales would be. Two measures of economic activity were used: taxable income of the county and the level of employment. The change in economic conditions on lottery sales is less certain. As noted above, if lottery tickets are viewed as a normal good, lower income, for a given level of employment, should result in less lottery sales. However, lower income reduces discretionary spending and individuals may switch entertainment dollars to lottery tickets since the expected return has increased relative to the individual's income. In this case income would be negatively related to lottery sales for a given level of employment.[4]

EMPIRICAL MODELS AND EVIDENCE

State-Wide Model & Evidence

For the state-wide model, monthly lottery revenue was collected from the Department of Revenue Monthly Reports for the period of January, 2004 to June 2010. Lottery sales were collected from PA Budget and Finance Committee Report on the Impact of Slots on Lottery Revenue for the period November 2006 to June 2010.[5] Monthly macro data was found at the St. Louis Fed's database.

The figure below indicates a dramatic increase in casino wagering while lottery sales appear to be to be stable during the observed period. By February of 2008 casinos were operating in every region of the state. After February 2008 four more casinos were added to the Allentown, Philadelphia and Pittsburg regions. Lottery sales also show a strong seasonal pattern. Table 1 presents the annual monthly means for the key variables in the model. Economic activity as measured by the unemployment rate and consumer sentiment was high the first two years of the sample, followed by a dip due to the strong downturn as indicated by the dip in sales tax revenue. Over time charter buses to Atlantic City, New Jersey declined for the period suggesting that Atlantic City was a major gambling destination. Gas prices were cyclical and by the end of the period they were on the rise.

Empirical Analysis of Lottery Revenue 2004-2010

The legislative model and the alternative model are used to examine the impact of casinos on lottery revenues. For each model two casinos variables are separately tested: casino wagering and casino revenues. Logs of the variables were used in the empirical model with the exception of the unemployment rate.

$$\textbf{Log Real Lottery Revenue}_{(t)} = a_1 + a_2 \text{ Log RCasino Wager/Revenue}_{(t)} + a_{2a} \text{ Log RCasino Wager/Revenue}_{(t)} \text{ x Early} + a_{2b} \text{ Log RCasino Wager/Revenue}_{(t)} \text{ x Late} + a_3 \text{ Log RPowerball Jack}_{(t)} + a_4 \text{ Unemp Rate}_{(t)} / \text{Log R Sales Tax Revenue}_{(t)} + a_5 \text{ Log RMA Gas Pr}_{(t)} + a_6 \text{ Log Con Sent}_{(t)} + a_7 \text{ log NJ Chart}_{(t)} + a_{8\text{-}17} \text{ Seasonal}_{(t)} + \mu_t$$

where all variables, except the unemployment rate, are in log form in time period t. Log RCasino Wager/Revenue is the log of the real dollars wagered or the log of the casino tax revenue to the state adjusted using the CPI. Since a portion of the period includes no casinos, a one was given to those months when no wagering and revenues occurred.[6] To capture the early and later stages of casino development two interaction variables were created with the casinos variables. "Early" is a dummy variable taking on a value of one for the period from November, 2006 to February 2008; zero otherwise. This period represents the beginning stages of casinos. "Late" is a dummy taking on a value of one after February, 2008 and zero otherwise. The "Late" period represents the period where new casinos were added to metropolitan areas. These dummies were multiplied by the casino variables to capture the impact of casino gambling on lottery revenues during these periods. The coefficients on the casino variables indicate the impact of each period on lottery revenue.

Log RPowerball Jack is the log of the real average Powerball Jackpot adjusted using the CPI. The Unempl Rate is the PA unemployment rate for two of the models and Log R Sales Tax Revenue is the log of sales taxes collected by the state adjusted using the CPI. Log RMA Gas Pr is the log of real average gas price in the Mid-Atlantic region for unleaded regular gas, log Con Sent is the log of U.S. Consumer Sentiment Index, Log NJ Chart is the log of the number of charter buses visiting Atlantic City, and Seasonal are monthly dummy variables to capture seasonality of lottery revenue.

The Yule-Walker results are provided in Table 2. The coefficients on Wagering indicate that prior to the operations of casinos, lottery revenues were growing.[7] In the models that used casino wagering, lottery revenues grew .024% and .027% per month while the models that used casino revenues, lottery revenues grew between .052% and .061% per month. After the start of casino operations, the coefficients on the interaction variables indicate that lottery revenues started to decline. In the casino wagering models during the early stages of casino operations, a one percent increase in casinos wagering resulted in a decrease in lottery revenues of .025% and .028%, suggesting that casino wagering put a halt to lottery revenue growth. Once the state was covered with casinos it appears that decline continued where a one percent increase in wagering resulted in a decrease in revenues of .033% and .046% respectively. The interaction variables of the legislative model are not statistically significant, but in the alternative economic specification model both of the coefficients are significant.[8] The results are also similar when casino revenues are used. (See last two columns of Table 2.) Prior to casino operations, lottery revenues were positive, but turned negative during the period of operations.

During the later stage of development a one percent increase in casino wagering lead to a decrease in lottery revenue of .055%. In terms of impact on the treasury, assuming average monthly wagering in 2010 was $2,566 million dollars, a one percent increase in casino wagers would have lead to a drop in lottery revenues of over sixty-one thousand dollars ($61,600).[9] This increase in wagering, however, would have generated state tax revenues of $639,000. This would yield a cannibalization rate of 9.6%. Lottery revenues were almost twice as sensitive to gaming revenues as to casino wagering which suggests that playing the slots has less influence on lottery revenues than the taxes that are retained by casino spending. State gaming revenue represents money that is not returned to gamblers and has a more direct impact on lottery purchases. During the early stage of casino development, a one percent increase in casino revenues resulted in a .04% decline in lottery revenue while during the later stages the decline was .09%. For the alternative model using casino revenues the estimated cannibalization rate is slightly higher at 15.8%.

These results suggest two interesting points. First, the early stage of casinos had less of an impact on lottery revenues since a large portion of initial spending was a recapturing of casino activity that was leaving the state. Once casinos blanketed the state and new casinos were added, the new spending was from within the state resulting in a bigger impact on lottery revenues.

Second, since lottery revenues are reported after expenses, it appears that casino competition had increased lottery expenses resulting in lower revenue to the state. Annual lottery reports showed an increase in payouts to lottery winners from 52% in 2003 to 61% in 2010. (PA Lottery Annual Report) This pressure on the lottery department prompted the PA legislature to give the lottery department relief from the minimum return (30%) on lottery sales. (PA Lottery Profit Report 2010)

Two other variables were statistically significant: Powerball Jackpot, and sales tax revenues. As expected, a one percent increase in the Powerball Jackpot results in a .2% increase in lottery revenues while a one percent increase in sales tax revenues results in a one percent decrease in lottery revenue. It appears that economic activity has a greater impact on lottery revenues than casino activity.

Empirical Analysis of Lottery Sales 2006 - 2010

The entry of casinos in Pennsylvania had a similar impact on lottery sales as lottery revenues. For the period of casino operations the legislative model is examined:[10]

$$\textbf{Log Real Lottery Sales}_{(t)} = a_1 + a_2 \text{ Log RCasino Wager/Revenue}_{(t)} + a_3 \text{ Log RPowerball Jack}_{(t)} + a_4 \text{ Unemp Rate}_{(t)} + a_5 \text{ Log RMA Gas Pr}_{(t)} + a_6 \text{ Log Con Sent}_{(t)} + a_7 \text{ log NJ Chart}_{(t)} + a_{8\text{-}17} \text{ Seasonal}_{(t)} \mu_t$$

The Yule-Walker estimates for the state wide legislative model are presented in Table 3. The model explaining lottery sales is slightly better than the revenue model above. Eighty-three percent of the model explains lottery sales while only 54% of lottery revenues are explained by the model. The first column model presents the results using casino wagering and the second column presents the results using casino tax revenues.[11] The results from both models are consistent: the operations of casinos lead to a decline in lottery sales, albeit the impact was very small. The level of significance is marginal at the 10% level. A one percent increase in casino wagering leads to a decline in lottery sales by .0351%. The coefficient in the casino tax revenue model is very close to the wagering model, and is statistically significant at the 10% level. A one percent increase in state gaming revenues resulted in a decline in lottery sales of .0398%. Since the difference between wagering and gross terminal revenue, which is the basis of state casino revenues, come from the expenses and payout, it is not surprising that the coefficient is close to the wagering model. These results suggest a smaller level of cannibalization than in the revenue model. A one percent increase in wagering or revenues lead to a loss in lottery sales between $90,900 and $100,300, and an estimated loss in lottery revenues between $42,400 and $48,000. The new casinos activity would raise $639,000 in state revenue; thus resulting in a cannibalization rate between 6.6% and 7.5%.[12]

Several other factors contributed to lottery sales: Powerball Jackpot, gas prices, and the unemployment rate. As expected the Powerball Jackpot had a positive impact on sales, while gas prices and the unemployment rate had a negative impact. All three had a very small impact on lottery sales.

County Level Model Results

In the county level model, casino wagering data came from the PA Gaming Control Board. Demographic data was collected from the Census Bureau and lottery data for each county for 67 counties for 2006 through 2009 was collected from legislative reports and lottery documents resulting in 267 total observations.[13] All monetary variables were estimated in dollars.

However, since the demographic data does not change significantly over a four year period the same data was used for each year.[14]

The county-level summary means for the whole sample, no-casino counties, and casino counties are presented in Table 4. Average county lottery sales were $46.8 million, where the average lottery sales in casino counties were over twice the state-wide average. Counties that contained casinos, wagering averaged over $215 million annually in lottery sales. About 32% of the counties in the state bordered a county that contained a casino, and 43.4% of the counties bordered a neighboring state that offered the Mega Millions Lottery. Casinos were placed in counties that had a higher average income, employment, and population. Casino counties also had a larger percent of the population that was black and a larger percent of the population that held a college degree.

Based on the general model above the empirical model appears as:

$$\textbf{RLottery Sales}_{(i.t)} = b_1 + b_2 \text{RCasino Wagers}_{(i.t)} + b_3 \text{Neighbor}_{(it)} + b_4 \text{Real Economic Activity}_{(it)} + b_5 \,\%\text{ BA Over 25}_{(i)} + b_6 \,\%\text{ White}_{(i)} + b_7 \text{ SS Recpt}_{(i)} + b_4 \text{ Border Cnty}_{(i)} + b_{8(t)} \text{Pop} + b_{9\text{-}11} \text{ DumYear}_{(t)} + \mu_{it}$$

where RCasino Wagers is the amount of real casino wagering in the county i in time period t. Neighbor captures the impact of casino gambling in neighboring counties i in time period t. Neighbor is a variable that measures casino wagering of its casino neighbor. If a neighboring county did not have a casino it would receive a zero. If the county bordered a casino county, it would have the amount of wagering that occurred in that county. If a county was bordered by two casino counties, the sum of the casino wagering was used. Two models measuring economic activity were used. The first model included real Wage Income and employment of county i in time period t.[15] The second model used real average wages in county i in time period t. Border Cnty is a dummy variable that gives a county that borders a neighboring state a 1 and zero otherwise. % BA over 25 is the percentage of the population in county i that has at least a BA degree. % White is the percentage of the population in county i that is white. SS Recpt is the number of social security recipients in county i. Pop is the estimate for the county's i population in time period t, and DumYear are a set of dummy variable to denote the years 2007 through 2009.

Table 5 has the results of lottery sales at the county level models. Two models are presented: one model used two variables to denote economic activity (employment and wage income) and the other model uses average wage income.[16] After running both variations of this model, there is no major difference between the models. Both models explain about 97% of the variation in the lottery sales.

All the demographic variables are statistically significant and have the expected signs. As expected, it appears that border counties lost lottery sales to neighboring states. This loss could be due to the attraction of playing the Mega Million lottery in these states. The only control variables that were insignificant were wage income, and employment. These variables were combined and average wage was used and shown in model two, but average wage was also statistically insignificant.[17]

The impact of casinos appears to have a small negative impact on lottery sales in the county where the casinos resides, and may have had an impact in neighboring counties. For every $1000 in real casino wagering, real lottery sales in that county declines between $2.35 and $3.32. Given an average lottery tax rate of 43%, the loss in lottery tax revenues ranges from $1.01 to $1.43 per $1000 lottery sales in the county. This loss compared to the $26.50 state tax revenues gained from the $1000 of wagering suggests a cannibalization rate in the county between 3.8% and 5.4%.[18]

One of the models shows that the coefficient on the neighboring county is statistically significant; lottery sales dropped slightly when a casino was operating in the next county. The

loss in lottery sales is small compared to the home county. For every $1000 in casino wagering the neighboring county lost 37 cents in lottery sales.

CONCLUSION

With the recent introduction of legalized gambling facilities in Pennsylvania, many policymakers and officials are asking whether or not the presence of casinos in the state are directly affecting lottery sales and revenue. A legislative report on the topic did not draw any definitive conclusions. In the past, the Pennsylvania lottery has played an important role in generating tax revenue that benefits older Pennsylvanians and casinos may threaten this source of revenue. The purpose of this research was to explore, discover, and examine the extent of casinos cannibalization of lottery sales and revenues. The question was examined from two perspectives using time series state-level data and panel county-level data. The results suggest that casino wagering does cannibalize lottery revenues. However, the Pennsylvania experience is quite different from the findings of other state studies. On a state-wide basis, casino tax revenues are offset by the loss in lottery tax revenues with a cannibalization rate between 6.6% and 15.7%. These estimates are far below other state-wide studies, but are consistent with the national study by Walker and Jackson. Counties that host casinos had a drop in lottery sales and this loss of lottery sales offset casino tax revenues from 3.8% 5.4%. This is almost half of the total tax revenue loss from casino wagering in the state. The large impact of casinos within counties on local lottery revenues may be due to the size of the counties. Most of the casinos in Pennsylvania are located in high population counties and a substantial number of casino participants are likely from the county. Although these counties appear to get the brunt of the cannibalization, these locations are compensated for hosting a casino; counties receive 4% of casino terminal revenues which is approximately 12% of revenues received by the state. Thus, local host counties would receive a net revenue gain for hosting the casinos. Understanding the reasons for the relative success of the implementation of Pennsylvania casino legislation is left for future research.

ENDNOTES

[1] Technically, the law allowed only slot machines. Those that open the slot parlors advertised as casinos. This paper will use the term casinos for these operations.
[2] The slot legislation included a provision that required the PA legislature to report annual on the impact of slot gaming on lottery revenues.
[3] Economopoulos (2010) has shown that minorities are less likely to participate in legalize gambling, but did not examine specifically the lottery.
[4] Average taxable income could be used, but this would not show which aspect of the economic conditions impacts lottery sales. Including employment, independent of what one earns, reveals how much of the purchase is due to the desperate conditions of the individual. If one is employed, there is less need to find a quick fix to your circumstances.
[5] Lottery sales were not available to the author prior to 2006.
[6] Woolridge (2008) recommends this when using logs and zeros appear in the data. This effectively yields a constant for the period.
[7] First-order negative serial correlation was present and was correct using the Yule-Walker technique.

[8] When using interaction variables the standard errors are inflated due to multicollinearity. This could explain the marginal statistical insignificance of the coefficients in the casino wagering model and the statistical significance casino revenue model.
[9] This estimate is based on the monthly mean lottery revenues of $112 million.
[10] The model presented does not include an interaction variable for the later stage of development. When the interaction variable was included in the model signs and size of the coefficients do not change dramatically, but they are statistically insignificant. The insignificance is due to the small sample size multicollinearity between the variable and its interaction variable.
[11] The monthly seasonal dummies were jointly significant, but are not presented in the table. Results are available upon request.
[12] The estimate assumes that the lottery revenue rate is 46.6% which was the rate prior to casinos operation.
[13] There was missing information on Clinton County for 2009.
[14] By keeping the demographic variables the same for each year, the model is a modified fixed effect model.
[15] Wage and employment income came from the Quarterly Census of Employment and Wages. This census covers those who are working within the county during the first twelve days of the month.
[16] The t-values of the variables for both county level models were adjusted for heteroskedasicity using White's correction method. The model with the two economic variables suffers from severe multicollinearity as measured by the variance inflation factors. The major collinearity is between real wage income, employment, social security and population. The second model reduced multicollinearity by combining two of the variables that were statistically insignificant. Severe multicollinearity is still present with social security and population. However, since both the coefficients of social security and population change slightly between the models and or near are statistically significant, they do not pose a problem.
[17] The intent of dividing the economic activity variables was to separate the economic motives of the lottery purchase. Multicollinearity posed a problem and combining the variables helped minimize the impact on the standard errors.
[18] For the period while casinos were in operations the state received a 2.65% of every wager dollar in revenue, and the local government received .31%. The economic impact reports by the PA Lottery department show how much of lottery revenues are directed to the counties. The amount of moneys received by the county from the lottery may not correspond to the amount of tax revenue generated by lottery sales.

Figure 1.

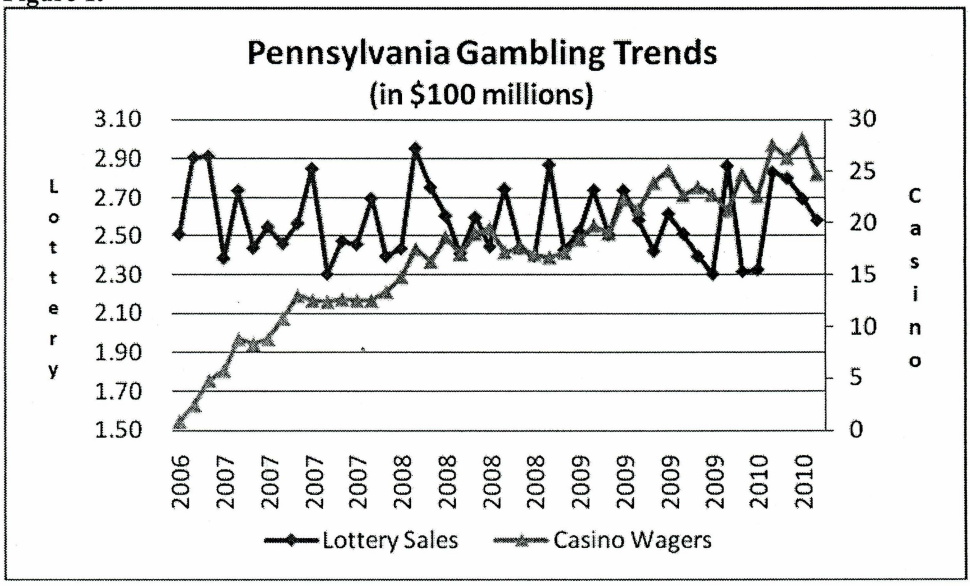

Table 1: Monthly Means of Key Time-Series Variables

Year	2004	2005	2006	2007	2008	2009	2010
Lottery Sales (mill)	na	na	258.1	256.8	258.6	255.2	259.1
Lottery Rev (mill)	97.5	108.1	120.7	136.2	122.2	123.8	112
Casino Wager (mill)	na	na	275	1,021	1,704	2,142	2,566
Casino Revenues (mill)	na	na	8.95	29.4	46.4	55.7	63.9
New Jersey Charters	23,132	20,504	17,584	17,991	16,771	14,625	13,606
Sales Tax Revenue (mill)	647.4	668.5	700.2	717.5	701.8	657.1	677.5
Consumer Sentiment	95.2	88.6	91.9	85.6	65.0	65.0	73.9
Unemployment Rate	5.5%	5.0%	4.4%	4.4%	5.2%	7.8%	8.8%
Gas Prices (per gallon)	$1.39	$1.78	$1.8	$2.27	$3.00	$1.81	$2.27

Table 2. State-wide Analysis Casinos on Real Lottery Revenues (2004-2010)

	Legislative Model	Alternative Model	Legislative Model	Alternative Model
Intercept	7.943 (2.56)**	15.974 (2.92)***	8.107 (2.43)**	16.06 (2.94)***
Log of Casino Wagering (Pre Casinos)	0.021 (1.69)*	0.027 (2.33)**		
Log of Casino Wager x Early Dummy	-0.038 (-1.24)	-0.052 (-1.76)***		
Log of Casino Wager x Late Dummy	-0.051 (-1.35)	-0.082 (-2.68)**		
Log of Casino Revenue (Pre Casinos)			0.052 (1.8)*	0.062 (2.33)**
Log of Casino Revenue x Early Dummy			-0.084 (-1.4)	-0.102 (-1.83)*
Log of Casino Revenue x Late Dummy			-0.107 (-1.5)	-0.152 (-2.66)**
Log of Powerball Jackpot	0.194 (4.37)***	0.202 (4.52)***	0.191 (4.17)***	0.203 (4.54)***
Log of Gas Prices	0.012 (0.09)	0.056 (0.46)	0.014 (0.1)	0.059 (0.48)
Unemployment rate	-0.018 (-0.52)		-0.015 (-0.39)	
Log of Sales Tax Revenue		-0.986 (-1.68)***		-1.005 (-1.71)*
Log of Consumer Sentiment	0.178 (0.53)		0.144 (0.41)	
Log of N.J. Charters	-0.207 (-0.63)	-0.066 (-0.21)	-0.207 (-0.6)	-0.077 (-0.23)
R2	0.54	0.56	0.54	0.56
DW	2.23	2.13	2.23	2.13
N	78	78	78	78

***, **, * denotes significance at the 1%, 5%, 10% levels.

Table 3: State Wide Analysis of Casinos on Log Real Lottery Sales – Legislative Model (2006-2010)

Variable	Model 1 Lottery Sales	Model 2 Lottery Sales
Intercept	8.086 (6.01)***	7.96 (6.20)***
Log Casino Wagering	-0.0351 (-1.91)*	
Log Casino Revenues		-0.0398 (-2.00)**
Log Powerball Jackpot	0.089 (5.54)***	0.089 (5.56)***
Log MA Gas Prices	-0.055 (-1.85)*	.-0.55 (-1.88)*
Log Unemployment Rate	-0.016 (-2.22)**	-0.016 (-2.27)**
Log Consumer Sentiment	0.025 (0.51)	0.025 (0.51)
Log NJ Charters	-0.098 (-0.74)	-0.095 (-0.73)
N	44	44
Durbin Watson	2.12	2.13
Adjusted R-Square	.84	.83

***, **, * denotes significance at the 1%, 5%, 10% levels.

Table 4. County Level Data for 2006-2009

Variable	Means Total Sample	Means Non-Casino Counties	Means Casino Counties
Lottery Sales (millions)	46.8	41.7	100.6
Casino Wagering (millions)	215.8	0	215.8
Counties Neighboring Casinos	31.8%	na	na
Average Income per employee	$35,495	$34,986	$40,892
Total County Income	$3,732,910	$3,360,148	$7,687,434
Employment	86,056	77,492	176,909
Border Counties	43.4%	na	na
% of Population White	93.4%	93.8%	88.5%
% of Population with College Degree	17.0%	16.4%	23.2%
Social Security Recipients	36,496	32,6284	76,934
Population	185,648	165,869	395,482

Table 5: County Level Analysis of Casino Wagering on Real Lottery Sales

Variable	**Wager Model[a]**	**Wager Model[a]**
Intercept	79921896 (6.40)***	85269073 (6.52)***
Real Casino Wagers	-0.00332 (-3.19)**	-0.00235 (-2.48)**
Neighbor	-0.00037 (-1.66)*	-0.00022 (-0.86)
White	-749195 (-5.96)***	-757178 (-5.95)*
Real Wage Income	0.025 (0.02)	
Employment	-40.36 (-0.80)	
Real Average Wage		-264.1 (-1.35)
% of Population with BA	-693895 (-6.64)***	-716745 (-7.11)***
SS Recipient	627.2 (5.72)***	572.7 (7.54)***
Border County	-2810671 (-4.45)***	-2255711 (-3.68)***
Population	35.82 (1.66)*	26.88 (1.52)
N	**267**	267
Adjusted R-Squared	**.978**	**.977**

***, **, * denotes significance at the 1%, 5%, 10% levels.

a- t-statistics are corrected for heteroscedasticity.

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