Examining the Impact of Competition on Casino Revenues and Prices in the Mid-Atlantic States

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Introduction

Since 1963, when New Hampshire enacted the first lottery legislation, states have been rushing to tap into the new source of tax revenues. The first wave of legislation by states was to enact state-run lotteries, with the exception of New Jersey, which also allowed casinos in Atlantic City.[1] In 1988, Congress passed the Indian Gaming Act, which allowed commercial gambling on Indian reservations. As public opinion and attitudes towards gambling changed, more and more states started to deregulate the industry and compete with their neighbors by allowing various forms of casino-type games in search of tax revenues.

Several studies have examined the effects of competition within a state, between two states, or within the industry, but few studies have examined the impact of competition for casino revenues from a regional perspective and the impact it has on the prices paid by casino patrons. By examining both issues states will be able to better estimate the impact of their expansion decisions on tax revenues from casino expansion. Furthermore, the analysis should reveal if competition has any benefits to casino patrons as standard theory would argue.

The Mid-Atlantic States is an excellent region in which to study competition in the casino market.[2] New Jersey was the lone state with casinos in that region for close to two decades. Then a wave of legalization came in the mid 1990's when Delaware (1996) and West Virginia (1997) loosened restrictions on gambling after the recession of 1992. They limited gaming to slot-type activities. The second wave occurred in the next decade when New York (2004) entered the market with Pennsylvania (2007) and Maryland (2010) close behind. The initial laws in these three states also limited gaming to slot-type activities. Competition among the states for casino revenues intensified as the third wave started after Maryland's entry; some states broadened their gaming offerings to include table games and allowed casinos in new locations in their quest to maintain and increase revenues. As one popular blogger noted, New York's lack of table games has put the state at a competitive disadvantage:

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[1] Prior to 1963 the only state that allowed casinos was Las Vegas. However, some states allowed civic organizations to offer bingo and other games of chance to raise money while others allowed horse and dog racing. After 1963, the states or tribes received tax revenues or ran gaming activities.

[2] For the purpose of this study the Mid-Atlantic States include Delaware, Maryland, New Jersey, New York, Pennsylvania, and West Virginia.

> "Is New York losing out on the gambling gold rush? Supporters of an amendment to expand casino gambling certainly think so. And they're framing their campaign to push voters on the issue by saying the Empire State is losing at least one billion dollars to full-blown casinos in other states." (State of Politics, 2013)

The impact of this intense level of competition among the states can be captured by the application of spatial econometric analysis. Spatial econometric analysis captures the interdependence of casino revenues among the geographic regions and estimates spillover effects from changes in explanatory variables within states as well as among the states. Thus, the amount of cannibalization between states from the expansion of casinos in the Mid-Atlantic States can be estimated. In addition to this unique modeling of casino revenues, data from two states (Pennsylvania and New Jersey) will allow the examination of the prices paid by patrons during this period of expansion.

Review of the Literature

The casino competition literature has generally focused its attention in two areas: competition among the states and competition within the industry from new entry. Only a few authors have examined competition and pricing.

Competition among States and within Industry

The earliest studies by Nichols (1998) and Atkins, Nichols, and Olsen (2000) illustrated the competition between Iowa and Illinois for gambling tax revenues. Iowa was the first to allow riverboat gambling in 1992.[3] Illinois observed Iowa's tax revenue windfall and quickly enacted its own version of riverboat gambling to compete for casino dollars. The decline in attendance and tax revenues in Iowa prompted Iowa lawmakers to relax some of their regulations to regain some of the gamblers from Illinois that Iowa had lost and to attract new Iowans to the market. (Nichols, 1998)

Walker and Jackson (2008), McGowan (2009), and Condliffe (2012) examined competition among the states. While Walker and Jackson's main focus was to explore the cannibalization within the gambling industry, they also studied the impact of gambling in neighboring states on the industry. Examining the U.S. market between 1985 and 2000, they found neighboring states with gambling do have a negative impact on the casinos within a state, but this impact appears to be slight. Walker and Jackson used the percent of neighboring states having a competing industry as a means of assessing interstate competition where "neighboring state" is defined as any state that is adjacent to it. Given that states are geographically fixed, the two neighboring states of Florida individually will have a bigger impact on Florida's casinos than anyone of the seven neighboring states of Colorado on Colorado's casinos. McGowan and Condliffe examined states in the Mid-Atlantic region. McGowan did an early analysis of the impact of Pennsylvania's entry into the casino industry on Atlantic City's casinos as well as the Atlantic City-Philadelphia casino market. McGowan forecasted Atlantic City casino revenues in 2007 based on 2000-2006 data using a simple trend model of seasonal data. His finding suggested that Atlantic City lost over $110 million dollars, but the overall Atlantic City-Philadelphia market grew by over $460 million. While McGowan did not include Delaware's influence in the adjustment of Philadelphia's casino revenues, Condliffe did. Condliffe extended the analysis to include three more years of data and examined three more specifications of the McGowan model,

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[3] Delaware in 1994 allowed video lottery machines at racetracks (which are commonly called racinos), but state competition for the revenues did not start until ten years later. For eight of the ten years, neighboring Pennsylvania had a Republican Governor who did not support the expansion of gaming in the state.

specifications which included other regressors. Examining aggregate casino revenue for the region, Condliffe found that the addition of casinos in Pennsylvania led to a slight decline in regional gambling spending of $1,262 per month.[4] The implication of Condliffe' s findings is that competition may have increased Pennsylvania casino revenues, but the loss in neighboring gambling revenues was greater than Pennsylvania's gain. This loss, however, was relatively small – less than .01% of mean monthly revenues.

Ali and Thalheimer (2003), Hunter (2010), and Walker and Nesbit (2014) examined the impact of new casino entry on existing casinos. Ali and Thalheimer found that a new casino (commercial or tribal) in the Missouri-Iowa-Illinois region had a relatively small negative impact on competing casinos; the decline in the slot handle was approximately 3%. Hunter's analysis showed a more significant impact on the market. His analysis of 100 casinos across the country over a fourteen-year period indicated that adding a casino next door (within three miles of an existing casino) helped existing casinos' aggregate gross revenue (AGR) by an average of $14 million, while adding a casino outside the three-mile radius hurt existing casinos' AGR by as much as $15 million on average. It appears that next-door casinos benefit existing casinos by helping to create gaming "destinations" is capturing the gaming destination strategies of Las Vegas and Atlantic City. Walker and Nesbit used a spatial competition model to estimate the impact of a casino in the Missouri market. The spatial model captures both the direct effects of competition as well as feedback effects from the change in competition. In general they found that a one percent increase in neighboring casinos' AGR leads to a .116 percent decline in a casino's AGR, holding slots and table games constant.[5] However, when neighboring casinos increase both slots and table games, there is a slightly bigger impact after the market adjusts. A one percent increase in slots and tables causes a .136 percent decline in casino's revenue.

Competition and Prices

Kilby *et al.* (2005) and Siu (2011) have explored the issue of price competition from two perspectives. Kilby *et al.* approached the issue of pricing from a practical operational management perspective while Siu developed a theoretical foundation for casino prices. Kilby *et al.* note that, from a practical standpoint, a change in the minimum bet is a means of managing "price" and is easier to adjust when there is excess demand or supply. Siu combines Kilby *et al.*'s practical with the theoretical. According to Siu, the price is determined by the interaction between suppliers (the casino) and demanders (the patrons). The casino's view of price is composed of two parts: the theoretical price of the game and the minimum bet. Siu writes, "The theoretical price of a game by itself merely represents a desired positive expected return after taking into consideration the rules of the game…" (p. 268). This expected return is called "the house's advantage of the game," and is realized over an extended period of time. For certain games, such as slot machines, the house advantage can be modified, but a casino's adjustment is limited in some cases by state minimum payout regulations. Thus, Sui argues that a measurement of price for a single game is the house advantage times the weighted average of the minimum bets (p.275).

The patron's view of price is not only based on the house advantage, but also based on "tradition," a term that encompasses the perceived fairness of the game as well as the patron's valuation of the gambling experience. Siu categorizes patrons into two groups according to experience: those that look at the gambling experience as a form of leisure, and those at that are concerned about potential losses. For the former type of patrons,

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4 Condliffe's models most complete model included Pennsylvania and Delaware casino data as regressors. It is not clear why N.J. casino regressors were omitted.

5 The estimates are provided by the authors. This first relationship is called the spatial autoregressive coefficient, and the second is the total average impact from a change in the two variables.

the act of playing has entertainment value, may plan on an expected payout of zero, expecting to win nothing. The limiting "pricing" factor for these patrons is the minimum bet, and this limit is only binding to patrons if the perceived available minimum bet does not produce entertainment value equal to the alternative leisure activities. Thus, as Kilby suggested, in the event that demand exceeds supply, the minimum bet can increase to ration patrons. Ex post, the patrons' experience at a casino may impact subsequent estimates of expected payouts and decisions to go there in the future.

Other patrons who are interested in gambling will include the expected payout as a consideration in their decision calculus, according to Siu. These patrons are more price-sensitive and are looking for a "better deal." They are willing to play for longer periods to gain an advantage (Siu, 2011, p. 270). Thus, the house advantage is critical to those patrons' demand for casino services.

Siu's price theory approach suggests that the market price for casino gambling will differ based on the degree of competition the casino faces. Local monopolies would have some price leverage, and, as long as there is excess capacity, the house advantage could be high with low bet minimums. Entry of new casinos into the market reduces transportation costs and will lower demand for existing casinos. Theory suggests that casinos will start to compete through different means: direct changes in price as well as indirect changes such as offering promotions. These promotions can be in several forms: sweepstakes, room deals, slot dollars, and free plays.

The Mid-Atlantic Casino Market: Evidence and Analysis

To better understand the degree of competition in the Mid-Atlantic States an overview of the data is given. The spending trends in the region and among the states show the intensity of the competition in the region. Following the overview, a spatial analysis for the region is presented. The spatial analysis will rigorously examine the impact of casino expansion on state and regional casino revenues (hereafter called adjusted gross revenues, or AGR). Finally, an analysis of price competition in Pennsylvania and New Jersey is presented. Both states provide data on wagers, payouts, and promotions. As competition increases in the region we would expect the "price" for gaming to decrease.

Overview of Mid-Atlantic Casino Market

Data on the Mid-Atlantic States were collected from state agencies. Adjusted gross revenues (AGR) is the money "left on the table", and is estimated by the total amount of wagering less the payouts to the patrons. As can be seen in Figure 1, AGR in the region grew from $4 billion to over $10 billion between 1997 and 2012, while the number of casinos increased from slightly under 20 to over 50 by 2012.[6] While casino spending grew, the number of casinos grew at a faster rate. Between 2006 and 2012 casinos grew 58.3%, while casino spending grew only 33.6%, resulting in a drop in the AGR per casino from $226 million to $177 million. This suggests that the increased access opened opportunities to patrons to participate and may have accomplished state objectives of capturing out-of-state casino spending. However, it appears that the expansion has also lowered market share per casino.

[6] A casino is defined in the traditional sense as a stand-alone facility. West Virginia is the only state that allows slots machine on a small scale. These locations were not included in the casino count. However, to make a comparison between states, a proxy was used for the number of casinos in West Virginia. This proxy was based on the average slots per casino in the region. Thus, WV had about 4 additional "casinos" operating in the state by 2012.

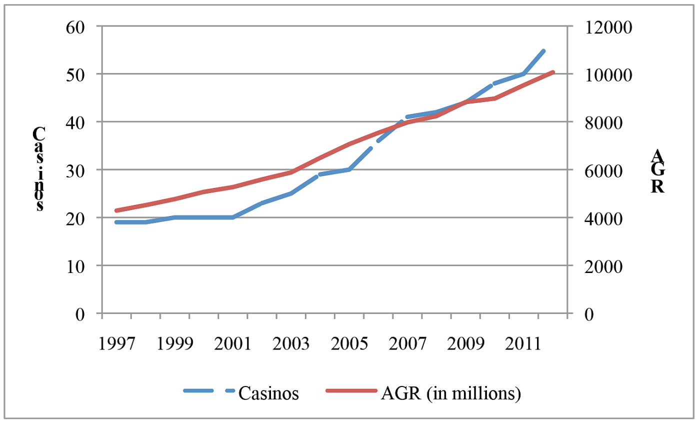

Figure 1. Trends in Casinos and Adjusted Gross Revenue in the Mid-Atlantic Region

An overview of interstate casino competition can be seen in Figure 2, where the percentage of AGR relative to state income each year from 1997 to 2012 is presented. In West Virginia, AGR is more important to the state economy than in the other states and had significant growth up until 2007. This growth is due in part to the lack of competition among its neighboring states. Once Pennsylvania (2007) and Maryland (2010) entered the market, there was a noticeable downturn. New Jersey, which was fully operating eleven casinos in 1997, saw a constant decline over the period. From 1997 to 2002, the decline could be attributed to Delaware (1996) and West Virginia (1997) entering the market. Between 2003 and 2007 casino AGR appeared to stabilize. After 2007 when New York and Pennsylvania entered the market both New Jersey and Delaware showed a sharp decline. While Pennsylvania can be identified as a possible cause for the decline in other states, it appears that Maryland's entry into the market may have slowed Pennsylvania's trend.

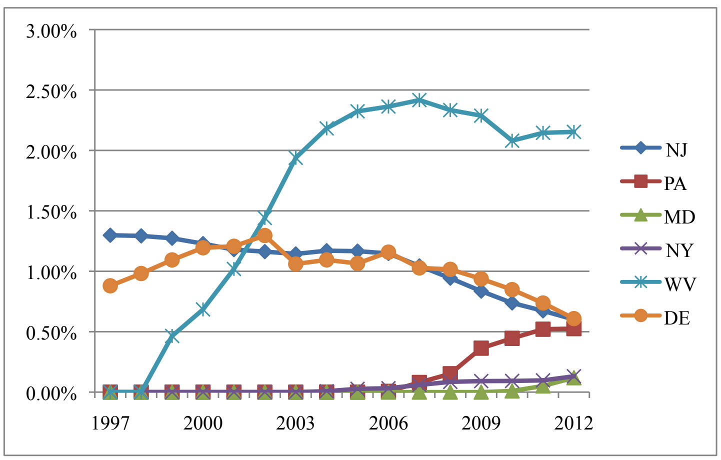

Figure 2. AGR as a Percentage of Gross State Product

Spatial Empirical Model of Interstate Casino Competition

Spatial Autoregressive Model

Given the nature of the data, a spatial autoregressive regression model (SAR) is used to identify the impact of competition among the states.[7] The SAR model takes the general matrix form:

[7] For an overview of SAR models see Le Sage and Pace, and Elhorst in the Handbook of Applied Spatial Analysis (2010).

$$Y = \lambda WY + X\beta + \mu \qquad (1)$$

where Y is a n x 1 vector, W is an n x n weighted matrix of neighboring states, X is an n x r matrix of exogenous variables, β is an r x1 vector of the estimated parameters, and λ is a scalar estimated parameter. Spatial regression models account for the spatial dependence among the observations, and is denoted by the "spatially lagged" dependent variable (WY). The spatially lagged dependent variable is a weighted dependent variable of the neighboring states with the matrix W as the set of weights. The weights can be as simple as equal weights of contiguous states. (In this study the weights are based on distances between casinos of different states and will be developed below.) The value of this model is the inclusion of the spatially lagged dependent variable that captures both direct impacts of neighboring states as well as indirect impact on neighboring states. For this study spatial dependence implies that a change in the adjusted gross real revenue (AGRR) of neighboring states would have an impact on an observe state's AGRR. If there is spatial dependence, there are significant implications when considering a change in the r^{th} explanatory variable (X_r). A change in X_r in a state not only has a direct impact on a state's AGRR, it will also have an indirect impact on the AGRR of its neighbor's. As noted by Le Sage and Pace, "this is, of course, the logical consequence of our simultaneous spatial dependence model. A change in the characteristics of neighboring regions can set in motion changes in the dependent variable that will impact the dependent variable in neighboring regions. These impacts will continue to diffuse through the system of regions." (Le Sage and Pace, 2009, p. 369).

The direct and indirect impacts can be illustrated by estimating the predictions from equation (1):

$$E(AGRR) = W_m X\beta, \qquad (2)$$

where $W_m = (I- \lambda W)^{-1} = I + \lambda W + \lambda^2W^2 + \lambda^3W^3 + \ldots$ W_m is commonly called the multiplier matrix. The impact of a change in X_r is no longer β, but it is much more complicated as noted above: a change in X_r within a particular state will have a direct impact on the state's casino AGRR, but it also includes spillover effects on the neighboring state (W), as well as neighbors spilling over to neighbors (W^2) and so on.

For a λ not equal to zero, the expected AGRR in each state for K variables, given six regional states, can be derived from equation (2) for a change in X_r:

$$E\begin{bmatrix} AGRR1 \\ AGRR2 \\ . \\ AGRR6 \end{bmatrix} = \sum_{r=1}^{k} \begin{bmatrix} Wm11 & \cdots & Wm16 \\ \vdots & \ddots & \vdots \\ Wm61 & \cdots & Wm66 \end{bmatrix} \begin{bmatrix} Xr1 \\ Xr2 \\ . \\ Xr6 \end{bmatrix} \beta_r \qquad (3)$$

$\beta_r\, Wmii$ is the direct impact from a change in X_r of the i^{th} state while $\beta_r\, Wmji$ are the indirect impacts on neighboring state j from a change in X_r from the i^{th} state, and the matrix elements include higher-order neighboring relationships.[8]

The coefficient λ is a scalar parameter that determines the average strength of association among the states, and is known as the spatial autoregressive coefficient which has a value between -1 and +1. Similar to the autocorrelation coefficient in a time series model, the closer the (absolute) value is to 1, the greater the feedback and persistence among the states in the region. Statistical tests of λ provide evidence of the presence of spatial correlation. A negative sign indicates that casinos in neighboring states are substitutes and compete with one another. A positive sign indicates that casinos in neighboring states are complements and support one another in their development. An estimated λ of 0 indicates that there is no global spatial dependence.

8 The value of W^m_{ii} does not necessarily have a value of 1. This is due to "feedback loops". (Le Sage and Pace 2009, p.35) Region i is a neighbor to state, and a change within a state will impact the neighboring state, and the neighbor's adjustments will have a residual, feedback impact on region i.

Since each state has a unique outcome from a change in X, LeSage and Pace (2009) formally define the Average Direct Impacts (ADI) from a change in X as $[\sum Wm_{ii} /n]*\beta_r$ and the Average Total Impact (ATI) as the sum of the i^{th} column $(\sum Wm_{ii}/n)*\beta_r$ $(i\neq j)$ as a means of interpreting the impacts on Y.[9] The difference between ATI and ADI is the Average Indirect Impact which measures the spatial spillovers falling on other regions.

Empirical Model

Panel data were gathered from six state casino regulatory bodies, the Federal Reserve Bank of St. Louis, and the U.S. Census, producing seventy-four observations between 1997 and 2012. Given some slight differences in state reports, estimates were made for a few states; a detailed discussion of the data and variables are given in the Appendix. All nominal variables were adjusted using the state's GSP price index to reflect real dollars. Since states are interested in tax revenues from gaming, real AGR is used as the dependent variable. Two models were examined: a linear model and a log model. The first model examined is:

$$AGRR_{it} = \beta_o + \beta_1\ RGSP_{it} + \beta_2\ Tables_{it} + \beta_3\ Neighbor\ Slots_{it} + \beta_4\ Access_{it} + \beta_5\ Access^2_{it} + \beta_6\ Casinos_{it}\ (+\ \beta_{7a}\ PreDE_{it}\ ) + \beta_{7b}\ DE_{it}\ (+\ \beta_{8a}\ PreWV_{it}\ ) + \beta_{8b}\ WV_{it} + \beta_9\ MD_{it} + \beta_{10}\ NY_{it} + (\beta_{11}\ PreNJ_{it}\ ) + \beta_{12}\ PA_{it} + \lambda\ (\lambda_2)WAGRR_{jt} + \mu_{it}.$$

And the second model is:

$$LAGRR_{it} = \alpha_o + \alpha_1\ LRGSP_{it} + \alpha_2\ Tables_{it} + \alpha_3\ LNeighbor\ Slots_{it} + \alpha_4\ LAccess_{it} + \alpha_5\ LCasinos_{it} + \alpha_{6a}\ PreDE_{it} + \alpha_6\ DE_{it} + \alpha_{7a}\ PreWV_{it} + \alpha_7\ WV_{it} + \alpha_8\ MD_{it} + \alpha_9\ NY_{it} + \alpha_{11}\ PreNJ_{it} + \alpha_{12}\ PA_{it} + \varphi WLAGRR_{jt} + \varepsilon_{it},$$

where the "L" before the variable indicates the log of the variable. AGRR is the adjusted gross real revenue from the gaming activity; i.e. wagers played by gamblers less payouts to gamblers. RGSP is the state's real gross state product. Table is a dummy variable indicating if state i allowed table games in its casinos in period t. Neighbor Slots is the number of slot machines that bordered state i when the state had gaming in time period t.[10] Access is the number of slots divided by the population density of the county in which the casino resides and in contiguous counties in period t.[11] Casinos is the number of casinos operating in state i in time period t.[12] State dummies are also included with New Jersey representing the benchmark state. For the established states a pre-competition dummy was used to distinguish the two periods. These states are New Jersey, Delaware, and West Virginia.

$WAGRR_j$ is called the spatially autoregressive (lag) variable. It is a weighted average of the real AGR of neighboring states. States closer to each other are more likely to have greater interdependence than states further away. There were three steps in constructing the weights within the matrix. First, distances were estimated between casinos among the states. In the event that there were several potential pairs of casinos between states, the closest distance was used. If a state did not have a casino the distance was from the largest population center to the casino. Second, the inverse of the distance was used. Casinos closer together will have greater impact than those further away. Finally, each neighboring state (j) was assigned a "closeness" percentage by dividing each state's

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[9] Since the Wm matrix is row normalize to equal one, the sum of the row would be a weighted average.

[10] Pennsylvania was broken into 3 regions (East, Central, and West) and the number of slots in each region was used to calculate the neighboring state's slots. Ohio was also used as a border state

[11] Population density was constructed by interpolating the 2000 and 2010 population density estimates assuming constant growth during the period.

[12] West Virginia had a unique model of gaming. They allowed between 5-10 VLT at various venues in the state, and the wins were included in the total wins of the state. A casino equivalent was use by dividing the number of non-casino LVTs by the average LVT's at WV casinos.

inverse distance by the total among the neighbors for a given period.[13] Thus, for an individual state in time period t, the spatial autoregressive variable is

$$WAGRR_{it} = \sum[\text{Inverse Dist}_{jt} / \sum \text{Inverse Dist}_{jt}] \text{x } AGRR_{jt} \text{ for all } j \neq i. \quad (4)$$

Since casinos could enter and exit, the weights could change in different periods. When a casino enters, and it is closer to a neighboring state than an existing casino, the distance is recalibrated and the weights for the period are recalculated.[14]

Expected Hypotheses and Results

The hypotheses are based on the previous literature on the casino market. AGRR in a state's industry should increase with the state's real gross state product, with the addition of table games to the list of gaming activities, and with the increase in the number of casinos. The number of neighboring slot machines[15] should directly compete with another states gaming activity, and result in a decline in AGRR. Access is the ratio of the number of slots in a given state at time period t relative to the average population density of the state casino market. The more slots machines that are available, the greater the potential for gamblers to play and AGRR to grow. However, slot growth should result in a slowdown in AGRR as the market becomes saturated. Finally, the spatial autoregressive coefficient is expected to be negative. Kao and Bera (2013) noted that in the spatial econometrics literature, where there is spatial competition among the regions, the autoregressive coefficient is negative.[16]

The results of the GMM regressions with adjusted Newey-West standard errors are presented in Table 1.[17] The statistical significance of the spatial coefficient will be used to determine regional interdependence. Once regional interdependence is known, an analysis of the coefficients will follow.

Each model explains at least 97% of the variation in adjusted gross real revenues and the signs are as expected. In the level models, all non-state dummy variables are significant at least at the 10% level of significance. The interpretations of the coefficients are based on the autoregressive coefficient of the weighted dependent variable (WAGRR). The statistically significant negative sign is consistent with other research in which there is competition among jurisdictions.[18] This statistical dependence filters throughout the model as noted in equation 3, and a change in one of the X's will lead to adjustments throughout the region. The signs in the table are indicative of the relationship, but the impact of each variable has to be evaluated based on the interactions among the states. These interactions can be divided into total, direct and indirect. Given the relative geographic locations of the states, the direct and indirect impacts differ. A state like Pennsylvania, surrounded by neighbors with legal casinos, is likely to have larger feedback effects and spillover effects. As noted above, estimates of the average, total, direct, and indirect can be used to analyze regional impacts. Table 2 provides the total, direct, and indirect average impacts along with the range of individual impacts for

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13 In the case of the paring of Pennsylvania and Maryland when they both had no casinos, the intermediate calculation was not made and a zero was assigned in the final matrix.

14 There are various weighting schemes that could be used. The distance between casinos seemed to be most appropriate to identify the degree of competition.

15 Video lottery terminals are considered in this study as equivalent to slot machines.

16 According to Koa and Bera spatial cooperation among regions typically yields a positive autoregressive coefficient.

17 OLS estimation of spatially dependent regions yields inconsistent and inefficient estimators. GMM is one method suggested when the model includes spatial interactions. GMM does not rely on the assumption of normality of the errors (Elhorst, 2010). Tests on the residuals from the GMM regressions with state dummy variables indicated that there was no heteroscedasticity, but serial correlation was present. Newey-West adjusted standard errors were computed to produce valid t-statistics.

18 This estimate is twice as large as the Walker and Nesbit estimate. This larger estimate indicates that the competition among the states was stronger than within the states.

the Mid-Atlantic casino market in 2010 for a spatial autoregressive coefficient of -0.36.[19]

Table 1

Spatial Competition Model of AGRR in the Mid-Atlantic States 1997-2013

	Model 1	t-stat	Sig	Model 2	t-stat	Sig	Log	t-stat	Sig
Intercept	-6455.82	-0.01		-6011753	-1.38		-25.34	-2.11	**
RGSP (in 000's)	0.0034	1.91	*	0.0048	2.44	**	1.98	3.20	***
Table	346028	4.19	***	356848	4.13	***	0.060	0.47	
Neighbor Slots	-19.16	-7.07	***	-15.90	-6.42	***	0.013	0.70	
Access	62507	2.33	**	79510	4.29	***	0.268	3.21	***
Access Sq	-3088.05	-1.78	*	-3574.49	-2.77	***			
Casinos	113622	8.23	***	115894	9.70	***	2.37	13.8	***
DE -Pre Comp	-41089	-0.77					0.313	2.52	**
DE	774613	2.05	**	1090414	2.75	***	5.42	6.08	***
WV - Pre Comp	-121849	-1.16					0.491	2.62	**
WV	-66585	-0.16	**	351826	0.85		4.11	4.37	***
MD	754402	3.36	***	785933	3.74	***	2.10	4.65	***
NY	-845299	-2.26	**	-1070699	-2.40	**	-0.444	-0.64	
NJ - Pre Comp	-169399	-2.67	***				-0.253	-1.69	*
PA	581536	3.10	***	-560333	-2.91		0.345	1.16	
WAGRR	-0.35	-2.83	***	-0.36	-3.73	***	-0.38	-4.03	***
N	74			74			74		
Adjusted r-square	97.6%			97.9%			98.0%		

Note. Dependent variable AGRR is in thousands of dollars. *** significant at the 1% level, ** significant at the 5% level, * 10% significant at the level.

Table 2

Weighted Matrix (W_m) Multipliers in 2010

Impacts	Average	Maximum	Minimum
Total	0.735	0.737 (WV)	0.730 (MD)
Direct	1.027	1.051 (PA)	1.002 (NY)
Indirect	-0.292	-0.315 (PA)	-0.273 (NY)

Note: The multiplier is based on the spatial autocorrelation coefficient (λ) of -0.36.

The average direct impact from a change in the exogenous variables is 1.027 times the coefficient. Based on the spatial lag coefficient, the average total impact on AGRR from the change in X is 0.735. From these two estimates, the average indirect impact due to competition among the states is -0.292. The state that had the largest direct impact was Pennsylvania, while the state that had the smallest impact was New York.

These direct and indirect impacts can be used to estimate the degree of casino competition among the states. When a state opens a new casino, on average, AGRR increases between $116.7 (1.027 x $113.6) and $119.0 (1.027 x 115.9) million in the state. However, neighboring states should expect to lose on average between $33.2 (0.297 x $113.6) and $33.8 (0.297 x $115.9) million AGRR. This loss is due to the recapture of patrons that were playing in another state as well as capturing some patrons from the neighboring state.[20] The net regional gain in AGRR is between $83.5 and 85.2 million.

[19] Given that the weighted matrix was row standardized such that the sum of the weights equals one for each state, the Average Total Impact will be the same for all states and is equal to $1/(1-\lambda)$. The diagonal elements of the weighted matrix represent the direct impact. The indirect average impact is the difference and represents the sum of all later adjustments by neighboring states.

[20] In this model, location of the new casino is embodied within the weighted matrix, and the autoregressive coefficient reflects the changes of locations over time.

In a given state, if the neighboring states increase slot machines by one, the expected AGRR, on average, will drop between $16,329 and $19,670. However, the slot increase in the neighboring states would improve their AGRR between $4,643 and $5,595, resulting in a net loss in gaming revenue for the region of between $11,687 and $14,083.[21] Base on the two factors discussed, if a state opened a new casino with 2,100 slot machines, the regional neighbors are likely to lose about $33 million AGRR due to the expansion and $27 million AGRR from play of the slots at the new casino for a total loss of $60 million.

To account for saturation of the gambling market at a particular location, the variable Access was included in the model. As expected, there is a positive increase in AGRR as the number of slots available in a given area (Access increases, but the increase in AGRR slows as more slots are added to the particular location. Evaluated at the sample mean, as slot density increases by one unit in a state, AGRR increases between $28 and $38 million in the state, but regionally the total casino AGRR increases by only $20 to $28 million after considering regional losses.[22] Given the locational densities of sample, the number of slots within the average state could double before AGRR is maximized.

Finally, the presence of table games (represented by the dummy variable Table) has a significant impact on casino revenues. When a state introduced table games, it received about $360 million in additional AGRR on average. For the region, the net revenue was $257 million; over $100 million less due to the loss in revenues in neighboring states.

The control variable, Real Gross State Product, is significant and has the expected sign. A one million dollar increase in a state's real gross state product will result, on average, in an increase between $3,490 and $4,930 in AGRR depending on the model used. Note that the higher real income within the state gets an added boost from its interaction with its neighbors. The within-state activity will impact the neighboring states' economic activity, which in turn will result in a slight positive average feedback of about 2.7%. However, the real GSP increase of $1 million will also cause AGRR to drop in neighboring states between $990 and $1,400 because of individuals staying within the state. Thus the results suggest that the net increase in AGRR (ie: the total impact) in the region was between $2,500 to $3,530.

In the log model, it appears that casino revenues are highly elastic within the state: a 1% change in real GSP leads to a direct change in AGRR of 2.03% (1.98 x 1.027). The indirect impacts are less elastic with a .57% decline in AGRR. A one percent increase in casinos within the state will raise revenues by 2.43%, but will lower neighboring states' AGRR by .19%. The statistical significance on Access suggests that the growth in slots in a given market is inelastic. A one percent increase will lead to a .27% increase in AGRR, and a net regional increase of only .19%. The introduction of Tables games may have increased AGRR, as noted above, but it did not impact the growth rate of the revenues. An increase in a neighboring state's slots did not impact a state's AGRR.

Thus, it appears that the casino market has room to grow, but the competition among the states appears to erode the regional benefits. Although this study is not estimating a steady state, it is clear that expansion may have its limits.[23]

Pricing Competition in Pennsylvania & New Jersey

Casinos compete for patrons in four ways: through the amenities they offer, their locations, the types of games, and the prices of games. Although the first three are important in attracting customers, data are not readily available for them. Price, however, can be estimated with available data on wagers, payouts, and promotions in two

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21 Although this model cannot be directly compared to Condliffe, our total estimates are slightly below his.

22 A slot density to increase by one would imply that there was in increase in the number of slots equal to the population density of the area.

23 The results also suggest that any social welfare cost-benefit analysis of gaming should be examined on a regional not on a state level.

states: Pennsylvania and New Jersey. As noted above, a price index for a single game is the weighted average of the minimum bet times the house advantage (wagers minus payouts). If minimum bets are constant over the period, or they do not increase with increased competition, one minus the payout ratio would be a proxy for the price (or house advantage) of slot machines. The movement in the price proxy would represent a minimum change in price due to competition. In addition to this price proxy, a casino can compete in the short-run with promotions. In general these promotions allow individuals to play with house money and, thus, improve their expected payout and lower their price.

Monthly reports for Pennsylvania casinos indicate that the increased number of facilities has increased the level of competition and lowered "prices" to slot players by raising payouts rates. The three-month moving average of slot machine payout ratios for each casino is given below in Figure 3. From the beginning, the payout ratios among the casinos ranged between 91% and 93%. The outlier from 2007 to 2010 was Mt. Airy Resort, which is classified as a small-resort casino. Once the casino was established, the payout ratio for Mt Airy moved towards the average. After mid-2010, the payout ratios show a wider range. In June of 2010, casinos were allowed to offer table games, which could explain the increase in variation. The average payout was slightly higher after June 2010, by 0.17%., but the variation in slot payouts among the casinos increased by 0.29%. A simple t-test on the average payout and the standard deviation of the 3-month moving average suggests that there was a significant difference between periods.[24] Increased competition would suggest convergence of payout ratios, not an increase in spread unless the casinos were resetting payout strategies on slots. [25]

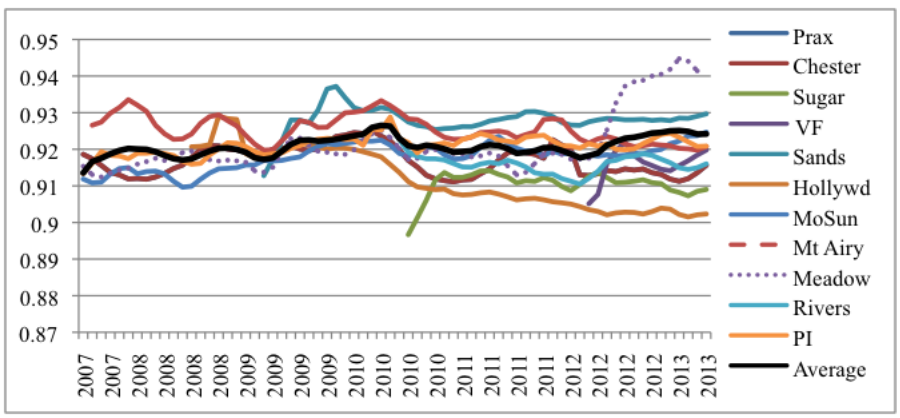

Figure 3. Pennsylvania Casinos: Slot Payouts as a % of Wagers (three month moving averages).

Another means of competing is the use of promotions to players. Pennsylvania requires casinos to track promotions since this cost can be deducted from revenues before taxes are paid to the state. As a percentage of wagers, promotions have been rising over the period. (See Figure 4.) As firms entered the market, promotions steadily increased. Since slot payout ratios are a function of how the machines are programed, it would appear that the casinos used promotions to entice customers. The two casinos on the extremes were Mohegan Sun and Hollywood, both of which are racinos.

24 The null can be rejected at the 1% level of significance.

25 One possible reason for the slot payout increase is the introduction of table games in Pennsylvania in July 2010. The explanation for such an observation is for future discussion.

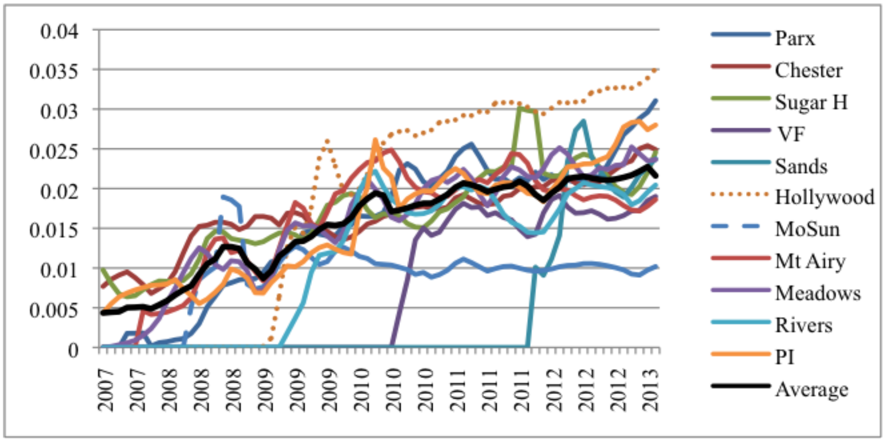

Figure 4. Pennsylvania Casinos: Promotions as a % of Wager (three month moving averages).

Combining the payout ratio and the promotional ratio will yield what the player received in return for his wager. (See Figure 5.) The difference between the wager and return on a per-dollar basis is a proxy for the price of gaming services. Over time, the Pennsylvania casino player was paying a lower price as competition increased. The highest "priced" casino after 2010 was Hollywood in Grantville, formerly Penn National. They are located in the middle of the state without any significant competition. The two lowest priced casinos were the Sands and the Meadows. The Sands has been one of the lowest price providers since it entered the market. It entered late in the market and is located between two northern casinos and the southern Philadelphia casinos. This suggests that the Sands needed to price below market to build clientele. The Meadows has recently shown a large drop in price. The lower price could be due to the recent increase in casino activity in Ohio. Overall, the average price dropped from 8.0% to 5.8% in Pennsylvania.

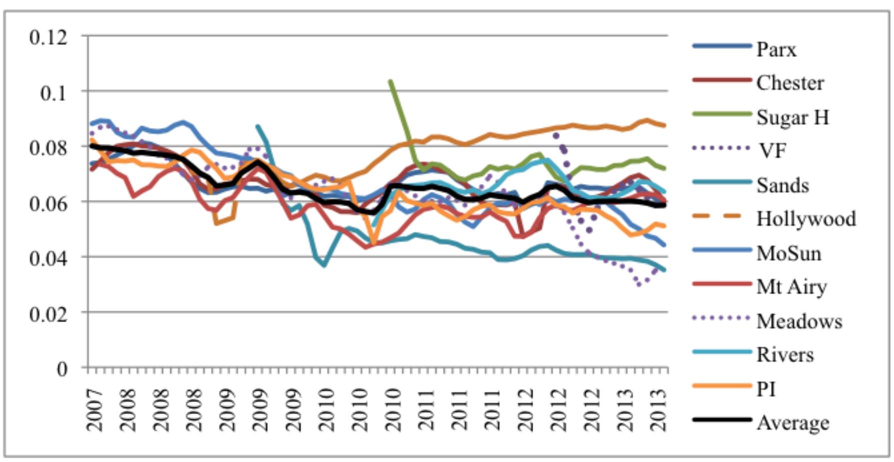

Figure 5. Pennsylvania Casinos Price of Gambling (three month moving averages).

The annual industry-wide data for New Jersey casinos suggests the same pattern as Pennsylvania.[26] The price of playing a slot, one minus the payout ratio, has increased over time, moving from 8.1% to 9.0% from 2003 to 2012. (See Figure 6.) During the same period the percent of wagers that was returned through promotions increased at a faster

[26] New Jersey monthly data were not available. The reporting of "promotion allowances" was not separated between slot and table promotions. The promotion percentage was based on the total handle.

pace from 2.4% to 3.8% resulting in a net price decline over the period from 5.7% to 5.2%. Although the number of casinos was relatively stable over the period, it appears the interstate competition had a slight impact on pricing at New Jersey casinos.

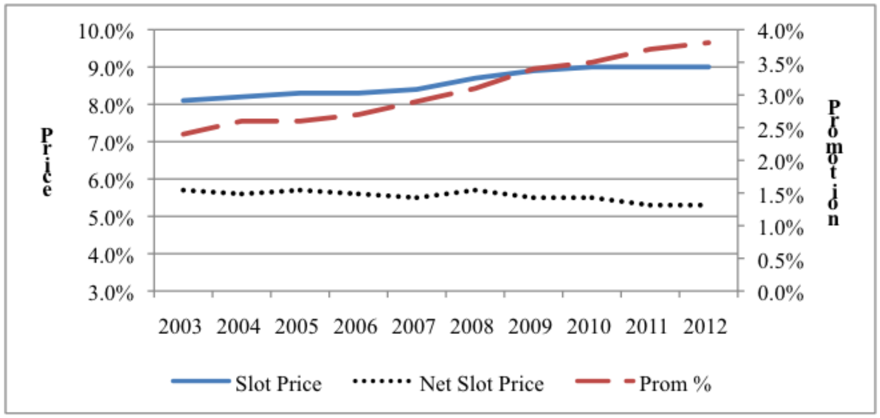

Figure 6. New Jersey Casinos Annual Slot Price and Promotions (percent of handle).

Conclusion

The attraction of tax revenues and the prospects of economic development have heightened the competitive climate in the Mid-Atlantic States. Delaware and West Virginia were the first to challenge New Jersey in the early 1990's by allowing casinos at all racetracks. During the first decade of the new century, the casino market expanded in West Virginia by allowing slots at private adult establishments. New York and Pennsylvania soon entered the market, with Maryland the last to approve casinos in 2008. The increased access to casino facilities stemmed the imports of gamblers by other states and increased spending within state markets. The expansion led to growth in tax revenues, but it appears that the expansion and competition is starting to erode regional gaming tax revenues. It appears that as states find ways to expand access to their markets, it is at the expense of their neighbors. Neighboring states lose from 25% to 35% of gaming revenues from the expansion within a state. For tax revenue planning purposes, this loss can be significant. The evidence also indicates that expansion within the state has limits, although the states examined here have not yet saturated the market. The increased competition has brought value to the consumer and a slow down or loss in tax revenue. Prices appeared to decline in Pennsylvania and New Jersey as competition increased.

It appears that another wave of competition is on the horizon. In 2013, there were several initiatives by state legislators and casino owners to find new sources of revenues. Since October of 2013 New Jersey has allowed internet gambling.[27] Delaware casino operators are seeking to reduce tax rates on slots.[28] The Pennsylvania Senate approved a bill that would allow "small games of chance" at bars – similar to the West Virginia structure.[29] The cannibalization literature has already examined the relationship between lottery and casino revenues (Economopoulos, 2012), but now researchers will need to take a closer look at internal markets to determine the optimal market structure for taxation. However, this study suggests that the optimal state revenues and structure must go beyond the borders of the individual state.

27 New Jersey, Section 69A, 10/ 28/ 2013
28 http://www.usatoday.com/story/money/business/2013/06/20/delaware-gambling-competition/2441541/
29 http://www.lehighvalleylive.com/opinion/index.ssf/2013/10/editorial_pennsylvania_taking.html

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Data Appendix

Access: For each state a measurement of market access to playing a slot machine was calculated in each period. Access is calculated by dividing total slot machines by total market population density. A market population density measurement was calculated for each casino in the state in time period t. The population density for each county where a casino resided and the counties that were adjacent to the casino's county was collected from the U.S. Census. A weighted average of the market population densities was calculated for the casino county. A 50% weight was given to the county where the casino resided and neighboring counties received equal proportioned weights. The total (state) market population density was the sum of the weighted average market population densities of the casinos in operation in that period.

Casinos: The number of casinos was tabulated from state gaming reports. In the case of New York, tribal casinos were included in the data. In 2001, West Virginia allowed up to ten video lottery terminals at adult establishments. A casino equivalent was calculated for these establishments by dividing the number of establishments by a fixed number equal to the average number of terminals per racino between 1997 and 2012. The equivalent was rounded to the nearest whole number.

Casino Revenue: Total casino revenues were collected from state gaming commissions. For Delaware, New Jersey, New York, and West Virginia, data were available or constructed from 1997-2012. For Pennsylvania, revenues were from 2006-2012, and in Maryland revenues were from 2010-2012. Casino revenues were estimated for New York for the period of 1997-2003. During this period only tribal casinos were in operation. Goss and Morse (2007) report AGR for NY tribes for 2003. NY Treasurer's reports document all sources of revenues, and tribal revenue was not listed separately and was assumed to be included in the miscellaneous category. AGR as a percent of NY tax revenue was calculated for 2003 and was used to calculate AGR for previous years. The percent was adjusted for the number of casinos in the market. Real casino revenue was computed by dividing nominal casino revenue by a state price index. A state price index was created using the nominal gross state product and real gross state product provided by the Federal Reserve Bank of St. Louis.

Slots: The number of tribal slots in New York was taken from the tribe's Web page. Connecticut was not included in New York's calculation of neighboring slots, nor was Ohio's in calculating Pennsylvania's or West Virginia's.

Weighted Matrix: Google maps was used to estimate distances between casinos and major population centers. For a casino state, the nearest casino to the population center was used to calculate the distance when a state did not have a casino. If two states had multiple casinos, the closest casinos were paired and the average distance was used.