The Lure of Gambling: What State Governments Can Gain from the Legalization and Expansion of Gambling

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by

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Abstract:

Gambling, both in the casino-style and lottery forms, has risen to become a major component of the entertainment industry in the United States. State governments are the gatekeepers of this growing industry, holding the power to legalize and regulate all aspects of gambling. This thesis explores the rationale state governments have for legalizing gambling as well as the impact gambling tax revenues have for state budgets. The main focus is casino-style gambling, as casino-style gambling in particular is being pursued for expansion by numerous states in a variety of forms. As various forms of gambling are legalized throughout the country, a state's gambling interests begin to face competition from both neighboring states and other forms of gambling within the state. Econometric models attempted to predict the tax revenues a state can obtain from legalized gambling based on such competition and a states own demographics. The results support a first-mover advantage for states expanding casino-style gambling and finds that new forms of gambling significantly erode established gambling industries.

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Introduction:

In the last fifteen years there has been a monumental shift in the gambling industry. Once dominated by state lotteries, with commercial casinos restricted to Nevada and Atlantic City, casino gambling is now growing substantially throughout the country. As lotteries began to experience declining rates of revenue growth, states turned towards other forms of gambling, namely casino-style, to gain much needed tax revenues (NGISC, 1999). The politics of legalization has led to a variety of forms of gambling expansion.

Similar to the experiences of the alcohol and tobacco industries, the supply of gambling is controlled and regulated by each individual state government in the U.S. As the gatekeepers of the gambling industry, state governments determine the forms and amount of gambling that will be legal in their respective states. While politics are a significant consideration, demographics, geography, and competition are key determinants of whether or not a particular form of gambling will be successful in a given state.

Question Statement:

The primary question of this thesis is: What amount of tax revenues can each State Government expect to gain from expanding gambling? It will predict the gambling tax revenues a state is capable of earning given the various forms of gambling explained later. In particular, it will include an analysis based on an econometric model that will focus on the rationale for each form of gambling available to states and the reasons each state has chosen or might choose one particular form of gambling over another.

Why this topic is of interest:

The question of what is possible for state governments in the realm of gambling has been made interesting by several new developments over the last decade. As casino-style gambling

has expanded, the industry has become dominated by corporations that have promoted and popularized gambling. The emergence of poker tournaments on cable television with events such as the World Series of Poker on ESPN has boosted the awareness and acceptance of the gaming industry. The popularity of such shows and events makes the topic and analysis of gambling expansion very interesting. Harrah's Entertainment studies have shown that greater than fifty percent of Americans find gambling personally acceptable while less than twenty percent of people find it not acceptable at all (Harrah's, 1999). The majority of Americans want to know when and where gambling will turn up next.

Why this topic is important:

It is dually important to understand why state governments are pursuing this controversial industry. In addition to the quantitative analysis that will project gambling tax revenues, an examination of the motivation that state governments have for expanding and regulating the gambling industry is necessary. The simple answer to this inquiry is tax revenues that states need for their ballooning state budgets. A more complicated analysis would show at first glance that states began the legalization of gambling not only to increase state tax revenues without the political backlash of raising sales or income taxes, but to also spur economic development in regions of the state experiencing economic hardship (Furlong, 1998).

Economic development was the basis used to garner government support when gambling was legalized in Atlantic City, New Jersey (Madhusudhan, 1996). The expansion of casino gambling that began in the early 1990's along the Mississippi river in the form of riverboats also targeted economically depressed areas. Now, as casino-style gambling has been legalized for many years, states are coming to rely more heavily on gambling tax revenues than ever before

(Table 1.1). They are beginning to expand gambling and loosen regulations on it solely to protect these tax revenues on which they have become reliant.

States relying on Gambling Tax Dollars:

In 2004, gambling tax revenues accounted for over 5% of total tax revenues in seventeen states. While it might not surprise anyone to learn that Nevada collects just over one-third of its tax revenues from casino gambling taxes, states such as South Dakota and West Virginia are also heavily dependant on gambling tax revenues, accounting for 17.7% and 12.1% of total tax revenues. Many of the states with the greatest reliance on gambling tax revenues are also the home of commercial casinos and riverboats, including Michigan (9.9%), Louisiana (10.9%), Mississippi (9.4%), and Indiana (8.6%).

Table 1.1: Gambling's Contributions to State Finances

State	Gambling Revenue	Total Revenue	Percentage
Delaware	208.9	2,918	7.2%
Florida	1192.2	21,197	5.6%
Illinois	1319.2	25,161	5.2%
Indiana	895.3	10,446	8.6%
Iowa	259.9	4,484	5.8%
Louisiana	723	6,662	**10.9%**
Michigan	884.4	8,895	9.9%
Mississippi	327.7	3,494	9.4%
Missouri	594.8	7,669	7.8%
Nevada	781.9	2,139	**36.6%**
New Hampshire	76.9	1,336	5.8%
New Jersey	1243.5	23,223	5.4%
New York	2172.4	40,328	5.4%
Oregon	326.4	3,969	8.2%
Rhode Island	262.2	2,735	9.6%
South Dakota	157.6	891	**17.7%**
West Virginia	380	3,139	**12.1%**
Total United States	19,217.70	523,548	3.67

Sources: Statistical Abstract of the US for 2004-05, State Regulatory Agencies

It is not only commercial casino states that reap in gambling tax dollars, states such as Rhode Island (9.6%), Delaware (7.2%), and Oregon (8.2%) have been able to garner their fair share of tax dollars by expanding their lotteries through Video Lottery Machines (VLT) machines. Many of the remaining states with gambling revenues over 5% of their total tax base have found success with their original lotteries. This preliminary data indicates that states have many options to leverage their tax revenues on gambling and their specific game of choice may be influenced more by demographics and politics than by the profitability of any one form of gaming.

The concern with states' new reliance on gambling tax revenues is growing as more states consider expansion of the industry. The expansion throughout the U.S. is a threat to each state that currently relies on gambling tax revenues. With a limited flexibility of demand, the significant potential increase in supply will hurt states currently with gaming, putting them in danger of budget shortfalls. Gaming tax policies that were once meant to cover state budget deficits may in the future create them.

Hurricane effects on States revenue source:

The summer of 2005 was a tumultuous one for the gulf coast, specifically Louisiana and Mississippi, where significant damage was sustained from Hurricanes Katrina and Rita. The casino industry was similarly damaged as the storms destroyed or flooded many of the casinos in the region. Mississippi's casinos, which were required to be built on barges over water, were at the same risk as the Louisiana riverboats that were permanently fixed at dockside. The hurricanes shut down these casinos and cut off the significant tax revenues they generate for the state for many months following, with few casinos reopening by the end of the year (Stutz, 8-2005).

Table 1.2 Hurricane Katrina Tax Revenue Effects

Mississippi

Fiscal 05		Fiscal 06	
July	$ 27.5	July	$ 27.0
August	$ 33.3	August	$ 30.4
September	$ 24.8	September	$ 16.1
October	$ 22.2	October	$ 21.3
November	$ 29.0	November	$ 15.4
December	$ 22.9	December	$ 16.6
January	$ 29.9	January	$ 24.3
Totals	$ 189.6		$ 151.1

Lost Revenue $ 38.5

Source: Mississippi Gaming Commission

While casino companies are insured for the damage and lost profits from closure, states will lose out on significant tax dollars while they are closed. Reports indicated that the state of Mississippi initially lost half a million dollars per day and a total of close to thirty-eight million dollars of potential gaming taxes due to casino closings. The damage led the Mississippi legislature to amend the regulations allowing companies to build land based casinos and resorts within 800 feet of the shoreline after the casino operators pushed for less-restrictive regulations (Stutz, 11-2005). Luckily for both Louisiana and Mississippi, the industry has been able to redevelop quickly and revenues have risen back to near pre-hurricane levels. The lesson to be learned from this however, is that once states rely on casino gambling, they begin to lose control of it.

The Current Competition for Tax Dollars:

The growth of states' reliance on gambling tax dollars has led to heated competition between states for the existing demand of gambling. With tax dollars at stake, state governments are competing with their neighbors to capture gambling tax dollars from their own citizens and

citizens of neighboring states. This is particularly true in the Northeast, where lotteries began in the 1960's and 70's. Starting with New Hampshire, lotteries were introduced one by one, moving westward, as Massachusetts, New York, and Connecticut quickly followed suit (von Herrmann, 2002).

Ballooning budget deficits and declining growth rates for lotteries have led to states in the Northeast to pursue a variety of non-lottery forms of gaming, making them an optimal case study for this topic. In the last 10-15 years, Northeastern states implemented their gaming strategies while others faced political opposition. As political opposition has lessened and states find an increased need for new tax revenues to fund state budgets deficits, new developments in the supply of gaming are sending shock waves through the Northeast gaming market.

Examples from the Northeast:

One of the most recent developments comes from Pennsylvania, where a bill has been passed that will allow up to 61,000 slot machines to be spread throughout the state at racetracks, resorts, and slot parlors in major cities including Philadelphia and Pittsburgh (Beyer, 2004). The competitive effects on neighboring states are considerable. Maryland, a state with a historic horse racing industry, stands to lose significantly if it does not quickly act and allow slot machines within its state boundaries (Beyer, 2004). States with a high concentration of gambling that formerly enjoyed pseudo monopolies, such as New Jersey, Delaware, and West Virginia will witness an erosion of their market power and thus, tax revenues.

New Jersey's Atlantic City casinos also face threats from other neighboring states. The introduction of Indian casinos in the Catskill region of New York, a priority for the New York Governor, George Pataki, would directly compete with Atlantic City for New York metro casino patrons (Gambling Magazine, 2001). The three projected casinos in southern New York would

not only potentially seize Atlantic City customers but also pose a threat to Foxwoods and Mohegan Sun, the two most successful Indian casinos in the country from neighboring Connecticut. All along the East Coast, states are positioning themselves to gain their maximum gaming tax revenues.

The Choices of Gambling Expansion:

Commercial Casinos:

State governments have shifted from lotteries to casino style gambling for expansion. The first of these forms of gambling is commercial casinos, made popular by Las Vegas and Atlantic City before the lotteries spread across the nation. Nevada, the birthplace of commercial casino gambling, for many years owned an unchallenged monopoly throughout the country (NGISC,1999). With low excise tax rates on casinos and few limitations, casinos have thrived and created a unique gambling market littered with non-gaming attractions and amenities. Regardless of casino gambling expansion of the last decade, Las Vegas remains the nation's top casino market with solid growth rates.

Atlantic City casinos in New Jersey followed the success of commercial casinos in Las Vegas. However, supply restrictions and competition from neighboring states have limited their success and growth. These types of casinos have been re-introduced by Mississippi and Michigan with similar restrictions to Atlantic City. Commercial casinos are typically targeted for urban areas, as evidenced in Michigan (Detroit), Mississippi (Tunica, Biloxi), and New Jersey (Atlantic City) (NGISC,1999). Commercial casinos are generally not an option for most state governments because many state constitutions forbid them. Casinos bear the greatest political and legal hurdles of all gaming choices throughout the industry.

Riverboat Casinos:

Riverboat casinos served as the primary reintroduction of casino expansion in the United States in the early 1990's. They were built all throughout the Midwest as an acceptable form of gambling because of the historical nostalgia associated with casino riverboats (McGowan, 2001). Riverboats, however, fundamentally differ from commercial casinos because their original amenities were limited and restrictions were placed on the dollar amount people gambled (NGISC, 1999).

Riverboats were required to leave the dock and sail along the Mississippi river for gambling to take place. In many states there were limits set on the amount of money customers could lose in a given time frame and customers were not permitted to re-board consecutive riverboat cruises. As time has passed and legislators realized that restrictions stifled casino and thus tax revenues, many of the limitations on riverboats have been lifted. They no longer sail along the Mississippi river and most are permanently docked and linked with land based resorts (Thalheimer, 2003).

Iowa was the first state to legalize riverboats in 1989, with many Midwestern states such as Illinois and Missouri quick to follow. States compete with one another by location and price, as some states have higher tax rates on casino revenues than others. Nowhere else is this true more than in Chicago, where both Indiana and Illinois have casinos positioned nearby. Tax rates also proved to be an important driver of revenues as casino operators shifted their marketing foci towards Indiana casinos when the state of Illinois raised their revenue tax rate up to 70% (Klatzkin, 2005).

Indiana has positioned its remaining casinos along its southern border to directly compete with and draw customers from neighboring Kentucky. Each casino is targeted to compete with a

specific horse racing track, for which Kentucky is famous. The positioning of such casinos has led Kentucky gamblers to cross the border and its race tracks to lose revenue (NGISC, 1999). This has prompted many discussions and debates in the legislature about legalizing slot machines at each of the states racetracks (Atkinson, 2000). The goal of such an expansion would be to bring back Kentucky gamblers and their tax dollars.

Indian Casinos:

With the passing of the Indian Gaming Regulatory Act (IGRA) in 1988, state governments were helpless to prevent the expansion of Indian casinos. The Act did, however, give the states a loophole to profit from these casinos. The IGRA classifies gaming into three separate classes. While Indian casinos have complete sovereignty over Class I and II gaming, consisting of bingo and traditional Indian gaming for small prizes. Class III gaming, which includes slot machines, roulette, blackjack, and craps is the most lucrative of the classes. Class III gaming is only allowed at Indian casinos when it is allowed in other jurisdictions throughout the state (NGISC, 1999). This forces Indian tribes to negotiate gaming compacts with state governments that had restricted such forms of gambling, allowing states to take a piece of the pie.

While Connecticut is home to the two most successful Indian casinos in the country, Foxwoods and Mohegan Sun, they are not the only state using Indian gaming to expand their tax revenue base. Governor Pataki of New York, is aggressively pursuing compacts with several Indian tribes to develop casinos from the Catskills to Buffalo. Rhode Island is another state that, in a heated competition with Massachusetts, is looking towards an Indian casino as a form of expansion (Gregg, 2004).

The use of Indian casinos, however, is not a strategy of expansion for many states with Indian tribes owning sovereign land. States that consider expanding casino-style gaming through slot machines or resort casinos must recognize the supply risks that Indian tribes pose. Legalizing such gaming options within the state would give the opportunity for Indian reservations to request and force a gaming compact for similar gaming options.

VLTs and Slot Machines:

Casinos, whether commercial, riverboat or Indian, are not the only options for state governments. The horse racing industry has long stood as a respected form of entertainment and gambling characterized by traditional pageantry. Very few people, however, would consider opening new racetracks for the expansion of pari-mutual wagering on the horse races, but rather to capitalize on the growing trend of placing slot machines or VLTs (video lottery terminals) at them. As the horse racing industry has suffered negative growth rates, the expense incurred from other forms of expanded gambling throughout the country, states have introduced VLTs and slot machines at these fledgling sites to rejuvenate them (McGowan, 2001).

Slot machines, the revenue drivers of casinos, have a significant effect on racetracks by drawing bigger crowds and increasing the amount of money wagered. The slot machines, which are operated independently of one another are significantly different than their sister machines, VLTs. Slot machines are by definition, Class III gaming machines that are independent (NGISC, 1999). Video lottery terminals, which may look nearly identical to slot machines, are primarily unique because they operate in a connected system like a lottery and are thus regulated by the lottery commission of the given state.

The Importance of the VLT – Slot Machine Difference:

The distinction between the two types of casinos style machines (VLTs and Slot machines) is noteworthy for both political and competitive reasons. States such as New York, with a longstanding lottery, are able to introduce VLT's with minimal legislative hurdles compared to the obstacles faced when slot machines and casinos are considered. Slot machines, because of their independence are more attractive to consumers and are given more flexibility in their placement, thus making them more profitable.

Slot machines are rare among states because of both the political hurdles and also the threat of competition from Indian casinos. Legalizing slot machines would force the state government to negotiate a gambling compact with any Indian reservations, thus further increasing the supply of gambling. Thus, slot machines have been pursued rarely, with the notable exception of Pennsylvania, a state with no Indian tribes wishing the build casinos.

The combination of potential Indian casinos and the legalization of slot machines would introduce an explosion in the supply of gambling within a state. This is one particular reason for the recent legislative battle in Florida, a state with many Indian tribes, over slot machines at race tracks. Relative tax rates of 65% were added to the voter mandated gambling resolution, limiting the building expansion plans for slot machines in the state and creating a hurdle to actual development (Stutz, 3-2005). This was one of the political efforts of conservatives in the state legislature that recognized the potential expansion of gambling within the state from such a resolution.

The Future in Gaming Expansion for States:

As gambling becomes more acceptable across the country and the supply of gambling increases, the logical economic result is decreasing gambling revenues in the current gaming states, due to cannibalization. Those states with large gaming investments have the most to lose from competition and expansion as evidenced by Atlantic City's position. States combat their fear of losing gambling tax revenues by further solidifying their position in the gambling market with supplementary gambling expansion.

Thus, current strategies, if undertaken by multiple states, may cause a self fulfilling prophecy in which states are destined to lose a portion of their tax revenues to their neighbors. While this may prove to be a more equitable distribution of gaming tax revenues among states, those states that heavily rely on gambling revenues will lose out as their potential for growth declines. The competitive nature of gambling expansion is not only necessary for understanding the motivations of state governments but also for quantifying the impact of their expansion choices.

Literature Review:

There is a substantial amount of existing literature examining the gambling industry. Books and economic papers vary from evaluating the different rationales for legalizing gambling to establishing the determinants of casino gambling demand. There is also currently work in the field that has addressed questions similar to the topic of this thesis where economists have examined the relationships between gambling industries (lottery, casino, pari-mutual). These papers have helped set the groundwork for which this thesis is based but none try to specifically

quantify state gambling tax revenues. While this thesis may draw from the knowledge of an abundance of sources, there are a certain few works that bear mentioning.

Gambling's Contribution to State Finances:

The topic of this thesis and its exploration of gambling tax revenues and how state governments have used gambling as a tax policy were drawn originally from an article in Christiansen Capital Advisors, "Insight". This gambling industry journal contained a front page article by Eugene Martin focusing on gambling's role in state finances that judges whether or not states are addicted to or dependant on gambling. This article, while not from an economic study perspective, is very helpful in identifying what makes a state gambling tax policy successful. It lends valuable insight into how the gambling policy choices states make lead to protective strategies down the road that would have been unthinkable at inception.

The article specifically examines the four states (Nevada, Louisiana, West Virginia, and South Dakota) with gambling revenues accounting for greater than ten percent of total state tax revenues. In evaluating each of the four states' dependency on gaming and the risks associated with such a dependency, the article focuses on gambling privilege tax rates, and the capital investment in the industry.

The tax rates and invested capital are not only related, but important to determining whether the reliance on gaming in a state is good. States with lower tax rates such as Nevada and New Jersey allow for increased capital investment in casino projects and significant economic development from non-gaming amenities and attractions. Large amounts of capital investment are crucial for a state's gaming tax policy because such expenditures help give casinos competitive advantages against neighboring states. A tax policy that encourages capital

investment not only helps secure the tax revenue stream but also makes excessive social problems less likely.

South Dakota, with high tax rates and little capital investment in the industry, epitomizes the addicted state with the legalization and promotion of storefront VLT machines, characterized in the NGISC Report to Congress as the "crack-cocaine of gambling." West Virginia, a state that also uses VLT machines, restricts them to racetrack facilities, effectively creating "racinos[1]." With slightly lower tax rates coupled with restriction to racetracks, West Virginia is able to encourage capital investment in their VLT's. It is not able, however, to completely secure its revenue tax base as significant gambling expansion in neighboring Pennsylvania will increase competition. Now the state legislators are unsuccessfully trying to introduce table games at their racinos. These scenarios show how easily states turn to unintended and excessive expansion once they rely on gambling.

Competition within the Industry, Casinos vs. Lotteries:

The relationships between the different forms of gambling are crucial to understanding the impact expansion will have on the existing gambling industry. Many economic studies have sought to determine whether gambling industries (casinos vs. lotteries) are complementary or partial substitutes. This determination is critical to measuring the effect of gambling expansion and quantifying the tax revenues a state can gain from gambling.

A study by gambling researchers Douglas M. Walker and John D. Jackson, titled "The Relationships among US Gambling Industries" seeks to understand the impacts gambling industries have on one another. Their work is noteworthy for not only its results but its approach. Their specification of variables employed to test the effects of cross-border competition successfully simplifies and captures a difficult variable. The econometric model in this thesis

[1] Racinos are considered racetracks that have slot machines and/or VLTs.

will imitate this variable specification. In addition to their variable specification, Walker and Jackson included demographic variables such as poverty level and religion, using the number of Baptists because they are a well-organized interest group. Expectedly, increases the number of people in poverty decreased casino revenues but ironically, an increase in the number of Baptists increased casino gambling.

The most important results to consider from this study are the competition and intrastate relationships between gambling industries. The authors found that casinos and lotteries within the same state are partial substitutes and cannibalize each other. In studying the interstate competition, they found similar results of cannibalization and substitution with one notable exception: casinos in neighboring states did not substitute each other in a statistically significant respect.

Explaining Recent State Casino Gaming Adoptions:

While the end result of this paper may be quantifying the tax dollars earned from gambling expansion, it is exceptionally important to understand why states adopt casino style gambling in the first place. Edward Furlong (1998) used a logistic regression model to explain the likelihood of casino gambling adoptions by states. His paper presents a very good starting point because he investigates the real reasons behind the casino gaming adoptions of the 1990's, including state economic condition and interstate tax competition.

Furlong presents four rationales that a state has for legalizing casinos: *revenue*, *political*, *competitive*, and *economic development*. His results exposed many false notions about casino adoptions; mainly that indicators of fiscal stress were insignificant and that casino adopting states were in better financial health than non-adopters. While many political variables failed,

state ideological identifications had strong effects, as did job growth, with poor performing states more likely to adopt gaming.

Furlong may not have been able to garner any significant variables to defend his *revenue* and *political* rationales for casino adoptions, but this does not discount their importance. One of the flaws inherent in his study, however, is that it was limited to riverboat casinos and did not include considerations for racinos and VLT machines run by the state lotteries. The other reason that Furlong was unable to capture these rationales is that they are extremely difficult to quantify in an econometric model. While many of the same problems may appear in this work, Furlong's methods will be helpful in adjusting the econometric model.

Casino Demand Determinants:

Among the body of research exists not only work that has sought to measure competition and legalization questions, but also the simple demand determinants of casino style gaming, namely slot machines. Given the goal of this study, to quantify gambling tax revenues by state, there must be a solid understanding of the determinants of gambling wagering in general. A study by Richard Thalheimer and Mukhtar Aliz has recently accomplished just that by focusing on the demand for slot machine wagering at riverboats and racinos.

Thalheimer and Aliz's paper, "The demand for casino gaming," yields support for many assumed truths about the competition for gambling patrons. Their measures of accessibility found that demand increased as the customers in its market area increased and the demand decreased as access to competing casinos increased. The findings support the strong state border effects that lead to the expansion of gaming in order to prevent the exportation of spending, jobs, and tax revenues.

The authors recognize the exportation factor and also found that the regulatory constraints they placed on the casinos diminished demand. The riverboat cruising mandates and loss limits were to found to have a statistically negative impact on slot machine demand. It should come as no surprise then that even before "The demand for casino gaming" was written, states lifted and overturned many of the loss limit and cruising mandate regulations at riverboat casinos were lifted and overturned. The lesson again shows that what the state might have started with good attentions, was forgotten in the search for tax revenues.

Measuring the Casino Cannibalization of State Lotteries:

The competition between gambling industries within the U.S. is just as important as the competition between states for the gambling tax dollars. As casino gambling is expanded, such casinos will not only find competition from neighboring states but also from other gambling sources within the state. Thus, it is crucial to understand how different forms of gambling compete and specifically how the two major forms, i.e., casinos and lotteries cannibalize each other.

Many studies have been conducted to find the cannibalization effect casinos have on lotteries; one of the more recent papers was one by Stephen Fink and Jonathan Rork, titled, "The Importance of Self-Selection in Casino Cannibalization of State Lotteries". Their paper stands out and has differentiated itself from previous papers that attempted to measure the same effect by controlling for negative selection bias. Their analysis yielded somewhat expected results showing that the cannibalizing effect is 56%, which while significant is much less than previous studies have showed. Nonetheless, the body of research and this particular study have shown that casinos and lotteries are not complementary goods but partial substitutes.

Data:

The goal of this thesis is to predict the dollar amount of tax revenues state governments can obtain from legalizing various forms of gambling. For a complete analysis, I collected panel data across all fifty states in the U.S. for the years 2001 to 2004, providing a total of 200 observations. This data consisted of dependant variables for gaming tax revenues and three sets of independent variables, gaming forms, competition, and demographic, that will aid in explaining the independent variable, gambling tax revenues.

Indian Gaming Caveat:

While Indian Casinos have been described throughout this thesis as a gaming form through which states can gain tax revenues, data for this variable was not available. Data describing Indian casinos, their age, revenues and the classes of gaming offered would have strengthened this study. However, the data for Indian casinos is not readily available because Indian tribes are not required to report their operations and a complete almanac from Casino City, a source of gaming news and data, only consists of data beginning in 2003. This omission should not diminish the importance of the econometric models in this study, as Indian gaming is not a major source of gambling tax revenues for the vast majority of states. The competitive effects that Indian casinos have on state regulated casino-style gaming and lotteries will nevertheless be captured in the model.

Dependent variable:

The independent variable that the model seeks to explain is gambling tax revenue that state governments collect from lottery operations and excise taxes on casinos and other forms of gambling. The data used for this variable was collected from the major forms of gambling explained earlier that are the focus of this thesis. State government's autonomy in reporting gaming statistics makes collecting a consistent set of data difficult.

Thus, not only were state regulatory websites and the American Gaming Association's State of the States report used, but Casino City's North American Gaming Almanac was drawn from in order to fill gaps in the data set. The tax revenue data was collected separately for lotteries and casino-style gaming due to states' reporting methods. The data was collected on an annual basis so that the sum of the lottery and gaming tax revenue would represent the total tax revenue gained by the state.

Gaming form variables:

A set of variables that described the current legalized types of gaming in each state were first collected. The primary variable of this set is the year in which each current gaming form was first legalized by state. This primary variable provided the data for dummy variables describing whether a gaming form is legal or not in each year of the sample. It also enabled the creation of a time variable representing the age of each gaming form by state (shown on the next page in Table 3.1).

Table 3.1 – Age of Gaming Forms

as of 2004 (time in years)	Lottery	VLTs	Commercial Casinos	Riverboat casinos	Slots Machines
ARIZONA	25	-	-	-	-
CALIFORNIA	20	-	-	-	-
COLORADO	22	-	14	-	-
CONNECTICUT	33	-	-	-	-
DELAWARE	31	10	-	-	-
FLORIDA	17	-	-	-	-
GEORGIA	12	-	-	-	-
IDAHO	16	-	-	-	-
ILLINOIS	31	-	-	14	-
INDIANA	16	-	-	10	-
IOWA	20	-	-	14	10
KANSAS	17	-	-	-	-
KENTUCKY	16	-	-	-	-
LOUISIANA	13	-	6	12	8
MAINE	31	-	-	-	-
MARYLAND	32	-	-	-	-
MASSACHUSETTS	33	-	-	-	-
MICHIGAN	32	-	6	-	-
MINNESOTA	15	-	-	-	-
MISSISSIPPI	-	-	-	13	-
MISSOURI	18	-	-	11	-
MONTANA	17	18	-	-	-
NEBRASKA	11	-	-	-	-
NEVADA	-	-	74	-	-
NEW HAMPSHIRE	42	-	-	-	-
NEW JERSEY	36	-	27	-	-
NEW MEXICO	10	-	-	-	6
NEW YORK	38	1	-	-	-
NORTH DAKOTA	1	-	-	-	-
OHIO	31	-	-	-	-
OREGON	20	-	-	-	-
PENNSYLVANIA	33	-	-	-	-
RHODE ISLAND	30	13	-	-	-
SOUTH CAROLINA	3	-	-	-	-
SOUTH DAKOTA	17	16	16	-	-
TENNESSEE	1	-	-	-	-
TEXAS	13	-	-	-	-
VERMONT	27	-	-	-	-
VIRGINIA	17	-	-	-	-
WASHINGTON	23	-	-	-	-
WEST VIRGINIA	19	11	-	-	-
WISCONSIN	17	-	-	-	-

***Alabama, Alaska, Arkansas, Hawaii, North Carolina, Oklahoma, Utah, and Wyoming have not legalized these forms of gaming

The other major variable that helps explain gambling tax revenues is the effective tax rate each state imposes on gaming revenues (shown in Table 3.2). The effective tax rate is very important for casino-style forms of gaming, but less so for lotteries due to minor variation. Data on the proceeds margin (tax revenues as a percentage of total lottery sales) is also not available for the sample. Data for this set of variables was collected from individual state gaming commission websites and Casino City's North American Gaming Almanac.

Table 3.2 - Effective Tax Rates by State

as of 2004	Commercial Casinos	Riverboat Casinos	Slots Machines	VLT Machines
COLORADO	14%	-	-	-
DELAWARE	-	-	-	35%
ILLINOIS	-	47%	-	-
INDIANA	-	32%	-	-
IOWA	-	24%	24%	-
LOUISIANA	22%	20%	29%	-
MICHIGAN	23%	-	-	-
MISSISSIPPI	-	12%	-	-
MISSOURI	-	27%	-	-
MONTANA	-	-	-	15%
NEVADA	8%	-	-	-
NEW JERSEY	10%	-	-	-
NEW MEXICO	-	-	25%	-
NEW YORK	-	-	-	71%
OREGON	-	-	-	53%
RHODE ISLAND	-	-	-	60%
SOUTH DAKOTA	15%	-	-	50%
WEST VIRGINIA	-	-	-	44%

*** Effective tax rates vary by year but remain consistent for most states with the exception of Illinois, whose effective tax rate rose from 30% in 2001 to 47% in 2004

The data for this set of gaming form variables in each state provides a weak descriptive of the actual gaming market. The specific nature of gaming forms in each state varies significantly and is partially ignored due to data limitations and specification problems. Data including the number of casinos and slot machines would have better described the state gaming markets and

been helpful in predicting gaming tax revenues differences between states. These alternative variables were not included because the data was not accessible. While a cross-section of data for the number of casinos and slot machines are available for 2004, a panel set for 2001-2004 was cost prohibitive.

Competition variables:

The introduction of this paper paid significant attention to the competition between states for gambling tax dollars. Thus, accounting for competition from other states becomes vital to understanding the true potential a particular state has for gambling tax revenues. This particular set of variables not only captures the competition that states face from their neighbors, but also intrastate competition between different forms of gaming. While the data for intrastate gaming can be copied from the first set of variables, there are many methods to account for competition from other states.

In accounting for interstate gaming competition, there are two considerations: gaining the gaming revenue of out-of-state consumers and losing the gaming revenue of state residents. With the exception of Las Vegas, which has become a tourist destination, consumers will cross state borders for gaming opportunities by car. Thus interstate competition is reduced to neighboring states. Neighboring states are specified as being adjacent to one another (listed in Table 3.3). New Jersey and Connecticut, which are not adjacent states, require a minor adjustment presenting them as neighboring states because they compete fiercely for consumers in the New York Metro area.

Exhibit 3.3 - States and their Neighbors

State	Neighbor	State	Neighbor
AL	FL,GA,MS,TN	NE	WY,CO,SD,IA,MO,KS
AR	NM,CO,UT,CA,NV	NV	CA,UT,AR,ID,OR
AK	OK,LA,TN,NM,TX,MO	NH	VT,MA,ME
CA	OR,NV,AR	NJ	NY,PA,DE,CT,MD
CO	NM,AR,UT,OK,KS,NE,WY	NM	AR,CO,TX,OK,UT
CT	RI,MA,NY,NJ	NY	NJ,PA,CT,VT,MA
DE	MD,PA,NJ	NC	VA,SC,TN,GA
FL	AL,GA	ND	MT,SD,MN
GA	AL,FL,SC,NC,TN	OH	WV,PA,KY,MI,IN
ID	WA,OR,MT,WY,UT,NV	OK	TX,AK,KS,MO,NM,CO
IL	IN,WI,IA,MO,KY	OR	ID,CA,NV,WA
IN	MI,OH,IL,KY	PA	DE,NY,NJ,OH,WV,MD
IA	WI,IL,MO,MN,SD,NE	RI	MA,CT
KS	MO,OK,CO,NE	SC	GA,NC
KY	TN,OH,IN,IL,MO,WV,VA	SD	MN,IA,NE,ND,WY,MT
LA	TX,MS,AK	TN	KY,MO,AK,MS,AL,GA,SC,NC
ME	NH,MA	TX	OK,LA,AK,NM
MD	DE,WV,VA,PA,NJ	UT	ID,NV,WY,CO,NM,AR
MA	VT,ME,NH,NY,RI,CT	VT	NH,NY,MA
MI	WI,OH,IN	VA	WV,MD,NC,KY,TN
MN	WI,IA,ND,SD	WA	ID,OR
MS	TN,AL,AK,LA	WV	MD,OH,VA,KY,PA
MO	AK,TN,KY,IL,IA,NE,KS,OK	WI	MI,MN,IA,IL
MT	ND,SD,WY,ID	WY	CO,UT,ID,MT,NE,SD

Capturing these cross border effects can be accomplished by several methods, including aggregating the number of casinos and lotteries that neighbor a particular state. While data limitations prevent the usage of such a method, previous literature presents another, more simple methodology. Calculating the percentage of neighboring states that offer a particular form of gambling is a method that has been used in Walker and Jackson (2004), reviewed earlier. This method is suitable because it generally captures the threats each state faces.

Demographic variables:

While legalization, different forms of gambling, and the competitive threats states face all factor in the determination of gambling tax dollars, demographic variables such as population are

key to understanding the potential revenues for each state. The fact that lotteries account for the majority of gambling consumption renders state population the primary demographic variable for this model. Previous literature on the determinants of casino gambling yielded a set of demographic variables that were also collected for this study comprising of the following: income, age of the population, educational attainment, unemployment, and tourism.

The income variable, specified as per capita income, is not used to measure the gambling tendencies of low or high income people, but as a general measure of the wealth of a state. Thus, I expect that per capita income will lead to greater gambling revenues. The unemployment rate is used to capture the economic position of low income people who gamble to achieve higher incomes, and thus should yield positive correlations. To capture the age of the population, the percentage of people over the age of sixty-five is used to represent retired persons. The proportion of retired persons in a state is important because this community has the most leisure time of any age group and thus is more likely to gamble.

Educational attainment is measured by two variables, the percentage of population over age twenty-five with bachelor degrees and the same percentage with high school diplomas. Two variables are used because education is the most difficult variable for which to predict the effects. It is more than likely that educated persons understand the negative pay-offs and expected value from gambling while research has also shown that casino players tend to have above average education. The tourism variable was measured by the number of employees in the Leisure and Hospitality industries and collected only for states with riverboat or commercial casinos from the Bureau of Labor Statistics. Data from states with slot machines and VLT venues were ignored because these forms of gaming do not attract the non-gaming amenities

associated with tourism. This variable helps measure the attractiveness and size of the casino markets in each state, a key determinant for revenues.

Methodology:

Projecting gambling tax revenues includes the proceeds states receive from running lotteries and taxes imposed on casino-style gaming forms. The tradition and age of lotteries has allowed them to keep an overwhelming share of the gambling market. In states such as New Jersey and Michigan that capture high values of casino tax revenues, lottery proceeds are still greater. Couple this fact with the higher incidence of lotteries than casino-style gaming and a lottery bias can be expected when measuring total tax revenues.

Separation of Lotteries and Gaming:

Thus, to combat this potential bias and ensure the reliability of the results, two approaches were used to estimate total tax revenues. The first method involves using the total tax revenues gained by a state from both lotteries and casino-style gaming as the independent variable. The second method requires a two pronged approach with a model estimating strictly casino-style gaming tax revenues and a separate model estimating lottery proceeds. For this approach, VLT gaming, while run by the state lottery commissions, is considered a casino-style form of gaming because it more closely resembles slot machines that any other lottery game.

Each method employs the same variables and similar specification, allowing a single discussion to accurately describe the process for all of the models. For methodology purposes and specification of variables, “gaming” will refer strictly to the casino-style forms of gambling that form the focus of this thesis and not to lotteries. Instances that require the summation of gaming and lotteries will be referred to as “gambling”.

The Model and Dummy variables:

A two way random effect model is preferred for our estimation, consistent with models used in the previous literature and the application of dummy variables. This model helps us avoid a major obstacle in estimating state gambling tax revenues for states with no lotteries or legalized gaming. While forty states run lotteries, only eighteen states have legalized casino-style gaming. In order to avoid projecting tax revenues for states that clearly should never receive any, dummy variables are repeatedly used throughout the models. This also enables us to isolate the effects certain variables have on the different forms of gaming. In each of the models, the constant is replaced with a dummy variable identifying the gambling form. Dummy variables accounted for lotteries, machine gaming, casino gaming, and all gaming (machine and casino gaming).

While the ideal model would have employed a separate dummy variable to pick up differences between each specific form of gaming, consolidation was necessary. The low incidence of legalization for each particular form of gaming decreased the significance of the dummy variables and the terms with which they were interacted. Consolidation of the dummy variables listed above improved the sample size applicable without hurting explanatory power. The consolidation only eliminated the differences between riverboat and commercial casinos as well as slot machines and VLT machines; distinctions that are important to politicians but have a minimal effect on revenue.

Variable Interaction:

The use of dummy variables goes beyond simply replacing the constant in the model and noting whether or not a state has a particular form of gambling. The dummy variables are used as interaction terms against each of the competition and demographic variables. The interaction

terms are necessary to avoid predicting competitive and demographic effects for states without the particular form of gaming in question.

The interaction allowed me to isolate competitive effects and examine how lotteries were affected separately by both neighboring lotteries and neighboring casino-style gaming. This method also enabled me to analyze the competitive effects for casinos and machine gaming separately. The dummy variable interaction was crucial for the intrastate competition variables that tested the cannibalization effects that lotteries, gaming forms and Indian casinos have on one another.

The demographic variables used in this model are only useful when interacted with the applicable dummy variables because each independent demographic variable is not expected to have the same effect on each form of gaming. One pertinent example is education; while greater percentages of high school level education may diminish lottery tax revenues, previous studies have shown that casino-style gaming consumers have higher than average education levels. Thus, the demographic variables are tested separately through interaction with both lottery and gaming dummy variables.

Dummy variables are not the only variables that are interacted with a states demographic characteristics. A major concern for state legislators when considering the legalization of casino-style gaming is the excise tax rate on revenues that should be applied. The demographic variables employed in this model are best suited to predict total sales dollars for each gambling form, not tax revenues.

The estimation of lottery tax revenues remain unaffected by this since as explained above, there is little variation across states in the lottery tax proceeds as a percentage of total sales. However, the tax rates states impose on casino style gaming vary greatly, requiring a

reconciliation of their differences for the demographic variables. Thus, tax rates must be accounted for not through additive variables in the multiple regression model, but as interaction terms against the demographic variables.

Need for Demographic Indexes:

The collection of demographic variables yields significant explanatory power for the model but produces an unintended problem. The high correlation between nearly all of the demographic variables creates substantial multi-collinearity in our model. This generates potential bias in the co-efficients of the demographic variables. Demographic indexes were created to combat this problem.

Due to the varying significance and relationships between the independent demographic variables and tax revenues by gaming form, separate indexes were built for each dummy variable. Each index was specified based on the significance and co-efficient signs from previous simple regressions (Table 4.1). Rather than ignore the results found from models run with the independent demographic variables, new models with the demographic indexes were generated in order to compare results and ensure reliability.

Table 4.1 - Specification of Demographic Indexes and other created variables

Components	Lottery Demo. Index	Gaming Demo. Index	Machine Demo. Index	Casino Demo. Index	Education Gap variable
Population	* * *	N/A	N/A	N/A	N/A
Per Capita Income	* * *	* * *	* * *	* * *	N/A
% of Population over Age 65	* * *	/ / /	/ / /	/ / /	N/A
Unemployment rate	* * *	* * *	* * *	* * *	N/A
Casino Tourism	N/A	N/A	N/A	* * *	N/A
% with High School degree	/ / /	* * *	* * *	* * *	* * *
% with Bachelors degree	N/A	/ / /	/ / /	/ / /	/ / /

Notes: * * * stands for Positively Multiplicative in Index while / / / stands for Negatively Multiplicative and N/A for not used

A New Variable for Education:

Preliminary regressions of the gaming-only model exhibited interesting results with the education variables. While the variable measuring high school education levels produced expected positive co-efficients, the bachelors degree education level variable yielded the opposite. Upon further analysis, these relationships make sense; people with limited (high school) education have increased interest in casino-style gaming over lottery type games, while those people with greater education understand the negative expected value of gambling.

Thus, to capture the effects of both variables with the collinearity problems associated with including both in the model, an education gap variable was created. The education gap variable, mathematically defined, is the high school level education percentage divided by the bachelors degree level education percentage. The new variable was deemed successful in capturing both effects when it exhibited greater significance than either individual education variable.

Results:

The methodology used to predict total gambling tax revenue for each state yielded six different models. Three pairs of models were specified; in each pair, one employed demographic indexes (secondary models) and the other (primary models) utilized individual demographic variables. The first pair of models forecasted total gambling tax revenue (overall gambling model), the second, lottery tax revenue (lottery model), and the third estimated casino-style gaming tax revenue (gaming model). The combination of the lottery and gaming models is equivalent to the overall gambling models.

The Lottery Models:

The lottery model fits lottery tax revenues well but less so than either of the other models. Nearly all the variables included in the model (Table 5.1) were significant at the 1% level with one demographic variables only significant at the 5% level. The lottery dummy variable was not significant at any level in the primary model without the demographic index but was included nonetheless to account for the constant in the model. In the secondary model that employed a demographic index, the lottery dummy variable was both positive and significant at the 1% level. The age-squared variable representing the number of years a lottery has operated was highly significant in both the primary and secondary specifications of the model.

The set of competition variables accounted for both interstate and intrastate competition. The variable specifying the competition lotteries face from neighboring lotteries was expectedly negative and significant. Similarly, intrastate competition that lotteries face from Indian casinos and other casino-style gaming turned out negative and significant, as anticipated. The interstate competition that lotteries face from neighboring casino-style gaming was insignificant and thus omitted from the model.

Table 5.1 - Lottery Model				
Dependant variable = Lottery Tax Revenues ($ millions)				
Independent Variables		Model #1 (w/o index)		Model #2 (with index)
Lottery Dummy (LD)		166.490		221.511***
		(0.417)		(3.287)
Lottery Competition - Neighboring Lotteries		-275.978***		-260.689***
		(-2.973)		(-3.070)
Lottery Competition - Intrastate Casinos		-97.911***		-115.939***
		(-3.291)		(-3.811)
Age of Lottery Squared (t^2)		0.236***		0.270***
		(4.576)		(6.044)
Population		0.043***		-----
		(18.386)		
Per Capita Income		16.184***		-----
		(3.641)		
% of Population over age 65		36.850***		-----
		(3.798)		
% with High School Degree		-10.537**		-----
		(-2.197)		
Lottery Demographic Index		-----		0.159***
				(21.690)
Adjusted R^2 statistic		0.871		0.865
F-statistic		169.096		256.918
Notes: * signifcant at 10% level, ** significant at 5% level, *** significant at 1% level.				
Competition and Demographic variables are all interacted with lottery dummy variables.				

The demographic variables that were employed for this model all turned out statistically significant with an expected sign. The population variable was the most significant and the greatest driver of the model. Per capita income and the percentage of retired persons (aged sixty-five and over) both yielded positive significant relationships. Also, as predicted, the model generated a negative relationships for the high school education level variable. The unemployment rate, which was assumed to be a considerable determinant in the model, was insignificant and left out of the model.

The demographic index for the lottery, which was composed of all the individual demographic variables tested, was highly significant in the secondary model. As described above, not only did the index make the lottery dummy variable significant but it also raised the significance of the other remaining variables. While the index was able to reduce multi-collinearity and increase the *F statistic*, it slightly lessened the *R-squared statistic*. Thus, it is inconclusive whether or not the demographic index increased or decreased the significance of the model, it seems to have had little effect on the fit and reaffirmed the co-efficients of the competition variables.

The Gaming Models:

The gaming model appears to fit gaming tax revenues better than either of the other models fits its dependant variable. The variables included in the primary model without the demographic index (Table 5.2) are all statistically significant at the 10% level and all but the competition for machine gaming are significant at the 1% level. The casino and machine gaming dummy variables are both positive, as expected, with a greater co-efficient for casino gaming initially indicating that casinos are more tax revenue lucrative than machine gaming. The time variables that represent the age of casinos and age of machine gaming were positive, as expected, with casinos yielding a greater impact once the gaming form has been established for seven or more years.

An analysis of the competition variables included in the model yields both expected and unexpected results. While the competition casinos receive from neighboring casino-style gaming is substantially negative and significant, machine gaming yields a positive co-efficient significant at the 10% level. The unexpected positive relationship between machine gaming and tax revenues may be attributed to the hypothesis that many states pursue the legalization of machine

gaming to recapture gambling tax revenues that residents spend in neighboring states. If such were the case, it would create a self-selection bias that explains the high co-efficient for casino competition and positive co-efficient for machine gaming. Other competition variables, including interstate competition from lotteries, were omitted due to lack of significance or sign errors.

Table 5.2 - Gaming Model

Dependant variable = Gaming Tax Revenues ($ millions)		
Independent Variables	Model #1 (w/o index)	Model #2 (with index)
Casino (Commercial or Riverboat) Dummy	681.900***	772.705***
	(23.492)	(17.655)
Machines (Slot Machines or VLTs) Dummy	313.695***	317.593***
	(11.933)	(13.295)
Casino Competition - Neighboring Gaming	-509.404***	-799.599***
	(-10.572)	(-11.692)
Machine Competition - Neighboring Gaming	44.563*	-----
	(1.788)	
Gaming Competition - Intrastate Indian Gaming	-232.051***	-118.695***
	(-16.669)	(-8.467)
Gaming Competition - Intrastate Lottery	-186.807***	-210.548***
	(-12.503)	(-9.436)
Age of Machines (t)	5.748***	-----
	(3.852)	
Age of Casinos Squared (t^2)	0.118***	0.124***
	(31.708)	(21.784)
Tax Rate * Per Capita Income	25.159***	-----
	(6.837)	
Tax Rate * % Population over age 65	-218.159***	-----
	(-14.454)	
Tax Rate * Education Gap	414.864***	-----
	(12.496)	
Tax Rate * Unemployment Rate	178.921***	-----
	(11.687)	
Tax Rate * Casino Tourism Employment	1.689***	2.909***
	(9.366)	(12.373)
Tax Rate * Gaming Demographic Index	-----	8.472***
		(9.166)
Adjusted R^2 statistic	0.983	0.959
F-statistic	901.029	592.552

Notes: * signifcant at 10% level, ** significant at 5% level, *** significant at 1% level.
Competition and Demographic variables are all interacted with gaming dummy variables.

The intrastate gaming competition variables both generated negative relationships that are consistent with cannibalization hypothesis between gambling industries. No distinction was made here between casino and machine gaming. After accounting for competition, the initial indication that casino gaming is more lucrative than machine gaming has been called into question. The competition casinos face from other states can be great enough to erode the tax revenue advantage exposed by the dummy variable.

With respect to the demographic variables, five out of the six variables tested in the model were employed and statistically significant at the 1% level. Per capita income, tourism employment, the unemployment rate all exhibited positive relationships as expected. The education gap variable affirmed the hypothesis stated earlier about the positive relationship for the high school educated level but negative relationship for college graduates. One peculiar negative relationship was for the percentage of elderly (aged sixty-five and over). This result is counterintuitive due to the expectation that leisure time would increase gaming visits. The single missing demographic variable from the model was population, but due to high correlation statistics and multi-collinearity, this omission did not seem to detract from the model.

The secondary specification of this gaming model using a demographic index did not vary much from the primary model. Despite changes in the magnitude of the co-efficients, many of which increased, the signs of the co-efficients remained the same. The two noteworthy differences were that the competition faced by machine gaming was no longer significant and there was a magnitude reversal between the intrastate gaming variables. In the primary model, competition from Indian casinos in the state was greater than competition from lotteries. The secondary model produced the opposite effect, with lottery competition winning out. The

demographic index did, however, lessen the overall fit of the model as evidenced by the *R-squared* and *F statistics*.

The Overall Gambling Models:

The overall model fits total tax revenues effectively, not as well as the gaming model but still better than the lottery model. With the exception of the dummy variables, all the variables in the primary and secondary models (Table 5.3) are significant at a 1% level. In the primary model, the lottery dummy variables is significant at a 5% level, while the machine gaming dummy variable is not significant at all and yields a negative co-efficient, which is definitely incorrect. This problem is solved, however, in the secondary model, where the machine gaming dummy variable is positive and significant at the 5% level, with the lottery dummy variable significant at the 1% level.

The age variables that help describe the time component of the model were somewhat consistent with the first set of models. The lottery age-squared and casino age-squared both turned out significant and with similar co-efficients compared to the separate lottery and gaming models. The machine gaming age variable, on the other hand, was omitted due to sign errors and insignificance. In the secondary model, the lottery age variable gained in co-efficient magnitude and significance while the co-efficient and significance of the casino age variables lessened.

The competition variables yielded similar results in the overall gambling models as they did in the separate lottery and gaming models. The most noteworthy of them was the competition machine-gaming faces from neighboring states with casino-style gaming, which generated the same positive significant correlation as in the gaming model. Similarly, the significance was lost and the variable was omitted from the secondary model with the demographic indexes.

Table 5.3 - Overall Tax Revenue Model		
Dependant variable = Total Tax Revenues ($ millions)		
Independent Variables	Model #1 (w/o index)	Model #2 (with index)
Lottery Dummy	1148.32**	232.834***
	(2.418)	(3.197)
Casino (Commercial or Riverboat) Dummy	608.829***	677.513***
	(4.846)	(4.877)
Machines (Slot Machines or VLTs) Dummy	-37.955	182.432**
	(-0.344)	(2.356)
Lottery Competition - Neighboring Lotteries	-260.156***	-239.273***
	(-2.694)	(-2.632)
Casino Competition - Neighboring Gaming	-569.033***	-682.297***
	(-3.086)	(-3.143)
Machine Competition - Neighboring Gaming	325.187***	-----
	(2.587)	
Lottery Competition - Intrastate Gaming (including Indian)	-107.346***	-160.870***
	(-3.152)	(-4.121)
Gaming Competition- Intrastate Indian Gaming	-154.267***	-175.547***
	(-2.740)	(-3.466)
Age of Lottery (t^2)	0.198***	0.210***
	(4.001)	(4.374)
Age of Casinos Squared (t^2)	0.138***	0.107***
	(7.774)	(5.362)
Lottery Dummy * Population	0.037***	-----
	(14.160)	
Lottery Dummy * Per Capita Income	21.456***	-----
	(4.910)	
Lottery Dummy * % population over age 65	41.542***	-----
	(4.384)	
Lottery Dummy * % with High School Degree	-23.990***	-----
	(-3.978)	
Tax Rate * Gaming Dummy * Population	0.105***	-----
	(8.315)	
Tax Rate * Gaming Dummy * % over age 65	-147.641***	-----
	(-4.704)	
Tax Rate * Gaming Dummy * Education Gap	540.420***	-----
	(4.387)	
Lottery Dummy * Lottery Demographic Index	-----	0.165***
		(19.712)
Tax Rate * Machine Demographic Index	-----	9.180**
		(2.580)
Tax Rate * Casino Demographic Index	-----	14.941***
		(3.700)
Adjusted R^2 statistic	0.927	0.902
F-statistic	151.042	153.763
Notes: * signifcant at 10% level, ** significant at 5% level, *** significant at 1% level.		
Variables categorized as Gaming includes Casinos and Machines		

While the lottery and casino interstate competition variables remained negative and significant, only two out of the three intrastate competition variables were significant in the overall gambling model. The variable specifying the intrastate competition that a state with gaming faces from its own lottery was insignificant and omitted from the model. One of the concerns with this development is that by aggregating the tax revenues and variables from the lottery and gaming model, significance and explanatory power would weaken from an overlap bias.

The demographic variables employed in this particular model survived significant multi-collinearity that favored lottery interacted variables and not casino-style gaming ones. This is most likely due to the fact that lottery tax revenues hold a major percentage of total tax revenues, thus giving lottery demographics greater significance. All four lottery demographic variables from the lottery model were included in this overall gambling model with significance at the 1% level and the expected signs. The casino-style gaming demographic variables experienced different results as the population variable was significant when omitted from the gaming model and two of the variables of the gaming model, per capita income and the unemployment rate, were omitted due to low significance.

The secondary model for overall gambling tax revenues used three demographic indexes, separate ones for the lottery, casinos and machine gaming. The levels of significance give a clear indication that the lottery demographic index, similar to the individual variables, dominated the model compared to the casino and machine gaming indexes. Besides confirming the lottery dominance in demographic variables, the secondary model verified the co-efficient signs and significance of the competition variables.

Result Consistency across all Models:

The purpose of using models with and without indexes as well as models to estimate casinos-style gaming and lotteries separately was to test consistency and verify results given high levels of potential bias. Verifying the results from the set of models will help in drawing conclusions from this study. Looking at the gaming form variables, the only dummy variable consistent is the casino gaming dummy variable. The lottery dummy variable is significant in all but the primary lottery model, in which it is most likely overshadowed by the more important demographic variables. The lottery and casino age-squared variables were both significant across all models, while the linear machine gaming age variable was only significant in one model.

Among the competition set, many of the variables were consistent. One of the minor exceptions was the counterintuitive interstate machine gaming competition variable that was positive in two models but insignificant each time the demographic index was introduced. The disappearance in significance for the lottery cannibalization of casinos in the overall model hurt the consistency found in the gaming model. The potential bias of aggregating the lottery and gaming competition variables may be the reason for such inconsistency.

The demographic variables should be considered in two separate sets, the lottery variables and the gaming variables. While the lottery variables are consistent across both models, with population being a major driver in each, the gaming demographic variables are inconsistent with the exception of education and the counterintuitive elderly age variable. The inconsistency is most likely due to the crowding out of gaming variable significance by the higher significance lottery variables.

The Fit and Limitations of the models:

The statistical measures of fit for all of the models indicated that they each had significant explanatory power and fit the data well. These statistics are partially inflated because the model was designed to predict zero revenues for the states that have no legalized gambling. To better test the fit of the models against the true tax revenues, a comparison was done on 2004 data, chosen due to the inability to collect gambling tax revenue data for 2005. The comparison measured for how many states the predicted tax revenues fell within twenty-five percent of the true tax revenues of the state (Table 5.4).

Table 5.4 - Accuracy of each Model predicting tax revenues

Tax Revenue Predictions for 2004	Method #1 Lotteries and Gaming Combined		Method #2 Total Gambling	
In 25% Range of 2004	Model #1 (w/o Index)	Model #2 (with index)	Model #1 (w/o Index)	Model #2 (with index)
Number of states	**20**	**20**	**26**	**16**
%	48%	48%	62%	38%

Tax Revenue Predictions for 2004	Method #1 Gaming Only		Method #1 Lottery Only	
In 25% Range of 2004	Model #1 (w/o Index)	Model #2 (with index)	Model #1 (w/o Index)	Model #2 (with index)
Number of states	**14**	**10**	**13**	**15**
%	78%	56%	33%	38%

This comparison table was necessary because the models predicted substantial negative gambling tax revenues (tax losses) for three states in 2004. The table is noteworthy however because it provides a better means of comparing the fit of each model. In particular, it indicates that the demographic indexes reduce the level of fit for the overall gambling model and the gaming model. While the lottery model shows a better fit with the demographic index, this is

expected because of the gain in significance of the lottery dummy variable in the secondary model. The comparison table also shows that the gaming model is the best predictor of tax revenues, as indicated by its owning the highest percentage of predictions within a twenty-five percent error margin.

A quick look at a table showing the percent differences in predicted and actual gambling tax revenues for each state in 2004 reduces confidence in the forecasting power of the best fit model (Table 5.5). The best model was determined to be the primary overall gambling model due to its highest percent accuracy. Nonetheless, nine out of the forty-two states with gambling have predicted tax revenues that are off by 100% or more. Omitted variable bias may be one reason for the errors, but the accuracy table indicates the lottery model and not the gaming model, for which there was difficulty obtaining key variables, is at fault.

There are clear limitations to this model because lottery tax revenues may be particular to states for reasons that cannot be captured in a model. The lottery operating strategy employed by a state can have a major impact on the tax revenues garnered and is one such example of a variable or reason that cannot be modeled. An approach worth trying in the future to forecast lottery tax revenues would more likely be a fixed effects model or ARIMA modeling on a particular state with key demographic variables.

Table 5.5 - Forecast vs. Actual tax revenues for 2004

2004 Predictions	Method #2 Total Gambling Model #1 (w/o Index)	2004 Actual Tax Revenues Total	% change
Arizona	$ 340	$ 113	++100%
California	$ 1,522	$ 1,104	38%
Colorado	$ 312	$ 203	54%
Connecticut	$ 534	$ 288	85%
Delaware	$ 265	$ 290	-8%
Florida	$ 925	$ 1,061	-13%
Georgia	$ 347	$ 783	-56%
Idaho	$ (90)	$ 26	--100%
Illinois	$ 1,380	$ 1,373	0%
Indiana	$ 808	$ 960	-16%
Iowa	$ 363	$ 311	17%
Kansas	$ 58	$ 71	-18%
Kentucky	$ 233	$ 196	19%
Louisiana	$ 760	$ 730	4%
Maine	$ 279	$ 44	++100%
Maryland	$ 525	$ 474	11%
Massachusetts	$ 713	$ 924	-23%
Michigan	$ 808	$ 935	-14%
Minnesota	$ 77	$ 78	-1%
Mississippi	$ 282	$ 333	-15%
Missouri	$ 653	$ 642	2%
Montana	$ (34)	$ 60	--100%
Nebraska	$ 30	$ 21	42%
Nevada	$ 796	$ 887	-10%
New Hampshire	$ 395	$ 74	++100%
New Jersey	$ 1,093	$ 1,276	-14%
New Mexico	$ 167	$ 82	++100%
New York	$ 2,173	$ 2,148	1%
North Dakota	$ (105)	$ 3	--100%
Ohio	$ 610	$ 658	-7%
Oregon	$ 447	$ 377	19%
Pennsylvania	$ 836	$ 837	0%
Rhode Island	$ 290	$ 294	-2%
South Carolina	$ 267	$ 311	-14%
South Dakota	$ 233	$ 129	80%
Tennessee	$ 407	$ 122	++100%
Texas	$ 966	$ 1,074	-10%
Vermont	$ 98	$ 20	++100%
Virginia	$ 401	$ 422	-5%
Washington	$ 185	$ 121	53%
West Virginia	$ 473	$ 559	-15%
Wisconsin	$ 139	$ 133	5%
Total Tax Revenues	$ 20,962	$ 20,544	2%

Conclusions:

This study set out to forecast the amount of gambling tax dollars that a state can obtain from legalization of casino-style gaming. The accuracy of the models makes it difficult to have great certainty of a dollar figure of tax revenues for states expanding gambling. Conclusions, however, can still be drawn about the relationships between gaming forms and what makes a gambling strategy successful.

The gaming form age and intrastate competition variables confirmed the fact that established and mature gaming forms are significant contributors to gambling tax revenues. This supports the notion of a significant first-mover advantage in the gambling industry. As such, any introduction of a new form of gaming would only erode the current established gaming form and have difficulty gaining similar magnitude in tax revenues. In terms of interstate competition, the results show that states only compete with neighboring states on similar gaming forms. A state considering the introduction of casinos or machine gaming should not be threatened by neighboring lotteries, but only other like gaming forms.

Among the demographic variables, many come as no surprise, but the education gap variable gives considerable insight into the effect education has on gambling. The differentiation between high school level and collegiate level educational attainment and the differing relationships to gambling is significant. The lottery demographic variables displayed high significance and consistency across models, indicating their importance to lottery tax revenues. The differentiator between state lotteries that was not captured by this model was strategy and leadership, components that are vital but difficult to model.

This study may not provide legislators with a dollar figure for the expansion of casino-style gaming, but it does give significant insight into the issues states must consider.

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