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The effect of casino tax policy on short-run gaming development

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THE IMPACT OF CASINO TAX POLICY ON SHORT-RUN GAMING DEVELOPMENT

by

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ABSTRACT

THE IMPACT OF CASINO TAX POLICY ON SHORT-RUN GAMING DEVELOPMENT

by

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This study examines the effect of casino tax rate structure on investment by casino operators. Using a panel data set consisting of all states with legal commercial casino gambling from 1998 to 2009, a fixed-effect model with two-stage least squares is estimated to examine the effect of gambling taxes on firms' short-run behavior. The study finds that maximum casino tax rates decrease casino employment, with an estimated average elasticity of -0.5. This result is noted to be robust to several different model specifications and data subsets. No robust relationship is found between maximum tax rates and casino wages. No significant relationship is found between effective tax rates and casino employment.

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CHAPTER 1

INTRODUCTION

Casino gaming is often cited as a desirable source to target for government tax revenue (Adam Rose and Associates, 1998; Chapman et al., 1997; Eadington, 1996, 1998; Smith, 1998). However, the way that gaming taxes are structured varies significantly from one jurisdiction to another, and even tends to differ sizeably within the same country. Although some variation is sensible, as each jurisdiction has a different market structure, the different tax policy decisions frequently seem to be made on an ad hoc basis, without full consideration to the complete economic impacts of those decisions (Anderson, 2005). This study is designed to provide guidance to policy makers, academics, and firms of how casino excise tax policy decisions can affect the economic impact of casino gaming.

Overview

In this chapter, the importance of the study is highlighted and the research questions that will be addressed through an extensive review of literature and a carefully designed empirical study are provided. Chapter two includes a summary of the tax theory related to gambling, a description of the relevant empirical studies on gaming economics and policy, and a discussion of the limitations and implications of existing academic literature. This overview of literature includes a review of how the presence of addiction and negative externalities in a small portion of the population may affect the generalizability of common economic theory. In chapter three, the econometric methodology that will be used in this study is described. In chapter four, the empirical results of a secondary data analysis on casino tax rates are provided. Finally, in chapter five, the potential applications of the results from this study are discussed, followed by discussion of considerations that should be made when designing a gaming tax structure.

Importance of Study

Both in the U.S. and throughout the World, gaming markets do not exhibit uniform structures, nor do they appear to follow any consistent economic guidelines – market structures vary from monopolies (typically run by or heavily taxed by government) to near perfectly competitive markets (which are typically taxed at a much lower rate) (Christiansen, 2005). In many jurisdictions, gaming policy has been shaped by the desire to raise (and perhaps maximize) public revenues (Adam Rose and Associates, 1998; Chapman et al., 1997; Eadington, 1996, 1998; Paldam, 2008; Smith, 1998), and to appease societal norms (Bernhard, 2007; Preston, Bernhard, Hunter, & Bybee, 1998). Indeed, the political economy of gaming in many jurisdictions has led to ad hoc policy making procedures, which may have ignored positivist theory and lead to unintended economic consequences. As noted by Gazel (1998):

> ”...with a few exceptions, many state and local economies in the United States have, most likely, experienced net monetary losses due to casino

gambling in their jurisdictions. One of the major reasons for such negative impacts is the strategy of the monopolistic or oligopolistic market structure chosen by the new jurisdictions." p.83[1]

This study attempts to highlight and estimate a potentially unintended consequence of gaming tax policy design, the effect that the gross gaming revenue (GGR) excise tax (the primary policy tool used to tax the casino industry) has on economic development by commercial casino operators.

The revenue generated from gaming taxes is often highlighted by politicians and other stakeholders as the most important indicator of the economic impact of casino gaming; but in actuality, gaming taxes are only a portion of the overall importance of the industry to the economy. Direct employment, income, gross domestic product (GDP), and other indicators of general economic activity are all important to regional economies, and policy decisions that affect these variables are critical to understand. Governments, which often view gaming as a source of tax revenue (Adam Rose and Associates, 1998; Chapman et al., 1997; Eadington, 1996, 1998; Smith, 1998; Walker & Jackson, 2008), should balance their effort to generate public funds against the deleterious effects that higher tax rates have on equilibrium levels in the gaming market.

[1]Of course, the pecuniary estimates of the effect of legal casino gambling have been widely disputed in the literature (Collins & Lapsley, 2003; Eadington, 1996, 1999a; Walker, 2007b), but notwithstanding those debates, the points made by Gazel (1998) on the effect of market structures retain some validity. Anderson (2005) has also suggested that the wide variation in tax rates that have been applied to gaming revenue warrants further economic analysis.

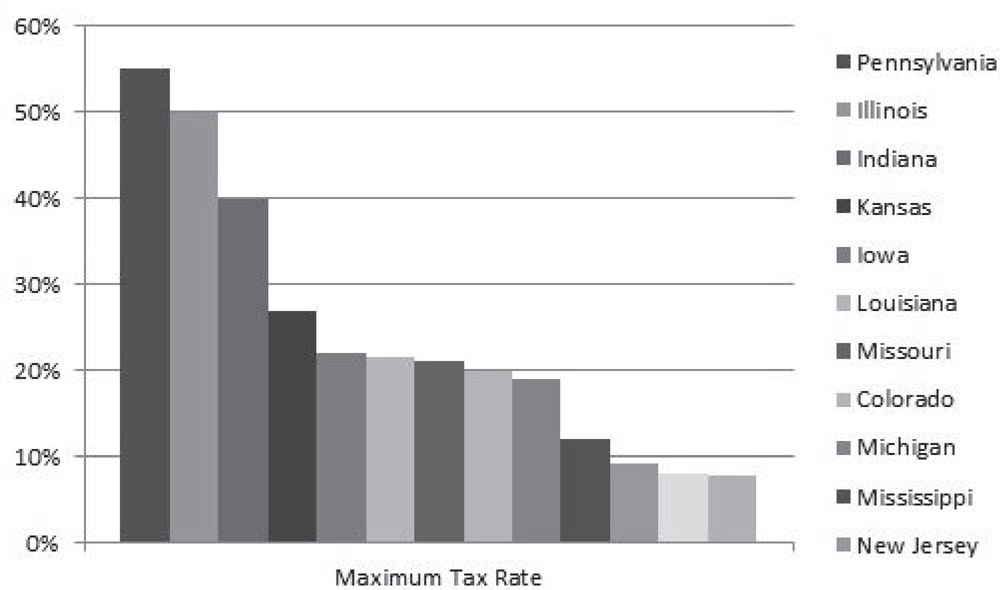

Figure 1. U.S. 2010 Gross Gaming Taxes by State

Empirically, it has been unclear how the selection of tax rate policy has affected incentives for casino investment. This may have contributed to significant variation in gaming tax rates charged across jurisdictions. As shown in Figure 1, maximum commercial casino tax rates in the U.S. varied from roughly 55% in Pennsylvania to roughly 7.75% in Nevada in 2010 (American Gaming Association, 2011). Variation in gaming tax rates is not limited to the U.S.. In the EU, gross tax rates on lotteries vary from a low of 12% in Estonia to a high of 50% in Poland (Forrest, 2008). Albon (1997) also found a similar theme of tax rate variation in the Australian market.[2]

[2]It should be noted that since gaming taxes are all applied in different manners by each jurisdiction, comparisons can sometimes be misleading. For example, 12% of the Pennsylvania tax is a transfer to the horse racing industry and their table games are also taxed at a lower rate; in addition to their ad valorum tax, Nevada also levies fees on gaming devices. This study focuses on the maximum gross gaming revenue excise tax applied commercial casino gaming, and the effective tax applied to gross gaming revenue.

To highlight the differences in policy approaches, consider the two neighboring states of Pennsylvania and New Jersey. In 2010, Pennsylvania, with its 55% gaming tax rate, generated close to four times the tax revenue of New Jersey's gaming industry, whose gaming revenue was taxed at 9.25% ($1.3 billion in Pennsylvania gaming tax revenue as compared to $306 million in New Jersey). However, the New Jersey commercial gaming industry employed close to three times as many people as the Pennsylvania commercial gaming industry (12,664 employees in Pennsylvania as compared to 34,145 employees in New Jersey)(American Gaming Association, 2010). Although there are many different factors that affect the different levels of tax revenue and employment in these two states, clearly, in terms of the casino industry's overall importance to the economy, tax revenues alone can be a misleading figure. Meich (2008) makes a similar argument in comparing the Nevada and Illinois gaming industries.

The welfare implications of developing a better understood tax system may be sizeable. The U.S. commercial casino industry alone employs 340,564 workers per year and contributes $7.59 billion in tax revenue to state and local governments in the U.S. (American Gaming Association, 2011). The total worldwide gaming industry was estimated to generate $117.6 billion in annual revenue in 2010 (PwC, 2011). Using the REMI economic impact model and some basic assumptions, Schmidt, Barr, and Swanson (1997) estimated that a four percent federal gaming tax would decrease jobs in Clark County by 11,454. Although this number appears to only be a very rough estimate, if it is close to the true effect in terms of order of magnitude, the importance of having a well regulated gaming market should be clear.

Research Questions

To date, no study has sought to empirically estimate the effect that casino excise taxes have on the decisions made by firms. This may have led to decision makers making uniformed decisions, and may have contributed to the wide array of market structures and tax policies observed in jurisdictions around the World. Although some studies such as Christiansen (2005) or Thompson (2011) have offered discussion of this issue, these studies have tended to be mostly qualitative descriptions that relied on endogenous cross-section correlation to support their findings. In this study, a multivariate approach is employed, intended to control for potential endogeneity from tax policies and market structures that are defined simultaneously by governments. Specifically, the following research questions are posed:

1. Maximum gross gaming revenue tax rates ⇒ Employment:

   What is the effect of a change in the maximum GGR tax rate on commercial casino employment?

2. Maximum gross gaming revenue tax rates ⇒ Wages:

   What is the effect of a change in the maximum GGR tax rate on commercial casino wages?

3. Effective gross gaming revenue tax rates ⇒ Employment:

   What is the effect of a change in the effective GGR tax rate on commercial casino employment?

4. Effective gross gaming revenue tax rates ⇒ Wages:

What is the effect of a change in the effective GGR tax rate on commercial casino wages?

5. Admission tax $\Rightarrow$ Employment:

   What is the effect of an admission tax on commercial casino employment?

6. Admission tax $\Rightarrow$ Wages:

   What is the effect of an admission tax on commercial casino wages?

In the absence of having firm level data available, the maximum tax rate is an appealing metric to study since it tends to reflect the marginal tax paid by the largest firms.[3] The effective tax rate is also interesting independent variable since it describes the average tax rate paid by firms, and therefore may capture some of the effects on smaller casinos. Although economic theory would suggest that firms only make decisions based on marginal rates, the effective tax may provide additional explanatory power in what tends to be a non-linear tax (as a function of gross revenue). Finally, admission taxes are an interesting policy tool to study since they are a retail gaming tax but are somewhat different from gross gaming revenue taxes as they do not directly tax consumption – an analogy to this design is a tax by a policy maker who wishes to reduce greenhouse gases from automobiles, but instead of levying a tax on the sale of fuel, he levies an (admission) tax on the sale of cars. It should be noted that admission taxes are generally levied as a secondary source of public revenue, on top of gross gaming revenue taxes.

[3]Relevant to this discussion, there is evidence of economies of scale in the casino industry (Gu, 2001).

Limitations

This empirical study focuses on the effect of commercial casino taxation in the U.S. at the state level. As such, the estimates will reflect statewide average effects, and may not be indicative of decision making at the firm level, or for states that do not reflect the average effect. Given the nature of how gambling is provided in other countries, the results from this study may not be generalizable beyond the U.S. border, as many intangible factors are known affect the gaming market, such as competitive philosophies, culture, and politics – as noted by Eadington (1999b)

> ...jurisdictions have undertaken fundamentally different approaches in introducing casino and casino-style gambling on such issues as ownership, market structure, permitted locations, and operating constraints. These different approaches reflect diverse philosophic, political and cultural views on how best to exploit the gains associated with allowing casinos, while at the same time mitigating negative side effects and political backlash related to permitted gambling. (p.134)

Implicit in the method chosen for the analysis, the assumptions required of regression analysis are presumed to hold. Those assumptions are empirically tested where possible, and are noted where tests cannot be performed. As this study relies on secondary data amalgamated from several different sources, the findings rely on the presumption that the acquired data is accurate and reliable.

This study is also limited by the availability of data, and the limitations of that data set. For example, the availability of neighbouring jurisdiction gaming, tribal gaming, online gaming, and other substitutionary goods would surely enable a more accurate estimate of the model coefficients. However, the ability to retrieve such data– and estimate a model over a sufficiently large sample that satisfies the central limit theorem – is not wholly feasible. This issue of potential misspecification extends to more abstract variables such as local attitudes towards gaming and local market structure. To address these limitations, carefully applied proxy variables are used, and other methods to address endogeneity are applied.

Definitions

Admission tax: A tax levied for each patron entering a casino. Typically these have been applied on riverboats in Illinois, Indiana, and Missouri (Anderson, 2005).

Commercial casino: A land-based, riverboat, or dockside casino as defined by the American Gaming Association (American Gaming Association, 2010). This does not include tribal casinos or card rooms.[4]

Effective tax rate: Total tax revenue from gaming excise taxes divided by total gross gaming revenue (American Gaming Association, 2010).

Elasticity: The percentage change in one variable given a percentage change in another variable (Mas-Colell, Whinston, & Green, 1995).

[4] The AGA only includes racetrack casinos in Indiana, Iowa, Louisiana and Pennsylvania as part of the commercial casino category, primarily because these four states also had other forms of commercial casinos in addition to their racetracks.

Endogenous variable: A variable correlated with a regression model error term. Endogenous variables violate an assumption of regression analysis and produce biased coefficients (Wooldridge, 2006).

Fixed effect: A static difference between one member of a population and the others (Wooldridge, 2006).

Gross gaming revenue: The amount wagered by players less the winnings returned. Revenue generated by a casino prior to any taxes, expenses, or promotional allowances (American Gaming Association, 2010).

Real gross state product: The sum of incomes earned by labor and capital and the costs incurred in the production of goods and services (U.S. Bureau of Economic Analysis, 2011).

Instrumental variable: In an equation with an endogenous explanatory variable, a variable that does not appear in the equation, is uncorrelated with the error in the equation, and is (partially) correlated with the endogenous explanatory variable (Wooldridge, 2006).

Instrumental variable estimator: An estimator in a linear model used when instrumental variables are available for one or more endogenous explanatory variables (Wooldridge, 2006).

Maximum tax rate: The highest ad valorem tax rate levied on gross gaming revenue. Where a set of gaming tax rates exist for various games or revenue in a jurisdiction, the maximum tax rate is defined as the highest value within this set (American Gaming Association, 2010).

Summary

The results of this study will provide an estimate of the change in gaming employment and wages that arise from a given change in the gaming tax rate. With this figure, policy makers will be able to use estimates of the economic impact of casinos to make much more informed decisions of the effects of their tax structures. The gains in tax revenue from a higher tax rate will be able to be balanced against the losses in economic impact, and those related economy wide taxes. This will also enable future researchers to calibrate general equilibrium models, which could compute the economically efficient or overall tax revenue maximizing tax rates, depending on research objectives.

CHAPTER 2

REVIEW OF RELATED LITERATURE

This section outlines the relevant literature for this study. First, a review of general tax theory is provided, followed by more specific discussion of taxation in the gaming industry. Discussion of literature relevant to the assumptions of these studies is then provided, including a review of gamblers economic characteristics within the political economy.

Tax Theory

Taxes are a necessary part of a well-functioning economy. When imposed correctly by government, they allow public welfare to increase beyond what would be available in their absence by providing funding for public goods. First-best taxation is characterized by lump-sum taxation, which does not distort competitive equilibriums – effectively, it is a transfer of wealth from one party to another that does not affect marginal decision making.[1] Under the assumption that government can redistribute wealth through these lump-sum transfers, the second fundamental theorem of welfare economics states that any pareto optimal outcome can be reached through transfer pay-

[1] The perversely phrased ”first-best taxation” is written as such since it is a corollary to ”second-best taxation” without lump-sum transfers.

ments (Mas-Colell et al., 1995), therefore any initial pareto optimal outcome is acceptable since all others are possible.

In the absence of an ability to use lump-sum taxes, the optimal commodity taxation structure has been described by Ramsey (1927). In his contribution, Ramsey concludes that if there are no correlations among commodities, that the tax rate should be inversely proportional to their price elasticities. That is, goods whose demand will respond least to a change in price should be taxed at a higher rate. Where correlations exist among the demand for goods, the policy prescription becomes more complicated as the effect of commodity taxes on a given good must be balanced against the change in demand (and therefore commodity tax revenue) of other complimentary and substitutionary goods.

Given the results of Ramsey (1927), the theoretically correct tax policy in gaming is not clear. Normative policy is complicated by various gaming industries ties to one another (Philander, 2011; Walker, 2007a) and their ties to the overall tourism industry (Eadington & Doyle, 2009). For example, since gaming is strongly tied to the lodging industry, a high tax on gaming may adversely affect tax revenue generated from hotels. Similarly, a tax on gaming may increase public revenue obtained from the amusement park industry if the two goods act as substitutes in the larger entertainment sector.

Diamond and Mirrlees (1971) show that in the absence of (first-best) lump-sum taxes, governments that require revenue should not tax intermediate goods and should instead tax final goods (like retail gaming) as this maximizes economic efficiency. Their study assumes that firms are characterized by constant returns to scale and zero externalities, which is not applicable in general to the gaming industry (Collins & Lapsley, 2003; Gu, 2001; Walker, 2007b).[2] Therefore, it may be more efficient to tax gaming suppliers, such as slot manufacturers, if gaming operators have some degree of market power or are characterized by economies of scale.

In the presence of externalities (a cost or benefit that is incurred by a third party of a transaction) optimal commodity tax policy is no longer characterized by the conditions described by Ramsey (1927). If consumption of a particular commodity leads to a negative externality, Pigou (1920) and Baumol (1972) suggest that those goods should be taxed at a higher rate. In particular, a "pigovian" tax should be equal to the negative externality, such that the private market is forced to internalize the social cost of the activity. Higher (pigovian) taxes could therefore be efficient if they are applied to offset social costs of gaming, such as those noted by Walker (2007b), Collins and Lapsley (2003), and Eadington (1996, 2003). As shown in Figure 2, a tax that increases the market price from P^* to P_d will reflect the full social cost of the good, and reduce the

[2] Although many of the specific negative impacts of gambling have been disputed (both in terms of their magnitude and the relevance), the discussion of the social costs of gambling, such as by Eadington (1996, 2003), Walker (2007a), Walker (2007b), and Collins and Lapsley (2003) has included:

- Reduced workforce production
- Health and counseling costs
- Increased policing, judicial system, and insurance costs from higher crime
- Regulatory, research, and evaluation costs
- Social assistance costs
- Loss of life, suffering, stress, and cultural impacts

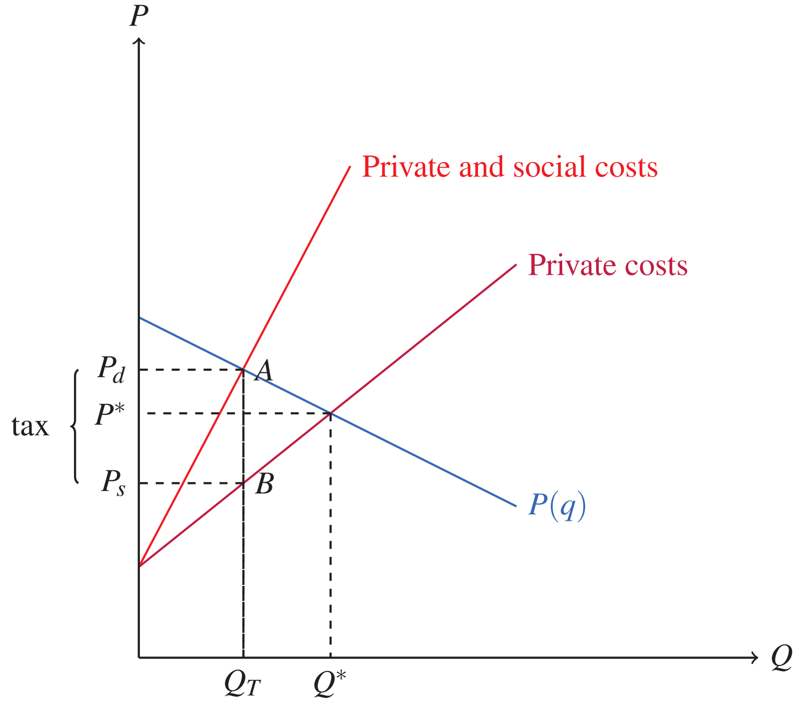

Figure 2. A Pigovian tax that increases the market price from P^* to P_d will reflect the full social cost of the good, and reduce the quantity consumed from Q^* to the efficient Q_T level. This generates tax revenue equal to the area P_DABP_S

quantity consumed from Q^* to the efficient Q_T level. This generates tax revenue equal to the area P_DABP_S.

In some cases, a tax greater than that described by Baumol (1972) may be appropriate. Tullock (1967) and Sandmo (1975) suggest that higher taxes may be desirable if those sin taxes are able to offset distortive taxes elsewhere in the economy, such as income taxes that reduce the incentive to work. This phenomenon has been described in the environmental economics literature as a double dividend (Pearce, 1991) since the tax both reduces the harmful externality and offsets distortions elsewhere. The double dividend is frequently cited as a reason to implement pollution based taxes.

Gaming Tax Policy

The theoretical discussion above addresses neither the incidence of the tax, nor the manner in which taxes are applied to the gaming industry. Although the first fundamental theorem of welfare economics would suggest that incidence of the tax is not a concern (Mas-Colell et al., 1995) – and therefore any undesirable regressivity of the tax structure can be corrected through transfers to low income groups – that theory assumes zero transfer costs in the economy, which is both intuitively unlikely and has been empirically shown to not be true in gaming (Smith, 1998, 2000). Empirical research in the gaming market has also shown mixed results in terms of earmarking gaming tax revenue (Smith, 1998), making the evidence of gaming tax regressivity (Borg, Mason, & Shapiro, 1991; Mason, Shapiro, & Borg, 1989; Price & Novak, 1999; Rivenbark, 1998; Suits, 1977, 1982) unlikely to be reversed through government transfers.[3]

In Australia, gaming taxes do not appear to follow any sort of pigovian objective. Chapman et al. (1997) found that the most socially harmful forms of gaming were not taxed at a higher rate in Australia. Taxes on pokies were fairly low, while the tax rate on less socially harmful lotteries was comparatively much higher. Similar comparative tax levels are illustrated in the U.S. by Clotfelter (2005).

Smith (1998) has conjectured that the reason for the observed tax levels is that gaming taxes have been set in order to capture economic rents, rather than to internal-

[3]The term gaming tax regressivity is used loosely in the literature, without a full consideration of what proportion of the tax falls to producers. In a monopolistic market structure, a monopolist would set quantity to maximize economic rents and therefore any specific excise tax would reduce producer surplus through an effective lump-sum transfer of economic rents, but not affect consumer surplus.

ize negative externalities. Walker and Jackson (2008) have also suggested that governments set gaming tax policy to maximize revenue rather than economic welfare. Eadington (1999a) cited an example where Illinois increased its percentage tax on casino winnings from 20 percent to 35 percent, in order to capture unforeseen economic rents that accrued as a result of the lower initial tax level. Chen and Chie (2008) found that average lottery tax rates were quite similar to the public revenue maximizing estimates that they produced. The tax revenue maximizing theory is not undisputed. Adam Rose and Associates (1998) and Meich (2008) suggest that tax rates reflect a joint objective to both raise public funds and to punish an activity characterized as sinful.

In terms of the decision of whether to implement ad valorem or specific excise taxes, Paton, Siegel, and Williams (2001) find that ad valorem taxation of net revenue is an alternative that is at least as efficient as a commodity based tax on gross stakes. Some jurisdictions, such as Singapore, Illinois, Indiana, and Missouri, have adopted a two-part tariff tax model where both an admission tax and a tax on gaming revenue is applied.[4] Anderson (2005) has noted that, "In practice, the wagering tax revenue typically goes to the state, while the admissions tax revenue goes to the casino host local government...Research is needed to analyze the optimal combination of admission fees and wagering taxes." (p.321)

An important distinction of the gaming industry compared to most other "sin" goods or industries with negative externalities, is that gaming is often introduced as an export good to other jurisdictions. That is, the home state is able to capture the eco-

[4] Singapore admission taxes do not apply to foreign visitors.

nomic rents from foreign state visitors, while exporting many of the negative externalities when the visitors return to their foreign homes. This changes the efficient strategy of the home state, and may lead to economically efficient proliferation of gaming, beyond that which would be prescribed by Pigou (1920). As stated by Eadington (1999a):

> Historically, casinos have often been introduced to capture economic benefits from "exporting" casino gaming to customers from regions where the activity is prohibited. Jurisdictions that legalized casinos were often resource poor, or under economic duress. One or both of these factors apply to Monaco (1863), Nevada (1931), Macao (in the early 20th century), the Caribbean (1960s), and Atlantic City (1976). (p.186-187)

This exportation strategy may also help explain the emergence of small island nations – such as Antigua, the Isle of Man, and Alderney – as large suppliers of online gaming licenses and regulation. However, this competitive result may only lead to short-run economic rents and eventually a long-run oversupply of gaming, as neighboring jurisdictions seek to legalize gaming to capture some of the economic benefits of gaming to offset the negative externalities that are being exported to their region. Calcagno, Walker, and Jackson (2010) have found that a determinant of casino legalization in a U.S. state is the availability of casino style gaming in a neighboring state.

Problem Gambling Political Economy

There are many different ways to classify gamblers for policy making, but a common delineation that is made is between problem gamblers and non-problem gamblers (American Psychiatric Association, 2000). In terms of their economic characteristics, there is evidence that these two groups exhibit different behavior in response to direct measures of price and their demand's sensitivity to gaming amenities. In their 1999 report, The Australian Productivity Commission 1999 modeled problem gamblers as having a more inelastic demand curve than non-problem gamblers, reflecting a lower sensitivity to price changes. A similar view on the reduced sensitivity of problem gamblers to price has been expressed by several authors, including Clarke (2008), Paldam (2008), Quiggin (2000); and Forrest (2008).

Since tax policy is often used as an instrument to regulate the gaming industry, examining how taxes affect each of these groups – either directly, or indirectly through an increase in gaming operators' costs – seems to be an important policy consideration. The potential for policy decisions that lead to the opposite of the intended outcomes is noted by Forrest (2010):

> Advocates of restrictive regulation have proposed that high prices should be retained in a gambling market in order not to encourage over-consumption by existing and potential problem gamblers. For this to be an effective policy, it would have to be the case that any fall in price would raise losses among dysfunctional players. Whether or not this or the contrary occurs depends on whether demand from this pool of players is 'elastic' or 'inelastic'. Inherent problems exist in designing an experiment to settle this issue and, to date, no relevant scientific evidence is available. (p.15)

Similar concern has been expressed by Smith (2000):

> Taxation is also perhaps an overly blunt instrument for achieving the social goals of gambling policy. Regulation may be more effective at restricting gambling and limiting the harmful effects of problem gambling than higher tax rates. Because excessive gambling impacts on a gamblers family and friends, high gambling taxes may worsen financial difficulties for problem gamblers, and add to the difficulties of children and spouses financially dependent on heavy gamblers. That is, prohibitively high rates or 'user pays' taxes on gambling may produce more gambling problems than they prevent. (p.136)

These authors' suppositions suggest that treating tax policy in the gaming industry in a manner similar to the way it is treated in other industries may not be appropriate. Put simply, an excise tax with a pigovian design may disproportionally discourage recreational gamblers over problem gamblers, and therefore not cause problem gamblers to fully internalize the social costs of their behavior.

There is evidence that gamblers are unable to perceive changes in the payback percentage of slot machines while at slot machines (Lucas & Singh, 2011; Weatherly & Brandt, 2004), which may alleviate some undesirable distortions from higher tax induced par values – that is, problem gamblers and non-problem gamblers would respond in a similar way to an increase in price. However, this does not imply that gamblers are insensitive to other factors that are influenced by the cost structure of gaming establishments. Differences could include advertisements (Derevensky, Sklar, Gupta, & Messerlian, 2010; Monaghan, Derevensky, & Sklar, 2008), casino assets/amenities (Lucas &

Kilby, 2008; Lucas & Santos, 2003; Suh & Lucas, 2011), and non-experience based price indicators, such as par values that can be retrieved from gaming commissions. Many price changes can also be clearly observed at table games, such as rules changes in blackjack or the addition of a second '0' on roulette wheels (Eadington, 1999a). For high-end players, sensitivity to price is especially transparent, as noted by Eadington (1999a):

> Casinos compete most significantly over internal policies like maximum limits that such top-end players are permitted to wager, credit facilities, advanced deposit requirements, and the handling of cash. Moreover, casinos often provide discounts to these customers by offering rebates on losses and commissions paid on handle. (p.180)

Problem gamblers and non-problem gamblers may respond in a different manner to any or all of the factors influenced by gaming establishments' cost structures. Finlay, Marmurek, and Londerville (2007) found that problem gamblers were significantly less sensitive to environmental pleasure than non-problem gamblers, and therefore may be more likely to gamble more in lower quality casino environments. Hewig et al. (2010) found that problem gamblers are more likely to make within game decisions that have a higher house advantage than non-problem gamblers, displaying more risk-loving behavior.

The discussion above is not intended to convince the reader that problem gamblers are much less sensitive to price and amenities. Indeed some scholars have postulated that the experience of problem gamblers would make them more sensitive to price

(Weatherly & Brandt, 2004); but the importance of considering this issue during the creation of a broad tax policy is high, given the plausibility that current policies are not targeting those consumers whom they were intended for.

Rational Addiction

Becker and Murphy (1988) make an interesting contribution with applications to the gaming tax literature in their discussion of a model of rational addiction. In their article, Becker and Murphy use a neoclassical framework to make predictions about rational agents behavior in regards to consuming addictive goods. The authors define their model as a consumer utility maximization problem with a numeraire good y, an addictive good c, and a level of addiction s. The consumer is forward looking, and therefore maximizes his utility over a (generally infinite in the article) timeline, subject to a budget constraint and another equation showing the rate of change in the stock level of addition over time – an increase in the past consumption of an addictive good will increase the utility obtained from the same good at present. Preference for goods are defined idiosyncratically such that they may be addictive to some people, but not others. [5]

A particularly interesting prediction of their model is that consumption can either be defined by steady or unsteady states, depending on the nature of preferences and the stock of assets and addiction. Becker and Murphy use the term "adjacent com-

[5]Becker and Murphy are quick to note that addiction as defined by their model design is not confined to detrimental activities such as drug use, alcohol abuse, or pathological gambling, but also healthy activities.

plementarity" to describe the case where a consumer will continue to consumer more of the addictive good if below the steady state equilibrium, and less if above. This idea is relatively straightforward to conceptualize if one thinks about a very mildly addictive good (such as gambling for most of the public), where the concave nature of the utility curve (characterized by diminishing marginal utility from consumption of any good including gambling), will not lead to unstable binges or a quick "cold-turkey" end to consumption.

Becker and Murphy describe the other potential consumption pattern as unstable. In this case, the forward looking consumer either binges on the good, consuming an increasing amount as time tends to infinity, or continues to reduce consumption until he no longer consumes any more of the good. Figure 3 illustrates the two potential scenarios. At s^{*1}, consumption is stable at level c^{*1} and any exogenous deviation from this point will be corrected by a move back towards it. The other inflection point is at coordinate (c^{*0}, s^{*0}), where stock levels of addiction below this point lead to cessation of consumption and levels above this point will lead to continued increased consumption. The authors describe this space above (c^{*0}, s^{*0}) as a conceptualization of tolerance phenomenon of addictive goods, characterized by the continual need to increase consumption in order to satisfy the same need this is a behavior that is commonly used to diagnose problem/pathological gambling (American Psychiatric Association, 2000). It should be noted that the model predicts that the more addictive a good is, the more likely the case will be that there is an unstable steady state.

The presence of this inflection point outcome is interesting from a tax policy perspective. If we assume that the market for gaming is perfectly competitive, an excise tax would be fully passed on to consumers. This increase in the consumer price would lead to coordinate (c^{*0}, s^{*0}) moving up, and would cause the group of consumers that were above the old inflection point but below the new point to discontinue consumption instead of "binging" to infinity. However, if the market is monopolistic, the results are not as clear. If a non-ad valorem tax structure is used – in particular, if a specific tax is used – firms will have no incentive to change their price or quantity supplied, since they will remain at the profit maximizing equilibrium. Although fully specific gaming taxes are rare, quasi-specific taxes such as licensing fees (per table, gaming device, or casino) are often used, and therefore may make poorer policy instruments for reducing harm than ad valorem taxes.[6]

[6]Of course, tax structure is not the only policy tool available for the control of the health issues and negative externalities that arise from casino gambling.

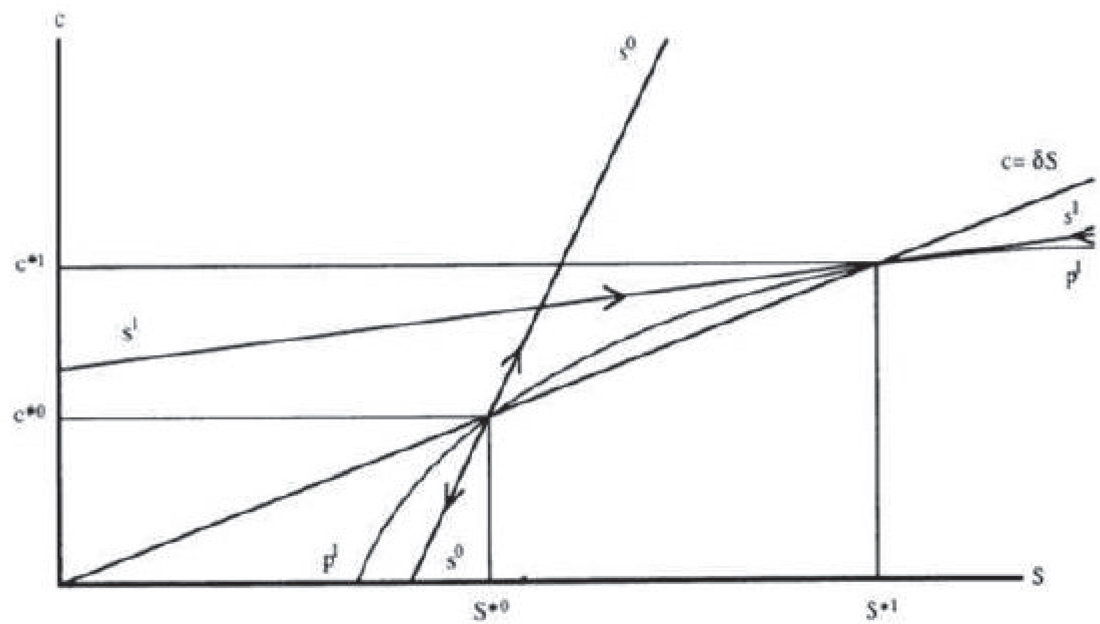

Figure 3. The Becker-Murphy Consumption Model illustrates two potential scenarios. At S^{*1}, consumption is stable at level C^{*1} and any deviation from this point will be corrected by a move back towards it. The other inflection point is at coordinate (C^{*0}, S^{*0}), where stock levels of addiction below this point lead to cessation of consumption and levels above this point will lead to continued increased consumption. Adapted from "A Theory of Rational Addiction," by G.S. Becker and K.M. Murphy, 1988, *Journal of Political Economy, 96*, p.681.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

The following section outlines the methodology used to complete this study. First, a justification of the secondary data analysis method is provided, followed by a description of the empirical estimation techniques. Then, an overview of the specific estimated models is provided, along with a description of the estimation data.

Methodological Justification

In order to estimate the effect of gaming tax rates on casino development, a secondary panel data analysis method is used. Secondary data is preferable to primary data in this case since the reliability and validity of self-report gambling behavior has not been well established for periods of several years, which would be necessary to account for infrequent changes in tax rates (Hodgins & Makarchuk, 2003; Volberg, Gerstein, Christiansen, & Baldridge, 2001). Similarly, to use a difference in difference type natural experiment method along with a firm survey would require sufficient changes in the tax rate, which occurs infrequently in the market. List-wise deletion will be used to missing data fields, which will lead to an unbalanced panel.

Accordingly, time series data on the 13 states that offer commercial casino gaming was obtained from the American Gaming Association (AGA) for the period from

1998 to 2009, to form a panel data set (American Gaming Association, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010) – this data consists of a census of all commercial casinos in the U.S., including their employment and wage figures. Both effective gaming tax rates (gaming tax revenue divided by gross gaming win) and maximum gaming tax rates are examined as explanatory variables. Effective tax rates are appealing since they exhibit the average tax rate paid, and maximum tax rates are appealing since they tend to indicate the marginal tax paid by the largest operators. An additional binary variable indicating whether the jurisdiction has an admission tax (i.e. riverboat entry fee) is included as part of the analysis, giving this study three different measures of casino taxation.

Employment and wages are both proposed as proxy variables of economic development. Employment and wages (income) are commonly used as variables to measure in economic impacts (Daley, Ehrlich, Landefeld, & Barker, 1997; Lynch, 2000; Weisbrod & Weisbrod, 1997), and may be a better response variable to changes in tax rates than, say, capital expenditures since they can be more readily adjusted by operators. Although capital investment is an alluring dependent variable because it reflects operators investments decisions, this variable tends to be relatively static since casino investments can take periods of several years to buy or sell. This will likely lead to insufficient variation in the data to reveal statistically robust findings, and will likely lead to Type II errors. Capital investment measures such as property, plant, and equipment may also excessively reflect accounting based measures of value (e.g. annual decreases due to depreciation/amortization) and will therefore bias estimates of the true economic value.

Christiansen (2005) found similar trends when comparing tax rates to capital investment and casino employment, further validating the use of employment as a dependent variable that will capture the general economic impacts. As socioeconomic control variables, state level income and labor data have been obtained from the Bureau of Economic Analysis, while population and unemployment data have been obtained from the U.S. Census Bureau.

To analyze the compiled secondary database, a fixed effects panel model design with two-stage least squares is used. Secondary data analysis creates difficulty in attributing causality, since producing consistent coefficient estimates requires eliminating the omitted variable bias. Previous analysis on this casino tax research topic, such as that done by Christiansen (2005) and Thompson (2011), likely suffered from endogenous cross-section correlational, and therefore may reflect non-causal relationships and biased estimates. In this type of analysis, the presence of different gaming policy restrictions and different market structures in each state creates measurement issues if a non-robust model is used. In particular, if a multiple linear regression (OLS) model was used that failed to account for those unobserved terms, a inconsistent estimate would be made that would compromise the findings of the study (Wooldridge, 2010).

Fixed effects models are commonly used in panel data sets when there is an immeasurable unobserved effect in each section, in order to alleviate omitted variable issues. This method alone does not ensure an unbiased estimate – if there are non-constant omitted variables within the model that are correlated with the variable of interest (gaming tax rate) the study estimates may be biased – but it greatly improves the reliability of the analysis over a pooled estimation procedure. In order to account for other potential endogeneity in the wage term, this study also implements a two-stage least squares instrumental variable approach.

Since there may be non-constant factors in the model error term that affect both the gaming tax and casino employment (e.g. tribal gaming, political environment, or a change in commercial gaming licenses), ordinary least squares (OLS) estimates may produce biased coefficient estimates. The two-stage least squares estimator consistently estimates the wage regression parameter by using an instrument to purge out the correlation between the explanatory variable and the model error term. Two-stage least squares estimation produces a consistent coefficient estimate through the use of an exogenous instrumental variable (Wooldridge, 2006).

In this study, two instruments are proposed for the endogenous gaming tax variable. The first instrument is the total state wide tax revenue as a percentage of state GDP. Tax revenue as a percentage of GDP is a common statistic used to measure the overall jurisdictional design of compulsory transfers to the state, e.g. OECD (2011). The second instrument is the total state wide alcohol tax revenue, as a percentage of state GDP. This second variable is similar to the first, but focuses on revenue from another specific sin tax.

In instrumental variable estimation, two necessary conditions need to be satisfied by valid instruments. The first condition is a correlation of zero between the instrument and the structural model error term. In this model, that would be characterized by $Cov(StateTaxRate_{it}, u_{it}) = 0$ and $Cov(AlcoholTaxRate_{it}, u_{it}) = 0$. Second, it must be the case that the instrument and the endogenous variable be correlated, i.e. $Cov(StateTaxRate_{it}, GamingTaxRate_{it}) \neq 0$ and $Cov(AlcoholTaxRate_{it}, GamingTaxRate_{it}) \neq 0$.

Theoretically, it seems intuitively plausible that the overall state-wide tax rate will not provide any additional explanatory power to gaming employment beyond what is already addressed by the model through the gross gaming revenue tax, the other control variables, and the fixed effects variables. For example, if the presence of a particularly pronounced recession in a single state causes both the gaming tax and the state-wide tax to change simultaneously, the economic control variables such as real GDP or the unemployment rate will likely capture this variation in the structural regression model. With regards to the alcohol tax rate variable, this seems even more likely to satisfy the first necessary condition of valid instruments. The variable focuses on a tax attributable to another industry and should not have a direct effect on casino employment. In addition to these theoretical arguments, an empirical Hansen J overidentification test (Hansen, 1982) will be conducted on the data to support the validity of these variables as instruments.

The second condition of a non-zero correlation between the gaming tax and state-wide tax has not been established empirically in the literature, however Furlong (1998) did find that tax collections contributed to casino adoption at the state level. Calcagno et al. (2010) also found that other fiscal variables affected casino policy adoption. With regards to the alcohol tax rate, it seems plausible that states that choose to heavily tax one sin good will also heavily tax other legal sin goods, so a positive relationship is expected between these variables. To reduce any theoretical concerns about the satisfaction of the $Cov(StateTaxRate_{it}, GamingTaxRate_{it}) \neq 0$ and $Cov(AlcoholTaxRate_{it}, GamingTaxRate_{it}) \neq 0$ assumption, empirical tests will also be conducted for the variables' signifance in predicting the gaming tax rate variable and the overall F-test of weak identification value (Staiger & Stock, 1997).

Model Design

In this section, the set of equations describing this study's estimation model is provided, along with a description of the various secondary data sources used to estimate the model coefficients.

First, consider linear Equation 1 defining the underlying relationship between economic output and gaming taxes:

$$y_{it} = \alpha_0 + \beta_1 \cdot \ Tax_{it} + x_{it} \cdot \lambda + d_t \cdot \delta + v_i + u_{it} \tag{1}$$

Where,

y_{it} is the indicator of casino gaming development, including:

- Casino Employees (American Gaming Association, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010)
- Casino Wages (American Gaming Association, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010)

α_0 is the model constant

Tax_{it} is the primary variable of interest, including:

- Maximum gaming tax (American Gaming Association, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010)
- Effective gaming tax (American Gaming Association, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010)

β_1 is the gaming tax coefficient

x_{it} is a vector of factors that affect gaming development that vary by state and year, including:

- Real gross state product (U.S. Bureau of Economic Analysis, 2011)
- Real personal income per capita (U.S. Bureau of Economic Analysis, 2011)
- Unemployment rate (U.S. Bureau of Labor Statistics, 2011)
- Population size (U.S. Census Bureau, 2011)
- Gaming availability proxied by number of instate commercial casinos (American Gaming Association, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010)
- Productivity proxied by gross gaming revenue per employee (American Gaming Association, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010)

- A binary variable indicating the presence of an admission tax (American Gaming Association, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010)

λ are the slope regression coefficients for x_{it}

d_t is a vector of non-state specific factors that affect gaming development and vary by year, including:

- The AGA measures of national gaming acceptability (American Gaming Association, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010)
- Other variables proxied by binary year variables

δ are the coefficients for non-state specific factors that affect gaming development and vary by year

v_i are state specific constant factors that affect gaming development

u_{it} is the model error term

Since the available data outlined in the bulleted sections above may not fully specify Equation 1, the model may produce a biased estimate of β_1. That is, it may be the case that missing variables included in the model error term, u_{it}, are correlated with our variable of interest (i.e. $Cov(Tax_{it}, u_{it}) \neq 0$). The proposed remedies to this methodological issue are outlined below.

Fixed Effects

If the mean of Equation 1 is taken over time and subtract it from itself, we have:

$$y_{it} - \overline{y}_i = \alpha_0 - \overline{\alpha}_0 + \beta_1 \cdot \ (Tax_{it} - \overline{Tax}_i) + (x_{it} - \overline{x}_i) \cdot \lambda + (d_t - \overline{d}) \cdot \delta + v_i - v_i + u_{it} - \overline{u}_i \quad (2)$$

or alternatively,

$$\ddot{y}_{it} = \beta_1 \cdot \ \ddot{Tax}_{it} + \ddot{x}_{it} \cdot \lambda + \ddot{d}_t \cdot \delta + \ddot{u}_{it} \quad (3)$$

Where the umlauts denote the time-demeaned values, but note that the coefficients remain the same for our variable of interest, and our other non-static variables. This fixed effects estimation method removes the need to specify a model with the state specific constant factors that affect gaming development. This reduces bias in our model from state specific factors that are difficult to control through proxy variables.

Two-Stage Least Squares

Since there may be other non-static variables that affect our two dependent variables (real casino wages and employment), we still may not have a fully specified model. If it is the case that those omitted variables now contained in $\ddot{u}_{it}$ are correlated with our tax variables of interest, we will still be violating the assumption of ordinary least squares whereby $Cov(\ddot{Tax}_{it}, \ddot{u}_{it}) \neq \ 0$. That is, our estimates of β_1 will suffer from the classic endogeneity problem, even with the fixed effects included in the model design. As a remedy for this potential bias, we specify the following reduced form (first stage) equation to obtain exogenous estimates of $\ddot{Tax}_{it}$, $\hat{Tax}_{it}$.

$$\hat{Tax}_{it} = \ddot{x}_{it} \cdot \pi + \ddot{d}_t \cdot \omega + \beta_2 \cdot z_{it} + \mu_{it} \tag{4}$$

In this equation, z_{it} denotes our instruments, effective statewide tax revenue per gross state product (Federal Reserve Bank of St. Louis, 2011; U.S. Bureau of Economic Analysis, 2011) and effective alcohol tax revenue per gross state product (Institute & Institution, n.d.; U.S. Bureau of Economic Analysis, 2011), which must satisfy the conditions previously described.

The fitted values from this first stage model are then used to replace the potentially endogenous wage variable in the second stage model. The second stage (structural) model equation is then:

$$\ddot{y}_{it} = \hat{\beta}_1 \cdot \ \hat{Tax}_{it} + \ddot{x}_{it} \cdot \lambda + \ddot{d}_t \cdot \delta + v_i + \ddot{u}_{it} \tag{5}$$

Which produces the now consistent estimator, $\hat{\beta}_1$.[1][2]

[1]The estimation procedure used by statistical packages differs somewhat from this explanation, but the logic for using an instrument to obtain a consistent instrumental variable for our endogenous variable of interest remains the same.

[2]For a proof that $\hat{\beta}_1 = \beta_1$ see Wooldridge (2010).

Summary

This section provided an overview of the method used to analyze the effect of casino taxes on employment and wages. The data used to complete this study is noted to come from an annual census conducted by the American Gaming Association of all U.S. commercial casinos. To supplement this gaming data, socio-economic control variables are extracted from various government databases. As a remedy for likely missing data to fully specify Equation 1, this study uses a fixed effects two stage least squares regression analysis to correct for potential endogeneity in the casino tax variables.

CHAPTER 4

RESULTS

The following chapter outlines the empirical results of the study. First, an overview of the data used in the analysis is provided, followed by an estimation of equation 5 from Chapter 3, including several tests of the assumptions of two-stage least squares. Then, to ensure the robustness of the results, several other related models are estimated. These include random-effect models, regression-adjusted models, alternate instrumental variables, a log-linear model, and various subsets of the data. Finally, alternate forms of the dependent variable and the variable of interest are estimated. The chapter concludes with an overview of the general results from the empirical analysis.

Data Overview

As discussed in Chapter 3, the empirical analysis makes use of data amalgamated from several sources. This section includes an overview of the data's summary statistics and includes plots of key variables over time.

Summary statistics of the non-binary variables are provided in Table 1. As shown in the table, all non-binary variables are transformed by the natural logarithm (Log). Changes in the natural logarithm approximate percentage changes, therefore coefficients in future regression models from this chapter can be interpreted as elasticities. The natural log function is negative for values less than one and positive for values over one; the function is undefined for values equal to or less than zero.

Table 1
Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Log of Employees	9.52	1.22	5.63	12.28	136
Log of Real Income per Capita	10.39	0.14	10.04	10.72	137
Log of Maximum GGR Tax Rate	2.87	0.61	1.83	4.25	136
Log of Effective GGR Tax Rate	-1.72	0.55	-2.69	-0.63	136
Log of Alcohol Tax Revenue per GDP	-8.27	0.51	-9.12	-6.96	137
Log of All Tax Revenue per GDP	-2.97	0.19	-3.36	-2.59	137
Log of Number of Commercial Casinos	2.87	1.16	0	5.61	137
Log of Average GGR per Casino	4.43	1.53	-0.46	6.22	136
Log of Population	15.32	0.77	13.5	16.37	137
Log of Real Income per Capita	10.39	0.14	10.04	10.72	137
Log of Unemployment Rate	1.6	0.32	0.96	2.59	137

Figure 4 highlights all states with commercial gaming in 1998 (the first year of this study's data set) and Figure 5 highlights all states with commercial gaming in 2009 (the final year of this study's data set). As noted in Chapter 3, this study uses an unbalanced panel, therefore not all states appear in all years of the study.

The primary dependent variable, commercial casino employment, is plotted for each state (except for Nevada) in Figure 6. No consistent trend is observed in all states.

The primary independent variable of interest, maximum casino tax rate, is plotted for each state in Figure 7. Abrupt changes in the tax rate for different states during different periods suggests that sufficient variation will be present to observe a signifi-

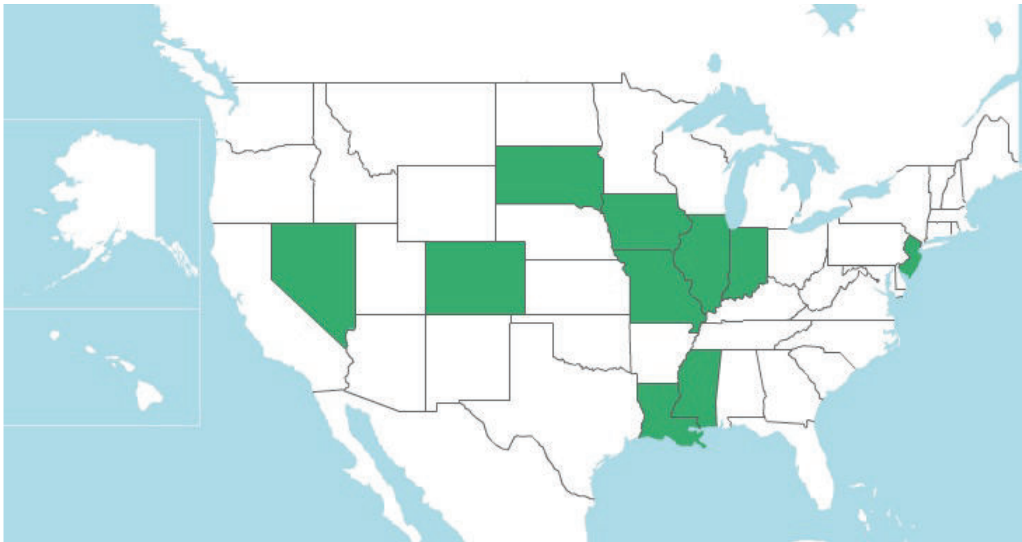

Figure 4. States with commercial casinos in 1998 are highlighted in green. Those states include Colorado, Illinois, Indiana, Iowa, Louisiana, Mississippi, Missouri, Nevada, New Jersey, and South Dakota.

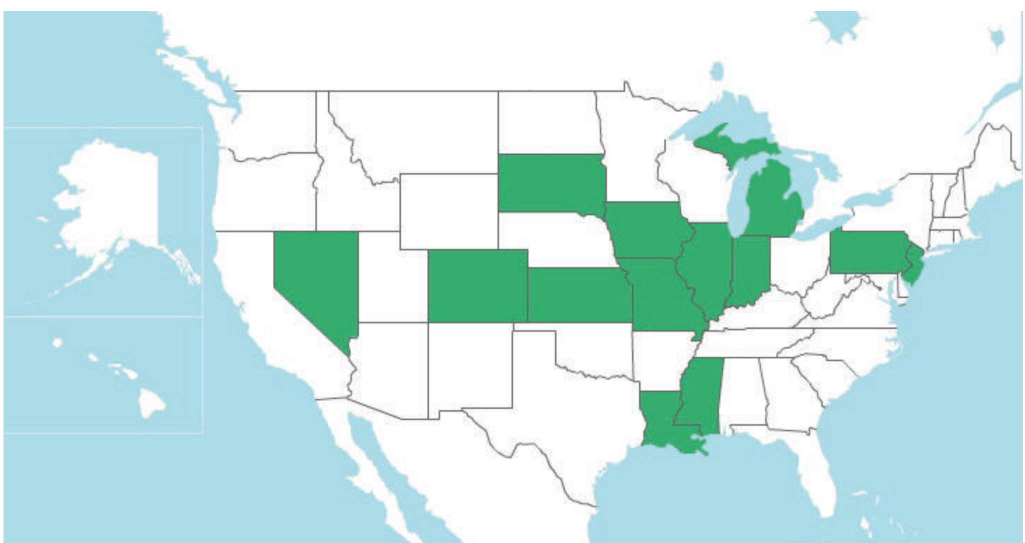

Figure 5. States with commercial casinos in 2009 are highlighted in green. Those states include Colorado, Illinois, Indiana, Iowa, Louisiana, Michigan, Mississippi, Missouri, Nevada, New Jersey, Pennsylvania, and South Dakota.

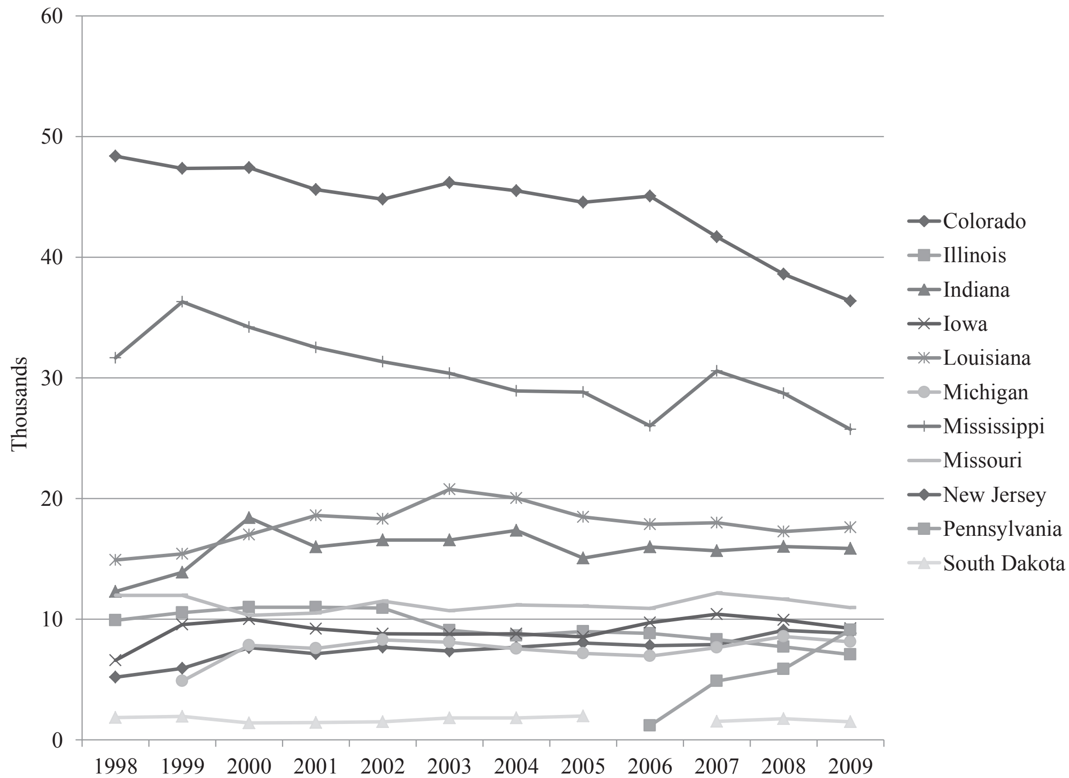

Figure 6. Commercial casino employment values are plotted by state. Nevada values are excluded to improve readability of the chart. Where other data points are missing indicates that there were no legally operating commercial casinos in that period. The exception to this is the 2006 South Dakota value where no estimates were available from American Gaming Association (2007).

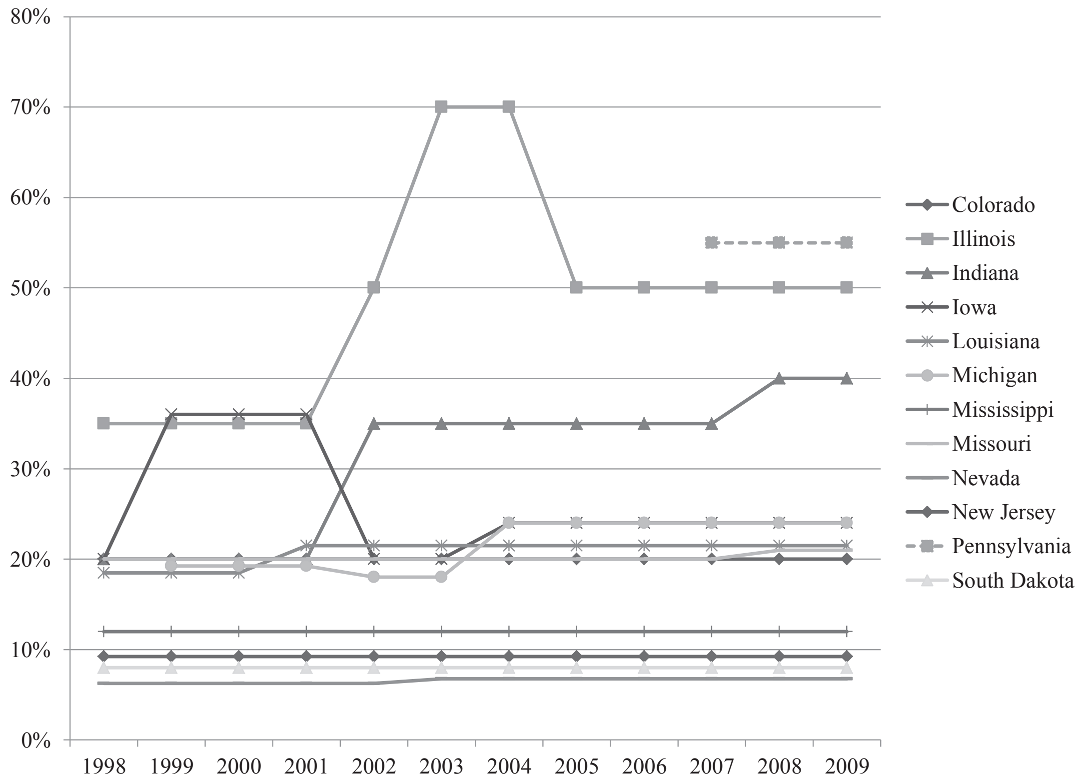

Figure 7. Commercial casino maximum tax rates are plotted by state. Where data points are missing indicates that there were no legally operating commercial casinos in that period.

cant coefficient from these natural experiments.

Fully Specified Empirical Model

The following section describes the results from the fully specified empirical model.

First Stage Model

The first stage results of the fully specified empirical model are provided in Table 2. The model, which produces the instrumental variable for the natural logarithm of the maximum tax rate on gross gaming revenue, appears to fit the data well. Both instruments, the natural logarithm of alcohol tax revenue per unit of state domestic product (Log Alcohol Tax) and the natural logarithm of all state tax revenue per unit of state domestic product (Log All Tax), have positive and statistically significant coefficients; $z(114) = 2.75, p = .007$ and $z(115) = 2.35, p = .021$, respectively. This finding supports the second necessary condition for the instruments, $Cov(AlcoholTaxRate_{it}, GamingTaxRate_{it})$ 0 and $Cov(StateTaxRate_{it}, GamingTaxRate_{it}) \neq 0$. To further establish the validity of the instruments, additional statistical tests were conducted and are provided in Table 3. The F-test of weak identification=12.15, exceeded the benchmark value of 10, suggesting that these variables adequately satisfied the second necessary condition of strong instruments (Sovey & Green, 2011; Staiger & Stock, 1997). The Hansen J statistic, $HJ = 0.67, p = 0.415$ (also known as the overidentification test), failed to reject the assumption that Log Alcohol Tax and Log All Tax do not belong in the structural model. This finding supports the first necessary condition of valid instruments.

Second Stage Structural Model

The structural model produced results that were generally in line with theoretical suppositions. The elasticity of casino employment with respect to the maximum gaming tax rate is estimated to be $\varepsilon = -0.46$, and is statistically significant, $z(115) = -2.55, p = .011$. This suggests that a 1% increase in the maximum tax rate

Table 2

First-Stage Model

	Log of Maximum GGR Tax Rate			
	b	se	z	p
Log of Alcohol Tax Revenue per GDP	0.26***	0.09	2.75	0.01
Log of All Tax Revenue per GDP	0.75**	0.32	2.35	0.02
Log of Number of Commercial Casinos	0.07	0.09	0.79	0.43
Log of Population	-0.47*	0.24	-1.91	0.06
Log of Average GGR per Casino	0.11	0.09	1.21	0.23
Log of Real Income per Capita	-1.15**	0.44	-2.60	0.01
Log of Unemployment Rate	0.10	0.09	1.07	0.29
1999	0.09	0.06	1.61	0.11
2000	0.12*	0.07	1.89	0.06
2001	0.14*	0.08	1.67	0.10
2002	0.21***	0.08	2.77	0.01
2003	0.30***	0.09	3.34	0.00
2004	0.36***	0.10	3.70	0.00
2005	0.32***	0.09	3.49	0.00
2006	0.35***	0.09	3.91	0.00
2007	0.36***	0.09	3.84	0.00
2008	0.37***	0.10	3.52	0.00
2009	0.34**	0.13	2.61	0.01

Heteroskedasticity robust standard errors provided.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 3

Tests of IV Assumptions

	IVs: Log Alcohol Tax/GDP & Log All Tax/GDP
Observations	133
F-test of weak identification	12.15
Hansen J statistic	0.66
Hansen J p-stat	0.41

would reduce casino employment by 0.46%.

Findings from other gaming related variables appeared to be reasonable. The gaming availability variable (log of number of commercial casinos) produced a reasonably inelastic coefficient (0.66), and the productivity variable (log of average GGR per casino) also produced an inelastic estimate (0.38). The findings support the assertion that U.S. casinos may be subject to economies of scale in labor. A doubling of the gaming revenue per casino would only increase employment by an estimated 38%. Indeed, Gu (2001) has previously provided evidence that casino operations are subject to economies of scale in payroll and other expenses, and this additionally validates the wave of operator consolidation in the U.S. gaming industry that occurred during the late 20th century and early 21st century.

The population variable produced a significant and positive elasticity coefficient (0.60), which suggests a positive relationship between total population growth and growth in short-run casino development. The two economic variables, log of real income per capita and log of the unemployment rate, failed to produce a significant coefficient. This may be the result of these variables indirectly affecting the employment level through the average GGR variable. That is, higher income and employment levels will lead to increased spending on casino gaming, thereby increasing employment through the average GGR variable.

Additional variables were tested for significance as part of the empirical analysis, but were omitted from the results due to high collinearity with the fixed-effects and the other explanatory variables. These excluded variables included the AGA mea-

Table 4

Full Model Specification

	Log of Employees			
	b	se	z	p
Log of Maximum GGR Tax Rate	-0.46**	0.18	-2.55	0.01
Log of Number of Commercial Casinos	0.66***	0.09	7.22	0.00
Log of Average GGR per Casino	0.38***	0.08	4.75	0.00
Log of Population	0.60**	0.24	2.55	0.01
Log of Real Income per Capita	0.25	0.47	0.53	0.60
Log of Unemployment Rate	0.11	0.08	1.41	0.16
1999	0.07	0.06	1.11	0.27
2000	0.03	0.07	0.51	0.61
2001	-0.03	0.07	-0.43	0.67
2002	-0.06	0.08	-0.69	0.49
2003	-0.06	0.10	-0.60	0.55
2004	-0.07	0.11	-0.59	0.56
2005	-0.10	0.11	-0.88	0.38
2006	-0.11	0.12	-0.98	0.33
2007	-0.13	0.12	-1.02	0.31
2008	-0.11	0.14	-0.82	0.41
2009	-0.20	0.15	-1.28	0.20

Heteroskedasticity robust standard errors are provided.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

sures of national gaming acceptability, the admission tax binary variable, real gross state product, and alternative transformations of all variables.

Tests of Assumptions

Having fit the structural model outlined in Chapter 3, select model assumptions are further analyzed for efficiency and validation in this section.

Hausman Test

A Hausman specification test (Hausman, 1978), measuring whether the fixed-effect is misspecified, is estimated and shown in Table 5. The Hausman test failed to show a statistically significant difference between the estimates in the fixed effect model, and the random effect model, $Chi^2(17) = 15.74, p = .542.$[1]. As the Hausman test failed to reveal a difference between the fixed-effect and the random-effect model, an instrumental variable model without fixed-effects, but that allows for standard error correlation within states, is provided in Table 6. The model fails to produce statistically significant values for the instruments in the first-stage, and also has an F-test of weak identification well below the required threshold of 10 ($F = 1.08$). Therefore, subsequent models in this section reject the non-fixed effect specifications, despite some concern from the Hausman test of a possible loss of efficiency. The fixed-effect model remains a consistent estimator, therefore the results should be asymptotically identical.

[1]Note that the Hausman model was estimated without the use of instruments

Table 5
Hausman Specification Test

	Fixed Effects	Random Effects
Log of Maximum GGR Tax Rate	-0.46 (0.18)**	-0.86 (0.24)***
Log of Number of Commercial Casinos	0.66 (0.08)***	0.92 (0.04)***
Log of Average GGR per Casino	0.38 (0.06)***	0.68 (0.07)***
Log of Population	0.60 (0.27)**	0.51 (0.32)
Log of Real Income per Capita	0.25 (0.53)	-1.32 (0.84)
Log of Unemployment Rate	0.11 (0.10)	-0.30 (0.33)
1999	0.07 (0.05)	0.06 (0.12)
2000	0.03 (0.06)	0.03 (0.13)
2001	-0.03 (0.08)	0.07 (0.16)
2002	-0.06 (0.09)	0.14 (0.22)
2003	-0.06 (0.11)	0.21 (0.25)
2004	-0.07 (0.12)	0.23 (0.26)
2005	-0.10 (0.12)	0.20 (0.26)
2006	-0.11 (0.13)	0.17 (0.24)
2007	-0.13 (0.13)	0.15 (0.23)
2008	-0.11 (0.15)	0.26 (0.29)
2009	-0.20 (0.17)	0.52 (0.42)
Constant	-4.68 (7.85)	12.48 (5.26)**

Heteroskedasticity robust standard errors provided in parentheses.

chi2(17) = 15.74, p-stat = 0.5423

* p<0.10, ** p<0.05, *** p<0.01

Table 6

No Fixed-Effects Model Specification

	Log of Maximum GGR Tax Rate				Log of Employees			
	b	se	z	p	b	se	z	p
Log of Alcohol Tax Revenue per GDP	-0.20	0.21	-0.96	0.36				
Log of All Tax Revenue per GDP	-0.27	0.57	-0.48	0.64				
Log of Maximum GGR Tax Rate					-0.86**	0.42	-2.04	0.04
Log of Number of Commercial Casinos	-0.02	0.06	-0.30	0.77	0.92***	0.10	9.35	0.00
Log of Average GGR per Casino	-0.24***	0.06	-4.02	0.00	0.68***	0.16	4.29	0.00
Log of Population	1.18***	0.23	5.10	0.00	0.51	0.53	0.96	0.34
Log of Real Income per Capita	-3.40***	0.62	-5.46	0.00	-1.32	1.21	-1.09	0.27
Log of Unemployment Rate	-0.88**	0.31	-2.82	0.02	-0.30	0.35	-0.85	0.39
1999	-0.00	0.08	-0.02	0.99	0.06	0.05	1.19	0.23
2000	0.14	0.09	1.58	0.14	0.03	0.06	0.49	0.63
2001	0.40***	0.10	3.81	0.00	0.07	0.13	0.56	0.57
2002	0.63***	0.15	4.13	0.00	0.14	0.24	0.60	0.55
2003	0.75***	0.18	4.10	0.00	0.21	0.29	0.74	0.46
2004	0.84***	0.19	4.50	0.00	0.23	0.31	0.74	0.46
2005	0.82***	0.15	5.32	0.00	0.20	0.29	0.68	0.50
2006	0.76***	0.15	5.05	0.00	0.17	0.28	0.60	0.55
2007	0.80***	0.15	5.22	0.00	0.15	0.28	0.52	0.60
2008	0.97***	0.18	5.39	0.00	0.26	0.35	0.76	0.45
2009	1.35***	0.28	4.89	0.00	0.52	0.55	0.95	0.34
Constant	19.57***	4.71	4.15	0.00	12.48*	7.05	1.77	0.08
Observations	134				134			
F-test of weak identification					1.08			

Heteroskedasticity robust standard errors are provided. Errors clustered by State.

* p<0.10, ** p<0.05, *** p<0.01

Normality Tests

Table 7 provides the Skewness/Kurtosis (SK), Shapiro-Wilk W, and Shapiro-Francia W tests of the normality of the distribution of the full model residuals. Although these tests provide different results when using a $.05\alpha$ rejection criteria, Gould and Rogers (1991) suggest that the SK tests for normality are preferred over Shapiro-Wilk W or Shapiro-Francia W tests when aggregated data is used. As this study does not use firm level data, but instead uses data aggregated by state, the SK test appears to be the preferred metric to validate the normality of the distribution of the residuals. The SK test fails to reject the assumption of normality at the $.05\alpha$ level, $Chi^2(2) = 4.82, (Joint)p = .09$, and therefore proceed on the assumption that this requirement is satisfied. The histrogram plot provided in Figure 8 also appears to reasonably bell shaped and fit a normal distribution, further supporting this assumption.

Table 7
Normality Tests

	Full Model Specification			
Skewness/Kurtosis	Pr(skewness)	Pr(Kurtosis)	Adj. Chi^2(2)	(Joint) p
	0.068	0.228	4.82	0.090
Shapiro-Wilk W	W	V	z	p
	0.977	2.439	2.008	0.022
Shapiro-Francia W	W	V	z	p
	0.977	2.595	1.943	0.026

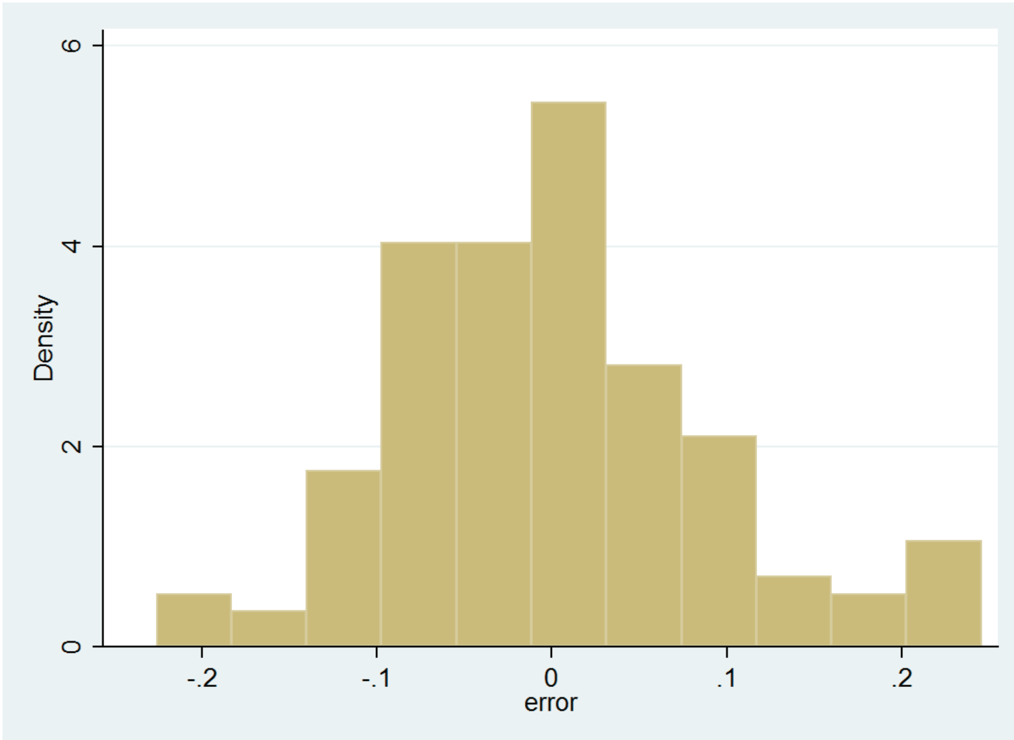

Figure 8. The histogram of the full model residuals do not appear to show any significant departures from normality.

Serial Correlation

Since an unbalanced panel is used in this study, conventional time-series tests like Breusch-Godfrey or Durbin-Watson are not available to test the assumption of uncorrelated error terms (over time). Similarly, the use of a simultaneously estimated instrumental variable method inhibited the ability to use a regression based approach to test the lag of model residuals for significance. To address this possible inference issue, several regression-adjusted models were estimated with Parzen kernel estimators that are robust to the presence of arbitrary heteroskedasticity and one period serial correlation (Baum, Schaffer, & Stillman, 2007). Table 8 compares these t-stats to the Eicker/Huber/White/sandwich heteroskedasticity robust estimators (Baum et al.,

2007) that appear in other models of this study, for several regression-adjusted models. In general, only minor differences appear in the magnitude of the t-stats, and the differences do not cause a change in the interpretation of hypotheses tests for any of the variables of interest.

Table 8

Serial Correlation Robust Model T-Statistics

	Log of Employees							
	H1	HAC1	H2	HAC2	H3	HAC3	H4	HAC4
Log of Maximum GGR Tax Rate	-3.00***	-2.72***	-2.29**	-2.11**	-2.87***	-2.67***	-2.55**	-2.36**
Log of Number of Commercial Casinos	4.42***	4.20***	7.04***	6.86***	7.17***	7.04***	7.22***	7.08***
Log of Average GGR per Casino			4.71***	4.68***	4.76***	4.74***	4.75***	4.72***
Log of Population					2.50**	2.27**	2.55**	2.33**
Log of Real Income per Capita	-0.42	-0.39					0.53	0.48
Log of Unemployment Rate	2.00**	1.91*					1.41	1.33
1999	1.70*	1.83*	1.11	1.20	1.02	1.11	1.11	1.19
2000	2.57**	2.50**	1.18	1.17	0.64	0.64	0.51	0.50
2001	1.70*	1.66*	0.62	0.61	-0.01	-0.01	-0.43	-0.42
2002	1.57	1.52	0.67	0.65	-0.01	-0.01	-0.69	-0.66
2003	1.49	1.44	0.79	0.77	0.15	0.15	-0.60	-0.58
2004	1.67*	1.59	0.73	0.71	0.09	0.08	-0.59	-0.56
2005	1.47	1.40	0.43	0.41	-0.37	-0.36	-0.88	-0.83
2006	1.52	1.43	0.02	0.02	-0.82	-0.80	-0.98	-0.92
2007	1.43	1.35	-0.02	-0.02	-0.96	-0.94	-1.02	-0.95
2008	1.16	1.09	0.48	0.46	-0.41	-0.40	-0.82	-0.76
2009	0.33	0.32	0.13	0.12	-0.83	-0.81	-1.28	-1.20

H denotes Eicker/Huber/White/sandwich heteroskedasticity robust estimators; HAC denotes Parzen kernel heteroskedasticity and serial robust estimators.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Regression-Adjusted Models

In order to ensure that the results were robust to the particular selection of the instruments, alternative models were specified using modified instruments. Three of these models' results are provided in Table 9 and Table 10. Model (1) uses an alternative measure of alcohol taxes, total revenue per income per capita, while models (2) and (3) use only a single instrument from the full model.[2] The regression coefficients in the structural models (Table 10) are reasonably robust to the instrumental variable used.

The robustness of the coefficient estimates were further validated by estimating various regression-adjusted models. Table 11 includes several of these regression-adjusted structural (second-stage) models alongside the fully specified model results that is labeled as model (8). A few noteworthy results arise. First, the inclusion of simple year dummy variables ensures that the coefficient on the variable of interest (Log of Maximum GGR Tax Rate) is statistically signficant, negative in direction, and inelastic. Second, the addition of Average GGR per Casino leads to a loss of significance on the Unemployment Rate variable. This may indicate that the effect of the economy on casino employment is indirectly occurring through the change in gross gaming revenue. The change in the Bayesian information criterion (BIC) further supports this assertion, as this value increases (decreases in absolute value) from model (7) to (8), despite the addition of a statistically significant population variable.

[2] Tobacco taxes was also tested as a potential instrument, but was excluded as it appeared to be a weak instrument.

Table 9

Alternate IV Specification: First-Stage Models

	Log of Maximum GGR Tax Rate		
	(1)	(2)	(3)
Log of Alcohol Tax Rev. per Inc. per Cap.	0.24 (0.09)***		
Log of Alcohol Tax Revenue per GDP		0.34 (0.08)***	
Log of All Tax Revenue per GDP	0.80 (0.31)**		0.92 (0.29)***
Log of Number of Commercial Casinos	0.08 (0.09)	0.08 (0.07)	0.09 (0.09)
Log of Average GGR per Casino	0.10 (0.09)	0.04 (0.06)	0.12 (0.10)
Log of Population	-0.42 (0.25)*	-0.77 (0.17)***	-0.10 (0.23)
Log of Real Income per Capita	-1.13 (0.46)**	-1.03 (0.43)**	-1.40 (0.44)***
Log of Unemployment Rate	0.11 (0.09)	0.02 (0.10)	0.10 (0.09)
1999	0.09 (0.06)	0.10 (0.06)	0.08 (0.06)
2000	0.13 (0.07)**	0.14 (0.07)**	0.12 (0.07)*
2001	0.15 (0.08)*	0.18 (0.08)**	0.13 (0.09)
2002	0.22 (0.08)***	0.23 (0.07)***	0.21 (0.08)**
2003	0.31 (0.09)***	0.31 (0.09)***	0.30 (0.10)***
2004	0.37 (0.10)***	0.36 (0.10)***	0.37 (0.11)***
2005	0.33 (0.09)***	0.35 (0.09)***	0.31 (0.10)***
2006	0.36 (0.09)***	0.39 (0.09)***	0.34 (0.10)***
2007	0.37 (0.09)***	0.42 (0.09)***	0.34 (0.10)***
2008	0.37 (0.11)***	0.44 (0.11)***	0.34 (0.11)***
2009	0.35 (0.13)***	0.42 (0.13)***	0.32 (0.14)**

Heteroskedasticity robust standard errors provided in parentheses.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 10

Alternate IV Specification: Structural Models

	Log of Employees		
	(1)	(2)	(3)
Log of Maximum GGR Tax Rate	-0.46 (0.18)**	-0.56 (0.20)***	-0.38 (0.22)*
Log of Number of Commercial Casinos	0.66 (0.09)***	0.67 (0.10)***	0.65 (0.09)***
Log of Average GGR per Casino	0.38 (0.08)***	0.38 (0.09)***	0.37 (0.07)***
Log of Population	0.60 (0.24)**	0.57 (0.24)**	0.63 (0.24)***
Log of Real Income per Capita	0.24 (0.47)	0.11 (0.50)	0.36 (0.49)
Log of Unemployment Rate	0.11 (0.08)	0.12 (0.09)	0.11 (0.08)
1999	0.07 (0.06)	0.08 (0.07)	0.06 (0.06)
2000	0.03 (0.07)	0.05 (0.07)	0.02 (0.07)
2001	-0.03 (0.08)	-0.01 (0.08)	-0.05 (0.08)
2002	-0.06 (0.09)	-0.03 (0.09)	-0.08 (0.09)
2003	-0.06 (0.10)	-0.03 (0.10)	-0.08 (0.11)
2004	-0.06 (0.11)	-0.03 (0.12)	-0.10 (0.12)
2005	-0.09 (0.11)	-0.06 (0.11)	-0.12 (0.12)
2006	-0.11 (0.12)	-0.07 (0.12)	-0.15 (0.13)
2007	-0.12 (0.12)	-0.08 (0.13)	-0.16 (0.13)
2008	-0.11 (0.14)	-0.07 (0.15)	-0.15 (0.15)
2009	-0.19 (0.15)	-0.15 (0.16)	-0.23 (0.16)
F-test of Weak Identification	12.17	18.30	9.70
Hansen J statistic	0.78		
Hansen J p-stat	0.38		

Heteroskedasticity robust standard errors provided in parentheses.

Hansen J statistics do not appear for models (2) and (3) since they are not overidentified

* p<0.10, ** p<0.05, *** p<0.01

There is a remarkable change in the maximum GGR tax rate coefficient, once average GGR per casino is added to the regression equation. Average GGR per casino is an imperfect measure of the average casino size (and therefore the number of employees needed to operate the facilities). The issue is that average GGR is affected by both supply and demand factors, and therefore may be overcontrolling the model. It is unclear if the change in the maximum GGR tax rate coefficient is due to a non-orthogonal relationship with supply side aspects of the casino size proxy variable, or due to a more well controlled model.

Table 11

Regression-Adjusted Structural Models

	Log of Employees								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log of Maximum GGR Tax Rate	-0.96	-0.63**	-1.23*	-0.92***	-0.85***	-0.90***	-0.45**	-0.51***	-0.46**
Log of Number of Commercial Casinos			0.78***	0.66***	0.66***	0.61***	0.65***	0.68***	0.66***
Log of Average GGR per Casino							0.36***	0.39***	0.38***
Log of Population					0.08			0.60**	0.60**
Log of Real Income per Capita						-0.26			0.25
Log of Unemployment Rate						0.24**			0.11
1999		0.19		0.14	0.14	0.17*	0.07	0.07	0.07
2000		0.26**		0.22**	0.21**	0.25**	0.07	0.04	0.03
2001		0.24*		0.20**	0.19**	0.19*	0.04	-0.00	-0.03
2002		0.27**		0.24***	0.23**	0.19	0.04	-0.00	-0.06
2003		0.29**		0.26***	0.25**	0.21	0.05	0.01	-0.06
2004		0.31**		0.29***	0.28***	0.26*	0.05	0.01	-0.07
2005		0.28**		0.25***	0.24**	0.22	0.03	-0.02	-0.10
2006		0.27*		0.23**	0.21**	0.24	0.00	-0.05	-0.11
2007		0.26*		0.22**	0.20**	0.24	-0.00	-0.06	-0.13
2008		0.29**		0.24**	0.23**	0.22	0.04	-0.03	-0.11
2009		0.26*		0.20**	0.19*	0.07	0.01	-0.06	-0.20
Observations	134	134	134	134	134	134	133	133	133
F-test of Weak Identification	3.04	10.90	2.60	9.76	13.39	9.88	9.49	12.36	12.15
Hansen J statistic	1.77	1.93	2.94	2.93	2.78	0.91	0.82	0.13	0.66
Hansen J p-stat	0.18	0.17	0.09	0.09	0.10	0.34	0.36	0.71	0.41
BIC	-35.02	-48.03	-43.50	-62.26	-67.07	-61.25	-183.72	-173.18	-175.82

Heteroskedasticity robust standard errors provided in parentheses.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Reduced Sample Models

In order to ensure that the results were not being excessively driven by an outlier state, several reduced sample models were estimated that excluded particular state's observations. Table 12 includes several of these reduced sample structural models. In all but one of the models shown, the variable of interest (Log of Maximum GGR Tax Rate) is statistically signficant, negative in direction, and inelastic. Given the changes in the BIC from model (7) to (8) in Table 11, overidentification may be the primary reason for the loss of signficance on the variable of interest in the ”(8)w/o NV” model. Regardless of the possible explanation, there is no strong theoretical argument to exclude valid observations from any particular state, and these results generally support the robustness of the results to state outliers.

Table 12
Reduced Sample Structural Models

	Log of Employees								
	(1)w/o NV	(1)w/o NJ	(1)w/o PN	(2)w/o NV	(2)w/o NJ	(2)w/o PN	(3)w/o NV	(3)w/o NJ	(3)w/o PN
Log Max. Tax	-0.72***	-0.77***	-0.85***	-0.44***	-0.43**	-0.45**	-0.18	-0.42**	-0.46**
Log Casinos	0.65***	0.58***	0.57***	0.64***	0.62***	0.61***	0.72***	0.64***	0.61***
Log GGR/Casino				0.36***	0.34***	0.34***	0.38***	0.36***	0.36***
Log Population	1.48*	-0.04	0.00				2.63***	0.58**	0.57**
Log Income	-0.04	-0.15	-0.35				0.84*	0.32	0.13
Log Unemployment	0.22*	0.21*	0.23**				0.07	0.12	0.11
1999	0.15	0.18*	0.17*	0.07	0.08	0.07	0.02	0.08	0.07
2000	0.19	0.26***	0.26**	0.07	0.08	0.07	-0.09	0.04	0.05
2001	0.12	0.21*	0.20*	0.03	0.05	0.04	-0.18**	-0.03	-0.02
2002	0.11	0.21	0.20	0.04	0.06	0.05	-0.22**	-0.05	-0.04
2003	0.11	0.23	0.22	0.05	0.07	0.06	-0.26**	-0.06	-0.04
2004	0.14	0.27	0.27*	0.06	0.07	0.06	-0.30**	-0.07	-0.04
2005	0.09	0.23	0.23	0.03	0.05	0.04	-0.33***	-0.10	-0.07
2006	0.09	0.23	0.25	-0.01	0.01	0.01	-0.37***	-0.12	-0.08
2007	0.08	0.24	0.27	-0.00	0.02	0.02	-0.40***	-0.13	-0.08
2008	0.06	0.23	0.24	0.03	0.06	0.05	-0.41***	-0.11	-0.07
2009	-0.08	0.10	0.06	0.01	0.03	-0.00	-0.48***	-0.20	-0.18
Observations	122	122	131	121	121	130	121	121	130

Heteroskedasticity robust standard errors provided in parentheses.

Abbreviated parameter labels correspond to labels in Table 11.

Model labels (X)w/o YZ denote: Model (X) without state YZ's observations included in estimation sample.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Tribal Model

Since reliable data on the tribal industry was not available for the full duration of the estimation sample, a reduced sample model is estimated for the years 2005-2009. This sample is not sufficiently large to produce significant results with an instrumental variable model, therefore an OLS fixed effect model is estimated. As described in Chapter 3, the proxy variable for tribal gaming size is the number of tribal casinos in the state. Table 13 outlines the results of this model, along with the full instrumental variable model. The tribal casino variable is not significant, and the variable of interest remains statistically significant, negative, and slightly inelastic. Although this is a rough comparison given the limited amount of data on tribal gaming, the results are generally in line with what was found in the other models that exclude tribal gaming but correct for possible associated endogeneity.

Log-Linear Model

As an alternate means to estimate the robustness of both the estimates and the tax rate elasticities, a log-linear model is fitted where the dependent variable (employment) continues to be transformed by the natural logarithm, but the right hand side variables all appear in level form. As shown in Table 14, the results appear to be fairly consistent with the log-log model estimations. The F-test of weak identification=10.27, exceeded the benchmark value of 10, suggesting that these variables adequately satisfied the second necessary condition of strong instruments. The Hansen J statistic, $HJ = 0.28, p = 0.59$, failed to reject the assumption that the linear form of alcohol tax

Table 13
Tribal Comparative Structural Models

	Log of Employees	
	Tribal Model (OLS)	Full Model (IV)
Number of State Tribal Casinos	0.01 (0.02)	
Log of Maximum GGR Tax Rate	-0.99 (0.41)**	-0.46 (0.18)**
Log of Number of Commercial Casinos	1.05 (0.33)***	0.66 (0.09)***
Log of Average GGR per Casino	0.53 (0.18)**	0.38 (0.08)***
Log of Population	-0.15 (1.12)	0.60 (0.24)**
Log of Real Income per Capita	-0.94 (1.23)	0.25 (0.47)
Log of Unemployment Rate	0.07 (0.13)	0.11 (0.08)
1999		0.07 (0.06)
2000		0.03 (0.07)
2001		-0.03 (0.07)
2002		-0.06 (0.08)
2003		-0.06 (0.10)
2004		-0.07 (0.11)
2005		-0.10 (0.11)
2006	0.01 (0.03)	-0.11 (0.12)
2007	0.01 (0.05)	-0.13 (0.12)
2008	0.05 (0.09)	-0.11 (0.14)
2009	-0.02 (0.14)	-0.20 (0.15)
Observations	58	133

Heteroskedasticity robust standard errors provided in parentheses.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

revenue per gross state product and all tax revenue per gross state product do not belong in the structural model. This finding supports the first necessary condition of valid instruments.

All of the explanatory variables that were significant in the log-log model are significant in the log-linear model, with the exception of population. It may be the case that a linear relationship between the log of employment and population does not adequately capture the true relationship of these variables.

Table 14
Log-Lin Model Specification

	Log of Employees			
	b	se	z	p
Maximum GGR Tax Rate	-1.772**	0.721	-2.458	0.014
Number of Commercial Casinos	0.003**	0.001	2.002	0.045
Average GGR per Casino (millions)	0.170***	0.031	5.458	0.000
Population (millions)	0.123	0.143	0.861	0.389
Real Income per Capita (thousands)	0.004	0.016	0.255	0.799
Unemployment Rate	1.051	1.532	0.686	0.493
1999	0.102	0.081	1.269	0.204
2000	0.114	0.091	1.253	0.210
2001	0.064	0.099	0.648	0.517
2002	0.067	0.111	0.604	0.546
2003	0.091	0.128	0.709	0.479
2004	0.086	0.141	0.609	0.543
2005	0.038	0.136	0.281	0.779
2006	0.009	0.145	0.062	0.951
2007	0.017	0.154	0.114	0.910
2008	0.052	0.163	0.315	0.752
2009	0.001	0.177	0.005	0.996
Observations	133			
F-test of weak identification	10.27			
Hansen J statistic	0.28			
Hansen J p-stat	0.59			

* p<0.10, ** p<0.05, *** p<0.01

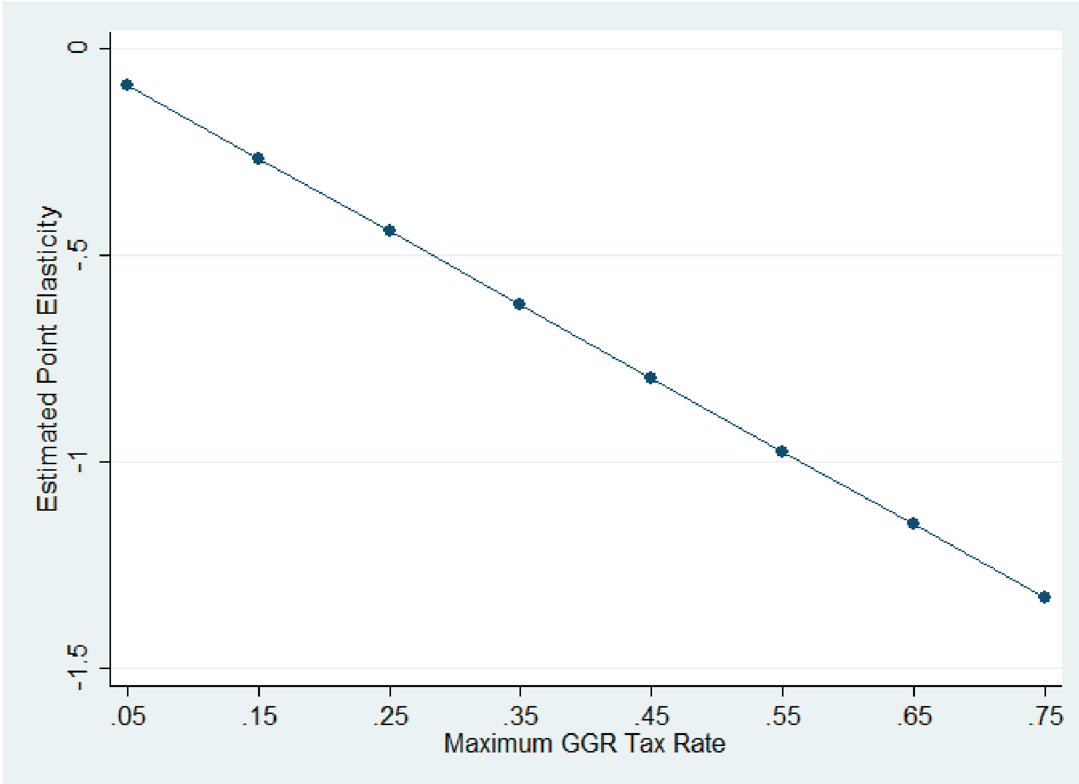

Figure 9. The elasticity of employment with respect to the maximum tax rate is quite inelastic at the lowest levels of tax rates observed in the sample, and does not reach the unitary level for even the highest tax rates observed in 2010, Pennsylvania's 55% rate.

An advantage of the log-linear model specification is that it allows for the computation of non-constant elasticity values. In particular, elasticities of employment can be computed as a function of the state tax rate, allowing for non-average values to be estimated, which may be more useful for policy making at the state level. As shown in Figure 9, the elasticity of employment with respect to the maximum tax rate is quite inelastic at the lowest levels of tax rates observed in the sample (e.g. Nevada at a 6.75% tax rate is estimated to have an elasticity of -0.12). Estimated elasticities do not reach the unitary level for even the highest tax rates observed in any state in 2010 – Pennsylvania's 55% rate is estimated to have an elasticity of -0.97.

Effective Tax Rates

The analysis of effective tax rates as a dependent variable failed to produce a meaningful and statistically significant relationship between those rates and casino employment. In part, this may be due to weakness in the instruments. As shown in Table 15, none of the models produced F-tests of weak identification with values above 10. Additionally, the Hansen J statistics rejected the null hypothesis in models 4-7. In none of the models did Log of Effective GGR Tax Rate produce statistically significant values at the $.05\alpha$ level.

Table 15

Effective Tax Structural Models

	Log of Employees								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log of Effective GGR Tax Rate	1.23	0.89	2.15*	0.98*	0.60	1.11**	0.07	-0.54*	-0.24
Log of Number of Commercial Casinos			0.99***	0.85***	0.78***	0.89***	0.60***	0.48***	0.55***
Log of Average GGR per Casino							0.34***	0.42***	0.39***
Log of Population					0.41			0.74***	0.78***
Log of Real Income per Capita						1.55*			0.74*
Log of Unemployment Rate						0.31**			0.08
1999		0.06		0.05	0.04	0.05	0.05	0.04	0.03
2000		0.10		0.11	0.10	0.05	0.05	0.00	-0.03
2001		0.10		0.10	0.08	-0.05	0.01	-0.06	-0.11**
2002		0.07		0.08	0.07	-0.16	0.00	-0.05	-0.14**
2003		0.06		0.05	0.04	-0.24*	-0.00	-0.05	-0.17**
2004		0.02		0.01	0.01	-0.30**	-0.02	-0.06	-0.20**
2005		-0.05		-0.08	-0.05	-0.41**	-0.04	-0.03	-0.20**
2006		-0.15		-0.11	-0.11	-0.43**	-0.07	-0.08*	-0.24***
2007		-0.02		-0.08	-0.06	-0.41**	-0.07	-0.08*	-0.26***
2008		0.02		-0.04	-0.04	-0.43*	-0.04	-0.07	-0.25**
2009		-0.01		-0.09	-0.09	-0.62**	-0.06	-0.09*	-0.31**
F-test of Weak Identification	1.99	4.32	1.65	5.10	6.71	5.83	3.94	4.42	5.85
Hansen J statistic	0.05	0.74	0.33	5.27	7.92	4.10	4.51	5.85	7.42
Hansen J p-stat	0.82	0.39	0.56	0.02	0.00	0.04	0.03	0.02	0.01
BIC	3.04	8.28	59.40	-54.14	-91.81	-34.58	-214.45	-195.94	-223.16

Heteroskedasticity robust standard errors provided in parentheses.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Wages

The analysis of wages as a dependent variable failed to produce a meaningful and statistically significant coefficient for the maximum gaming tax rate variable. As shown in Table 16, only three of the models produced F-tests of weak identification with values above 10 (models 2, 5, and 7), but none of these produced statistically significant coefficients for Log of Effective GGR Tax Rate at the $.05\alpha$ level. Only one of these three models produced a statistically significant coefficient at the $.1\alpha$ level (model 6). In that model, the Hansen J statistic produced a p-value that sat at the rejection criterion, $HJ = 3.78, p = 0.05$, and the F-test of weak identification=8.16 was below the required threshold of 10. That model did produce elasticity estimates that were similar in magnitude to the estimates with employment as a dependent variable, i.e. negative and inelastic.

Since total wages is simply the product of employment and the average wage, a significant finding with respect to employment but a lack of a significant finding with respect to wages suggests one of three explanations (or a combination thereof). The first possible cause is poor data quality. A higher variance in the wage data from poor survey reliability (as compared to the employment data) would increase the likelihood of returning a Type II error. However, it seems unlikely that the wage data would be of poorer quality than the employment data since they are both obtained from the same source (American Gaming Association, 2010), and the surveyed firms are highly regulated casinos with strong accounting controls. The second possible cause is that the average wage responds in the opposite direction to the change in employment, thereby abating the effect of taxes on total wages. There is general evidence of wage stickiness in the economy as a whole, e.g. Keynes (1939) or Solow (1979), suggesting that any such movement would be moderate and more likely to occur as a wage increase that is paired with a decrease in total employment, rather than a wage decrease paired with an increase in total employment. The third possible explanation is a poor empirical model. For example, the validity of instruments in Table 11 tends to be generally more robust than in Table 16, as the former's Hansen J statistic fails to reject the null hypothesis in any model specification shown. Further discussion of this observation is provided in Chapter 5.

Table 16

Real Wages Structural Models

	Log of Real Wages								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log of Maximum GGR Tax Rate	-0.58	-0.04	-1.34	-0.57*	-0.47	-0.70*	-0.19	-0.23	-0.24
Log of Number of Commercial Casinos			1.03***	0.84***	0.82***	0.85***	1.38***	1.42***	1.42***
Log of Average GGR per Casino							0.70***	0.74***	0.72***
Log of Population					0.16			0.58***	0.62***
Log of Real Income per Capita						0.36			0.52
Log of Unemployment Rate						0.20			0.07
1999		0.15		0.15*	0.14*	0.17*	0.03	0.02	0.01
2000		0.07		0.12	0.11	0.13	-0.05	-0.08	-0.11
2001		0.20		0.25***	0.23***	0.22*	0.06	0.02	-0.03
2002		0.21		0.29***	0.27***	0.22	0.05	0.00	-0.07
2003		0.28**		0.36***	0.33***	0.27	0.10*	0.06	-0.03
2004		0.27*		0.36***	0.33***	0.28	0.08	0.02	-0.07
2005		0.28*		0.37***	0.34***	0.28	0.08	0.03	-0.07
2006		0.35**		0.43***	0.40***	0.37*	0.13*	0.07	-0.03
2007		0.33**		0.40***	0.37***	0.33	0.11*	0.05	-0.06
2008		0.41***		0.48***	0.45***	0.38*	0.22***	0.15**	0.03
2009		0.37**		0.42***	0.39***	0.23	0.18***	0.10	-0.04
F-test of Weak Identification	3.50	10.76	2.51	8.54	12.07	8.16	9.56	12.11	12.70
Hansen J statistic	0.05	1.94	0.57	4.57	4.63	3.78	1.30	0.09	0.21
Hansen J p-stat	0.83	0.16	0.45	0.03	0.03	0.05	0.25	0.76	0.65
BIC	-4.36	-46.99	43.55	-60.28	-67.08	-36.65	-145.10	-142.47	-133.15

Heteroskedasticity robust standard errors provided in parentheses.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Summary

This section described the empirical results of tests related to the research questions stated in Chapter 1. In general, a robust, negative, and inelastic relationship was found between the maximum gross gaming revenue tax and commercial casino employment. Depending on the precise model specification, the constant elasticity models produced estimates ranging from roughly -0.4 to -0.9. The gaming availability variable (log of number of commercial casinos) and the productivity variable (log of average GGR per casino) generally produced inelastic estimates (roughly 0.7 and 0.4 respectively), supporting the assertion that U.S. casinos are characterized by economies of scale in labor.

No relationship was estimated between the presence of an admission tax and employment, since there was insufficient variation in this tax variable to capture an effect size. No robust relationship was found between the effective tax rate and commercial casino employment, suggesting that the maximum tax rate reasonably captures the marginal tax rate used for decision making by operators, but effective tax rates do not at the state aggregation level. No robust relationship was found between total wages and the maximum tax rate. This result is likely attributable to a Type II error due to poor data quality, a positive relationship between the average wage and the tax rate, and/or poor empirical modeling.

CHAPTER 5

CONCLUSION

In jurisdictions around the World, legal casino style gaming is viewed as both an economic catalyst and public revenue generator (Eadington, 1999a). After observing many different market structures for the provision of casino gaming, this study provided some evidence of whether those two objectives were discordant. In particular, this study estimated the relationship between casino tax rates and short-run casino development (proxied by labor measures). In this chapter, a conclusion of the study is provided. Empirical findings and their relevance are discussed, followed by an overview of the study's limitations, and suggestions for future research.

Discussion

To date, no study has provided an empirically sound estimate of the effect that casino excise taxes have on the decisions made by firms. Using an estimation method that controlled for potential endogeneity in the selection of a tax rate, this study found strong evidence that maximum gross gaming revenue taxes have an adverse effect on casino employment. The study revealed an elasticity of roughly -0.5, with the entire 95% confidence interval lying in the inelastic range [-0.81,-0.11]. Using these estimates, policy makers should be able to make a more informed decision about what casino tax rate will maximize the overall welfare of their constituents. Even in a model that ignores wider welfare effects and strictly focuses on public revenue maximization, these results will be helpful since the direct tax revenue from the gaming excise tax can now be integrated into a wider model of the economy and compared to the change in indirect tax revenue (e.g. resulting changes in employment related income or payroll taxes).

Although the study found strong evidence of the effect of the maximum tax rate on casino employment, it failed to find a similar impact by the effective tax rate. Effective tax rates do not represent any particular marginal tax rate paid by casinos, whereas the maximum tax rate is typically the marginal rate paid by the largest casinos. If this insignificant finding is not a Type II error, this provides empirical evidence to support the theory that quasi-specific taxes (such as admission fees or fixed transaction fees on wagers) will be less distortive than ad valorem excise taxes, suggesting potential reforms to the method in which taxes are levied on the gaming industry. Currently, these tend to be used only in limited capacity (Anderson, 2005).

Given the evidence discussed in Chapter 2 regarding the difference in sensitivity to price of problem and non-problem gamblers, reforms may be even more important. The implication is that an increased reliance on ad valorem taxes to generate revenue from the gaming industry will disproportionally cause more of the public revenue to come from problem gamblers. This is the opposite effect desired if policy makers are attempting to force problem gamblers to internalize the negative externalities caused by their consumption and their related health issues. However, the effective tax rate may suffer from an endogenous selection issue that affects entry and therefore biased the analysis towards an insignificant result. In particular, potential firms may not enter the market due to high effective rates, but once committed to operating through heavy capital investments, many of these taxes become sunk costs. Therefore, the effective tax rate may have a indirect effect on employment through the already controlled 'Number of Casinos' variable.

No significant effect was found from the admission tax variable, but this lack of significance was due to methodological limitations. The fixed effect and year dummy variables were excessively collinear with the admission tax dummy variables, forcing them to be removed from the model. This over controlling was necessary to remove endogenous effects on the other tax variables, but came at the expense of the findings on this particular variable. However, the discussion in Chapter 2 suggests that the use of admission taxes may be a more effective tax design than ad valorem taxes on gross gaming revenue. Due to the differences in the sensitivity of problem gamblers and non-problems gamblers to price, an increased reliance on ad valorem taxes to generate public revenue may disproportionally cause more of the public revenue to come from problem gamblers and tend to distort the behavior of non-problem gamblers into consuming other goods. Accordingly, admission taxes may lead to less distortions in behavior versus other forms of gambling taxes. Alternatively, if a Becker-Murphy (1988) rational addiction model is employed, ad valorem taxes may be more effective at efficiently curbing addictive behavior.

No robust relationship was found between maximum GGR taxes and real commercial casino wages. This was a surprising result given that a significant relationship was found with taxes and employment, and given that real wages are simply the product of employment and the real average wage. This non-finding could have been caused by the somewhat related issues of a poorly specified empirical model, a countervailing movement in the real wage rate that hid the effects on employment, and generally noisier data than in the employment model (or equivalently, an insufficiently large data sample to produce consistent estimates). It seems plausible that an increase (decrease) in the tax rate is responded to by a decrease (increase) in the employment level – the main significant finding of this study – which is then abated by an increase (decrease) in the average wage, which causes this result. For example, a casino that increased employment in response to a reduction in their tax rate may no longer have to rely as heavily on overtime shifts by their staff to accommodate spikes in demand, and therefore will have a reduced average wage. Although a study with a larger sample may be able to capture this potentially smaller effect of taxes on real total wages, the standard errors in this sample were too large to reject the null hypothesis on the tax rate coefficient.

Limitations

The purpose of this study was to examine how casino excise taxes affect casino development, but this study only examined part of this relationship. In particular, this study focused on how gaming revenue taxes affected measures of labor – employment and wages – but not long-term capital investment. As such, the empirical findings in this study tend to reflect short-run effects of the change in tax rates, as opposed to long-run effects. Given the large financial investments that are made in modern resort-style casinos, the long-run effects of changes in tax rates may take years or decades to occur, therefore accurately estimating these empirical effects is not easily done, but certainly worth pursuing.

This study was limited by its use of data that was aggregated by state, as opposed to more meaningful firm level data. In part, the inability to detect a significant coefficient from the effective tax rate may be a function of the use of aggregated data figures. Gaming data aggregated at the state level does not reflect the effective tax rate of any particular firm, but is an average across all firms in the state. Conversely, maximum tax rates – where a significant coefficient was found – may be more robust to this source of error since that rate represents the actual rate paid by many firms. In general, the use of this aggregated data should decrease the probability of a Type I error, but increase the probability of a Type II error.

Data was also aggregated by year, which creates measurement issues when variables of interest change during the year in a way that cannot be obviously captured empirically. For example, the maximum tax rate variable is measured at the end of the calendar year, changes caused by this variable that occur for only part of the calendar year will not be fully captured.

The data used in this study was limited to states with U.S. commercial casinos. As such, the empirical estimates may have bias if extrapolated to other jurisdictions or other forms of gaming (e.g. video lottery terminals or slot parlors). If there is a non-orthogonal relationship between the adoption of legal commercial casino gaming and the estimated empirical relationships, a selection bias may also be introduced into the estimates. A selection model may be a useful remedy in that case to produce unbiased results, e.g. Heckman (1979).

Another data limitation is that the sampling frame of this study relied on the somewhat arbitrary definition of a commercial casino by the AGA. Nevertheless, using a well-established industry organization like the AGA should be a more reliable means to define sampling frame boundaries than a capricious designation on a state-by-state basis. The definitions of commercial casinos were additionally examined in each year that the AGA produced their state of the state reports to ensure consistency over time (which resulted in the exclusion of 2010 data that amalgamated various racetrack casinos into the aggregate data). The labor figures acquired from the AGA should also be subject to some scrutiny, since the industry organization has a particular incentive to publicize the positive economic impacts of the gaming industry. However, the various labor reports produced by the AGA have generally been found to be acceptable over the course of their 15 year production period, therefore there is no obvious reason to consider the figures especially dubious.

For the majority of the data analysis, no useful proxies of the size of the tribal gaming industry were available as control variables. In Table 13, limited analysis was conducted with a proxy variable (number of in state tribal casinos), which did not appear to lead to coefficients meaningfully different from those in other models – the maximum tax rate elasticity remained significant, negative, and inelastic. Nevertheless, this was a small sample size that did not include any instrumental variables, so the comparison was not ideal. Similarly, the availability of gaming (tribal and otherwise) in neighboring jurisdictions, online, or at non-commercial casinos may affect the dependent variable and were not able to be control directly. To the extent that the general proxy variables (fixed effects and year dummy variables) and instruments fail to control for endogeneity, the coefficients on variables may be biased.

Future Research

As mentioned in the introduction to this chapter, a useful extension of this study would be to integrate it into a wider model of the economy. Such an extension would yield powerful information for decision makers, by allowing for more accurate estimates of the costs and benefits of changes in casino tax policy. Qualitative case study analyses would also be useful to better understand the decision making processes that occur within firms as a result of changes in tax policy. They may yield useful information to adapt government policies, and provide guidance for future empirical tests.

A similar analysis using firm level data would likely yield more precise estimates since actual marginal tax rates could be used as part of the study. Such an approach may reveal significant relationships among variables that were tested but found to have insignificant relationships, e.g. effective tax rates and employment. Firm level data would also be useful in attempting to estimate tax effects on long-run investment decisions, such as capital allocation. Such analysis could benefit from an ability to closely examine accounting data figures. Using firm level data, a full panel of the U.S.

may not be entirely necessary, as relatively straightforward difference-in-difference studies could yield accurate estimates.

A quantile method for examining the effects that taxes have on casino operator incentives would also be useful, since this would yield non-average elasticity effects. At a certain threshold, increases in the tax rate fail to increase total tax revenue (Laffer, 2004), and quantile regression would provide more evidence where this inflection point in the Laffer curve may exist.

Admission taxes deserve further study, as their effect on both operator and consumer incentives is interesting. In a jurisdiction with a 20% GGR tax and an average 10% theoretical win, $500 in coin-in would be required to generate the same per player tax revenue as a $10 admission tax. Given the limited use of admission taxes in the U.S. casino industry, an empirical test of how behavior changes in response to these different excise taxes could yield evidence of many potential pareto improvements.

Finally, expanding this study beyond commercial casinos would be useful in order to increase reliability and generalizability of the findings. Tribal gaming, lotteries, video lottery terminals, online casinos, and other forms of gaming all may react in different ways to changes in their cost structure, and this is worth exploring. For example, the global competitiveness of online gaming may exacerbate the sensitivity of those firms behavior to changes in the tax rate. Understanding these subtleties will be important for the development of an overall understanding of best practices in gaming policy design.

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