An Economic Sensitivity Analysis of Las Vegas Gaming Revenues

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ABSTRACT
The gaming industry has long been considered recession proof. However, the industry expanded exponentially over prior decades in addition to increasing its exposure to the lodging and conventions industries. The industry also struggled with declining gaming revenue during the recession in 2007. This study uses the Las Vegas region to investigate gaming revenues' exposure to economic change between the two most recent recessions (e.g. 2001 & 2007). The results show that casinos were more exposed to economic conditions in the latest recession and more sensitive to economic downturns. The results further suggest that increased exposure to lodging may reduce the economic sensitivity of gaming revenue. This study contributes to the industry literature by examining the economic sensitivity of casinos' gaming revenue considering exposures to lodging and convention industries. The study results can be leveraged to optimize expansion investments and operational decisions in the casino industry.

Keywords
Gaming Industry, Recession Proof, Business Cycle, Economic Sensitivity, Logarithmic OLS-HAC Regression

INTRODUCTION
Before the recession of 2007, empirical evidence hinted that the gaming industry was recession proof (Linn, 2008). In previous recessions leading up to 2007, commercial gaming revenues rose. This includes the recession of 2001, which saw commercial gaming revenues increase by 3.1% (State of the States, 1999-2018). Literature on gambling has revealed a number of factors for casinos being less sensitive to market downturns. These factors range from gambling addiction and regulation-related lack of competition to patronization by individuals seeking relief from economic hardships (Grinols & Mustard, 2001; Klempt & Pull, 2009; Shonkwiler, 1993). Following the recession of 2007, an empirical study showed that the economic downturn held an insignificant effect on non-destination casinos such as those in Iowa (Zheng, Farrish, Lee, & Yu, 2013).

As conditions in the marketplace have evolved, the gaming industry has increased its reliance on both the lodging and convention industries to drive in gaming revenues by attracting gamblers to casinos (Plume,

2002; Yi & Busser, 2008). However, the gaming industry's greater reliance on the lodging and convention industries is not without repercussions.

Casinos must undertake significant financial exposure to augment their gaming offerings with lodging rooms and convention meetings spaces, as these non-gaming amenities can cost tens of millions of U.S. dollars to build (Belko, 2019; Daykin, 2017). This significant investment can add considerable fixed expenses to a casino's bottom line, while limiting its ability to adapt to unforeseen changes in the market. Additionally, unlike the gaming industry, historically the lodging and convention industries are more sensitive to market downturns (Friess, 2009; Smith, 2009). Furthermore, the gaming industry has experienced further saturation over the previous decade as it has expanded exponentially and a number of states have legalized lotteries, which serve as economic substitutes to casino gambling (Elliott & Navin, 2002; Legg & Hancer, 2020; Moss, Ryan, & Wagoner, 2003; State of the States, 1999-2018).

These changes, combined with decreasing gaming revenues during the recession of 2007, have led some to note that the total gaming industry is no longer recession-proof, although the impact of the recession can vary by destination (Linn, 2008; State of the States, 1999-2018). For example, U.S. commercial gaming revenues peaked at $37.52 billion before the recession of 2007, then fell to $30.74 billion in 2009, and finally recovered to $37.87 billion in 2013. This study investigates why casinos are no longer recession-proof, using the largest commercial gaming market in the U.S., Las Vegas, as an econometric case study. Moreover, this study investigates the role that lodging and convention revenues play on the economic sensitivity of gaming revenues, considering competition from other regions and lotteries.

We find that the Las Vegas gaming market industry was no longer recession-proof during the recession of 2007. Additionally, gaming revenues, while historically less susceptible to economic conditions than lodging and convention revenues, showed higher sensitivity to economic levels than lodging and convention revenues. The results of this study, therefore, contribute to the hospitality literature by uncovering the increased economic impact of recessions on gaming revenue growth. Lastly, understanding how gaming revenue's economic sensitivity shifts by the level of economic growth can be leveraged for optimizing investment and operational strategies considering other economic sensitive factors (e.g. lodging, convention, and competition).

LITERATURE REVIEW

Recessions and gaming revenues
There were two periods of economic decline after the year 2000. The earliest recession spanned February to November of 2001. The latest recession lasted 19 months from December 2007 to June 2009. During these two recession periods, the economy saw a decline in gross domestic product (GDP) for more than two successive quarters. The decline in GDP is attributed to a number of factors ranging from decreased production in several industries to lags in consumer spending as buying behavior shifts, negatively impacting various industries (Kotler & Caslione, 2009).

During the 2001 recession, gaming revenues within the United States increased even as economic activity in the other industries decreased (State of the States, 1999-2018). However, casinos in all markets did not fare as well during the latest recession spanning 2007 to 2009. This is shown in the two largest gaming markets, as Nevada posted one of the worst decreases in year-over-year revenues at a 9.73% decrease in total win from 2007 to 2008, and multiple casinos filed for bankruptcy in Atlantic City (2008 Las Vegas Executive Summary, 2008; State of the States, 1999-2018; "Tropicana files for chapter 11 protection amid Jersey joust," 2008). Meanwhile, various tribal casinos held layoffs because of declining gaming revenues

and delayed investment in new casinos (Headlee, 2008; "The seven-member Kansas Lottery Facility Review Board announced Friday that it would delay a decision on the winning bidder to build and manage a destination casino in Dodge City," 2008). This study therefore hypothesizes that the recession of 2007 had a significant negative impact on gaming revenues when compared to the previous recession of 2001. Hence, the following hypothesis is proposed:

H1: The recession of 2007 to 2009 had a greater negative impact on casino gambling revenues than the recession of 2001.

Economic sensitivity of gaming revenues
Following the Great Recession of 2007, gaming revenues plunged 22.1% to $30.74 billion from their peak of $37.52 billion earlier that year. Although a study of the gaming volume in Iowa demonstrated no effect from the recession, this minor destination may not be representative of the much larger casino industry in the United States (Zheng, 2013). This study, therefore, measures the economic sensitivity of gaming revenues at a major casino destination, Las Vegas, following the 2001 and 2007 recessions.

There is some research that explores the relationship between economic growth and tourism. Tang and Jang (2009) found short-term positive relationships between economic growth and tourism-related industries such as airline, casino, hotel and restaurant. Another study from Aratuo and Etienne (2019) also uncovers a short-term unidirectional Granger causality from economic growth to tourism sub-industries and a long-term relationship between economic growth and tourism sub-industries (e.g. the lodging and food-and-beverage sectors). The relationships among tourism expansion, tourism uncertainty and economic growth in Taiwan and Korean tourism markets were explored (Chen & Chiou-Wei, 2009). The study examined the causal relationship between tourism expansion and economic growth and the different impacts of positive and negative economic growth information on tourism uncertainty. These studies provide a general foundation for the gaming industry's connection to the economy but did not consider the influences of the changing environment (e.g. more lodging facilities, convention areas, competitions from other regions and substitutes) that casinos face in recent years.

Lodging, conventions and gaming industries
Previous studies have found that hotels not only attract gamblers to casinos but also help improve repeat visitations (Dandurand & Ralenkotter, 1985; Richard, 1997). Given this importance, casinos have expanded their lodging operations over the previous decade to drive in gambling revenue. In Las Vegas and Atlantic City from the end of the recession of 2001 to 2010, a total of 20% and 50% more hotel rooms were added, respectively (2001 4th quarter New Jersey Casino Industry Reports, 2001; 2002 Las Vegas Executive Summary, 2002; 2009 4th quarter New Jersey Casino Industry Reports, 2009; 2009 Las Vegas Executive Summary, 2009; Las Vegas Convention and Visitors Authority, 2002, 2009; New Jersey Casino Control Commission, 2001, 2009). Even states legalizing gambling have pushed for casinos to establish hotels as a means to draw out-of-town visitors (Dense & Barrow, 2003).

Along with lodging operations, casinos in the past decade have expanded their convention facilities to attract one of the fastest-growing segments, convention events travelers (Plume, 2002; Suh & West, 2010). In highly competitive markets, casinos have gone to great lengths to upgrade their convention facilities to attract higher-profile events ranging from sports to music (Campbell, Martinez-Jerez, & Epstein, 2006). By hosting these events, casinos are able to increase foot traffic on the property through the presence of events travelers while also increasing the likelihood that gamblers will make repeat visitations (Suh & West, 2010; Yi & Busser, 2008).

While the gaming industry increased reliance on lodging and conventions, both of these industries were adversely affected by the latest recession. Not only did over half of hotel respondents in a survey report being negatively impacted during the most recent recession, but this bearish view coincided with a decline in occupancy rate in all lodging segments (Pizam, 2009; Smith, 2009). As lodging revenues derive from consumers' discretionary consumptions, casino hotels' lodging revenues can be reduced tremendously in recession periods because of decreasing travel expenditures (Youn & Gu, 2010). The revenues from hotel guests may fluctuate more during a recession, which in turn makes gaming revenues more volatile.

The convention industry saw declines during the 2007 recession as well. The top five cities for convention travel experienced declining convention business following this recession (Baeb, 2009; Frederick, 2009; Friess, 2009; Keefe, 2005; Metro Orlando Annual Occupancy Report, 2009, 2009; Trubey, 2009). Many other regions across the country similarly experienced declining convention travel (Kuhles, 2009; Reddy, 2007). Given increased reliance on the sensitive lodging and convention industries, we expect that the gaming industry also demonstrated economic sensitivity during the latest recession. Therefore, the following hypotheses are proposed:

H_2: The growth in lodging revenues of casino hotels amplified the economic sensitivity of gaming revenues during the recession of 2007.

H_3: The growth in the convention business of casino hotels amplified the economic sensitivity of gaming revenues during the recession of 2007.

Casino gambling substitutes and competition
The growth of lotteries has fueled a number of studies demonstrating that lotteries are an economic substitute for and negatively influence casino gambling revenues (Elliott & Navin, 2002; Siegel & Anders, 2001; Walker & Jackson, 2008). In addition, after the recession of 2001, 6 states legalized some form of lottery. In 2009, 11 states adopted multistate lotteries, and now 33 states are members of the Multistate Lottery Association, potentially further cannibalizing the gaming industry (Elliott & Navin, 2002).

The growth of lotteries in the past decade coincided with an expansion in the gaming industry. Newly built casinos negatively impact established gaming revenues by attracting patrons who used to frequent established casinos (Grinols & Mustard, 2001; Moss et al., 2003). Even though the literature indicates that competition negatively impacts established casinos, this has not stopped the expansion of the industry. During the previous decade after the recession of 2001, 17 casinos were added to the Nevada market, while the Indiana market added approximately 43% more slots and 20% more tables (Indiana Gaming Commission: 2001 Annual Report to the governor, 2002; Indiana Gaming Commission: 2009 Annual Report to the governor, 2009; State of the States, 1999-2018). This growth was not limited to only these markets, as 97 class-III native casinos were built and 10 states legalized casinos during this period (Gaming Revenues 2001-2006, 2006; Gaming Revenues 2005-2009, 2009; State of the States, 1999-2018). The dependence of the gaming industry on lodging and conventions, the growth of lottery business, and competition within the casino industry from growth all amplified the economic sensitivity of gaming revenue during the recession of 2007 and the recovery phase after the recession.

METHODS

Data
This study collected monthly economic data from 2000 to the end of 2017. Since there is a lack of consistency and availability of macro gaming and hospitality data in different regions, this study used Clark County, Nevada (Las Vegas), to test the hypotheses. Las Vegas was chosen because it is the most mature and largest gaming market in the United States.

The dependent variable is the year-over-year growth of the Clark County gaming revenues ($GAME_{YoY}$) sourced from the Las Vegas Convention and Visitors Authority (hereafter, LVCVA). Note, YoY subscript is used to denote transforming variables to year-over-year growth. The independent variables, also sourced from LVCVA, are the year-over-year growth rate of Las Vegas lodging revenue ($LODGE_{YoY}$) and the year-over-year growth rate of convention attendees ($CONV_{YoY}$), as the lodging and convention revenue growth proxies. This study also included GDP growth as the proxy for economic conditions, sourced from the Bureau of Economic Analysis. For the proxy of the independent substitution, this study used the year-over-year growth rate of lottery incomes ($LOTTO_{YoY}$) that was sourced from the annual survey of state government finances lottery table in the United States Census Bureau. Lastly, the year-over-year growth rate of casino gambling revenues in the United States except the revenues from Las Vegas ($COMP_{YoY}$) was derived from the monthly gaming revenue report from the Center for Gaming Research at the University of Nevada, Las Vegas and each state's gaming authorities.

Figure 1: Las Vegas (Clark County) Gaming and Lodging Revenue (2000 to 2017)
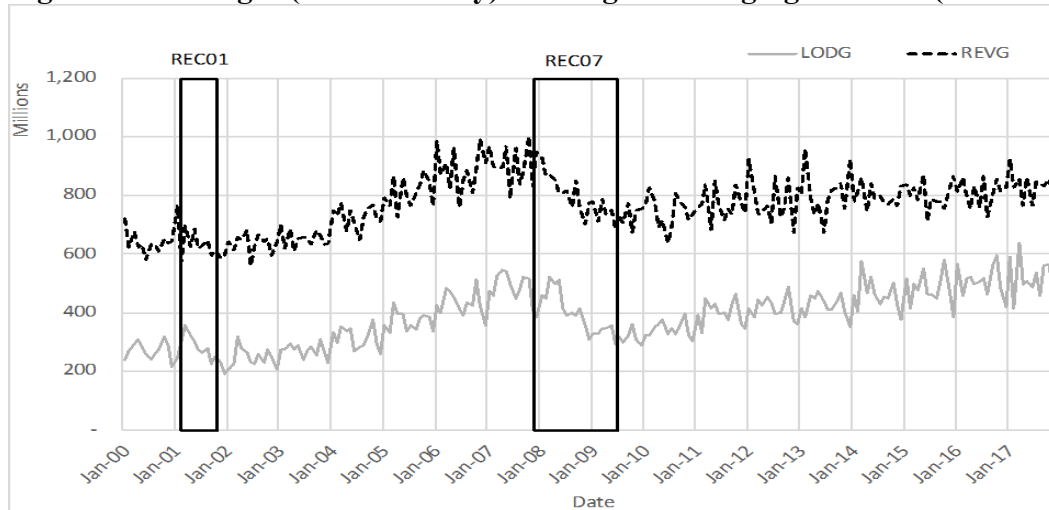
Note. LODGE=Las Vegas lodging revenue, GAME= Las Vegas gaming revenue, REC01= recession in 2001, REC07= recession in 2007

Models and hypotheses testing
The ordinary least-squares (OLS) models with heteroskedasticity-and-autocorrelation (HAC) covariance matrix estimators were used to limit these errors in the models (Davidson & MacKinnon, 2004). To test the first hypothesis, two binary variables were created, recession 2001 (REC01) and recession 2007 (REC07). This study then included these two binary variables into the OLS-HAC model to be run on a panel data from the year 2000 to 2017. Las Vegas lodging revenue growth and the growth of convention visitors were included to find an impact from those businesses in the region. Also, the gaming industry competition and lottery income growth were included to control possible influence from those factors. Hence, the model is specified as,

$$\text{GAME}_{\text{YoY}} = \beta_0 + \beta_1 REC01 + \beta_2 REC07 + \beta_3 LODGE_{\text{YoY}} + \beta_4 CONV_{\text{YoY}} + \beta_5 COMP_{\text{YoY}} + \beta_6 LOTTO_{\text{YoY}} + \varepsilon \tag{1}$$

This study first observed the significance of the coefficients of two binary variables. Then the estimates of two binary variables were additionally tested through a one-sided t-test to see if the recession (2007/2009) had a greater impact on gaming revenues than the recession of 2001,

$$H_1: \beta_2(REC07) < \beta_1(REC01). \tag{2}$$

To test hypotheses 2 and 3, this study ran the 12-month rolling correlations (CORR) between the growth rate of gaming revenues of Las Vegas and the GDP growth rate (Cox & Baum, 2005; Liang & McIntosh, 1998). To create the rolling correlations, this study started with 12-month correlations (e.g., 01/2001-12/2001) and the correlations calculated by shifting over one month (e.g., 02/2001-01/2002) and repeated to the last. These rolling correlations are used for the dependent variable for the second model as they show the sensitivity of Las Vegas gaming revenues to GDP growth. Thus, the model for the second stage, set as:

$$CORR = \beta_0 + \beta_1 REC07 + \beta_2 LODGE_{\text{YoY}} + \beta_3 CONV_{\text{YoY}} + \beta_4 COMP_{\text{YoY}} + \beta_5 LOTTO_{\text{YoY}} + \varepsilon \tag{3}$$

RESULTS
Table 1 presents a summary of variable statistics for the entire sample. The dependent variable (Las Vegas gaming revenue growth) of model (1) has a positive and significant mean of 1.992% (t-statistic: 3.035, $p < 0.01$), which indicates that gaming revenues in the Las Vegas region had a positive growth rate on average from 2000 to 2017. Another dependent variable (the rolling correlation between GDP growth and gaming revenue growth) also has a positive mean of 0.186 (t-statistic: 8.9675, $p < 0.01$) for model (2). The mean value of all independent and control variables was significantly different than zero (Table 1).

Table 1: Summary Statistics

	Mean	Std. Dev.	Min	Max
GAME$_{\text{YoY}}$	0.020**	0.094	-0.243	0.245
CORR	0.186**	0.289	-0.712	0.782
LODGE$_{\text{YoY}}$	0.046**	0.132	-0.334	0.315
CONV$_{\text{YoY}}$	0.061**	0.231	-0.589	0.830
COMP$_{\text{YoY}}$	0.040**	0.062	-0.081	0.312
LOTTO$_{\text{YoY}}$	0.044**	0.030	-0.009	0.094
GDP$_{\text{YoY}}$	1.975**	2.380	-8.400	7.500

Note. ** $p < 0.01$. the unit for GDPG is percentage (%).

Table 2 provides the pairwise correlations. The results in Table 2 suggest that gaming revenue growth is positively correlated with independent and control variables. This indicates that the growth of lodging and conventions in the same region followed similar paths in their relationship with gaming revenue growth. Another interesting finding was that gaming revenue growth had the highest correlation coefficient with GDP growth. This might be additional evidence that gaming revenue is quietly sensitive to economic growth, and the industry is no longer recession-proof. The rolling correlation between Las Vegas gaming revenue growth and GDP growth showed a negative relationship with lodging revenue growth, visitor growth in conventions, and lottery income growth. The negative correlation coefficients imply that lodging revenue, convention visitors, and the growth of lottery income may alleviate the economic sensitivity of gaming revenues (Table 2).

Table 2: Pairwise Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) GAME$_{YoY}$	1.000						
(2) CORR	-0.259**	1.000					
(3) LODGE$_{YoY}$	0.531**	-0.333**	1.000				
(4) CONV$_{YoY}$	0.126**	-0.179*	0.395**	1.000			
(5) COMP$_{YoY}$	0.146*	0.008	0.220**	0.100	1.000		
(6) LOTTO$_{YoY}$	0.248**	-0.179*	0.299**	0.230**	0.233**	1.000	
(7) GDP$_{YoY}$	0.425**	-0.332**	0.346**	0.153*	0.066	0.198**	1.000

Note. * $p < 0.05$. ** $p < 0.01$.

Rolling correlations between gaming revenues and GDP growth

To better understand the results in the hypotheses testing, rolling correlations of the regressors on Las Vegas gaming revenue growth were calculated. The correlation coefficients from each of the rolling periods are graphically shown as the relationship between GDP growth and Las Vegas gaming revenue growth (Figure 2). The interesting result from the rolling correlations is that the correlations were higher in economic downturn. The rolling correlation hit the highest of 0.782 in the middle of the recent recession (November 2008), and the relative level of correlations was lower in the recovery period.

Figure 2: Rolling Correlations between Las Vegas Gaming Revenue and GDP growth
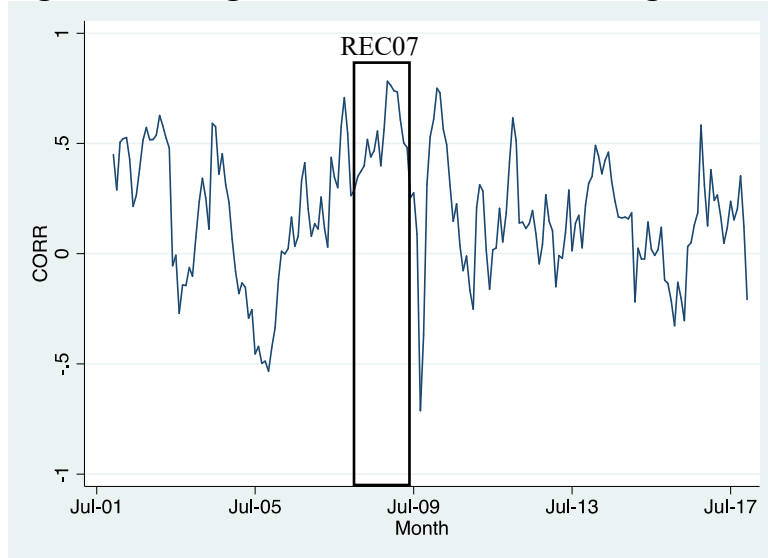
Effects of lodging and conventions on economic sensitivity of gaming revenues

To test the first hypothesis, we first conducted the OLS-HAC model with the binary recession variables (Table 3). In the results of model (1), the coefficient for REC07 of -0.059 ($f = 8.09$, $p < 0.01$) indicates the recession of 2007 had a significantly negative impact on Las Vegas gaming revenue, while the impact of the recession in 2001 was not significant. The one-way t-test of the binary recession variables also showed a difference between the recession of 2001 and the recession of 2007. The *f*-statistic test result was 4.59 ($p < 0.05$). Thus, hypothesis 1, predicting that the 2007 recession had a greater impact on gaming revenue growth than the 2001 recession, is supported.

It is interesting to note that among regressors, except for two recession dummies, only the growth rate of lodging had a significantly positive effect on the growth rate of gaming revenue in Las Vegas. Competition-related factors, such as the growth in gaming industry competition and lottery income growth, were not significant.

Since the results in the first model showed a significantly negative relationship between the recession of 2007 and the gaming revenue growth in Las Vegas, this study further investigated the effect of regressors on the economic sensitivity of gaming revenue growth. This study, therefore, constructed a similar OLS-HAC model with the rolling correlations between gaming revenue growth and GDP growth as the dependent variable. Model (2) in Table 3 showed the results of the analysis. First, lodging revenue growth had a negative effect on the economic sensitivity of gaming revenue, thus, hypothesis two is not supported. The results imply that casino hotels' lodging revenue alleviates the economic sensitivity of their gaming revenues. Second, convention revenue growth did not significantly contribute to the economic sensitivity of gaming revenue. Therefore, hypothesis three is also not supported. Among the control variables, the growth in competition significantly increased the sensitivity of gaming revenue growth on the economic condition.

Although this study has insufficient evidence to support hypothesis 2 and 3, the results demonstrated interesting empirical findings. The results of correlation analysis showed that the economic sensitivity of gaming revenue growth (rolling correlations) is negatively correlated with GDP growth. This means that the correlation between gaming revenue and the economy becomes stronger during periods of negative GDP growth rates. The finding supports the notion that the gaming revenue would be hit more severely by economic downturns and would not recover as quickly as the economy in expansion phases. This result is consistent with the findings of a tourism-economic causality study conducted by Chen and Chiou-Wei (2009), suggesting that the greater impact of negative economic growth information compared to positive economic growth information on uncertainty. The findings also suggest that the economic sensitivity of gaming revenue growth is negatively related to lodging revenue growth. It implies that the growth of the lodging business in the casino industry is not a cause of increased economic vulnerability of gaming revenue, but rather can be a useful asset to maximize revenue.

Table 3: OLS(HAC) regression results

	(1) Dependent variable: $GAME_{YoY}$	(2) Dependent variable: $CORR$
REC01	-0.002	
	(0.020)	
REC07	-0.059**	0.255**
	(0.021)	(0.0721)
$LODGE_{YoY}$	0.327**	-0.449*
	(0.051)	(0.226)
$CONV_{YoY}$	-0.0494*	-0.0449
	(0.0250)	(0.106)
$COMP_{YoY}$	-0.0230	0.920**
	(0.113)	(0.337)
$LOTTO_{YoY}$	0.259	-0.788
	(0.200)	(0.781)
Constant	0.00289	0.190**
	(0.0112)	(0.0466)
# of obs.	204	193
R^2	0.324	0.186

Note. Standard errors in parentheses. ** $p<0.01$, * $p<0.05$

DISSCUSSION

The results show that Las Vegas gaming revenue was more exposed to economic downturn in the recession of 2007 than the recession of 2001. While all businesses of casino hotels (gaming, lodging, and conventions) are positively correlated with the economic growth, this study implies that the economic sensitivity of gaming revenue can be mitigated if casinos have a diversified portfolio beyond the gaming businesses, such as lodging.

The theoretical contribution of this study is twofold. First, this study demonstrates the role casinos' lodging and convention businesses play in gaming revenues. This finding complements the existing gaming industry literature, which is primarily based on the time-series data of gaming revenues. Second, this study analyzed the economic sensitivity of gaming revenue during and after the recent recession of 2007 by using rolling correlations between gaming revenue growth and GDP growth. This provides new perspectives on the impact of casino hotels' relationships with other businesses (e.g. lodging and convention business) and industry competition on the economic sensitivity of gaming revenue.

These findings also have practical implications for the casino industry, particularly for investment and operational decisions on lodging and convention businesses. From the investors' perspective, this study would be helpful for their portfolio allocation as gaming, lodging, and conventions have different sensitivity to economic growth. Fund managers can no longer use casino stocks as a defense investment in an economic downturn. In other words, casino stocks have become more like cyclical stocks. For example, in an economic expansion phase, investors may increase their investment in gaming business more than

lodging or convention businesses to maximize their profit. In an economic downturn, however, investors may reduce their gaming portion and increase lodging exposure to reduce portfolio volatility.

Although direct evaluation of additional amenities such as entertainment and amusement parks was precluded due to a scarcity of industry data, investment in these diversions may similarly mitigate the economic sensitivity of casinos. Moreover, these diversified attractions may bring in new segments of players to the casino properties, augmenting and further diversifying the player base.

While this study contributes to the hospitality and tourism literature both theoretically and practically, there were some limitations. First, the findings may have to be adjusted for other regions, as the sample is based on Las Vegas gaming revenues. Second, this study collected the aggregated gaming revenue, lodging revenue, and convention visitors' data from Clark County (Las Vegas). Therefore, individual casino hotels' economic sensitivity may have some differences. This may be a worthwhile topic for future research.

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