The impact of macro-economic fluctuations on casino revenues in major U.S. gaming markets

Frank Flanegin
Robert Morris University

Stanko Racic
Robert Morris University

Denis P. Rudd
Robert Morris University

ABSTRACT

Continually increasing gaming revenues, generated in ever larger and more opulent casinos, led many to believe that gaming in general, and especially the Las Vegas strip, were recession proof. The most recent financial and economic turmoil shattered this belief implying that the impact of macro-economic factors on casino gaming revenue is still important.

Following our findings of significant effect of foreign exchange rates on hotel occupancy (Flanegin et. al. 2009), we extend and focus our analysis to the impact of GDP, unemployment rate, inflation rate, Misery Index and stock market returns on the gaming revenues of major U.S. casino destinations: Atlantic City, the Las Vegas Strip, Downtown Las Vegas, Laughlin and Boulder City Nevada.

Our results indicate that GDP, unemployment and stock market returns have statistically significant effect on casino revenues, consistent with theoretical predictions, in all or majority of regressions on a contemporaneous and one period lagged basis, using quarterly and annual data. While inflation had significant, theoretically expected impact only on revenue of casinos along Las Vegas Strip on a contemporaneous basis using annual data, Misery Index had no significant effect on gaming wins in any regression.

Keywords: misery index, recessions, squares regression, house, inflation.

INTRODUCTION

Although there is no consensus on the definition of the recession, The Business Cycle Dating Committee of National Bureau of Economic Research (NBER) is generally accepted as the authority for dating US recessions. The NBER defines an economic recession as "a significant decline in [the] economic activity spread across the country, lasting more than a few months, normally visible in real GDP growth, real personal income, employment (non-farm payrolls), industrial production, and wholesale-retail sales."[1]

According to NBER,[2] after WWII US economy has gone through eleven business cycles, with average recession lasting eleven months. However, the latest recession started in December of 2007 and ended in June of 2009, spanning eighteen months. Following 2006/2007 the correction in housing market[3] and the collapse of the subprime mortgage industry in March of 2007, in December of 2007 the US economy entered the longest lasting recession since the stock market and economic crash of 1929-1933. The fact that most all major US trading partners simultaneously went through their own recession introduced additional problems which have slowed down the recovery despite aggressive and government intervention.

Until this last recession the widespread belief, based on continuous increasing revenues or wins generated in ever larger and more opulent casinos, was that gaming revenues in general, and especially those on the Las Vegas Strip, were recession proof. Although odds of casinos' win vary for different games, they are always on the side of the "house" and over the long term they guaranty hefty revenues. Even though casinos' win is 2 to 3% of the amount bet by gamblers, combined Nevada and Atlantic City annual revenues have exceeded one billion dollars since 1999.

Recently several articles in the popular press reported the significant decline in casino revenues even after the recession officially ended in June of 2009. Steve Green's article "Analysts Expect Gaming Revenue at Pre-Recession Level in 2014," published in the Las Vegas Sun on December 6, 2010, quotes the report from the national accounting firm Pricewaterhouse Coopers, LLP that based on experience "an upturn in vacations to casino gaming centers tend to lag about 12-18 months behind a rebound in the economy." According to the Associated Press article "Recession, Competition Chip Away at Atlantic City Casino Profits" published in the New Haven Register on December 12, 2010, the monthly revenue of eleven Atlantic City casinos in November of 2010 fell 12.5% from a year ago. In addition "Atlantic City is wrapping up its fourth straight year of declining casino revenues" due to "rise in casino competition in neighboring Pennsylvania, New York and Delaware" which "coincided with the nationwide recession." The fact that combined Las Vegas Strip and Atlantic City annual winnings broke the one billion dollar mark in 2004 but fell below it in 2009 further illustrates the financial difficulties that recession brought to the gaming industry.

To shed more light on whether casino winnings are recession proof or driven by macro-economic factors we analyzed the relationship between revenues for major gaming centers in Nevada (the Las Vegas Strip, Downtown Las Vegas, Laughlin and Boulder City) and Atlantic

[1] www.nber.org/cycles/recessions.html
[2] www.nber.org/cycles.html
[3] According to David Lereah, chief economist for National Association of Realtors, housing prices peaked and real estate market boom ended in August of 2005. During 2006 to 2007 period real estate market balloon had burst and price correction was felt in every region of the U.S.A.

City,[4] versus nominal Gross Domestic Product (GDP),[5] unemployment, inflation, their sum or Misery index[6] and stock market return, proxied by the S&P 500 index[7] over the 1990-2009 period using ordinary list squares regressions.

THE MODEL

Simple univariate linear regression (ordinary least squares)[8] produces the slope and the intercept of a line that best fits data points, in our case the relationship between macroeconomic factors and casino revenues, by reducing the sum of the squared differences between each data point and the forecasted line.

We analyze the proportion of variation in casino revenue, our dependent or Y variable, explained by the variation in macro-economic factors (our independent or X_i variables) in the following model:

$$Y_t = \beta_0 + \beta_1 X_{it} + \varepsilon$$

Y_t = The Dependent Variable (Casino win) in period t
X_{it} = The Individual Independent Variable (each of macro-economic factors) i in period t
$\varepsilon = Error\ Term\ (\ assumed\ to\ be\ close\ to\ 0)$
$\beta_0 = the\ Y\ Axis\ \ Intercept$
$\beta_1 = The\ Slope\ of\ the\ Line$

By assuming that the expected value of the error term (ε) is very close to zero, this then becomes the equation for a straight line. In addition to a contemporaneous comparison we believe there may very well be a lag period between the change in macro-economic factors and the change in casino win. This lag may be as little as three months, but is expected to be closer to one year as many casino visitors, especially for the Las Vegas Strip, plan vacations a year or more in advance.

The success of our model is measured by "Coefficient of Determination" r^2 also known as the "goodness of fit" statistic. The Coefficient of Determination reports the proportion of the variation in the dependent variable Y as a result of the introduction of the independent variable X. The range of r^2 is from 0 to 1.Thus, the closer r^2 is to 1 the larger proportion of the total variation of the dependent variable Y is explained by the independent variable X.

Another statistic, the correlation coefficient (r), is easier to understand. It represents a much broader relationship and indicates how the two time series move together. If the correlation coefficient is +1 then they move exactly the same, a 10% increase in X is mirrored by a positive movement of 10% in Y. If the coefficient is -1 then the exact opposite is true, and if the coefficient is 0 then there is no relationship at all. Although it appears that the easiest way to calculate (r) is to take the square root of (r^2) that is not the case. To determine the correlation between two time series data sets, their co-variance must be standardized by the product of standard deviation (σ) of variables Y and X. Since the covariance can be positive or negative, the range of the correlation coefficient is bounded between minus and plus one:

[4] Data was obtained from Nevada Gaming Control Board and New Jersey Casino Control Commission.
[5] www.bea.gov/national/nipaweb/TableView.asp?SelectedTable=5&Freq=Qtr&FirstYear=2007&LastYear=2009
[6] www.miseryindex.us/raw_data.asp
[7] Adjusted closing prices for S&P 500 Index (Regular Trading Hours) from www.yahoo.com/finance
[8] Netter et. al. 1990.

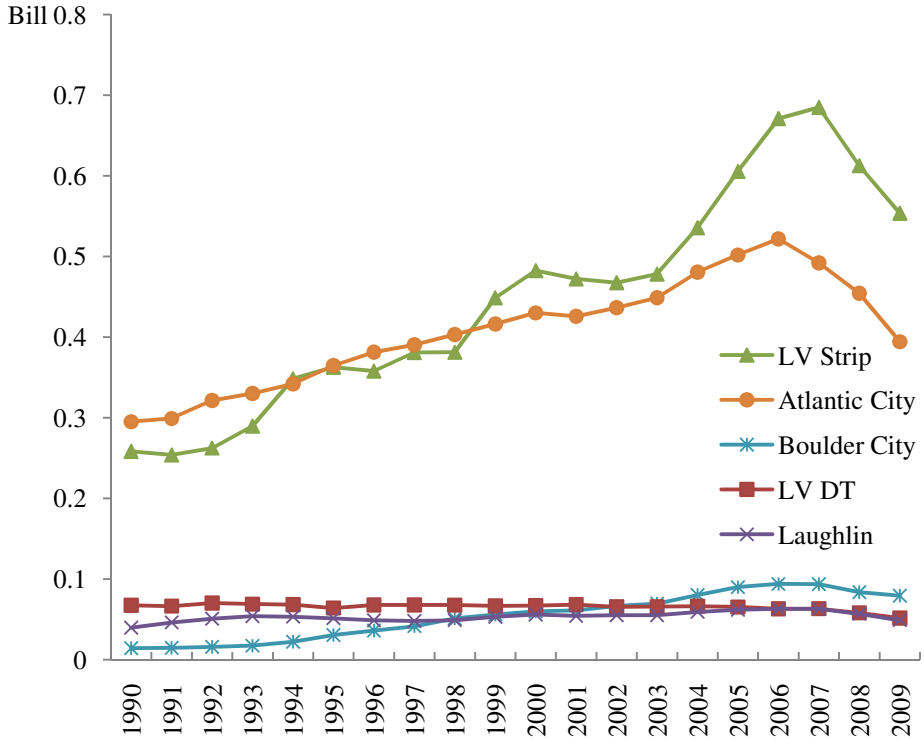
Correlation Coefficient $r = Cov(Y, X) / (SD_Y * SD_X) = \sigma_{YX} / (\sigma_Y * \sigma_X)$.

As can be seen from the above equation, the Covariance can be negative or positive and hence the correlation coefficient can range from -1 to +1. The plus or minus sign is attached to the coefficient according to the relationship between two time series, illustrated by the slope of the fitted regression line.

DATA

For every variable other than GDP, we were able to find monthly data. However, figures for GDP were only available in annualized quarterly and annual form. Hence to bring all variables to the same frequency monthly casino revenues were added up to create quarterly and annual data. Due to their seasonal nature in both monthly and quarterly form only aggregated annual gaming returns are presented in Figure 1. Since the unemployment, inflation and Misery index were recorded as annualized monthly rates, quarterly and annual rates were calculated as arithmetic means for corresponding three and twelve months. Quarterly and annual returns on the S&P 500 Index were calculated from corresponding monthly adjusted closing prices reported at www.yahoo.com/finance. In order to have a meaningful comparison all quarterly and annual data series were converted into percentage changes.

Figure 1: Annual Casino Revenues in Billions of Dollars
(Source: Nevada Gaming Control Board and New Jersey Casino Control Commission)



During twenty years of our sample period the US economy went through two recessions that lasted eight months each: July 1990 - March 1991 and March 2001 - November 2001, and the mega one lasting eighteen months: December 2007 - June 2009. Visual inspection reveals that all of the major casino centers in Nevada exited the 1990/1991 recession with higher

monthly revenues, while it took Atlantic City 5 more months to exceed pre-recession monthly winnings. Whereas Las Vegas Strip and Atlantic City emerged from 2001 recession with higher monthly revenues, Boulder City, Laughlin and Downtown Las Vegas needed 2, 3 and 4 months, respectively, to reach their pre-recession monthly revenues. Not only were year-to-year monthly revenues for all five gaming centers falling during 2007-2009 recession, but they continue to decrease through the end of our sample period in December 2009.

Based on economic theory we expect casino revenues to be positively affected by GDP, inflation and stock market returns, while unemployment is predicted to have negative effect on casino winnings. Influence of the Misery index is ambiguous and depends on whether unemployment or inflation dominates movements of their sum.

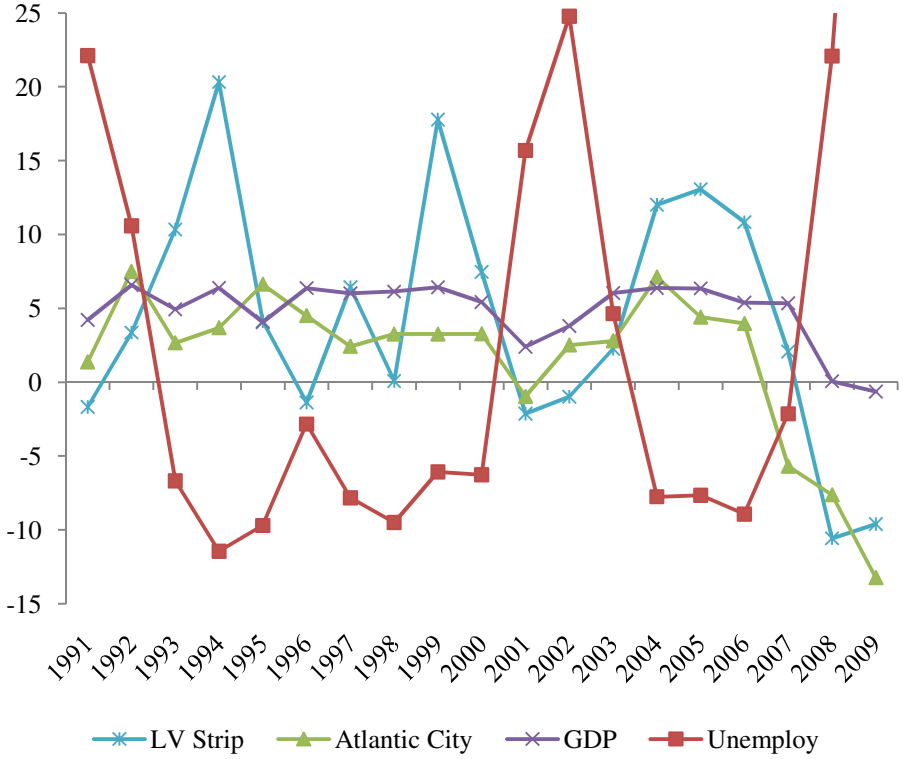
The correlations coefficients of annual percentage changes, presented in Table 1, support our expectations. Revenues from different gaming centers exhibit positive correlation among themselves. GDP has the strongest positive correlation with casino winnings, followed by inflation, while returns on the S&P 500 index have the weakest positive influence. Unemployment has a consistent and strong negative effect on casino revenues. As predicted the effect of Misery Index is not uniform. While it had negative impact on casino wins along Las Vegas Strip and Boulder City, Nevada, revenues in all other gaming centers had a positive relationship with percentage changes in Misery Index.

Table 1: Correlations of Annual Percentage Changes in Casino Revenues and Macro-economic Factors

	LV Strip	Atlantic City	Boulder City	LV DT	Laughlin	GDP	Unemploy-ment	Inflation	Misery Index
Atlantic City	0.6267								
Boulder City	0.5040	0.6859							
LV DT	0.3049	0.6236	0.2525						
Laughlin	0.4876	0.6197	0.1205	0.4999					
GDP	0.7309	0.8165	0.5518	0.7568	0.6184				
Unemployment	-0.7347	-0.7321	-0.6291	-0.5285	-0.3847	-0.8118			
Inflation	0.4175	0.4337	0.0929	0.3090	0.3043	0.4156	-0.6263		
Misery Index	-0.0709	0.1209	-0.2587	0.3678	0.2013	0.1799	0.1263	-0.1562	
S&P500	0.1640	0.2409	0.4418	0.0888	0.1390	0.3532	-0.1932	-0.1778	-0.0384

Since graph of revenues from all 5 gaming centers and for all 5 macro-economic factors is very cluttered and hard to read, to illustrate the relationship between casino wins and macroeconomic factors in Figure 2 we only presented data for dominant casino destinations (Las Vegas Strip and Atlantic City) and major macro-economic factors (GDP and unemployment).

Figure 2: Annual Percentage Changes in Las Vegas Strip and Atlantic City Casino Revenues Versus Annual Percentage Changes in GDP and Unemployment



THE RESULTS

In order to take full advantage of available data and increase power of statistical tests we began analysis with monthly data. However, as in the Flanegin et.al. 2009 a similar study of the relationship between foreign exchange rates and hotel occupancy, monthly casino revenues contained a significant amount of noise and seasonality. The seasonality problem was a major concern since we felt seasonal leisure and business travel patterns could easily dwarf changes resulting from the broader macro-economic factors.

Markets that we analyze have different seasonality patterns and attempting to correct for them would present a major problem. For example, while visits to Atlantic City increase during summer months, they decline in Nevada due to extreme heat. The easiest way to solve the seasonality problem was to aggregate the data on quarterly and yearly basis, market by market, eliminating much of the seasonality patterns. While this substantially eliminated the number of data points, we believe that it greatly reduced the noise and seasonality inherent in the data.

Results from contemporaneous regressions of quarterly percentage changes, presented in Table 2, indicate that only GDP and unemployment had statistically significant effects on casino revenues, but just in Boulder City and along the Las Vegas Strip. The impact of GDP was also statistically significant on casino winnings in Atlantic City. Consistent with theoretical predictions and correlation coefficients reported in Table 1, GDP had a positive and unemployment a negative relationship with casino revenues.

Table 2: Quarterly Percentage Change in Casino Wins vs. Contemporaneous Macro-economic Factors

Macro-econ Factor	Statistical Results	Las Vegas Downtown	Las Vegas Strip	Laughlin	Boulder City	Atlantic City
GDP	R^2	0.005	0.054	.0006	0.056	0.065
	Coefficient	0.528	2.224	0.377	2.405	7.781
	F-Stat	0.391	4.468**	0.048	4.576**	5.396**
Unemployment	R^2	0.014	0.052	0.002	0.073	0.003
	Coefficient	-0.119	-0.286	-0.105	-0.363	-0.243
	F-Stat	1.153	4.242**	0.218	6.109**	0.283
Inflation	R^2	0.007	0.006	0.025	0.00002	0.0003
	Coefficient	-0.123	-0.146	-0.178	0.009	0.108
	F-Stat	0.573	0.495	0.543	0.001	0.026
Misery Index	R^2	0.006	0.031	0.0001	0.0002	0.0001
	Coefficient	0.135	0.385	0.040	-0.037	0.084
	F-Stat	0.490	2.495	0.010	0.019	0.010
Stock Returns	R^2	0.021	0.00004	0.032	0.003	0.022
	Coefficient	-0.088	-0.001	0.220	0.048	-0.374
	F-Stat	1.667	0.003	2.597	0.266	1.807

Level of significance 10%=*, 5%=**, 1%=***

Lack of a statistically significant relationship between macro-economic factors and casino revenues in Down Town Las Vegas and Laughlin could be attributed to their stagnant winnings, as illustrated in Figure 1. The absence of the statistically significant impact of inflation could be the result of active monetary policy conducted by FED, which if not distorted then at least dampened the expected relationships with other macro-economic factors and casino winnings. One possible explanation for no significant effect of Misery Index on casino revenues is that the opposite effects of unemployment and inflation cancelled each other out. No significant relationship between casino revenues and returns on S&P 500 index is consistent with the behavioral finance theory that most investors reinvest rather than spend stock market gains and the fact that most investments in the stock market by the individuals are driven by long-term pension planning rather than short-term consumption needs.

Results of regressing macro-economic factors against casino revenues in the subsequent quarter, reported in Table 3, indicate fewer statistically significant relationships relative to contemporaneous analysis. While impact of GDP remains significant only for revenues from casinos along the Las Vegas Strip, unemployment no longer has a significant effect on revenue from any gaming center. Statistically significant negative relationship between inflation and casino revenues, consistent with macroeconomic predictions, was found only for the Down Town Las Vegas. However, marginally significant negative effects of returns on the S&P 500 index on Laughlin casinos' revenues are unexpected and might be the result of the erroneous relationship driven by seasonality characteristics of quarterly data.

Table 3: Quarterly Percentage Change in Casino Wins vs. 1 Period Lagged Macro-economic Factors

Macro-econ Factor	Statistical Results	Las Vegas Downtown	Las Vegas Strip	Laughlin	Boulder City	Atlantic City
GDP	R^2	0.019	0.048	0.001	0.443	0.007
	Coefficient	1.043	2.133	0.668	0.784	2.719
	F-Stat	1.483	3.906**	0.146	0.443	0.597
Unemployment	R^2	0.026	0.018	0.004	0.029	0.0003
	Coefficient	-0.159	-0.168	-0.129	-0.231	0.073
	F-Stat	2.036	1.393	0.321	2.321	0.024
Inflation	R^2	0.055	0.020	0.003	0.022	0.002
	Coefficient	-0.336	0.261	-0.183	-0.291	0.295
	F-Stat	4.429***	1.568	0.304	1.568	0.194
Misery Index	R^2	0.023	0.009	0.013	0.001	0.008
	Coefficient	0.264	-0.222	0.407	0.101	-0.661
	F-Stat	1.805	0.767	1.036	0.139	0.669
Stock Returns	R^2	0.004	0.011	0.053	0.009	0.005
	Coefficient	-0.039	-0.085	-0.287	0.081	0.182
	F-Stat	0.312	0.917	4.987*	0.719	0.407

Level of significance 10%=*, 5%=**, 1%=***

In attempt to mitigate noise and seasonality problems inherited in quarterly data, regression analysis was repeated using annual percentage changes of casino revenues and macro-economic factors. Contemporaneous regression results for annual data, presented in Table 4, are similar to results of contemporaneous quarterly analysis but stronger. This time GDP has a strongly significant and, as predicted, positive effect on winnings for casinos from all gamming centers. Other than a marginally significant and unexpectedly positive effect on Laughlin's casino revenues, unemployment has a strongly significant and, as predicted, negative impact on casino winnings.

Consistent with our predictions, inflation has a significant positive effect on casino revenues, but only for the Las Vegas Strip and Atlantic City. The return on the S&P 500 index has a significant positive relationship only with revenues for casinos from Boulder City.

Similar to the relationship between contemporaneous and one period lagged quarterly data regressions, results from regressing annual percentage changes in macro-economic factors on percentage change of casino winnings in the following year, presented in Table 5, are somewhat weaker than those from contemporaneous annual analysis but stronger than those from one period lagged quarterly analysis. Although impact of GDP remains significant and positive, it only affects revenues for casinos from Atlantic City, Laughlin and along the Las Vegas Strip. Contrary to both quarterly and contemporaneous annual regressions, unemployment no longer significantly affects casino revenues. Instead the effect of S&P 500 index returns is now significant and positive in all gaming centers with the exception of Boulder City.

Table 4: Annual Percentage Change in Casino Wins vs. Contemporaneous Macro-economic Factors

Macro-econ Factor	Statistical Results	Las Vegas Downtown	Las Vegas Strip	Laughlin	Boulder City	Atlantic City
GDP	R^2	0.572	0.534	0.382	0.304	0.667
	Coefficient	1.463	2.867	2.035	2.944	2.015
	F-Stat	22.786***	19.502***	10.527***	19.502***	34.001***
Unemployment	R^2	0.279	0.539	0.147	0.395	0.536
	Coefficient	-0.116	-0.329	0.144	-0.383	-0.206
	F-Stat	6.588**	19.933***	2.952*	11.136***	19.640***
Inflation	R^2	0.095	0.174	0.092	0.008	0.188
	Coefficient	0.033	0.092	0.056	0.027	0.060
	F-Stat	1.794	3.588*	1.734	0.147	3.938**
Misery Index	R^2	0.135	0.005	0.040	0.066	0.014
	Coefficient	0.256	-0.100	0.239	-0.497	0.107
	F-Stat	2.659	0.085	-0.718	1.219	0.252
Stock Returns	R^2	0.007	0.026	0.019	0.195	0.058
	Coefficient	0.019	0.070	0.049	0.256	0.064
	F-Stat	0.135	0.470	0.334	4.123*	1.048

Level of significance 10%=*, 5%=**, 1%=***

Table 5: Annual Percentage Change in Casino Wins vs. 1 Period Lagged Macro-economic Factors

Macro-econ Factor	Statistical Results	Las Vegas Downtown	Las Vegas Strip	Laughlin	Boulder City	Atlantic City
GDP	R^2	0.105	0.311	0.279	0.123	0.281
	Coefficient	0.801	2.754	1.904	2.373	1.673
	F-Stat	1.882	7.235**	6.206**	2.262	6.265**
Unemployment	R^2	0.014	0.098	0.000	0.139	0.029
	Coefficient	-0.040	-0.211	-0.003	-0.342	-0.073
	F-Stat	0.239	1.745	0.001	2.586	0.486
Inflation	R^2	0.0006	0.004	0.038	0.026	0.028
	Coefficient	-0.003	-0.020	-0.042	-0.065	-0.031
	F-Stat	0.010	0.078	0.642	0.433	0.473
Misery Index	R^2	0.022	0.016	0.052	0.006	0.012
	Coefficient	-0.105	0.181	0.233	-0.158	-0.099
	F-Stat	0.374	0.276	0.892	0.112	0.201
Stock Returns	R^2	0.433	0.159	0.313	0.134	0.306
	Coefficient	0.140	0.170	0.174	0.214	0.151
	F-Stat	12.247***	3.038*	7.304**	2.494	7.077**

Level of significance 10%=*, 5%=**, 1%=***

THE CONCLUSIONS

The accepted belief, supported by empirical evidence from the 1990/1991 and 2001 recessions, that gaming in general and especially on the Las Vegas Strip were "recession proof", is no longer correct. During the last 2007-2009 recession it turns out that the gaming industry behaves the same as most industries, and is susceptible to the general economic health of the country, reflected in changes of macro-economic factors such as GDP, unemployment, inflation, Misery Index and stock market returns, proxied by returns on the S&P 500 Index.

The only macro-economic factor which consistently had a statistically significant and expected effect on casino revenues in both contemporaneous and 1 period lag regressions using both quarterly and annual percentage change in gaming wins and macro-economic variables was GDP. With the exception of one period lag regression of annual percentage changes, unemployment had statistically significant negative impact on casino revenues in at least one gaming center.

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