Examining the Link Between Poker Room Business Volume and Gaming Activity in Slot and Table Games: A Closer Look at a Key Assumption in the Full Service Theory

Anthony F. Lucas, Ph.D.

Abstract

Results from three different Nevada hotel-casinos failed to support the popular notion that poker rooms drive business to the slot and table game areas of the casino floor. This result not only questions the validity of a key and somewhat bold operating assumption, it casts a shadow of doubt on the broader Full Service Theory, as applied to the casino floor. Additionally, this work extends Ollstein (2006) by empirically examining the relationships between the daily business volumes of poker rooms and both critical gaming centers (i.e., slots and table games). Five of six key results question the wisdom of offering live poker, based on the assumption of indirect revenue contribution to slots and table games. Double-log time series models are advanced to analyze the daily operating results of three casinos over a seven-month period, offering a rare and insightful look at actual casino performance data.

Keywords: Poker room operations, casino management, slot operations, table game operations, operations analysis

Introduction

There is no shortage of claims that poker rooms drive business to key casino profit centers such as slots and table games (Cosgrove-Mather, 2005; Grochowski, 2005; Legato, 2010; McGowan, 2010; Taucer, 2004; Walters, 2003; Wiser, 2004). However, there *is* a shortage of compelling empirical support for these claims. Only one published study has examined the relationship between the business volumes of the poker room and the slot floor (Ollstein, 2006). Worse yet, no studies have examined the relationship between the business volumes of poker rooms and table games.

Poker rooms are somewhat notorious for their inability to produce competitive levels of profit per square foot (Grochowski, 2005; McGowan, 2010; Taucer, 2005). Others have described live poker as something of a loss-leader (McGowan 2010; Grochowski 2005), existing only because of assumed revenue contributions to slots and table games. This assumption of contributions to other gaming areas is absolutely critical. For some,

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insufficient profits from operations combined with the weakly supported assumption of external revenue contributions makes the poker room worthy of a closer look.

Although there are Las Vegas poker rooms that continue to draw crowds, several operators have begun to question the wisdom of offering live poker, in spite of the widely held assumption of external revenue contributions. For example, in 2011, casino executives at the Gold Coast closed the poker room, using the floor space to accommodate additional slot machines (Sieroty, 2011). In 2008, the Las Vegas Hard Rock constructed an extravagant $30-million, 18-table poker lounge (Boncek, 2008). By 2010, the poker lounge was closed, with live poker relegated to a far less glamorous location that accommodated only eight games (Arnett, 2010). This downsizing occurred following a major hotel and casino expansion, suggesting the decision was not driven by a shortage of gaming space. Other notable poker room closures included the Paris Hotel Casino in 2008, and the Tropicana, Aliante Station, and Silverton, all three of which were shuttered in 2012 (Mehaffey, 2012). While live poker rebounded from near extinction in the late nineties to reach unimaginable heights in the mid-aughts, it would seem as though some are once again beginning to wonder whether it is the best use of casino floor space.

An improved understanding of the poker room's contribution to the casino is a particularly important issue for operators who (1) manage space-constrained casinos with viable alternative uses for the poker room's floor space and (2) are considering the addition of a poker room to an existing property. Developers would also benefit from such knowledge, as they must decide whether to include a poker room in the plans for a casino expansion or an entirely new property. These operators and developers cannot afford to assume that poker rooms supply significant revenue contributions to slots and table games, based on little more than popular opinion.

Casino executives are pressured to offer the game mix that optimizes profits, while simultaneously complying with a host of curious operating paradigms such as the full service theory. Among other things, the full service theory holds that the presence of the poker room increases wagering volume on both table games and slots. This study empirically examines the relationships between the business volume of the poker room and those of both slots and table games, providing a detailed examination of the poker room's role in the full service theory. The results will help gaming managers and casino developers better understand a critical operating assumption that affects both important game mix decisions and overall casino profits.

Literature Review

Direct and Indirect Revenues

It will be helpful to define and few key terms before an in-depth review of the literature. In a hotel-casino resort, "non-gaming amenities" refers to on-site facilities such as restaurants, retail outlets, bars, and the hotel itself. This is not an exhaustive list, as there are many forms of non-gaming amenities. While a limited form of gaming can occur in a non-gaming amenity, such as keno service within a restaurant, non-gaming amenities typically do not feature gaming.

"Gaming amenities" informally refers to profit centers within the overall casino which produce marginal operating profits, if any at all. The term "amenity" is assigned to these gaming areas because the amount of operating profit they produce is nominal in comparison to that generated by the critical casino profit centers such as slots. For example, bingo and keno are often referred to as gaming amenities, or ancillary gaming activities. Poker rooms and race and sports books also fall into this category for many operators.

It is also important to define the difference between *direct* and *indirect* revenue contributions, a distinction advanced by early gaming scholars (Dandurand and Ralenkotter, 1985; Roehl, 1996). For example, direct revenues in a casino-operated restaurant stem from purchases of items such as meals, which are sold in the outlet itself. Additionally, these restaurants are often assumed to produce indirect revenues in other areas of the resort by either attracting patrons to the property or keeping them from leaving (Brock, Newman and Thompson, 1992). Many operators assume that restaurants draw diners to the resort who eventually find their way into the casino (Lucas and Santos, 2003). Once in the casino, these diners produce gaming win and ultimately, operating profits for the casino. The gaming revenues generated by diners who were supposedly lured to the resort by its restaurants would be considered a form of indirect revenue produced by or at least informally credited to the restaurants.

The Full Service Theory

This may be more of an operating assumption than a theory, at least from an academic perspective. In any case, it is quite popular among gaming industry executives. Simply put, the full service theory holds that amenities attract play that would otherwise be absent (Lucas and Kilby, 2008). It applies to both non-gaming and gaming amenities. For example, by having a poker room (a gaming amenity), it is assumed that a casino becomes increasingly attractive to groups of two or more people containing at least one person interested in playing poker. In general, the full service theory is based on the idea of capturing more customers by casting a wider net. The width of this “net” is defined by the diversity of the games offered by the casino.

In practice, the full service theory is often used to justify the existence of an amenity which is failing to produce sufficient direct profits. The justification usually takes the following form: While it may be obvious the amenity is unable to demonstrate acceptable operating profits, eliminating it would cause a decline in critical gaming volumes such as slot and table game play. It is important to note here that revenues and expenses from poker rooms are almost never reported on the table game department’s internal income statement. A separate income statement is prepared, including only those revenues and expenses produced by the poker room. Alternatively stated, poker tables are not considered table games, which may be counterintuitive to those outside of the gaming industry.

The full service theory defense is most likely to be invoked by managers of the underperforming department when there are viable alternative uses of their floor space. However, measuring an ailing amenity’s indirect revenue contributions is very difficult and remains a challenge for most in the gaming industry (Lucas and Kilby, 2008). When the claims of indirect revenues cannot be definitively established or refuted, the manager of the amenity is able to play this troubling reality to something of an inconclusive stalemate. Should the decision makers (e.g., senior management) subscribe to the widely accepted full service theory, the ailing amenity is likely to dodge elimination. Poker room managers are among those who are naturally familiar with this game.

Figure 1 is offered as an overview of the full service theory. It is based on descriptions found in Lucas and Kilby (2008) who discuss but do not endorse the theory. The contents of Figure 1 are further described in the ensuing paragraphs.

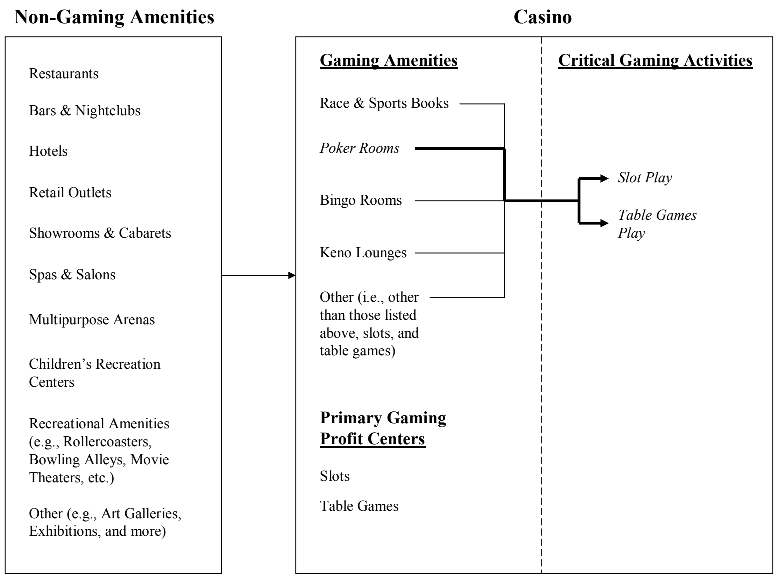


Figure 1. Illustration of causal assumptions included in the Full Service Theory, as applied to hotel-casino resorts.

Starting at the far left of Figure 1, non-gaming amenities are shown to influence casino business volumes. While amenities that produce substantial direct profits such as hotels and nightclubs do not have to rely on the full service theory for survival, the overall performance of others such as showrooms and even restaurants is sometimes questioned (Lucas & Kilby, 2008). In this case, overall performance is defined as the sum of direct profits and all estimated or assumed indirect profit contributions. The full service theory is often used to justify annual operating losses in casino-operated restaurants and showrooms.

Couched within the broader framework of the full service theory, the focus of the current study resides within the Casino block of Figure 1. This area is further divided into two sections, Gaming Amenities and Primary Gaming Profit Centers. Within the Gaming Amenities section, this study empirically examines the relationships illustrated by the bold line linking Poker Rooms to both Slot Play and Table Games Play. When direct profits in the poker room are deemed unacceptable, continued operation often relies on the assumption that the poker room drives business to critical gaming areas such as slots and table games (as illustrated in Figure 1). Alternatively stated, if casino executives feel that the poker room is not producing enough operating profit from live poker, they must justify the existence of the poker room based on the belief that it is driving business in other key areas of the casino.

Although not shown in Figure 1, the full service theory extends to the game level. For example, there is much debate regarding the appropriate game mix within the table game operation. Specifically, management strives to optimize operating profits by managing the supply mix, in terms of betting limits and the types of games offered (e.g., blackjack, roulette, craps, baccarat, etc.).

Supply Mix

The Casino section of Figure 1 illustrates something of a supply/game mix problem occurring within the space of the entire casino floor. Broadly speaking, space optimization challenges are abundant in the hospitality sector and have been for many years. Most of these challenges have been addressed by way of revenue management techniques within the hotel, airline, and restaurant industries (Hanks, Noland & Cross, 1992; Smith, Leimkuhler & Darrow, 1992; Kimes & Thompson, 2004). While few would argue that an optimal supply mix leads to optimal revenues, the gaming question illustrated in Figure 1 poses an additional hurdle.

To apply revenue management techniques, management must be able to forecast and measure "total" revenues. However, claims of indirect revenues confuse the issue. Specifically, how can a revenue management process be applied to an area in which "total" revenues cannot be directly computed? Again, in the case of the poker room, total revenues would equal direct revenues plus any indirect revenues credited to the poker room. Without a sophisticated measurement process, these indirect revenues can only be crudely estimated. A mere claim of indirect revenues gives the poker room manager grounds to question the accuracy of any optimization process that does not include this elusive estimate.

Spillover Effect

From the retail literature, the spillover effect is consistent with the general idea of the full service theory. The spillover effect is the term used to describe the condition whereby the sales of one store are found to affect those of another. It is often attributed to anchor stores in retail shopping centers (Eppli and Schilling, 1995). In the current study, the key issue is whether the poker room attracts gamblers who spillover into other areas of the casino.

Cherry Pickers

The idea of cherry picking also comes from the retail literature. Contrary to the full service theory, cherry pickers have specific targets in mind. For example, cherry picking is thought to occur when stores aggressively drop prices on selected items and experience no increase in the sales of complementary items. In retail settings, even loss-leader pricing has failed to increase the sales of the full-priced complementary goods (Walters and Rinne, 1986; Walters and MacKenzie 1988). For example, if hotdogs were priced below cost, no increase would occur in the sales of complimentary items such as hotdog buns, ketchup, and mustard. Only increases in the purchases of the loss-leader item would occur (i.e., the hotdogs).

Within the gaming industry, loss-leader pricing strategies in casino-operated restaurants have failed to produce corresponding increases in the wagering activity of key gaming areas (Lucas and Brewer, 2001). Cherry picking was advanced as one explanation for this disappointing result. That is, the loss-leader pricing was thought to have attracted deal-prone restaurant customers to the property, with little interest in gaming, if any at all.

Regarding the current study, it is certainly possible that poker players are only interested in playing poker. Poker is a notoriously slow game that usually features a very low cost per hour for the player (Taucer, 2005). It is also somewhat unique in that players are pitted against each other and compete for each other's bankroll. At a minimum, a subdued form of cherry picking by poker players is a possibility worthy of consideration.

Trade Literature

A trade literature review is important to the extent that it establishes the widespread acceptance of some critical assumptions related to the current study. First, while there are always exceptions, poker rooms are not known for producing stellar operating profits (Cosgrove-Mather, 2005; Gellar, 2009). Some have gone as far as comparing poker rooms to loss-leader pricing strategies (McGowan, 2010; Grochowski, 2005). Second, many operators and industry pundits believe that poker rooms drive slot and table game play, which is actually a causal statement (Cosgrove-Mather, 2005; Grochowski, 2005; Legato, 2010; McGowan, 2010; Taucer, 2004; Walters, 2003; Wiser, 2004). This assumption is critical to the existence of the poker rooms, especially when direct operating profits are in short supply. The assumed indirect revenue contributions are thought to occur from two sources. The first origin is crossover play, which is based on the assumption that poker players produce meaningful gaming activity in other areas of the casino (Byrne, 2010). The second source is similar to what Lucas & Kilby (2008) describe as the entourage effect. In this case, it is assumed that other parties accompany poker players to the casino, and these other parties engage in meaningful gaming activity outside of the poker room (Cosgrove-Mather, 2005; Wolf, 2010).

Claims such as the ones described in the previous paragraph are the bedrock of the full service theory. Similar if not identical claims are made about bingo and race and sports books. The next section reviews the extant literature related to the alleged relationships described within the Casino block of the full service theory, as depicted in Figure 1.

Indirect Contributions of Gaming Amenities

Only Ollstein (2006) has examined the link between the poker room and slot play, as illustrated in Figure 1. He examined daily performance data ranging from February 1, 2005 to August 31, 2005, in an effort to assess the nature of the relationship between daily poker room rake and aggregate slot coin-in. It is important to note that Ollstein's data were collected at a Las Vegas Strip resort during a time that is generally considered to be the zenith of live poker's popularity (i.e., c. 2005 – 2006).

Ollstein found a significant and positive relationship between daily poker room rake and daily aggregate coin-in ($B = 98.63$; $p < 0.05$). This result indicated that a one-dollar increase in poker room rake could be expected to produce a \$98.63 increase in slot wagers. The rake variable represented the aggregate dollar amount of daily fees collected from poker players. Other than hourly poker room headcount data, which most casinos do not have, rake is considered to be the best available business volume indicator. On the slot side, the coin-in variable represented the aggregate daily dollar amount of wagers accepted in coin- or voucher-operated wagering devices. Ollstein did not examine the relationship between poker room rake and table game drop, as illustrated in Figure 1.

Like the current study, Ollstein (2006) analyzed times series data using a model consisting of the following types of predictor variables: Day of the week, holiday periods, rake, property-wide promotions, special events, and ARMA terms. The ARMA terms were used to create an independent error process. While it may seem simplistic, Ollstein's model explained 89% of the daily variation in the resort's daily coin-in.

In spite of the positive relationship, Ollstein expressed concern for his result. First, he noted that the casino could only expect to retain 7.5% of the expected \$98.63 increase, as the regression coefficient represented wagering volume and not expected win. Second, he mentioned the incremental operating costs associated with processing the additional wagers. Third, after comparing estimates of what the poker room floor space could produce as a slot area, he questioned whether the magnitude of the regression coefficient was sufficient to sustain poker room operations.

Staying within the Casino block of Figure 1, Lucas and Brewer (2001) found a positive relationship between the aggregate daily bingo headcount and aggregate daily coin-in. However, more recent research employing the same methodology has produced different results. Lucas, Dunn, and Kharitonova (2006) failed to find a statistically significant relationship between daily bingo headcount and coin-in levels. This result was produced using data from both a Las Vegas resort and a Southern California Indian casino.

Abarbanel, Lucas, and Singh (2011) is the only study to have empirically examined the relationship between race and sports book business volume indicators and daily coin-in levels. Their original model included predictor variables representing the daily gaming activity in both the race and sports books, but neither variable produced a statistically significant effect on the criterion variable - daily aggregate coin-in. The theoretical model was well specified in Abarbanel et al., predicting 90% of the daily variation in the dependent variable, over a 250-day period ranging from January 1, 2009 to September 7, 2009.

Abarbanel et al. (2011) included commentary from operators and industry pundits claiming the existence of a positive relationship between book and casino gaming levels (e.g., Manteris, 1993). Manteris cited the importance of the sports book's indirect revenue contributions; given its less than noteworthy direct revenues. In Eng (2008), Manteris cited the draw power of a state-of-the-art race and sports book, again claiming indirect contributions to other areas of the resort. This is further evidence of subscription to the full service theory. However, with regard to slot play, the results produced in Abarbanel et al. failed to support Manteris' claims.

Time Series Models in Gaming

The current study employed the base model described in Ollstein (2006), which first appeared in Lucas and Brewer (2001). This model has been an effective predictor of both daily aggregate coin-in (Abarbanel et al., 2011; Ollstein, 2006; Suh, 2006) and daily aggregate table game drop (Lucas, 2004; Lucas 2010; Suh, 2006), making it appropriate for this study. In fact, the R^2 values for the cited coin-in models ranged from a low of 89% to a high of 91%. The R^2 values for the cited table game drop models ranged from a low of 70% to a high of 91%. Five of the six drop models produced an R^2 value of least 90%, only the sixth model generated an R^2 of 70%. The sixth model produced its result from data donated by the management of a high-end Las Vegas Strip resort. Because of its premium clientele, this casino experienced much more variance in its daily table game drop, which was caused by marker (i.e., credit) transactions. This is not an unusual result/condition for casinos that cater to premium table game players (a.k.a. high-rollers).

One minor difference from the coin-in model described in Ollstein (2006) was the addition of a linear trend variable, which appeared in the coin-in model advanced in Lucas et al. (2006). Figure 2 illustrates the specific theoretical model tested in the current study. The operalization of each model variable is described in the Method section.

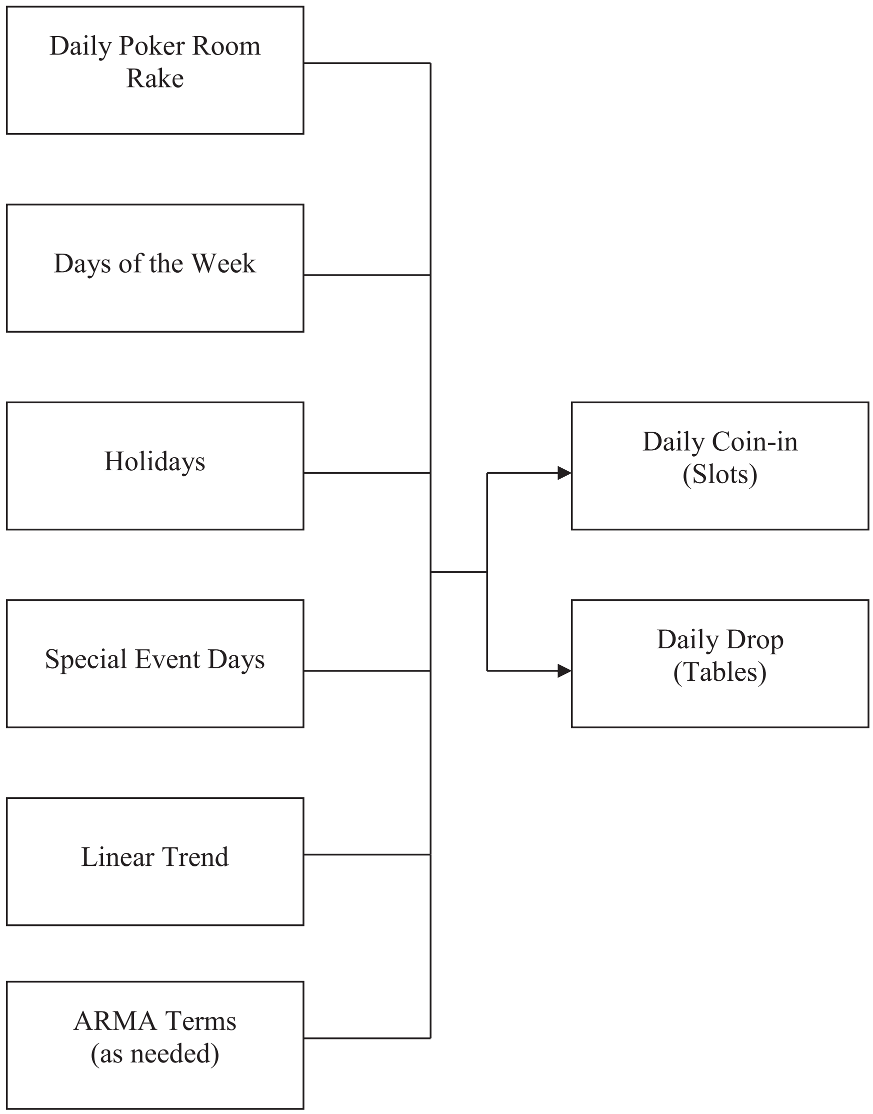


Figure 2. Theoretical model designed to predict daily coin-in and table game drop.

Hypotheses

With regard to the Casino block of Figure 1, five of the hypotheses tested by previous researchers failed to support the full service theory (Abarbanel et al., 2011; Lucas, et al., 2006). However, two of the hypothesis tests provided at least partial support for the theory (Lucas and Brewer, 2001; Ollstein, 2006). Given the low number of hypotheses tested and the mixed results of previous researchers, a directional hypothesis was not advanced. Instead, the following null hypothesis was tested using data from three different hotel-casino resorts.

$$H_0\text{: } B_{Rake} = 0$$

In the above null hypothesis "B_{Rake}" represented the regression coefficient for the poker room rake variable in each of the models tested (i.e., coin-in and drop models), for each of the three donor properties. All hypothesis tests were conducted within the framework of the model depicted in Figure 2.

Methodology

Data Sources

Audited secondary data were donated by three different Las Vegas hotel-casino resorts. The donor properties are referred to as Resorts 1, 2, and 3, as the management teams requested that the actual names of the properties not appear in the study. All three properties have consistently generated in excess of $72 million in annual gross gaming win, placing them in the top tier of the Nevada Gaming Control Board's revenue reporting hierarchy. The number of tables in the poker rooms varied by resort. At the time the data were collected, Resort 1 operated only 8 games, while Resorts 2 and 3 operated 22 and 12 games, respectively.

Resort 1 was located on the Las Vegas Strip, featured over 3,500 hotel rooms, and catered to customers attracted to what its management described as mid to low-end price points. Resort 2 also resided on the Las Vegas Strip, offered over 3,500 hotel rooms, but catered to what its management referred to as a mid-level to high-end clientele. Because of its presence in the premium player market, Resort 2 also offered an impressive array of restaurant and entertainment amenities. Resort 3 was located off the Las Vegas Strip, featured less than 750 hotel rooms, and the casino catered primarily to the Las Vegas-area residents. As the off-Strip location would suggest, Resort 3 offered much less in terms of restaurant and entertainment amenities and operated most facets of the property at price points well below those of the Strip casinos.

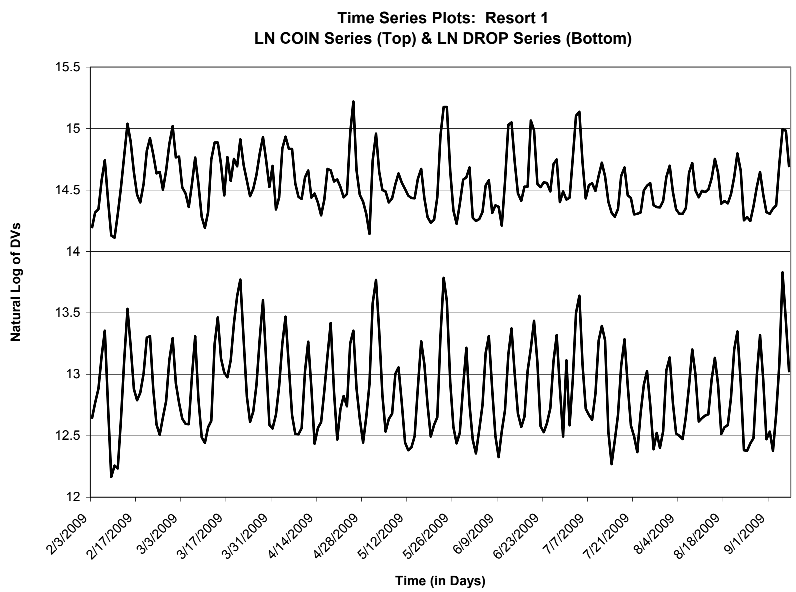
Sample Period

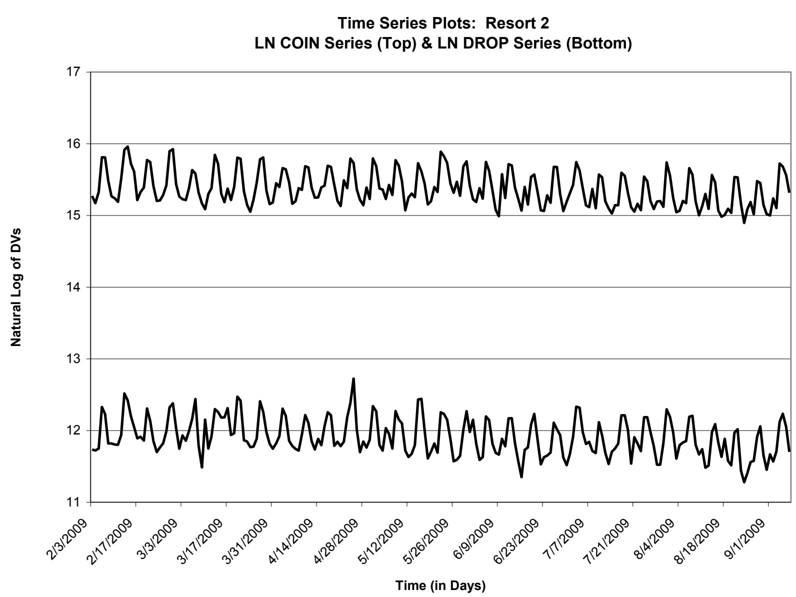
Each resort's data were sequentially ordered by day, with the 217-day samples beginning on February 3, 2009 and ending on September 7, 2009. These were the dates for which all three properties could supply a common data set. However, this general sample period is quite common in gaming studies of Las Vegas resorts, as it does not include the typical trough and peak business periods. For example, November is generally a big convention month, which fills hotel rooms with low-gaming-value guests. Additionally, the end of November includes Thanksgiving, the beginning of the holiday season, which extends to the end of December. This seven- to eight-week-long trough in casino business is followed by some of the busiest gaming days of the year – New Year's Eve and New Year's Day. This peak period may extend for a week, which will be followed by a sharp decline in daily gaming levels. It is very difficult for techniques such as time series regression analysis to produce a set of coefficients which are able to incorporate the consecutive phenomena of the trough period, peak period, and subsequent fall-off in daily gaming volume, while remaining sensitive to the changes occurring in the relatively stabile periods of the year. Further, given the current form of the time series model, the inclusion of additional binary variables representing the extended trough period and post-holiday decline would greatly increase the level of multicollinearity. Of course, this condition often obscures a clean look at the key variable, which in this case is poker rake. In fact, none the studies reviewed in this article included the months of November or December in the sample.

Data Analysis

After the data were screened, time series line plots of the dependent variables revealed periods of non-constant variance. However, a natural log transformation provided a remedy for this condition. Figure 3 illustrates the critical line plots following the natural log transformation. Any remaining peaks are the result of special events, holidays, and phenomena reflected on the right side of the regression equation. As endorsed by Kennedy

(1998, p. 264), these line plots were used to visually assess both first and second order stationarity (i.e., with regard to the series mean and variance). No unit root tests were performed, as such tests have been repeatedly found to lack statistical power (Campbell and Perron, 1991; Cochrane, 1991). However, each original model did include a linear trend variable to account for any significant changes in the mean of the series, over the course of the sample period.





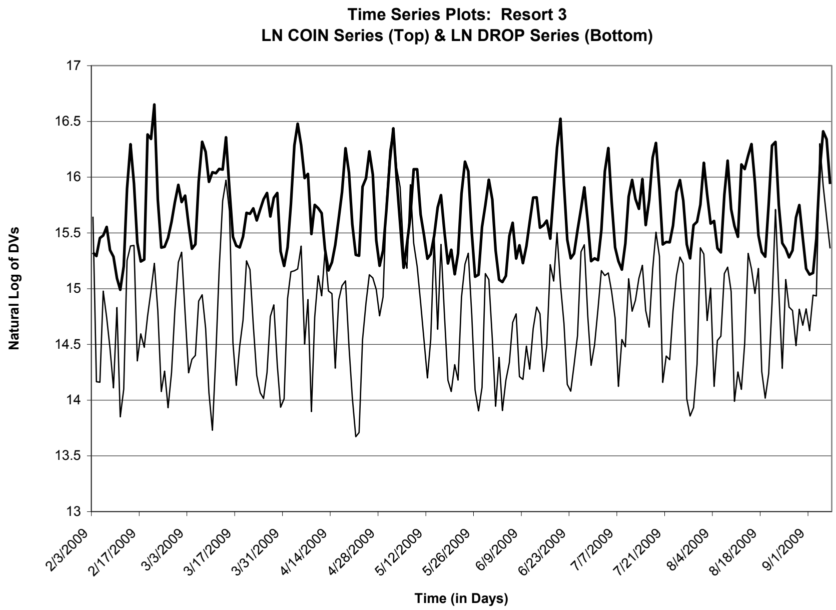


Figure 3. Time series plots of dependent variables for Resorts 1, 2, and 3.

To ease interpretation of the final model results, all continuous independent variable values were also converted to their natural log form, creating double-log models. A technique common in econometric modeling (Dielman, 1996), the double-log model features regression coefficients which are expressed as elasticities, i.e., the elasticity of Y with respect to X (Kahane, 2008, p. 84). Additionally, any replication of this double-log model would express the poker room effect in a comparable metric (i.e., in the form of an elasticity).

Following the natural log transformation of the continuous model variables, descriptive statistics were reviewed along with relevant bivariate correlation coefficients. The theoretical model illustrated in Figure 2 was tested via simultaneous-entry time series regression analysis. All hypotheses were tested at the 0.05 alpha level. EViews, version 3.1, and SPSS, version 18 were used for all data screening, exploratory data analysis, formal data analysis, and testing of methodological assumptions. The final time series models were produced in EViews, version 3.1.

Operalization of Dependent Variables

In total, there were six dependent variables, the natural log of aggregate daily coin-in (COININ) and the natural log of aggregate daily table game drop (DROP), for each of the three resorts. In the gaming industry, coin-in refers to the dollar amount of wagers placed in some number of slot machines, over a given period of time. In this paper, "slots" or "slot machines" refer to any coin- or voucher-operated device on the casino floor, including but not limited to reel slots, video poker games, and electronic roulette games. COININ did not include any wager placed in any gaming device that was permanently attended to by a live dealer.

In the table game area of the casino (a.k.a. the pit), drop is the most widely used business volume indicator. Although it is difficult to precisely describe what it actually represents, drop remains the most common and usually best measure available for describing the business volume in the pit. The following formula from Lucas & Kilby (2012, p. 140) is the most effective way to describe/define drop in a Nevada casino:

Table Game Drop = Dollar-value of Currency in the Drop Box + Dollar-value of Gaming Cheques in the Drop Box + Dollar-value of Marker Issue Slips in the Drop Box – Dollar-value of Marker Redemption Slips in the Drop Box

This formula is used to compute the dollar-value of the drop box contents for each table game. “Marker Issue Slips” refers to ticket-like forms detailing the issuance of credit to a casino customer. “Marker Redemption Slips” represents the retirement of debt issued by way of marker issue slips. Because marker redemption slips are included in the formula, table game drop does not represent the dollar-amount of cheques *purchased* at the tables (a.k.a. buy-in). This is a common mistake, when attempting to describe the meaning of drop. There are other issues related to the use of buy-in as a proxy for drop, but they are beyond the scope of this article.

Operalization of Independent Variables

The variable of interest in this study was RAKE, which represented the natural log of the daily aggregate dollar amount of fees paid by poker players. Simply put, rake is the fee charged to gamblers who play poker in the casino. Poker is somewhat unusual in that the game has no house edge. With no casino advantage, management must levy a rake against the players to make the game profitable. Aside from hourly headcounts of the poker room, which few management teams collect, rake represents the best available business volume indicator for a poker room.

TREND is the natural log form of the variable designed to represent the presence of any positive or negative linear trend in the dependent variable values, over the course of the sample. This is equivalent to taking the natural log of a counter variable, which is assigned a value of one on the first day of the sample and increases by a value of one with each additional day.

The day-of-the-week variables were expressed in a binary format. For example, on Sunday, the Sunday variable was set to a value of one, with all other of day-of-the-week variables set to a value of zero for that day. The final day-of-the-week variables were labeled as follows: TUE, WED, THU, FRI, SAT, and SUN. Monday was used as the base period, providing a level from which all other day-of-the-week variables either did or did not vary.

Like the day-of-the-week variables, the holiday and special event variables were also expressed as binary variables. These variables were included to represent the days of a particular holiday period or special event. The final variables were labeled as follows: INDDAY (Independence Day holiday), KDERBY (Kentucky Derby event), LABORDAY (Labor Day holiday), MEMDAY (Memorial Day holiday), NCAABBALL (men’s college basketball tournament event), PRESDAY (Presidents’ Day holiday), and STPATS (Saint Patrick’s Day holiday).

Finally, appropriate ARMA terms were added to the models as needed, to produce an independent error process. The “AR” stands for autoregressive and the “MA” represents moving average. Common to time series models, these terms not only remove serial correlation from the errors, they also represent an unnamed and often powerful explanatory process within the error structure.

Results

Descriptive Statistics

Once the data were screened, descriptive statistics were computed and examined. These measures are listed in Table 1, stated in natural log form. Other than the key variable, RAKE, Table 1 only includes the continuous variables appearing in the final models for each resort. Results for variables that failed to produce a statistically significant effect are not shown in any of the tables appearing in this section.

Table 1

Descriptive Statistics for Continuous Model Variables: Resorts 1, 2, and 3 (n = 217)

	Mean	Std. Dev.	Min.	Max.
Resort 1 Variables:				
COIN-IN	14.55	0.22	14.11	15.22
DROP	12.86	0.35	12.16	13.78
RAKE	8.68	0.31	7.59	9.38
Resort 2 Variables:				
COIN-IN	15.67	0.36	14.99	16.65
DROP	14.76	0.54	13.67	16.43
RAKE	9.93	0.23	9.37	10.49
Resort 3 Variables:				
COIN-IN	15.38	0.24	14.90	15.96
DROP	11.91	0.26	11.28	12.72
RAKE	8.26	0.25	7.64	8.95
TREND	4.40	0.96	0.00	5.38

*Not*es. All values are expressed as the natural log of the original metric.

From Table 1, the standard deviation of Resort 2's DROP is noticeably greater than its Resort 1 and 3 counterparts. This is most likely due to Resort 2's high-roller table game clientele, which is infamous for the volatility it creates. Table 2 lists the bivariate correlation coefficients for the natural log of the continuous variables appearing in the final models.

Table 2

Correlation Matrices for Continuous Model Variables: Resorts 1, 2, and 3 (n = 217)

	COIN-IN	DROP	RAKE	TREND
Resort 1 Variables:				
COIN-IN	--			
DROP	0.79	--		
RAKE	0.64	0.72	--	
TREND	n/a	n/a	n/a	--
Resort 2 Variables:				
COIN-IN	--			
DROP	0.57	--		
RAKE	0.51	0.41	--	
TREND	n/a	n/a	n/a	--
Resort 3 Variables:				
COIN-IN	--			
DROP	0.83	--		
RAKE	0.68	0.61	--	
TREND	-0.23	-0.22	-0.22	--

Notes. All correlation coefficients were significant at the 0.01 alpha level (2-tailed). "n/a" represents not applicable, as TREND was not present in the final models for Resorts 1 and 2.

Slot Models

Table 3 contains the results of the double-log models designed to predict COININ at each of the three resorts. For Resort 1, the model generated an R^2 of 78.2% and an F-statistic of 59.87 (df = 11, 205). The model was slightly more effective on the Resort 2 data set, posting an R^2 of 81.7% and an F-statistic of 59.35 (df = 14, 202). Finally, the model was most successful in explaining the variation of COININ at Resort 3, producing an R^2 of 89.9% and an F-statistic of 123.8 (df = 13, 203). As for the key variable, RAKE, it failed to produce a significant model effect in any of the three data sets (i.e., all three p-values > 0.05).

Table 3

Results of Double-log Time Series Regression Analyses
Dependent Variable: Natural Log of Aggregate Daily Coin-in

	Resort 1		Resort 2		Resort 3	
Variable	B	p	B	p	B	p
Constant	13.8990		14.5259		15.0887	
RAKE	0.0646	0.0959	0.0991	0.4265	0.0570	0.1404
TUE	-0.0368	0.0499	-0.0886	0.0017	n/a	
WED	-0.0626	0.0011	-0.1077	0.0084	0.1541	0.0000
THU	n/a		0.1109	0.0112	0.1077	0.0000
FRI	0.2279	0.0000	0.4074	0.0000	0.5182	0.0000
SAT	0.3297	0.0000	0.5751	0.0000	0.4715	0.0000
SUN	0.1383	0.0000	0.3001	0.0000	0.1789	0.0000
TREND	n/a		n/a		-0.0870	0.0002
PRESDAY	n/a		0.6225	0.0000	0.2742	0.0000
STPATS	0.2650	0.0040	n/a		0.2637	0.0003
MEMDAY	0.2774	0.0006	n/a		0.1660	0.0044
INDDAY	0.2248	0.0053	n/a		n/a	
LABORDAY	n/a		n/a		0.1798	0.0166
FEB 22	n/a		-0.2218	0.0443	n/a	
MAR 12	0.2513	0.0061	n/a		n/a	
MAR 27	n/a		-0.1567	0.0499		
JUN 10	n/a		n/a		0.3015	0.0001
JUN 19	0.2480	0.0070	n/a		n/a	
AUG 12	n/a		0.4267	0.0007	n/a	
AR (1)	0.6257	0.0000	0.8797	0.0000	0.4610	0.0000
MA (2)	n/a		-0.2320	0.0129	n/a	
MA (3)	n/a		-0.2274	0.0090	n/a	
MA (7)	n/a		-0.1790	0.0098	0.2390	0.0001
R^2	78.23%		81.66%		89.89%	
Model F-Statistic	59.87	0.0000	59.35	0.0000	123.82	0.0000

Notes. "n/a" represents not applicable, i.e., the variable did not appear in the final model. The VIFs for RAKE were 1.7, 2.1, and 2.1 for the Resort 1, Resort 2, and Resort 3 models, respectively. A p-value of 0.0000 indicates a value less than 0.00005. Per the Methodology section, all p-values < 0.05 indicate a statistically significant effect, i.e., alpha = 0.05.

The following variables listed in Table 3 represented outlier dates: FEB 22, MAR 12, MAR 27, JUN 10, JUN 19, and AUG 12. With a sample size of 217 observations from each resort, the presence of outliers came as no surprise. Outliers were defined as dates exhibiting a studentized deleted residual greater than 3.0. After carefully examining the variable values for the outlier dates, there was no reason to doubt the legitimacy of the observations. Therefore, binary indicator variables representing the unusual conditions on these dates were created and included in the final models.

Finally, the appropriate AR and MA terms were added to each of the models, following a review of the correlograms associated with each model's autocorrelation function and partial autocorrelation function of the errors. Once the ARMA terms listed in Table 3 were added to the models, the correlograms were examined a second time to

verify that the model errors were free from significant serial correlation. This implied that the independent variables and ARMA terms provided a good fit to the data.

Table Game Models

Table 4 includes the results of the double-log models designed to predict DROP at each of the three resorts. The Resort 1 data fit the model best, producing an R^2 of 91.0% and an F-statistic of 184.15 (df = 10, 206). The Resort 2 model posted an R^2 of 65.5% and an F-statistic of 29.54 (df = 12, 204), while Resort 3 generated an R^2 of 80.7% and an F-statistic of 77.38 (df = 10, 206). Again, Resort 2's relatively low R^2 value was most likely a function of its high-roller table game clientele. On any given day, a single high-roller can produce an extreme outcome capable of greatly affecting the casino's aggregate drop.

RAKE produced a significant model effect at Resort 1 ($B = 0.0886$; $p < 0.05$). That is, a 1% increase in RAKE produced an 8.86% increase in DROP. RAKE failed to produce a statistically significant effect in the Resort 2 and 3 models.

The identification, investigation, and treatment process of outliers was identical to that described in the previous section. The ARMA terms were also specified according to the protocol described in the previous section. However, each of the three table game models required only the addition of an AR (1) term, otherwise known as an ARIMA (1,0,0) model.

Table 4

Results of Double-log Time Series Regression Analyses
Dependent Variable: Natural Log of Aggregate Daily Table Game Drop

	Resort 1		Resort 2		Resort 3	
Variable	B	p	B	p	B	p
Constant	11.8308		14.0277		11.8653	
RAKE	0.0886	0.0268	0.0430	0.8565	0.0236	0.6599
TUE	-0.0457	0.0058	n/a		n/a	
THU	0.1588	0.0000	0.2147	0.0015	0.0785	0.0008
FRI	0.5261	0.0000	0.6493	0.0000	0.4940	0.0000
SAT	0.7245	0.0000	0.7243	0.0000	0.4853	0.0000
SUN	0.3675	0.0000	0.4957	0.0000	0.1885	0.0000
TREND	n/a		n/a		-0.0745	0.0002
STPATS	n/a		n/a		0.3032	0.0051
MEMDAY	0.2865	0.0007	n/a		n/a	
INDDAY	n/a		n/a		n/a	
LABORDAY	n/a		0.7436	0.0096	n/a	
NCAABBALL	0.1560	0.0449	n/a		n/a	
KDERBY	n/a		0.5891	0.0234	n/a	
FEB 4	n/a		-0.5889	0.0394	n/a	
FEB 11	n/a		-0.5139	0.0496	n/a	
MAR 10	n/a		n/a		0.4990	0.0000
APR 8	n/a		-0.7842	0.0058	n/a	
APR 25	n/a		n/a		0.4030	0.0002
MAY 15	n/a		-0.9073	0.0017	n/a	
JUN 1	n/a		n/a		0.3701	0.0007
JUN 17	n/a		0.5689	0.0448	n/a	
JUN 30	0.6393	0.0000	n/a		n/a	
JUL 13	-0.2605	0.0031	n/a		n/a	
AR (1)	0.7358	0.0000	0.6013	0.0000	0.5111	0.0000
R^2	90.97%		65.53%		80.67%	
Model F-Statistic	184.15	0.0000	29.54	0.0000	77.38	0.0000

Notes. "n/a" represents not applicable, i.e., the variable did not appear in the final model. The VIFs for RAKE were 1.8, 2.1, and 2.1 for the Resort 1, Resort 2, and Resort 3 models, respectively. A p-value of 0.0000 indicates a value less than 0.00005. Per the Methodology section, all p-values < 0.05 indicate a statistically significant effect, i.e., alpha = 0.05.

Slot and Table Game Model Diagnostics

With regard to methodological assumptions, independence was addressed by examining correlograms of the autocorrelation and partial autocorrelation functions of the error process for each model. After the appropriate ARMA terms were added to the models, the Q-statistics associated with the correlograms revealed no statistically significant serial correlation across 36 lags.

The linearity assumption was examined by reviewing scatter plots of the model errors against each predictor variable series. The presence of nonconstant variance was also assessed by way of the scatter plot. In this case studentized deleted residuals were plotted against corresponding predicted values. With respect to both linearity and nonconstant variance, the scatter plots revealed no cause for concern. Finally, the distributions of the model errors were examined via histograms, which revealed no problematic departures from the normal distribution.

Multicollinearity levels were assessed by reviewing the variance inflation factors (VIFs) for each set of predictor variables. As RAKE was the key variable in this study, its VIFs were the primary concern. As listed in the notes of Tables 3 and 4, the VIFs for RAKE ranged from 1.7 to 2.1 in the COININ models and from 1.8 to 2.1 in the DROP models. These results indicated low to mild levels of multicollinearity. In fact, the greatest VIF of any predictor variable in the COININ models was 2.5, with the DROP models posting a high VIF of 2.1.

Discussion

Only one of six null hypotheses was rejected, indicating a considerable lack of support for both the full service theory, in general, and the assumption of indirect revenue generation by poker rooms, in particular. These results were consistent with the findings of previous researchers exploring the links between coin-in levels and other gaming amenities such as race and sports books and bingo rooms (Abarbanel et al., 2011; Lucas et al., 2006). However, these same results were not consistent with the findings of Ollstein (2006), with respect to the general effect of poker rooms on daily coin-in levels, and Lucas and Brewer (2001), regarding the effect of bingo headcount on daily coin-in.

Including this work, there have been five studies that have empirically examined the relationships depicted in the Casino block of Figure 1. In total, these studies have tested 13 Casino block hypotheses, using secondary data from eight hotel-casinos. The results of ten of the 13 hypothesis tests have failed to support the full service theory within the Casino block. Operators may want to consider this battery of results, when discussing and/or estimating the indirect revenue contributions of gaming amenities such as poker rooms, race and sports books, and bingo rooms. This is not to say that further research is not needed, but the collective results are considerably one-sided.

The findings of the current study also supported the notion of cherry picking, in that poker players seemed to lack interest in slots and table games. Specifically, the lack of significant effects for RAKE suggested a general unwillingness to patronize more profitable areas of the casino, especially the most profitable area – slots. Staying with the retail literature, these same results failed to support the spillover effect. That is, the findings did not cast the poker room as a draw that produces business for other key areas of the casino.

Finally, the outcome of this work was at odds with the popular opinions of industry insiders regarding the ability of poker rooms to drive business to slots and table games

(Cosgrove-Mather, 2005; Grochowski, 2005; Legato, 2010; McGowan, 2010; Taucer, 2004; Walters, 2003; Wiser, 2004). As academic research continues to produce conflicting empirical results, the trade journal consensus on the full service theory grows increasingly mysterious. At some point, these insiders must show their cards. Exactly what is it that suggests a significant and positive relationship between gaming amenities and key gaming business volumes?

From the trade literature, it would seem as though many operators are content in assuming the full service theory is valid until proven otherwise. This may be a dangerous and costly default position, given the paucity of objectively and rigorously derived empirical support for the full service theory. While it is very difficult to identify the origin of the full service theory, it seems to survive on the legs of simplistic cross-tabulations, casual observations, fear of extinction, and a general resistance to change.

Managerial Implications

The findings are particularly troubling for Resorts 2 and 3. If these poker rooms were producing insufficient profits per square foot, then executives would be wise to entertain alternative uses of the floor space. For these operators, continued justification of live poker by way of indirect revenue contributions may have just become a tougher sell. Of course, additional research is recommended before making any decisions. Alternative approaches are described in the upcoming Future Research section.

As for Resort 1, the bulk of its operating profits came from slots and the hotel. Both of these profit centers typically feature impressive profit margins (Lucas & Kilby, 2012). Although RAKE posted a significant and positive effect in Resort 1's table game drop model, the regression coefficient reflected the increase in *drop*. Of course, drop must be converted into win and ultimately into operating profits. This conversion process is subject to the inflated variable cost structure of the Table Games Department, eroding much of the contribution reflected in the regression coefficient (i.e., the 8.86% increase).

At a minimum, those faced with poker room addition, deletion, or modification decisions may consider decreasing the weight of any indirect revenue gains/losses included in their projections. This recommendation holds for operators and developers alike. The demonstrated lack of empirical support for the full service theory in general, and as it applies to poker rooms, must be considered in these important decisions.

Limitations

The results of this work cannot be generalized beyond the casino floors of the donor properties. Further, including Ollstein (2006), poker data from only four different hotel-casino resorts have been examined. All three of the samples examined in this research began in early February and extended through early September. Ollstein featured a nearly identical sample period. Although there is no reason to believe so, it is possible that the indirect revenue contributions of poker rooms are different in the period ranging from mid-September to February.

The econometric models used in this research are often referred to as causal models. However, time series regression analysis does not prove cause and effect. Its use herein only served to test the plausibility of the theoretical model advanced. Proving cause and effect is not a statistical question.

Future Research

While replication of the current model would supply valuable results to the research stream, alternative measures of poker room business volume would provide a more diverse representation of possible indirect revenue contributions. One such measure would be an hourly headcount of poker players, to be used in lieu of daily rake. Hourly headcounts analyzed in conjunction with hourly coin-in would allow for a more temporally congruent measurement of the relationship between the business volumes of the poker room and the slot floor. The results of the current study may provide the push that is needed to gain support for the study of hourly business volumes.

A before-and-after look at a property featuring a poker room closure would provide an alternative yet useful perspective. For example, a times series model could examine daily business volume data for several months before and after the closure. The poker room variable could be expressed in a binary format, producing a regression coefficient that would represent the offset/value of having the poker room, expressed in terms of key gaming volumes such as coin-in and table game drop. There are several Las Vegas properties with data to accommodate this approach, given the recent closure of several poker rooms.

An observational study could be conducted to better understand the crossover effect as it applies to poker players. For example, how many poker players relocate at a gaming position after leaving the poker room? How long do they play slots and/or table games? How much do they wager? Such a study would also contribute to a more complete understanding of the poker player's total value to the casino. However, it would be much more difficult to conduct an observational study of poker players *prior* to their arrival in the poker room. Observers would have to be able to identify poker players as they enter the casino or be willing to follow a great number of subjects to locations other than the poker room.

Finally, the relationship between the poker room and profitable nongaming amenities could be examined. The results of the current study will surely produce claims of contributions to nongaming amenities. Any research aimed at these claims should focus on estimating the relationship between the poker room and the hotel or something along the lines of a hyper-profitable nightclub such as the Cosmopolitan's Marquee or Encore's XS. When it comes to operating profits, not all nongaming amenities are alike. For example, few if any come close to matching the profits of the hotel operation (Lucas and Kilby, 2012). To the contrary, demonstrating a positive relationship with restaurant or showroom business volumes is not likely to save the poker room, as neither of these areas would be considered a profit juggernaut.

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