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Consumer spending in the gaming industry: evidence of complementary demand in casino and online venues

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Brick and mortar gambling stakeholders have scrutinized Internet gambling sites over concern that online operators may serve as substitutes for their products. In some cases, this has led to regulatory protection to prevent or restrict entry by online providers. However, many industry observers have remarked that the two gambling modalities may serve different consumers/consumer needs, or even serve as complementary goods. Policymakers, who look to gambling as an important source of tax revenue, must determine how expansion of Internet gambling will affect overall economic welfare. Using self-reported consumer gambling behaviour data from the United Kingdom, the net effect of Internet-based gambling activity on land-based demand is estimated in this study. A robust complementary (positive) relationship between online and offline gambling is found, using ordinary least squares, two-stage least squares, and two-part modeling techniques. These particular findings suggest that economic concerns around the cannibalization of traditional gambling industries should be reconsidered, and provide support for prior research showing that Internet based firms can be complementary to brick and mortar businesses.

Keywords: casino gambling; Internet gambling; cannibalization; consumer behaviour; policy

Introduction

In most of the service sector, the Internet provides no viable threat to brick and mortar consumption. While Internet-based channels can be used as an alternate point of purchase (e.g. purchasing a hotel room with a third-party online travel agent [OTA] instead of directly), they cannot replace a service – consumption must still occur where it always has, at the brick and mortar location. The gambling industry therefore has a relatively unique challenge. Consumption of gambling no longer must occur in multimillion (or billion) dollar gaming venues, but can instead occur on nearly any device with a working Internet connection.

Worldwide online gambling has seen substantial market growth over the past decade. Global gross gaming win (online and offline) was an estimated USD $529 billion in 2012, and online gambling accounted for an estimated USD $30 billion (5.6%) of that amount (H2 Gambling Capital, 2012). In 2003, the online gambling market was estimated at ~ USD $8.6 billion and between 2003 and 2012, the compound annual growth rate for the online gambling market was 14.1% (H2 Gambling Capital, & Odobo, 2013).

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In some respects, online gambling appears to provide a direct competitor to brick and mortar gaming, from bingo rooms to casino-style table games to slot machines. This makes it important to investigate the online–offline relationship in the changing industry. Not only can gambling consumption occur online, but software-based innovation has also enabled the delivery of new products that are not feasible in a brick and mortar casino setting – for example, some poker sites allow a single player to play up to 24 tables at once. Key elements of hospitality service management, like atmospherics and servicescape (Abarbanel, 2013), service reliability (Richard Wood & Griffiths, 2008) and customer service (Richard Wood & Griffiths, 2008) have all been demonstrated as important components of the online gambling product. This suggests that the online domain may have more in common with brick and mortar gambling than may initially be expected. Perhaps most importantly to brick and mortar casino stakeholders (and integrated resort stakeholders more generally), online gambling is a relevant industry because of its potential to change consumption patterns of gamblers and/or create new players for traditional venues. The potential threat of online gambling's cannibalization of the offline gambling market is an industry hot topic at conferences and in the media. The impacts of online gambling on existing offline markets are often discussed in parallel with the impacts of new offline casinos on those same existing markets (Martin, 2012). At the most recent Global iGaming Summit & Expo (GiGSE), North America's largest online gambling industry conference, four sessions debated the possibility of online gambling's cannibalization of offline gambling and how gambling operators can effectively converge an online and offline business (Bakun, 2014; GambleID, 2014; OpenBet, 2014; Ryan et al., 2014).

As online gambling becomes legal in more jurisdictions and a larger variety of games are offered online, stakeholders of land-based gambling companies need to understand the potential link between offline and online gambling operations. Most importantly, stakeholders must understand if the new medium is a complement to ongoing operations or whether it is a substitute good, cannibalizing casino revenue. More formally, is the cross-elasticity of demand negative (complement) or positive (substitute). In addition, government policymakers must understand the link: without a clear grasp of their relationship, policymakers will be unable to design legislation that takes into account how Internet gambling expansion will affect tourism activity, public revenue, or employment in brick and mortar gaming locations.

To empirically examine the relationship between online and brick and mortar gaming demand, a simple theoretical model to understand the potential impact of online gambling expansion is first developed. Data from the British Gambling Prevalence Survey is then used to empirically estimate the relationship. The United Kingdom (UK) has permitted and regulated online gambling since the implementation of the Gambling Act 2005, making it a useful market in which to analyse the potential association between gamblers' behaviour in online and offline gambling products. It is of note that the UK gambling market is much different from the United States and other markets that include integrated resorts. The overall UK gambling market serves as an useful foundation for market analysis due to its history as a regulated market offering numerous game types and varieties in online and offline settings and the large prevalence of gambling – 73% of British adults have gambled in some form, either online or offline, in the past year (Gambling Commission, 2014; National Centre for Social Research, 2011; National Lottery Commission, 2013).

Gambling in Britain is comprised of six primary, sometimes cross-categorical, sectors: amusement arcades, betting, bingo, casinos, electronic games, lotteries and remote/online

gambling (Gambling Commission, 2014). Remote/online gambling encompasses any gambling (including many of the games above) that is placed via electronic communication, such as through a computer, mobile phone or Internet-capable television. The most recent published data (September 2013) from the UK Gambling Commission shows that remote/online gross gaming yield (GGY) represents approximately 16% of the regulated gambling market.[1]

Literature review

Online and offline consumer behaviour

Outside the gaming industry, researchers have noted potential differences in online and in-store consumer motivations. Online and offline shopping are described as different experientially. Online shopping typically provides consumers with time and effort savings, as well as better search and compare abilities, while offline shopping offers expert advice and social interaction, a tactile experience and a shorter delivery time (Kollmann, Kuckertz, & Kayser, 2012). Online shopping may also not provide the same outcome as offline shopping since consumers are multi-channel shoppers who prefer online and offline shopping mediums at different times (y Monsuwé, Dellaert, & de Ruyter, 2004). In the gaming industry, the comparative advantage of offline gambling in terms of delivery time and expert advice would appear to be less clear. For example, gambling is consumed as quickly online as offline (that is, there is little difference in delay in waiting for delivery); and expert advice may be easier to offer online, since gamblers can learn how to play the games for free (Griffiths, Parke, Wood, & Rigbye, 2010).

An important advantage for brick and mortar gambling venues may be a higher level of service. Kollmann et al. (2012) analysed consumers' shopping motives and found that convenience is positively related to online customers, but a customer's desire for service will move shoppers from online to offline experiences. Binde (2013) has noted the reduced social dimension within some games played online (e.g. poker and bingo); in-person gambling attracts gamblers for social interaction possibilities (a night out with friends, for example), while online gamblers seek the activity for means other than social purposes. Overall, evidence supports a hypothesis that offline and online consumers have different shopping motives. Price is therefore not likely to be the only important characteristic for determining demand across these mediums, and online goods will not be perfect substitutes to offline goods.

The online gambling consumer

Since gambling is a service (as opposed to a tangible good), there may be reason to think that consumer behaviour findings from general retail literature – such as the importance of a tactile experience or shorter delivery time – are less applicable to the gambling industry. Gambling motivations have been relatively well studied from a psychological perspective. Lloyd et al. (2010) identified mood regulation, obtaining money, and enjoyment as the primary motivations for gambling online. McCormack and Griffiths (2012) identified one major theme motivating online gambling (greater opportunity to gamble) and four subthemes (convenience, value for money, greater game variety, and anonymity). We also identified one major inhibiting theme of online gambling (reduced authenticity of gambling) and four sub-themes (reduced realism, asocial nature of the Internet, use of electronic money and concerns about the safety of sites). Mowen, Fang, and Scott (2009) noted that general gambling propensity and introversion – perhaps due to the isolation of

gambling alone in one's home – are predictors of online gambling proneness, while financial conservatism and emotional instability serve as predictors of online gambling avoidance.

When considering the individuals that make up the online gambling market, there is no homogenous population across jurisdictions. In the United Kingdom, online gambler demographics tend to skew toward males in younger age groups, with higher income and levels of education at A-levels or higher[2] (National Centre for Social Research, 2011; Robert Wood & Williams, 2012). In 2010, 14% of the British adult population participated in a least one online gambling variant, including betting, lotteries, bingo, football pools, casino-style games, and online slots (National Centre for Social Research, 2011). Approximately half of this online gambling participation can be attributed to wagers placed on the National Lottery, with the remaining online gambling population participating in poker, bingo, slot games and/or casino games.

While the online gambling population is heterogeneous at the jurisdictional level, there are some international composite data that allow comparisons to the worldwide mean. The British online gambler demographic profile reflects the typical international player description, which is likely to be male, younger, employed full-time and/or a student, with a higher average income than non-gamblers and less likely to be married (Robert Wood & Williams, 2012). Specific games split the international gambling population. Females between the ages of 46 and 55 tend to prefer online casino-style games, while males between the ages of 26 and 35 tend to prefer online poker (Parke, Parke, Rigbye, Suhonen, & Williams, 2012). In the National Centre for Social Research (2011) Britain-specific data, men have a higher prevalence of gambling in all reported online games. Prior research has also suggested that technology anxiety, in addition to demographics, impacts participation in new technologies like online gambling (Meuter, Ostrom, Bitner, & Roundtree, 2003).

Online gamblers have the flexibility to gamble anywhere Internet access is present, which carries both benefits and drawbacks. While many gamblers may view this flexibility as a benefit akin to the ability to access other information and activities from anywhere, the isolation of gambling alone in one's home may bring with it asocial behaviours. Gambling sometimes replaces participation in social circles, which may lead to gambling addiction and other health issues (Putnam, 2000; Shaffer & Kidman, 2003).

Empirical research on the relationship between gamblers' online gambling activity and offline gambling behaviour is relatively undeveloped. While most online gamblers also gamble offline (Wardle, Moody, Griffiths, Orford, & Volberg, 2011), it remains unclear how consumption is linked. Some studies have investigated empirical relationships between online and offline gambling, but the conclusions drawn in these studies were based on aggregate macroeconomic data from jurisdictions where online games were not fully legalized and regulated. Philander (2012) examined time series data of online gambling revenue in the US from grey market sites, estimating a small negative relationship with offline gambling revenue, but noted that this relationship may not be indicative of the present relationship. Philander and Fiedler (2012) examined the post-Unlawful Internet Gambling Enforcement Act (UIGEA) North American poker market using a cross-sectional analysis of US states and Canadian provinces. The authors found that online poker revenue was positively related to commercial casino revenue. Leal, López-Laborda, and Rodrigo (2014) found results indicative of a negative impact of online gambling on casinos, but the authors used a panel estimation procedure that is likely to have been biased by endogenous macroeconomic events.

Consumer theory

Based on the evidence in prior literature that suggests motivation for online consumption differs from offline consumption, a simple two-good theoretical model of consumer behaviour is proposed to describe the actions of gambling consumers (Mas-Colell, Whinston, & Green, 1995). As shown in Figure 1, a representative consumer chooses between out-of-home (social) leisure activities and in-home (private) leisure activities along a budget line constraint – the constraint can be thought of as the number of non-working hours available in the day, and/or the income available to spend on leisure activities.[3] The budget line intersects the y- and x-axes where only social leisure or private leisure is respectively consumed. The set of combinations of social and private leisure consumption that lead to the same level of utility are represented by indifference curves – that is, consumers are indifferent about consuming any point along the same curve. Indifference curves farther from the origin represent higher levels of utility and are therefore preferred over curves closer to the origin. Consumers choose the combination of social and private leisure that maximize utility, subject to the budget constraint. Maximization therefore occurs at the point where the budget line is tangent to the highest possible indifference curve (Mas-Colell et al., 1995).

The ability to consume online causes an increase in the maximum consumption of private leisure, as technology reduces costs of consumption.[4] This shifts the point where the budget line intersects with the x-axis, but the y-axis intersection does not change, since the cost of social leisure remains unchanged. However, the change in technology has another effect. The shape of the indifference curve becomes steeper as private consumption becomes more desirable than was previously the case – the available range of private consumption options has improved.

As shown in Figure 2, the net effect of the change in consumption of social leisure –in this case, casino gambling – depends on how these two factors compete against one another. The left panel shows the case where no noticeable change in preferences occurs and consumption of social leisure ends up increasing. This would be the case if Internet gambling simply substituted other (more expensive) private leisure activities but had no influence on social leisure activities. The right panel illustrates a case where there is a large

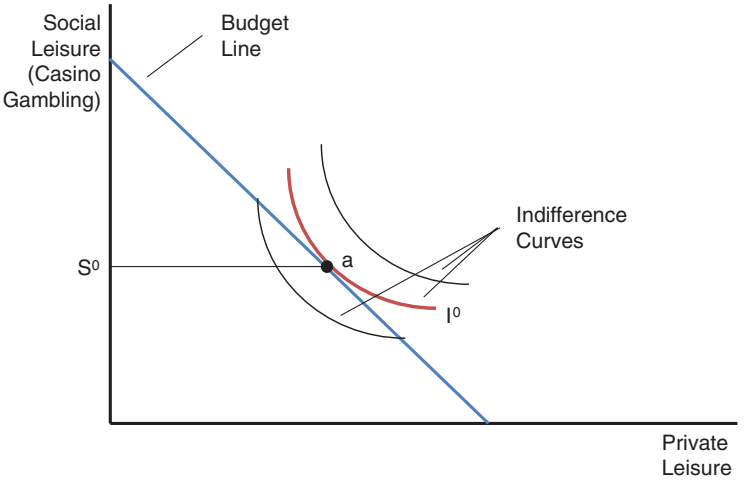

Figure 1. Two-good model of social leisure and private leisure.

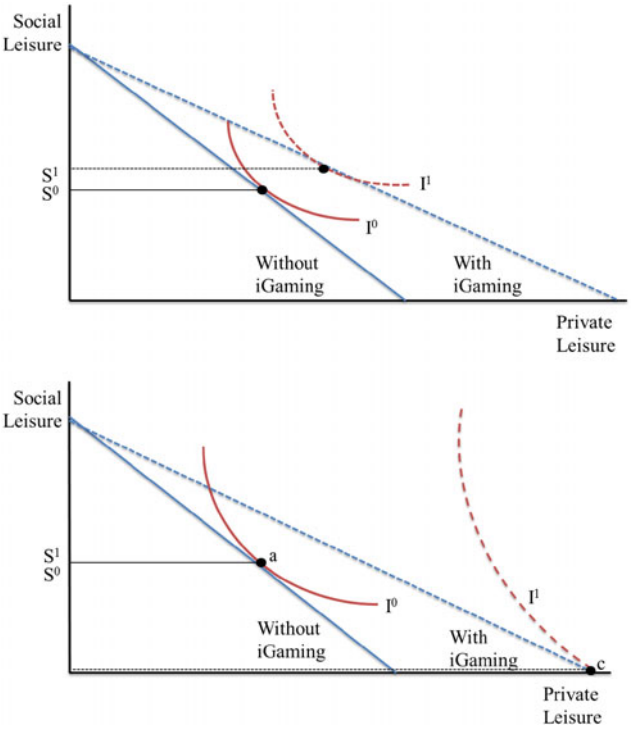

Figure 2. Alternate cases of the effect of the availability of Internet based consumption on the market for social and private leisure.

change in preferences towards private leisure. The availability of Internet-based consumption in this case leads to a corner solution – there is no tangent point and only private leisure consumption occurs. This describes a case where Internet gambling substitutes away all casino consumption. In general, the larger the budget line and smaller the preference effect, the more likely that online gambling expansion will have a complementary relationship, while the smaller the budget line and the larger the preference effect, the more likely a substitutionary (or cannibalistic) relationship will occur.

The outcomes predicted from this theoretical model appear to be reasonable descriptions of what could occur in a gambling market. In the next section, we describe an empirical model that is used to estimate aggregate effects of Internet gambling consumption on offline gambling consumption. We pay particular attention to the directional effects, to identify whether the two mediums are net complements or net substitutes.

Methodology

Data for this analysis is taken from the 2010 British Gambling Prevalence Study (BPGS; National Centre for Social Research, 2011). This data set is a nationally representative survey of 7756 adults aged 16 and older living in private households in England, Scotland and Wales. The BGPS aims to measure the gambling behaviour of Great Britain residents and assess the prevalence of problem gambling, factors associated with problem gambling, and general attitudes toward gambling.

Data collection and description

Researchers for the BGPS collected data both in-person with computer-assisted interviewing and via telephone when interviewers were unable to make direct in-person contact with randomly sampled households. Gambling behaviour data was self-reported and interviewers were trained to ensure uniform terminology definitions were provided to all respondents.

Respondents were asked about their participation in various gambling activities in the past 12 months (in person, online or both) and their respective levels of involvement in those activities. Due to data availability issues, this investigation looks at online and offline participation levels for only slot machines, casino-style games and bingo. Other forms of gambling were examined in the survey, but those other forms did not have similar frequency data as was available for casino, slot and bingo and thus were not included in the relationship analysis. While this survey does include questions on average spending, self-reported spend data has been shown to be unreliable in gambling (Shaffer, Peller, LaPlante, Nelson, & LaBrie, 2010). Therefore, this analysis focuses on the frequency with which people gamble for money, offline and online. Frequency of play response options were divided into 8 ordinal categories of involvement, ranging from no involvement (1) to everyday/almost every day (8).

Table 1 summarizes the level of participation in each of the gambling categories used in this study. When examining slot data, 34 observations were removed since the offline slot behaviour questions asked if respondents had participated in fruit machines in 'other' locations, and it may have been ambiguous if 'other' could include online slots.

Other variables used in this study include problem gambling status, gender, age range, ethnicity, economic status, highest level of education, smoking status and level of alcohol use. Problem gambling was measured with criteria from the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001). PGSI scores are categorized into non-problem, low-risk, medium-risk and problem gambling categories. The categories are ordinally ranked, with non-problem as the lowest rank and problem gambling as the highest rank. A more detailed breakdown of demographic characteristics and gambling participation rates can be found in National Centre for Social Research (2011).

Model

Equation 1 defines the linear regression model for the underlying relationship between online gambling frequency and offline gambling frequency:

$$Offline_j = \beta_0 + \beta_1 \cdot Online_j + \beta_2 \cdot x_{2j} + \cdots + \beta_k \cdot x_{kj} + u_j \tag{1}$$

Where $Online_j$ and $Offline_j$ are variables indicating past-year frequency of participation in online and offline gambling for respondent j, respectively, and are treated as continuous in

Table 1. Gambling participation summary statistics.

	Casino participation		Slot participation		Bingo participation		
	Offline	Online	Offline	Online	Offline	Online	Total sample
Count	266	138	943	198	602	133	7756
Percentage of total sample	3.46%	1.80%	12.32%	2.59%	7.83%	1.73%	100.00%

a linear model; $x_{2j} \ldots x_{kj}$ are other explanatory variables believed to affect offline gambling frequency; and u_j is the standard model error term.

Not all $k - 1$ variables that explain offline gambling frequency can be fully identified. For example, data on the respondent's travel distance to a gambling venue is not available. The effect of these m number of unidentified variables will be captured in the error term, $\beta_{k-m} \cdot x_{k-mj} + \cdots + \beta_k \cdot x_{kj} + u_j = v_j$. The presence of these missing variables in the error term can create measurement bias if they are correlated with our variable of interest, online gambling frequency: $Cov(Online_j, v_j) \neq 0$. For example, if an individual who does not live in a casino catchment area is more likely to gamble online if the goods are substitutes and less likely if they are complements, then our coefficient estimate of the effect of online gambling may be biased. To remedy this potential source of bias, a two-stage least squares (2SLS) instrumental variable approach is employed, which produces a consistent coefficient estimate for the (endogenous) variable of interest, online gambling frequency (Wooldridge, 2010). Instead of Equation 1, the following system of Equations (for each gambling variant) is estimated:

$$Offline = \beta_0 + \beta_1 \cdot \widehat{Online}_j + \beta_2 \cdot x_{2j} + \cdots + \beta_k \cdot x_{kj} + v_j \tag{2}$$

$$Online_j = \alpha_0 + \alpha_1 \cdot z_{1j} + \alpha_2 \cdot z_{2j} + \alpha_3 \cdot z_{2j} + \cdots + \alpha_{k-n+1} \cdot x_{(k-n)j} + \varepsilon_j \tag{3}$$

Where $\widehat{Online}_j$ in Equation 2 is the predicted value from Equation 3, n is the number of missing explanatory variables, and z_{1j} and z_{2j} are exogenous variables that must satisfy two necessary conditions: (1) have zero correlation with v_j, that is, they provide no more explanatory power for offline gambling frequency than the variables already included in the model; and (2) they must have a non-zero correlation with online gambling frequency. The predicted values of online gambling participation are then used in lieu of the actual values, which produces an unbiased estimate of the model coefficient that explains the relationship between offline and online gambling participation (Wooldridge, 2010). Separate models are produced for each of the different forms of gambling (casino, slot and bingo).

Two variables are suggested as potential instruments for online gambling frequency, which are represented by z_{1j} and z_{2j}. The variables are two available responses to the survey question, 'In a month, which of the following activities, if any, do you usually do?' One potential response is 'Online chat rooms/social networking sites' (Social Networking) and another potential response is 'Play Computer Games' (Computer Games). The two variables are binary, where '1' indicates participation and '0' indicates non-participation.

Both of these measures describe familiarity and comfort in interacting with computers and playing games in a virtual setting. Comfort with the Internet/computers is likely to be important to choosing to gamble online, therefore the instruments should be positively related to online gambling, and satisfy necessary condition (2): a nonzero correlation with online gambling participation. These variables have no direct or established empirical relationship to offline gambling and it would seem unlikely that familiarity with computers would have a meaningful effect on offline gambling – at the very least, no more so than online gambling does directly – satisfying necessary condition (1). These necessary conditions are tested empirically in the next section.

Lastly, we estimate a two-part model for each of casino, slot and bingo. A two-part model is used when a data set is characterized as having many outcomes of the dependent variable reported as zero (Humphreys, 2013). As previously described in Table 1, many BGPS respondents reported that they did not participate in given forms of brick and mortar

gaming. A related question to ask with this analysis therefore would be, given that a player is willing to gamble in a brick and mortar location, what effect does online consumption have on his or her frequency of offline consumption? The two-part model empirically addresses this query by estimating a participation decision model (probit) and then a consumption level model (OLS). As noted by Humphreys (2013), the two-part model recognizes that participation decisions will differ from quantity decision.

Other independent variables used during the estimation procedure include: number of gambling activities participated in during the past year (Number of gambling activities), gender (Gender), age group 16 + in 10 year bands (Age), ethnic group (Ethnicity), the main economic activity of the household representative (Economic activity), highest educational qualification (Education), spending time with friends and family (Friends and Family), government office region of residence (Gov. Region), smoking status (Smoking), and category of alcohol consumption (Alcohol). Model error terms are clustered by government office region, since these different regions will have different gambling availability and support services.

Results

In the interest of readability, only coefficients for the variables of particular interest and an indication of the presence of other control variables (and their significance level) that were created from categorical responses are provided. The number of categorical variables is noted in brackets next to the variable name. Spending time with friends and family, a control variable to measure levels of social interaction, was not found to be significant in any model, nor was it of theoretical value in prior literature, and it was removed from analysis.

Table 2 provides ordinary least squares (OLS) model results for each of casino, slot and bingo. After controlling for demographic information, government office regions and

Table 2. Linear model (OLS).

	(1) Offline casino freq.		(2) Offline slot freq.		(3) Offline bingo freq.	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Online casino freq.	0.088***	0.009				
Online slot freq			0.396***	0.021		
Online bingo freq.					0.191***	0.029
PGSI Low	0.255***	0.022	0.805***	0.046	0.341***	0.053
PGSI Moderate	0.377***	0.039	1.221***	0.081	0.406***	0.094
PGSI Problem	0.934***	0.060	2.283***	0.127	0.955***	0.146
Gender (2 cat.)	Yes**		Yes***		Yes***	
Age group (7 cat.)	Yes*		Yes***		Yes**	
Economic activity (7 cat.)	Yes		Yes***		Yes*	
Education (6 cat.)	Yes**		Yes**		Yes***	
Ethnicity (4 cat.)	Yes		Yes**		Yes	
Gov. Region (12 cat.)	Yes		Yes*		Yes***	
Smoking (2 cat.)	Yes		Yes***		Yes***	
Alcohol (6 cat.)	Yes***		Yes***		Yes	
Constant	0.034	0.033	0.695***	0.069	0.260**	0.080
Observations	7688		7654		7688	

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

health variables (including PGSI categories), the results of this study show that online gambling frequency is positively related to offline gambling frequency. The effect size using OLS modelling appears to be fairly small, as a 1-point increase in reported online frequency (along a scale of 8 options) is related to a 0.088-point increase in casino, 0.396 in slot and 0.191 in bingo. None of the control variables produced results that were inconsistent with prior literature.

Table 3 shows the first stage of the 2SLS models for each of casino, slot and bingo. The results generally support the approach taken in this study. The two instrumental variables, Social Networking and Computer Games, are statistically significant predictors of each online gambling variant, with a positive sign as expected. Additionally, the F-statistic of weak identification exceeded the benchmark value of 10 for all 3 variants: casino, $F(2,7642) = 16.689$, $p < 0.001$; slot, $F(2,7608) = 11.086$, $p < 0.001$; bingo, $F(2,7642) = 15.960$, $p < 0.001$. These results further support these variables adequacy in satisfying the second necessary condition of strong instruments (Sovey & Green, 2011; Staiger & Stock, 1997). The Sargan tests of overidentifying restrictions all failed to reject the validity of necessary condition 1: casino, $\chi^2(1) = 2.93$, $p = 0.086$; slot, $\chi^2(1) = 1.66$, $p = 0.198$; and bingo, $\chi^2(1) = 1.29$, $p = 0.255$. None of the other variables provide unexpected results. For example, the PGSI variables are consistent with prior research showing high correlation between online gambling participation levels and problem gambling severity (Robert Wood & Williams, 2007, 2009). Therefore the analysis further proceeded under the assumption that Social Networking and Computer Games are strong and valid instruments.

Table 4 displays the results from the second stage of the 2SLS model, which describes the effects of the online gambling variants on their respective offline variables. In general, the direction of the effect is consistent with results from the OLS models, which describe online gambling as a complementary good to offline gambling. However, the results from the 2SLS models suggest that the effect size is actually larger than those estimated in the

Table 3. First-stage results.

	(1) Online casino freq.		(2) Online slot freq.		(3) Online bingo freq.	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Social Networking	0.062***	0.016	0.041**	0.015	0.042***	0.013
Computer Games	0.051***	0.014	0.045***	0.013	0.042***	0.011
PGSI Low	0.214***	0.027	0.231***	0.025	0.175***	0.020
PGSI Moderate	0.464***	0.047	0.552***	0.044	0.201***	0.036
PGSI Problem	0.477***	0.073	0.981***	0.068	0.477***	0.056
Gender (2 cat.)	Yes***		Yes		Yes***	
Age group (7 cat.)	Yes		Yes**		Yes	
Economic activity (7 cat.)	Yes**		Yes***		Yes***	
Education (6 cat.)	Yes		Yes**		Yes*	
Ethnicity (4 cat.)	Yes		Yes**		Yes*	
Gov. Region (12 cat.)	Yes		Yes*		Yes	
Smoking (2 cat.)	Yes**		Yes		Yes*	
Alcohol (6 cat.)	Yes***		Yes		Yes**	
Constant	0.085*	0.041	0.022	0.038	0.069*	0.032
Observations	7686		7652		7686	
F-Stat	16.689		11.086		15.960	

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 4. Second-stage results.

	(1) Offline casino freq.		(2) Offline slot freq.		(3) Offline bingo freq.	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Online casino freq.	0.365*	0.151				
Online slot freq.			2.543***	0.599		
Online bingo Freq.					0.814	0.471
PGSI Low	0.194***	0.041	0.297	0.159	0.233*	0.102
PGSI Moderate	0.246**	0.082	0.027	0.355	0.279*	0.136
PGSI Problem	0.797***	0.098	0.148	0.626	0.651*	0.274
Gender (2 cat.)	Yes		Yes		Yes***	
Age group (7 cat.)	Yes		Yes***		Yes**	
Economic activity (7 cat.)	Yes		Yes		Yes	
Education (6 cat.)	Yes**		Yes		Yes***	
Ethnicity (4 cat.)	Yes		Yes		Yes	
Gov. Region (12 cat.)	Yes		Yes**		Yes***	
Smoking (2 cat.)	Yes		Yes**		Yes**	
Alcohol (6 cat.)	Yes***		Yes***		Yes	
Constant	−0.005	0.041	0.558***	0.112	0.190*	0.078
Observations	7686		7652		7686	

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

OLS models, creating a much more economically meaningful effect. A 1-point increase in reported online frequency of gambling (along a scale of 8 options) is related to a 0.365-point increase in casino, 2.543 in slot and 0.817 in bingo. Readers should use caution when interpreting the bingo coefficient, however, as the effect size is significant at the $\alpha = 0.1$ level but not the $\alpha = 0.05$ level. Part of the issue with the lack of statistical significance in the bingo model may be the loss of statistical power when using a 2SLS model. While the combined large magnitude of the slot frequency coefficient and the absence of significance of the PGSI variables in the slot model is particularly remarkable, none of those variables had a variance inflation factor (VIF) above 1.11, suggesting that multicollinearity is not an issue in the difference between the OLS and 2SLS results. No variable had a VIF above 4.30 in any of the 2SLS models.

In the final test of the findings' robustness, a two-part model is estimated. This model treats the level of consumption of gambling as a different decision from the participation in gambling. This addresses potential bias that could be introduced from a high frequency of consumers who choose not to gamble at all, and therefore have zero frequency in both online and offline gambling. The results from this series of models again show that online casino and slot frequency is positively related to their brick and mortar variants, but bingo is found to have an insignificant relationship. The casino and slot frequency coefficient sizes are 0.155 and 0.151 respectively, which is higher than the OLS estimates, but lower than the findings from the 2SLS models.

Discussion

To date, offline gambling companies offer conflicting views on the value of online gambling. US-based operators present a microcosmic example of the worldwide debate – some operators actively seek to ban online gambling while others welcome it to the market.

Table 5. Two-part model.

	(1) Offline casino freq.		(2) Offline slot freq.		(3) Offline bingo freq.	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Probit						
Online casino freq.	0.110***	0.032				
Online slot freq.			0.336***	0.037		
Online bingo freq.					0.143***	0.039
PGSI Low	0.828***	0.091	0.815***	0.074	0.498***	0.087
PGSI Moderate	0.978***	0.145	1.000***	0.132	0.613***	0.153
PGSI Problem	1.244***	0.214	1.362***	0.207	0.857***	0.220
Gender (2 cat.)	Yes**		Yes*		Yes***	
Age group (7 cat.)	Yes***		Yes***		Yes**	
Economic activity (7 cat.)	Yes*		Yes**		Yes***	
Education (6 cat.)	Yes**		Yes***		Yes***	
Ethnicity (4 cat.)	Yes		Yes***		Yes**	
Gov. Region (12 cat.)	Yes*		Yes**		Yes**	
Smoking (2 cat.)	Yes		Yes***		Yes***	
Alcohol (6 cat.)	Yes***		Yes***		Yes	
Constant	Yes***		Yes***		Yes***	
Regress						
Online casino freq.	0.155*	0.071				
Online slot freq.			0.151**	0.046		
Online bingo Freq.					0.144	0.096
PGSI Low	0.525*	0.227	0.758***	0.143	0.401	0.260
PGSI Moderate	0.415	0.316	1.174***	0.218	0.463	0.460
PGSI Problem	2.141***	0.498	2.454***	0.306	1.812**	0.607
Gender (2 cat.)	Yes		Yes***		Yes	
Age group (7 cat.)	Yes		Yes***		Yes***	
Economic activity (7 cat.)	Yes**		Yes**		Yes	
Education (6 cat.)	Yes		Yes***		Yes**	
Ethnicity (4 cat.)	Yes		Yes		Yes	
Gov. Region (12 cat.)	Yes		Yes**		Yes**	
Smoking (2 cat.)	Yes		Yes		Yes	
Alcohol (6 cat.)	Yes		Yes**		Yes	
Constant	Yes**		Yes***		Yes***	
Observations (probit)	7062		7654		7688	
Observations (regress)	261		899		601	

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

The results from the analysis in this study generally point to a complementary (positive) relationship between online gambling activity and offline gambling activity. In no model did we find evidence of a cannibalistic relationship among the gambling modes. The results expand on those of Philander and Fiedler (2012), who found that online poker revenue was positively related to land-based casino revenue. The results, though, contradict findings in Philander (2012) and Leal, López-Laborda, and Rodrigo (2014). Philander (2012), however, notes that his results stem from analysis of grey market sites operating in the US, data that is different from that collected in regulated markets like the analysis here. Meanwhile, Leal, López-Laborda, and Rodrigo (2014) comment that the negative relationship they observed between online and offline gambling may be largely due to non-taxation of online gambling during the years of their data.

In a theoretical model of two-good consumer choice, results from this study suggest that the effect of reduced costs of consumption from the Internet medium outweigh the perceived change in preferences towards more private (i.e. Internet based) leisure. This should perhaps be expected, since prior research on online gamblers has been consistent with that the theory that online gambling is comprised of a different demographic profile from offline gamblers.

Online gamblers tend to skew toward males in younger age groups, with higher income and levels of education, whereas offline gamblers have a much higher proportion of females with a wider age range and have lower average levels of full-time employment and income than do online gamblers (Gainsbury, Wood, Russell, Hing, & Blaszczynski, 2012). Online sites' lower marginal cost of production and economies scale also allow them to offer smaller stakes,[5] making it more attractive for people who previously had not been able to afford higher stakes gambling at offline venues. For either group, we should therefore not expect to see much of a change in preferences between social leisure consumption and private leisure consumption. People who previously participated in offline gambling continue to have a strong preference for that medium, while people who did not previously gamble offline would already have indifference curves that reflect that preference.

In the OLS, 2SLS and two-part models, all the online frequency coefficients were positive. The 2SLS and two-part models also produced larger coefficient sizes than the OLS models, suggesting that the relationships between the two gambling media are biased downwards in the linear models. The largest relationship was between online slots and offline slots, where a 1-unit increase in the slot frequency variable online was related to a 2.5-unit increase in offline frequency under the 2SLS model. As a means of providing context, a 2-unit change could be the difference between 'about once a month' to 'about once a week'.

The nature of the complementary relationship holds implications for both operators and policymakers in other jurisdictions. For example, in the US the debate to legalize and regulate or ban online gambling has become quite contentious. US operators should recognize the positive value that online gambling can have with relation to their offline operations. Further, these results support a perspective that both offline and online gambling can coexist in the same market, and that there may be synergistic opportunities. Rather than resisting change and working actively on the political scene to ban online gambling, casino operators may be better off developing their own online gambling site or partnering with existing sites. Their brand recognition has the potential to attract a wide audience, but continuing to hold out allows other brands a first-mover advantage.

Governments may also benefit from online gambling adoption, since the expansion of online gambling will lead to new (online) revenue sources and higher revenue within existing (complementary) products. These results show that local tourism dollars being generated by offline casinos are enhanced by the addition of online gambling legalization. The positive relationship between online and offline gambling frequency can reassure local governments that tax revenue and employment generated from tourism activities of offline gambling are not likely to decrease due to the legalization of online gambling. In addition, the significant positive relationship between online and offline frequency may lead to more non-gambling revenue, such as food and beverage sales, which also increases tax revenue and employment.

Policymakers also need to consider responsible gambling issues that run in tandem with new gambling outlets. Generally, new online gambling availability follows a novelty effect, with a spike of at-risk behaviour with the activity's introduction, followed by a

steep reduction and eventual low plateau of problematic behaviour (LaPlante & Shaffer, 2007). Most new recreational online gamblers tend to adapt quickly and participate in gambling as a healthy leisure activity, but heavily involved gamblers maintain their at-risk status and may need special attention (LaPlante, Schumann, LaBrie, & Shaffer, 2008). Of particular note in relation to prior research, higher PGSI category involvement was related to higher offline gambling frequency.

Limitations

While relatively robust evidence of a positive relationship between offline and online gambling frequencies was found in this study, we note that a limitation of this study is that this may not directly translate to revenue, since average spend figures may differ. At the very least, however, it appears unlikely that a substitutionary relationship exists overall (of course, individual consumers still may respond with substitutionary behaviour). It should also be noted that these results are from only one western country with a relatively well-developed gambling infrastructure, regulatory scheme and Internet connectivity. The offline/online relationship may certainly be different in another jurisdiction without these, or other, characteristics. The BPGS also relies on self-reporting data, which can create bias in the responses. It is possible the respondents did not truthfully answer all questions to make themselves seem like more or less of a gambler, leading to potentially unreliable results. Self-report bias is regularly recognized as a limitation in studies on gambling behaviour (Baumeister, Vohs, & Funder, 2007; Volberg, Gerstein, Christiansen, & Baldridge, 2001). As more data continues to emerge from newly regulated jurisdictions such as Nevada, New Jersey, British Columbia and Quebec, the relationship between online and offline gambling should be investigated for individual regions and for the composite industry.

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Conflicts of Interest

None of the authors received direct funding for research related to this study. Each of the authors has received direct compensation for gambling related work from government, non-profit, and private organizations in the past.

Competing interests: The first author is employed by an organization that operates online and offline gambling.

Constraints on publishing

None of the authors received direct funding for research related to this study. Each of the authors has, in the past, received direct compensation for gambling related work from government, non-profit, and private organizations.

Notes

1. This proportional estimate of GGY does not include British bookmakers serving the population from an offshore licence, such as Gibraltar.
2. A-level education levels are approximately equivalent to secondary school, generally completed at ages 16–18.

3. The model describes a representative consumer, while the aggregate outcome is the sum of individual responses.
4. In gambling, reduced costs of consumption could be thought of as replacing the need to organize a home poker game with easy online access. This effect could also be thought of as reduced uncertainty costs with black market consumption (e.g. replacing private bookies). Finally, economies of scale from large online operations can also reduce price.
5. For example, the lowest denomination No Limit Hold'em poker game typically offered in a casino is USD $1/$2 blind stakes. Online, 92% of hands are played below this level, with 49% of hands played at USD $0.05/$0.10 blind stakes or less (Fiedler, 2012).

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