NIH Public Access

Author Manuscript

Drug Alcohol Depend. Author manuscript; available in PMC 2009 July 14.

Published in final edited form as:

Drug Alcohol Depend. 2008 July 1; 96(1-2): 155–164. doi:10.1016/j.drugalcdep.2008.02.011.

Drinkers and Bettors: Investigating the Complementarity of Alcohol Consumption and Problem Gambling

Michael T. French[a], **Johanna Catherine Maclean**[b], and **Susan L. Ettner**[c]

[a]University of Miami, Department of Sociology, 5202 University Drive, Merrick Building, Room 121F, P.O. Box 248162, Coral Gables, FL 33124-2030, USA.; 1-305-284-6039 (phone); 1-305-284-5310 (fax); mfrench@miami.edu

[b]College of Human Ecology, Department of Policy Analysis and Management, Cornell University, Ithaca, NY 14853-4401, USA

[c]Department of Medicine, Division of General Internal Medicine and Health Services Research, UCLA School of Medicine, Los Angeles, CA 90095-1736, USA

Abstract

Regulated gambling is a multi-billion dollar industry in the United States with greater than 100 percent increases in revenue over the past decade. Along with this rise in gambling popularity and gaming options comes an increased risk of addiction and the associated social costs. This paper focuses on the effect of alcohol use on gambling-related problems. Variables correlated with both alcohol use and gambling may be difficult to observe, and the inability to include these items in empirical models may bias coefficient estimates. After addressing the endogeneity of alcohol use when appropriate, we find strong evidence that problematic gambling and alcohol consumption are complementary activities.

Keywords

Alcohol Use; Gambling; Endogeneity; Bivariate Probit; Treatment-Effects Model

1. Introduction

As its popularity has increased, disagreement over how to properly classify and regulate gambling in the United States (U.S.) has become more pronounced. Some claim that gambling is a component of spectator sports, particularly when it involves activities such as horse racing, dog racing, and Jai-Alai. Others view professional gambling as an occupation, with many accomplished players earning large sums of money each year. Yet another perspective treats low stakes recreational gambling as a social activity, as friendly and loosely organized card games are a daily event throughout the country. In the form of government sponsored lotteries and taxed casinos, gambling is heavily promoted and legitimized as a worthwhile public initiative to support needed programs such as education, environmental protection, and social welfare. Naturally, the extent and enforcement of government regulation varies across the gambling spectrum.

Correspondence to: Michael T. French.

Regardless of the type of gambling or the venue, however, gambling can be highly addictive and even disabling for some individuals. Recent estimates based on criteria developed by the American Psychiatric Association (1994) suggest that 2.5 million adults in the U.S. are pathological gamblers and that another 3 million adults are problem gamblers (National Opinion Research Center, 1999). The total cost of gambling to the U.S. is $5 billion per year with an additional $40 billion in lifetime costs for productivity reductions, social services, and creditor losses (National Opinion Research Center, 1999). Local chapters of Gamblers Anonymous are present in all 51 states (including the District of Columbia), and meetings are held each day to offer a confidential setting for those who seek help with their gambling addiction (Gamblers Anonymous Website). These meetings follow the twelve-step principles of Alcoholics Anonymous and Narcotics Anonymous.

Several studies in the literature have examined the risk factors (Barnes et al., 1999; Breslin et al., 1999; Welte et al., 2004b), consequences (Blaszczynski and Silove, 1996; Erickson et al., 2005; Ledgerwood et al., 2005; Williams et al., 2005), and costs (National Opinion Research Center, 1999) of problematic gambling. Others have investigated the effectiveness of various prevention (Ferland et al., 2005) and treatment (Dannon et al., 2005; Saiz-Ruiz et al., 2005) programs. One potential risk factor for problematic gambling is alcohol use, but past studies of this relationship have not addressed the potential endogeneity of alcohol use in the gambling equations and/or had minimal generalizability. Through the use of econometric analysis and endogeneity-correction techniques, we were able to examine the influence of alcohol use on gambling-related problems by controlling for difficult to measure and/or unobservable characteristics correlated with the willingness both to consume alcohol and to engage in problematic gambling. Because we used nationally representative data from a large and recently completed survey, the study results are widely generalizable to the U.S.

Economists have historically been curious about why individuals choose to gamble, as this activity does not appear to agree with traditional utility-maximizing principles (see Rosett [1965] for an early review of the issues). Assuming that 1) the act of gambling may produce a negative outcome (i.e., the gambler may lose the wager) and that 2) the marginal utility of income is diminishing, both fair and unfair gambles seem to be economic "blunders" (Kwang, 1965). Economists have proposed a number of possible explanations for gambling, including non-concave utility curves (Friedman and Savage, 1948; Hartley and Farrell, 2002), differences of opinion (Morris, 1994; Shin, 1993), varying risk preferences (Ali, 1977; Quandt, 1986), augmented income theory (Kim, 1973), "dream" demand functions (Johnson et al., 1999), money values and probabilities in any risky situation generating direct value beyond that represented by an expected utility function (Conlisk, 1993), and expenditure indivisibility (Kwang, 1965). Economists have also examined the economic impact (e.g., employment, mortality rates, quality of life, crime rates) of casino gambling (Evans and Topolski, 2002; Grinols and Mustard, 2006; Kearney, 2005a; Nichols et al., 2002), consumer behavior and economic growth in the presence of lotteries (Kearney, 2005b; Walker and Jackson, 1999), casino revenue taxation (Anderson, 2005), and determinants of lottery and casino demand (Clotfelter and Cook, 1990; Cook and Clotfelter, 1993; Garrett and Sobel, 1999).

While economists have focused on the economic rationale for gambling and its associated consequences, clinicians, public health officials, and other researchers have examined the determinants (e.g., substance use, mental disorders, individual characteristics) of problematic gambling (e.g., clinical diagnosis of problem or pathological gambling). One such possible determinant is alcohol, a psychoactive agent whose consumption has been associated with impaired decision-making and increased risk-taking behaviors (Chesher and Greeley, 1989). The consumption of alcohol can influence gambling choices, making individuals more (less) likely to initiate (terminate) gambling and increasing the amount they are prepared to wager in a particular gambling session. Specifically, alcohol consumption may inhibit the proper evaluation of the costs and benefits of gambling, impair the ability to understand the rules of the game, and/or lead to an inflated confidence in the ability to win.

The literature suggests that higher rates of alcohol use are present among pathological gamblers as compared to the general population (Cunningham-Williams et al., 1998; Maccallum and Blaszczynski, 2002; Toneatto et al., 2002), problem gambling is more common among individuals with alcohol use disorders as compared to those without such disorders (Grant et al., 2002), alcohol use is a risk factor for pathological gambling (Welte et al., 2004b), and gambling and excessive alcohol consumption are co-occurring activities (Elia and Jacobs, 1993).

Despite the sizable literature on alcohol use and gambling, several shortcomings limit the interpretation of the findings for policy purposes. Much of the published research has relied upon experimental or convenience samples (Baron and Dickerson, 1999; Breslin et al., 1999; Kyngdon and Dickerson, 1999). Evidence from general population surveys suggests an association between alcohol use and problematic gambling behaviors (Abbott and Volberg, 1992; Becona, 1992; Dickerson et al., 1994; National Opinion Research Center, 1999), but not without exception (Welte et al., 2004a). As yet, however, no study has addressed the potential endogeneity of alcohol use when estimating these gambling relationships. If alcohol use is endogenous in the gambling equation due to omitted variables, self selection, or other causes, then single-equation coefficient estimates will be biased. Furthermore, research studies have rarely documented the relationship between alcohol use and gambling among moderate drinkers and gamblers, focusing instead on individuals with addictions. The present study will make an important contribution to the literature by addressing and overcoming potential endogeneity bias through the use of a large, recent, and nationally representative dataset.

2. Conceptual Background

The present paper examines the relationship between alcohol use and gambling-related problems at the level of the individual. This relationship, if it exists, may not be linear. Infrequent light drinking is unlikely to directly cause gambling-related problems. On the other hand, frequent heavy drinking means high exposure to the intoxicating effects of alcohol and may also mean a corresponding engagement in risky gambling, which could lead to gambling-related problems. One of the primary empirical questions of this research is whether the level of alcohol consumption determines the extent to which drinkers place themselves at risk of developing gambling-related problems. A secondary but related question is whether alcohol consumption has an impact on the number of gambling-related problems for those individuals who already suffer from such problems and whether this effect depends upon the level of consumption.

One of the statistical challenges of deriving consistent estimates of these relationships is to ensure that our alcohol use measures are not picking up the gambling-related effects of unobservable or difficult-to-measure variables. If alcohol use is strictly exogenous in the gambling equations, then single-equation methods will generate consistent estimates of the true effect of alcohol consumption on gambling-related problems. If important variables are unobservable or unintentionally omitted from the gambling equations that are correlated with both alcohol consumption and gambling behavior (e.g., risk aversion, sensation seeking, peer effects), then the estimates generated by such models will be biased. One way to overcome this type of omitted variables bias is to employ simultaneous-equation models, such as recursive bivariate probit models and their linear equivalent, that explicitly model the correlation of the error terms in the alcohol and gambling equations. Our selected dataset contained state-specific identifiers that allowed us to merge alcohol policies and other potential instruments into the core dataset. Detailed descriptions of our instruments and assessments of their reliability are presented in later sections.

Another potential source of bias that cannot be addressed in this study is reverse causality. We assume through our model that alcohol use occurs before gambling problems emerge or at least that drinking raises the likelihood of problem gambling. However, it is certainly possible that problem gambling could lead to alcohol use, particularly heavy consumption. While not a panacea, both omitted variables bias and direction of causality could be investigated with longitudinal data, but we are only able to address the former with cross-sectional data from the NESARC (see data description that follows).

Given this conceptual background, we tested three hypotheses: 1) that alcohol use (measured in three ways: weekly or more frequent drinking, drinking to intoxication, and alcohol abuse and/or dependence) is associated with a higher probability of experiencing any gambling-related problems and a larger number of problems, 2) that the associations are stronger for alcohol abuse and/or dependence compared to weekly or more frequent drinking, and 3) that alcohol use is endogenous in any model of gambling-related problems.

3. Data

3.1. NESARC Survey

The dataset for this investigation was obtained from the National Epidemiological Survey on Alcohol and Related Conditions (NESARC) Wave 1, a large and nationally representative survey.[1] Respondents were asked fifteen questions on problems associated with gambling, thereby permitting calculation of various gambling-related problem measures. Use of simultaneous-equation modeling in conjunction with a large, detailed, and nationally representative survey such as the NESARC allowed the current analysis to avoid some of the pitfalls of previous research, such as failure to account for potential omitted variables bias and questionable generalizability due to small and localized samples.

The first wave of the NESARC was advantageous for the current analysis because it provided comprehensive data on alcohol consumption, gambling behaviors and associated problems, geographic identifiers, and had a nationally representative design. Field work for the NESARC was conducted by the U.S. Bureau of the Census on behalf of the National Institute on Alcohol Abuse and Alcoholism (NIAAA). Wave 1 of the NESARC was a representative sample of the U.S. population, including both citizens and non-citizens. A total of 43,093 respondents aged 18 to a top-coded age of 98 were interviewed face to face through computer-assisted personal interviewing between August of 2001 and May of 2002. The overall survey response rate was 81 percent, which is comparable to other comorbidity surveys (Division of Health Interview Statistics, National Center for Health Statistics, 2004). For additional information on sampling frame, instrumentation, and key findings of the NESARC, see Grant et al. (2003).

Our analysis sample included individuals between the age of 18 and a top-coded age of 98 (inclusive). Respondents who did not provide valid responses to the items of interest were excluded, resulting in a final sample size of 41,270. The conditional sample of individuals who reported at least one gambling-related problem included 1,203 people.

[1]The NESARC instrument and all other documentation (including dataset) are in the public domain and available at: http://niaaa.census.gov/.

3.2. Measures

3.2.1. Gambling-Related Problems—Three measures of gambling-related problems were examined in this study: a dichotomous variable for any gambling-related problems (scored 1 if the respondent reported having experienced any of the 15 gambling-related problems in the past year and 0 otherwise), a count of the number of gambling-related problems, and a conditional count of the number of gambling-related problems among affected respondents.[2] The motivation for analyzing the conditional measure of gambling-related problems was a desire to determine whether alcohol use has a differential impact on problem gambling severity among those individuals who reported having experienced at least one problem. A second motivation was a desire to estimate the full effect of alcohol use on gambling-related problems by combining the estimates from both parts of the two-part model (the probit model of the probability of any gambling problems and the conditional count model). These two-part model estimates were then compared with the estimates from the unconditional count models to determine whether the predictions were robust to functional form. This sensitivity analysis showed that the estimates were almost identical; therefore, only the unconditional count model estimates are presented.

3.2.2. Alcohol Use—The explanatory variables of interest were dichotomous measures of alcohol consumption during the past year: consuming alcohol on a weekly or more frequent basis (frequency), any self-reported drinking to intoxication (drunkenness), and a clinical diagnosis of alcohol abuse and/or dependence. Although individuals who meet criteria for a DSM diagnosis of alcohol abuse could be quite different from those who meet DSM diagnosis for alcohol dependence (and those who have both diagnoses for that matter), we decided to combine these groups into one category to increase sample size and power and limit the number of alcohol use measures in the core analysis. These selected measures present a range of drinking behaviors and reflect conventional alcohol use measures of the extant literature (Cherpitel, 1999; Cherpitel et al., 2004; Leadley et al., 2000).

3.2.3. Control variables—The NESARC provided detailed socioeconomic and demographic information on all respondents. This feature of the survey permitted the inclusion of numerous controls for alcohol demand and gambling behavior identified within the literature. Earlier studies have found that males and young adults are at higher risk for problematic gambling relative to females and older adults (Welte et al., 2001; Welte et al., 2004b). Schissel (2001) suggested that youth may gamble in response to their feelings of disempowerment from society. Published research has associated various measures of socioeconomic status, including education (Cunningham-Williams et al., 1998), employment (Feigelman et al., 1998; Kearney, 2005b), and income (Kearney, 2005b) with problematic gambling. Individuals with lower socioeconomic status may consider gambling a form of investment (Weiss, 1988) and an escape from poverty (Schissel, 2001). Educational attainment was operationalized by three binary measures: less than high school education, some post secondary education, and a university degree (high school completion was selected as the comparison group). A continuous measure of household equivalent income[3] and a dichotomous indicator of current employment were included as additional markers of socioeconomic status. Race and ethnicity have also been identified as correlates of problematic gambling (Welte et al., 2004b) because minorities demonstrate higher risk for this behavior. Race and ethnicity indicators may capture aspects of socioeconomic status in addition to those represented by education, income, and employment markers. Minorities in the U.S. have much

[2]Gambling-related problems ranged from “ever gamble to get out of a bad mood?” to “ever raise gambling money by writing a bad check, signing someone else’s name to a check, stealing, cashing someone else’s check or in some other illegal way?” The full series of questions is available from the corresponding author or the NESARC website. All gambling measures pertain to the past year.

[3]Calculated using the Luxembourg Income Study equation for equivalent household income: total household income/(household size)$^{1/2}$ http://www.lisproject.org/keyfigures/methods.htm [4/07/2006].

lower net wealth relative to Whites: the U.S. Department of Commerce (2001) reported that African American and Hispanic households possess only 1/7 of the net wealth of White households. The current analysis included dichotomous indicators for African American and other non-White races (White race was selected as the index category), a dummy variable for Hispanic or Latino ethnicity, along with an adjustment for birth outside the U.S. Published research suggests that non-married individuals are more likely to gamble (Feigelman et al., 1998; Kearney, 2005b). Those who choose not to marry or to leave a marriage may face less responsibility and therefore have more opportunity to gamble relative to married individuals who must also consider the needs of their spouses and/or children. We therefore included binary measures for single and divorced, separated, or widowed status. As a proxy for the real price of gambling (e.g., costs associated with traveling to a gambling venue, social acceptability of gambling), we included a dichotomous indicator of whether the state of residence had legal casino gambling during the interview year (American Gaming Association, 2002, 2003).[4]

3.2.4. Instruments—After conducting numerous specification tests, we selected four instrumental variables for the alcohol use measures: two state-specific alcohol policy measures, respondent height, and per capita beer sales among the population aged 21 and older in the state of residence. The state level alcohol policy measures were merged into our core dataset from external sources and included restricted off-premises sale of alcohol on Sundays and any exemption (family, location, or other) for underage alcohol possession (NIAAA Alcohol Policy Information System, 2006). States that chose to restrict the off-premises sale of alcohol on Sundays were expected to have a more conservative view of alcohol consumption while states that permitted underage alcohol possession in specific circumstances were expected to have a more liberal one. Height was self-reported by NESARC respondents and was included as an exogenous factor related to one's ability to metabolize alcohol.[5] Per capita beer sales were included as a proxy measure for social attitudes and controls on alcohol consumption in a particular state (Lakins et al., 2004). All four instrumental variables were hypothesized to be significantly correlated with our measures of alcohol use and uncorrelated with our gambling outcomes. Similar alcohol price and policy instruments for alcohol consumption have been used within the published literature (e.g., Dee, 1999; Dee and Evans, 2003; Kenkel and Ribar, 1994; Mullahy and Sindelar, 1996; Sen 2002).[6]

4. Methods

The empirical strategy was to first estimate a series of single-equation structural models of the following form:

$$GRP = f(A, GP, X) \tag{1}$$

where *GRP* is a measure of gambling-related problems, *A* is a measure of alcohol use, *GP* is a measure of gambling policies in the state of residence, and *X* is a vector of all other exogenous variables. The function *f* is either linear or probit, depending on whether the dependent variable, *GRP*, is continuous or dichotomous.

[4]We also experimented with several other proxy measures for the real price of gambling (e.g., legalized horse racing, legalized dog racing), but these other measures were not significantly related to gambling problems.

[5]We chose height over weight because the former is clearly exogenous.

[6]We experimented with several other potential instruments, including the often-used state-specific excise tax on beer. All of the other potential instruments exhibited lower validity and/or reliability than the selected instruments. Specific estimation results are available upon request from the corresponding author.

Although the specifications with conditional and unconditional number of gambling problems perhaps would have been more appropriately estimated with a count data technique (e.g., Poisson, negative binomial), we employed OLS for the main set of analyses so that these single-equation results would be directly comparable to the simultaneous-equation results presented later. To ensure that the choice of estimation technique did not substantially alter the main findings, we re-estimated all single-equation count models with the zero-inflated negative binomial technique instead of OLS and found all results to be similar.[7] Estimation was conducted with Stata 9 (StataCorp, 2005).[8] Stata is a powerful and flexible statistical package that can handle complex survey designs, sampling weights, and clustering.

Estimation of single-equation models such as Equation (1) will be consistent if none of the regressors are jointly determined with gambling-related problems. Theoretically, however, there are reasons to believe that some or all of the alcohol use measures will be significantly correlated with important omitted variables that are either unobservable (e.g., risk aversion, discipline, addictive tendencies) or observable but not available in our selected dataset (e.g., financial obligations, personal and professional stress). If this omitted variables problem is present, then the coefficient estimates for the alcohol use variables will be biased. Furthermore, the direction of the bias would be theoretically indeterminate because it depends not only on the nature of the omitted variable(s) but also on the correlations among the covariates (the bias resulting from a single endogenous covariate can spread even to uncorrelated regressors).

Depending on the distribution of the gambling variables, we employed two related estimation techniques to test for and, if present, overcome this potential bias. When the gambling variable was dichotomous (i.e., any gambling-related problems), we used a recursive bivariate probit technique to estimate *GRP* and *A* simultaneously:

$$GRP* = \beta_0 + A\beta_1 + GP\beta_2 + X\beta_3 + \varepsilon,\ GRP = 1 \text{ if } GRP^* > 0,\ 0 \text{ otherwise}, \quad (2)$$

$$A* = \gamma_0 + IV\gamma_1 + X\gamma_2 + \upsilon,\ A = 1 \text{ if } A^* > 0,\ 0 \text{ otherwise}, \quad (3)$$

$$E[\varepsilon] = E[\upsilon] = 0$$

$$Var[\varepsilon] = Var[\upsilon] = 1$$

$$Cov[\varepsilon, \upsilon] = \rho$$

where *IV* represents exogenous instruments for alcohol use (i.e., individual height, restricted off-premises sale of alcohol on Sundays, any exemption for underage alcohol possession, and per capita beer sales), ε and υ are disturbance terms for the gambling and alcohol use equations, and all other variables are the same as defined earlier. Under the assumption that ε and υ are jointly normally distributed with means equal to zero, variance equal to one, and correlation

[7]The full set of results is available upon request from the corresponding author.

[8]We chose p<0.10 as the lowest threshold for statistical significance, but also denoted statistical significance at p<0.05 and p<0.01 in all tables.

equal to ρ, this system of equations can be estimated as a recursive bivariate probit model using maximum likelihood methods.

Greene (2003) and others have shown that if ρ is not significantly different from zero, then the above model reduces to independent probit equations, which can be estimated separately. If the null hypothesis of $\rho = 0$ is rejected, then the recursive bivariate probit will generate consistent estimates even when the same unobservable factors simultaneously influence alcohol use and gambling-related problems. Although technically these models can be estimated without any exclusion restrictions, the existence of valid instruments allows for identification of the model without relying entirely on difficult to test assumptions about the joint distribution of the error terms.

For the conditional and unconditional number of gambling-related problems, we employed a treatment-effects regression model (Greene, 2003). The estimating equations are similar to Equations (2) and (3) above, with the exception that GRP^* is the (observed) number of gambling-related problems (conditional or unconditional), which makes Equation (2) a linear regression rather than a probit model. Similar to the recursive bivariate probit model, a test of $\rho = 0$ can be performed to determine whether the single-equation estimate of the effect of alcohol use on gambling-related problems is biased due to correlation of the error terms in the two equations. To examine the validity of our instruments, we first estimated alcohol demand equations of the following form:

$$Prob(A=1 \backslash IV,X)=\Phi(\alpha+IV\beta+X\delta) \tag{4}$$

where Φ is the cumulative normal distribution. We then performed χ^2 tests of the IV s to determine whether these measures jointly predicted a significant amount of the variation in alcohol use. Finally, we verified that our IV s were excludable from the gambling equations by conducting overidentification tests (Bollen et al., 1995; Rashad and Kaestner, 2004).

After verifying the validity and reliability of the instruments, we estimated recursive bivariate probit models with binary gambling measures and treatment-effects models with continuous gambling measures. For comparability across models, we computed and reported marginal regressor effects rather than coefficient estimates.[9] We then tested the null hypothesis of $\rho = 0$ in all specifications. When the null hypothesis was rejected (i.e., when alcohol use was endogenous), we emphasized the simultaneous-equation estimates. When the null hypothesis could not be rejected (i.e., independent equations), we emphasized the single-equation estimates.

Finally, Generalized Estimating Equations (GEE) with independent error structures were used to adjust standard errors for potential clustering (correlation of the error terms) among respondents living within the same state. For example, this method would account for shared policy and social environments among geographically proximal inhabitants. We reran all analyses using primary sampling units (PSUs) as the clusters instead of states. The results were almost identical, and are available upon request. Sample weights provided within the dataset were employed to adjust for survey design and to generate nationally representative estimates.

[9]One can either compute marginal effects at the sample means for all other regressors or calculate a marginal effect for each observation and then take the sample average of all individual marginal effects. Although the marginal effects presented in the tables were derived through the first approach, we employed both methods, and the estimates were very similar in all cases. This was not an unexpected result, as the two approaches converge at the same number as sample size increases (Greene, 2003).

5. Results

Table 1 presents descriptive statistics for all variables included in the subsequent specifications. Just over 3 percent (n=1,203) of the sample reported any gambling-related problems within the past year. The mean number of gambling-related problems in the full sample was 0.069 (SD=0.520). Conditional on experiencing at least one gambling-related problem, the mean number of problems was 2.275 (SD=1.988). Overall, 29.69 percent (n=11,450) of the sample consumed alcohol at least once a week, 24.19 percent (n=9,050) reported some drinking to intoxication, and 8.50 percent met the American Psychiatric Association (1994) definition of alcohol abuse and/or dependence (n=3,196).

A full set of single-equation estimation results for weekly drinking and our three gambling measures is reported in Table 2.[10] Weekly or more frequent drinking was a positive and statistically significant ($p \leq 0.01$) predictor for the probability of any gambling-related problems and the unconditional number of such problems. Quantitatively, this level of alcohol consumption was associated with a 1.3 percentage point increase in the probability of any gambling-related problems and 0.036 more problems. Although these marginal effects appear rather small in absolute terms, the relative size is quite large given that only 3.0 percent of respondents reported any such problems and that the unconditional average number of problems was 0.069.

Several of the significant coefficient estimates for the control variables in Table 2 are noteworthy. Legalized gambling and being male were positively and significantly related to any gambling-related problems and the unconditional (but not the conditional) number of problems. African Americans and other non-White races, and non-married individuals were significantly more likely to have gambling-related problems than White and married individuals, respectively. Foreign-born and highly educated individuals were significantly less likely to have gambling-related problems than U.S.-born and less-educated individuals. The state-specific unemployment rate was positively associated with the conditional and unconditional number of gambling-related problems at conventional levels of significance. All of these results are consistent with the existing literature.

Estimation results for the alcohol demand equations are contained in Table 3. The four instruments described earlier were jointly significantly related to each of the three alcohol use variables ($p \leq 0.01$). Additionally, all instruments carried the expected signs, and two or more instruments were independently predictive of our alcohol use measures ($p \leq 0.10$) in each specification.

To test the excludability of our instruments in the gambling equations, we followed Bollen et al. (1995) and Rashad and Kaestner (2004).[11] The test results indicated that the null hypothesis (i.e., exclusion of the instruments from the gambling equation was valid) could be rejected in only one of the nine specifications. Given the strong intuitive and statistical support for these instruments, we proceeded with this instrument set in simultaneous-equation estimation.

The potential endogeneity of alcohol use in the gambling problem equations was examined through likelihood ratio tests for $\rho = 0$. Estimation results rejected the null hypothesis of $\rho = 0$ (i.e., the error terms in the alcohol and gambling equations are uncorrelated) in two of the three recursive bivariate probit and one of the unconditional sample treatment effects regressions

[10]We chose $p \leq 0.10$ as the threshold for statistical significance, but also note significance at $p \leq 0.05$ and $p \leq 0.01$ in Tables 2-4. Selected estimation results for drinking to intoxication and alcohol abuse or dependence are contained in Table 4 and discussed later in the text.

[11]The authors recommend including all but one instrument in the estimating equation (i.e., gambling-related problems) and using a Wald statistic to test the joint significance of the remaining instruments. If these instruments are jointly significant in the estimating equation, then the exclusionary restrictions are not valid.

specifications. We failed, however, to reject the null hypothesis of $\rho = 0$ in all of the conditional treatment-effects models, indicating that single-equation estimation was appropriate in these cases. Given that single-equation estimation is the preferred approach in six out of nine specifications, we do not report a full set of simultaneous-equation estimates among the main tables.

The final set of results (Table 4) presents selected marginal effects for the alcohol use measures in all single-equation and simultaneous-equation models. The purpose of this table is to show how the estimates differ when endogeneity is addressed and to determine whether the effects of alcohol use on gambling-related problems become more pronounced as the intensity of drinking increases. Table 4 also contains test results for exogeneity and instrument reliability. Based on these specification tests, the estimated marginal effect for alcohol use corresponding to the most appropriate model is bolded in Table 4.

It is interesting to note that while ρ is not significantly different from zero in all specifications, the sign is always negative. A negative value for ρ in the recursive bivariate probit models signifies that the error terms (residual) in the alcohol use and problem gambling equations are negatively correlated. In other words, this would occur if important unobserved and/or omitted variables in each equation were negatively related or had an opposite effect on the dependent variables. One possibility here is that some sensation-seeking personality traits that are positively associated with problem gambling are negatively related to heavy drinking Similarly, some reclusive personality traits associated with a greater probability of problem drinking may be negatively related to gambling problems. Because one can also propose plausible reasons for why the correlation among error terms could be positive, it is difficult to strongly argue for the sign of ρ a priori.

Table 4 demonstrates that although the sign and significance of the alcohol use estimates were generally similar for the single-equation and simultaneous-equation models, the single-equation estimates were often smaller in magnitude. In addition, the set of estimates within a particular problem gambling measure became larger in magnitude as the intensity of drinking increased. The significant positive effects of the alcohol use measures on gambling-related problems confirm our earlier hypothesis that problem gambling and problem drinking are complementary activities.

6. Discussion

This research makes a unique contribution to the gambling literature in the U.S. because it is the first study to employ rigorous econometric techniques and a nationally representative sample to examine the effect of alcohol use on gambling-related problems. The inclusion of a range of alcohol-use and gambling measures also constitutes an important advancement for the field. Geographic identifiers permitted the analysis to address the potential endogeneity of alcohol use in the gambling-related problems equations. Both single-equation and simultaneous-equation models were employed, and findings were compared across models.

The empirical analysis supported two of our three hypotheses. Alcohol consumption was positively associated with the likelihood of experiencing any gambling-related problems and with the number of problems experienced. In addition, the estimated effect became larger as drinking increased (i.e., the marginal effects were generally larger for alcohol abuse and/or dependence than for weekly or more frequent alcohol use). Finally, contrary to our expectations, we failed to reject the null hypothesis of exogenous alcohol use in the majority (six out of nine) of specifications.[12]

As with any empirical study, one must acknowledge and understand the limitations of the data in order to properly interpret the findings. First, NESARC respondents self-reported their gambling behavior and associated problems, so these measures have unknown reliability. The existence of such misreporting within our sample is impossible to determine, but the likely impact (if present) is lower coefficient estimates. The fact that the results were generally statistically significant suggests that the findings are robust.

Second, it is often noted in this type of research that the alcohol consumption measures are also self-reported, which raises questions about reliability. While this issue cannot be completely resolved, the published literature on this topic suggests that self-reported alcohol consumption measures are reliable for use in statistical analyses (Del Boca and Darkes, 2003; Friesema et al., 2004; Lintonen et al., 2004; Townshend and Duka, 2002).

Third, we are not able to examine the temporal order of events with gambling and alcohol use due to the cross-sectional nature of the NESARC data. As a result, we assume that problem alcohol use predates problem gambling, but the reverse could be true or these behaviors could begin simultaneously. While correcting for one form of possible endogeneity (omitted variables bias) through techniques such as bivariate probit and treatment effect regression moves the analysis closer to identifying causal effects, reverse causality is still a possible concern in the final analysis. Thus, we want to emphasize that results demonstrate a strong positive association between problem drinking and gambling rather than causality per se.

These data limitations appear minor when compared to the research strengths of the NESARC. The NESARC is recently collected (2001/2002) and, with over 43,000 observations, represents one of the largest alcohol related surveys ever conducted in the U.S. Furthermore, it contains geographic identifiers, has a nationally representative design, features a group quarters sampling frame, and over-samples many previously understudied minority groups.

In current policy debates concerning the rise in the popularity of gambling and associated social consequences, the focus is typically placed on government regulation of gambling venues. Given the strong relationships identified in this research between alcohol consumption and gambling, alcohol policies (e.g., beverage taxes, restrictions on availability of alcohol in gambling establishments) could represent another potential target area in the battle against gambling-related problems. Federal and state governments have used their influence over alcohol advertising, distribution, and prices to combat the most visible harms associated with excessive alcohol consumption, such as motor vehicle accidents and alcoholism. Our analysis suggests that these policies may have important indirect effects on the prevalence and number of gambling-related problems as well.

References

Abbott, M.; Volberg, R. Frequent Gamblers and Problem Gamblers in New Zealand: Report on Phase 2 of the National Survey, Research Series No 14. Department of Internal Affairs, National Research Bureau Ltd; Wellington, NZ: 1992.

Ali MM. Probability and utility estimates of racetrack bettors. J Polit Econ 1977;85(4):803–815.

American Gaming Association. State of the States: The American Gaming Association Survey of Casino Entertainment, 2002. American Gaming Association; Washington, DC: 2002.

American Gaming Association. State of the States: The American Gaming Association Survey of Casino Entertainment 2003. American Gaming Association; Washington, DC: 2003.

American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. Vol. 4. American Psychiatric Press; Washington, DC: 1994.

[12]One possible extension of this research would be to investigate whether other forms of substance use (e.g., marijuana, cocaine, amphetamines) significantly affect gambling-related problems. In addition, as future waves of the NESARC become available, one could use the longitudinal nature of this dataset to examine the gambling-alcohol relationship over time.

Anderson JE. Casino taxation in the United States. Natl Tax J 2005;58(2):303–324.

Barnes GM, Welte JW, Hoffman JH, Dintcheff BA. Gambling and alcohol use among youth: influences of demographic, socialization, and individual factors. Addict Behaviors 1999;24(6):749–767.

Baron E, Dickerson M. Alcohol consumption and self-control of gambling behavior. J Gambl Stud 1999;15(1):3–15. [PubMed: 12766451]

Becona E. The prevalence of pathological gambling in Galicia (Spain). The Society for the Study of Gambling Newsletter 1992;20:10–18.

Blaszczynski A, Silove D. Pathological gambling: forensic issues. Aust N Z J Psychiatry 1996;30(3): 358–369. [PubMed: 8839948]

Bollen KA, Guilkey DK, Mroz TA. Binary outcomes and endogenous explanatory variables: tests and solutions with an application to the demand for contraception use in Tunisia. Demography 1995;32 (1):111–131. [PubMed: 7774727]

Breslin FC, Sobell MB, Cappell H, Vakill S, Poulos CX. The effects of alcohol, gender, and sensation seeking on the gambling choices of social drinkers. Psychol Addict Behav 1999;13(3):243–252.

Cherpitel CJ. Drinking patterns and problems, drug use and health service utilization: a comparison of two regions in the U.S. general population. Drug Alcohol Depend 1999;53(3):231–237. [PubMed: 10080049]

Cherpitel CJ, Ye Y, Bond J. Alcohol and injury: multi-level analysis from the Emergency Room Collaborative Alcohol Analysis Project (ERCAAP). Alcohol Alcohol 2004;39(6):552–558. [PubMed: 15351747]

Chesher, G.; Greeley, J. The effect of alcohol on cognitive and psychomotor functioning. In: Greeley, J.; Gladstone, W., editors. The Effects of Alcohol on Cognitive Psychomotor and Affective Functioning NDARC Monograph No 8. National Drug and Alcohol Research Center; Sydney: 1989. p. 28-43.

Clotfelter CT, Cook PJ. On the economics of state lotteries. J Econ Perspect 1990;4(4):105–119.

Conlisk J. The utility of gambling. J Risk Uncertain 1993;6(3):255–275.

Cook PJ, Clotfelter CT. The peculiar scale of economies of lotto. Am Econ Rev 1993;83(3):634–643.

Cunningham-Williams RM, Cottler LB, Compton WM, Spitznagel EL. Taking chances: problem gamblers and mental health disorders – Results from the St. Louis Epidemiologic Catchment Area study. Am J Public Health, Nations Health 1998;88(7):1093–1096.

Dannon PN, Lowengrub K, Gonopolski Y, Musin E, Kotler M. Topiramate versus fluvoxamine in the treatment of pathological gambling – A randomized, blind-rater comparison study. Clin Neuropharmacol 2005;28(1):6–10. [PubMed: 15711432]

Dee TS. The complementarity of teen smoking and drinking. J Health Econ 1999;18(6):769–793. [PubMed: 10847934]

Dee TS, Evans WN. Teen drinking and educational attainment: evidence from two-sample instrumental variables estimates. J Labor Econ 2003;21(1):178–209.

Del Boca FK, Darkes J. The validity of self-reports of alcohol consumption: state of the science and challenges for research. Addiction 2003;98(Suppl):21–12.

Dickerson MG, Baron E, Hong S-M, Cottrell D. Estimating the extent and degree of gambling-related problems in the Australian population: a national survey. J Gambl Stud 1994;12(2):161–178.

Division of Health Interview Statistics, National Center for Health Statistics. 2003 National Health Interview Survey (NHIS) Public Use Data Release: NHIS Survey Description. Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; Hyattsville, MD: 2004.

Elia C, Jacobs DF. The incidence of pathological gambling among Native Americans treated for alcohol dependence. Int J Addict 1993;28(7):659–666. [PubMed: 8500926]

Erickson L, Molina CA, Ladd GT, Pietrzak RH, Petry NM. Problem and pathological gambling are associated with poorer mental and physical health in older adults. Int J Geriatr Psychiatry 2005;20 (8):754–759. [PubMed: 16035119]

Evans, WN.; Topolski, JH. Working Paper No 9198. National Bureau of Economic Research, Inc., NBER; 2002. The social and economic impact of Native American casinos.

Feigelman W, Wallisch LS, Lesieur HR. Problem gamblers, problem substance users, and dual-problem individuals: an epidemiological study. Am J Public Health 1998;88(3):467–470. [PubMed: 9518986]

Ferland F, Ladouceur R, Vitaro F. Efficiency of a problem gambling prevention program for youths: results from the pilot study. Encephale-Revue de Psychiatrie Clinique et Therapeutique 2005;31(4): 427–436.

Friedman M, Savage LJ. Utility analysis of choices involving risk. J Polit Econ 1948;56(4):279–304.

Friesema IH, Veenstra MY, Zwietering PJ, Knottnerus JA, Garretsen HF, Lemmens PH. Measurement of lifetime alcohol intake: utility of a self-administered questionnaire. Am J Epidemiol 2004;159(8): 809–817. [PubMed: 15051591]

Gamblers Anonymous. 2006. Accessed on Gamblers Anonymous website on 4/11/06. http://www.gamblersanonymous.org

Garrett TA, Sobel RS. Gamblers favor skewness, not risk: further evidence from United States' lottery games. Econ Lett 1999;63(1):85–90.

Grant, BF.; Kaplan, K.; Shephard, J.; Moore, T. Source and Accuracy Statement for Wave 1 of the 2001-2002 National Epidemiologic Survey on Alcohol and Related Conditions. National Institute on Alcohol Abuse; Bethesda, MD: 2003.

Grant JE, Kushner MG, Suck WK. Pathological gambling and alcohol use disorder. Alcohol Res Health 2002;26(2):143–150.

Greene, William H. Econometric Analysis. Vol. 5. Prentice Hall; Upper Saddle River, NJ: 2003.

Grinols EL, Mustard DB. Casinos, crime, and community costs. Rev Econ Stat 2006;88(1):28–45.

Hartley R, Farrell L. Can expected utility theory explain gambling? Am Econ Rev 2002;92(3):613–624.

Johnson JEV, O'Brien R, Shin HS. A violation of dominance and the consumption value of gambling. Journal of Behavioral Decision Making 1999;12(1):19–36.

Kearney MS. The economic winners and losers of legalized gambling. Natl Tax J 2005a;58(2):281–302.

Kearney MS. State lotteries and consumer behavior. J Public Econ 2005b;89(1112):2269–2299.

Kenkel DS, Ribar DC. Alcohol consumption and young adults' socioeconomic status. Brookings Pap Econ Act Microeconomics 1994;1994:119–175.

Kim YC. Choice in the lottery-insurance situation augmented-income approach. Q J Econ 1973;87(1): 148–156.

Kwang NY. Why do people buy lottery tickets? Choices involving risk and the indivisibility of expenditure. J Polit Econ 1965;73(5):530–535.

Kyngdon A, Dickerson M. An experimental study of the effect of prior alcohol consumption on a simulated gambling activity. Addiction 1999;94(5):697–707. [PubMed: 10563034]

Lakins, NE.; Williams, GD.; Yi, H-y; Smothers, BA. Apparent per Capita Alcohol Consumption: National, State, and Regional Trends, 1977–2002, Surveillance Report #66. Alcohol Epidemiologic Data System, Division of Epidemiology and Prevention Research, NIAAA; Bethesda, MD: 2004.

Leadley K, Clark CL, Caetano C. Couples' drinking patterns, intimate partner violence, and alcohol-related partnership problems. J Subst Abuse 2000;11(3):253–263. [PubMed: 11026124]

Ledgerwood DM, Steinberg MA, Wu R, Potenza MN. Self-reported gambling-related suicidality among gambling helpline callers. Psychol Addict Behav 2005;19(2):175–183. [PubMed: 16011388]

Lintonen T, Ahlstrom S, Metso L. The reliability of self-reported drinking in adolescence. Alcohol Alcohol 2004;39(4):362–368. [PubMed: 15208172]

Maccallum F, Blaszczynski A. Pathological gambling and comorbid substance use. Aust N Z J Psychiatry 2002;36(3):411–415. [PubMed: 12060192]

Morris S. Trade with heterogeneous prior beliefs and asymmetric information. Econometrica 1994;62 (2):1327–1347.

Mullahy J, Sindelar J. Employment, unemployment, and problem drinking. J Health Econ 1996;15(4): 409–434. [PubMed: 10164037]

National Institute on Alcohol Abuse and Alcoholism. Underage Possession of Alcohol. National Institute on Alcohol Abuse and Alcoholism's Alcohol Policy Information System (APIS). 2006 [6/14/2006]. NIAAA website: http://www.alcoholpolicy.niaaa.nih.gov/index.asp?SEC={DA244DAF-EB78-425C-915B-D26D303F9E13}&Type=BAS_APIS

National Opinion Research Center (NORC). Overview of the National Survey and Community Database Research on Gambling Behavior: Report to the National Gambling Impact Study Commission. National Opinion Research Center; Chicago, IL: 1999.

Nichols M, Stitt BG, Giacopassi D. Community assessment of the effects of casinos on quality of life. Soc Indic Res 2002;57(3):229–262.

Quandt RE. Betting and equilibrium. Q J Econ 1986;101(1):201–208.

Rashad I, Kaestner R. Teenage sex, drugs and alcohol use: Problems identifying the cause of risky behaviors. J Health Econ 2004;23(3):493–503. [PubMed: 15120467]

Rossett RN. Gambling and rationality. J Polit Econ 1965;73(6):595–607.

Saiz-Ruiz J, Blanco C, Ibanez A, Masramon X, Gomez MN, Madrigal M, Diez T. Sertraline treatment of pathological gambling: a pilot study. J Clin Psychiatry 2005;66(1):28–33. [PubMed: 15669885]

Schissel B. Betting against youth: the effects of socioeconomic status on gambling among young people. Youth Soc 2001;32(4):473–491.

Sen B. Does alcohol-use increase the risk of sexual intercourse among adolescents? Evidence from the NLSY97. J Health Econ 2002;21(6):1085–1093. [PubMed: 12475127]

Shin HS. Measuring the incidence of insider trading in a market for state-contingent claims. Econ J 1993;103(420):1141–1153.

StataCorp. Stata Statistical Software: Release 9. College Station, TX: StataCorp LP; 2005.

Toneatto T, Skinner W, Dragonetti R. Patterns of substance use in treatment-seeking problem gamblers: impact on treatment outcomes. J Clin Psychol 2002;58(7):853–859. [PubMed: 12205725]

Townshend JM, Duka T. Patterns of alcohol drinking in a population of young social drinkers: a comparison of questionnaire and diary measures. Alcohol Alcohol 2002;37(2):187–192. [PubMed: 11912076]

United States Department of Commerce. Net worth of Nation's Households Unchanged, Census Bureau Reports. 2001 [5/15/2006]. http://www.census.gov/Press-Release/www/2001/cb01-33.html

Walker DM, Jackson JD. State lotteries, isolation, and economic growth in the U.S. Rev Urb Reg Dev Stud 1999;11(3):187–192.

Welte JW, Barnes GM, Wieczorek WF, Tidwell M-CO. Simultaneous drinking and gambling: a risk factor for pathological gambling. Subst Use Misuse 2004a;39(9):1405–1422. [PubMed: 15462237]

Welte JW, Barnes GM, Wieczorek WF, Tidwell M-CO, Parker JC. Alcohol and gambling pathology among U.S. adults: prevalence, demographic patterns and comorbidity. J Stud Alcohol 2001;62(5): 706–712. [PubMed: 11702810]

Welte JW, Barnes GM, Wieczorek WF, Tidwell M-CO, Parker JC. Risk factors for pathological gambling. Addict Behaviors 2004b;29(2):323–335.

Weiss, MJ. The Clustering of America. Harper & Row; New York: 1988.

Williams RJ, Royston J, Hagen BF. Gambling and problem gambling within forensic populations: a review of the literature. Crim Justice Behav 2005;32(6):665–689.

Table 1

Variable Means and Proportions (N=41,270)

Variable	Means and Proportions
Gambling Variables	
Any gambling related problems past year (%)	3.02
Number of gambling related problems past year	0.069 (0.520)
Conditional number of gambling related problems past year	2.275 (1.988)
Legalized casinos in state of residence (%)	58.81
Alcohol Variables	
Weekly or more frequent drinking past year (%)	29.69
Any drinking to intoxication past year (%)	24.19
Alcohol abuse and/or dependence past year (%)	8.50
Instruments	
Height (inches)	67.03 (4.082)
Off-premises sales of alcohol restricted on Sundays (%)	35.75
Any exemption for underage alcohol (%)	73.41
Per capita beer sales (gallons)	1.401 (0.212)
Socio-demographics	
Male (%)	47.78
Age (years)	45.22 (17.64)
African American (%)	11.01
Other race except White (%)	6.45
Hispanic (%)	11.48
Foreign born (%)	14.51
Divorced/Separated/Widowed (%)	17.37
Single (%)	20.58
High school education (%)	29.31
Some post-secondary education (%)	30.28
University degree (%)	24.93
Currently employed (%)	64.97
Currently unemployed (%)	6.50
Past year equivalent income ($1,000s)	1.235 (2.605)

Notes: Standard deviations are reported in parentheses for continuous variables. All estimates are calculated using sampling weights provided in the NESARC.

Table 2

Single-Equation Estimation Results for Gambling Outcomes Past Year

Explanatory Variables	Any Gambling Related Problems[a]	Number of Gambling-Related Problems (conditional)[b]	Number of Gambling-Related Problems (unconditional)[c]
Baseline Means/Proportions	0.030	2.275	0.069
Weekly or more frequent drinking	0.013*** [0.009,0.018]	0.041 [-0.214,0.296]	0.036*** [0.021,0.051]
Legalized casinos in state of residence	0.008** [0.002,0.014]	-0.062 [-0.312,0.187]	0.016* [-0.001,0.033]
Male	0.016*** [0.011,0.020]	-0.083 [-0.357,0.192]	0.036*** [0.024,0.048]
Age	0.0004 [-0.0002,0.001]	0.018 [-0.025,0.061]	0.001 [-0.001,0.003]
Age squared	-0.001** [-0.001,-0.00004]	-0.026 [-0.071,0.019]	-0.001 [-0.003,0.0005]
African American	0.007** [0.001,0.013]	0.367* [-0.052,0.787]	0.033*** [0.009,0.056]
Other race except White	0.014** [0.001,0.027]	0.286 [-0.268,0.839]	0.041** [0.007,0.075]
Hispanic	-0.006** [-0.011,-0.0004]	0.046 [-0.331,0.424]	-0.013 [-0.030,0.004]
Foreign born	-0.013*** [-0.018,-0.007]	0.079 [-0.514,0.671]	-0.032*** [-0.055,-0.009]
Divorced/Separated/Widowed	0.007** [0.001,0.013]	0.342* [-0.028,0.713]	0.026** [0.004,0.048]
Single	0.007*** [0.003,0.012]	0.364* [-0.027,0.756]	0.029*** [0.010,0.049]
High school education	-0.002 [-0.009,0.004]	-0.090 [-0.463,0.283]	-0.011 [-0.033,0.011]
Some post-secondary education	-0.006* [-0.013,0.001]	-0.220 [-0.593,0.154]	-0.024** [-0.048,-0.001]
University degree	-0.016*** [-0.023,-0.009]	-0.215 [-0.617,0.188]	-0.050*** [-0.076,-0.024]
Currently employed	0.003 [-0.003,0.009]	0.159 [-0.274,0.593]	0.010 [-0.008,0.029]
Currently unemployed	0.009 [-0.003,0.021]	0.506* [-0.042,1.054]	0.046** [0.005,0.087]
Past year equivalent income ($1,000s)	0.0002 [-0.0002,0.001]	-0.023 [-0.052,0.005]	0.0001 [-0.001,0.002]
N	41,270	1,203	41,270

[a] Estimated with probit. Coefficients are marginal effects and were estimated at mean values for other regressors. 95% confidence intervals in parentheses.

[b] Estimated with OLS. Sample includes respondents who experienced one or more gambling-related problems within the past year. 95% confidence intervals in brackets.

[c] Estimated with OLS. 95% confidence intervals in brackets.

* Statistically significant, $p \leq 0.10$;

** Statistically significant, $p \leq 0.05$;

*** Statistically significant, $p \leq 0.01$.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 3

Estimation Results for Alcohol Use during the Past Year (N=41,270)

Explanatory Variables	**Weekly or more Frequent Drinking**	**Any Drinking to Intoxication**	**Alcohol Abuse and/or Dependence**
Baseline Proportions	0.297	0.242	0.085
Instruments			
Height (inches)	0.005*** [0.003,0.007]	0.002** [0.0003,0.004]	0.001*** [0.0004,0.002]
Alcohol purchase banned on Sundays	-0.024* [-0.050,0.003]	-0.009 [-0.031,0.013]	0.004 [-0.006,0.013]
Any exemption for underage alcohol possession	0.034* [-0.001,0.068]	0.037*** [0.016,0.058]	0.007 [-0.001,0.015]
Per capita beer sales (10,000s)	0.015 [-0.032,0.062]	0.048** [0.006,0.089]	0.027*** [0.011,0.043]
Other Explanatory Variables			
Male	0.153*** [0.138,0.168]	0.080*** [0.063,0.097]	0.052*** [0.044,0.060]
Age	0.004*** [0.002,0.006]	-0.007*** [-0.010,-0.005]	-0.001 [-0.002,0.001]
Age squared	-0.005*** [-0.007,-0.003]	-0.001 [-0.003,0.001]	-0.002*** [-0.003,-0.001]
African American	-0.072*** [-0.091,-0.055]	-0.103*** [-0.117,-0.089]	-0.026*** [-0.034,-0.019]
Other race except White	-0.103*** [-0.133,-0.074]	-0.067*** [-0.096,-0.037]	-0.006 [-0.022,0.009]
Hispanic	-0.058*** [-0.077,-0.038]	-0.054*** [-0.073,-0.035]	-0.009** [-0.017,-0.001]
Foreign born	-0.050*** [-0.075,-0.025]	-0.103*** [-0.116,-0.089]	-0.034*** [-0.040,-0.027]
Divorced/Separated/Widowed	0.031*** [0.015,0.046]	0.066*** [0.048,0.084]	0.057*** [0.045,0.069]
Single	0.032*** [0.013,0.051]	0.030*** [0.016,0.045]	0.034*** [0.025,0.043]
High school education	0.050*** [0.034,0.066]	0.015 [-0.004,0.034]	-0.005 [-0.013,0.003]
Some post-secondary education	0.086*** [0.067,0.105]	0.048*** [0.030,0.066]	0.003 [-0.005,0.011]
University degree	0.158*** [0.136,0.181]	0.060*** [0.039,0.081]	-0.013** [-0.023,-0.002]
Currently employed	0.024*** [0.012,0.037]	0.049*** [0.033,0.064]	0.014*** [0.006,0.023]
Currently unemployed	-0.021 [-0.049,0.006]	0.061*** [0.036,0.085]	0.022** [0.005,0.038]
Past year equivalent income ($1,000s)	0.013*** [0.009,0.017]	0.005*** [0.002,0.007]	0.001*** [0.0003,0.002]

Explanatory Variables	Weekly or more Frequent Drinking	Any Drinking to Intoxication	Alcohol Abuse and/or Dependence
χ^2 test for joint significance of the instruments	38.18***	21.69***	18.05***

Note: All coefficient estimates are marginal effects and are estimated at mean values for other regressors. 95% confidence intervals in brackets.

*Statistically significant, $p \leq 0.10$;

**Statistically significant, $p \leq 0.05$;

***Statistically significant, $p \leq 0.01$.

Table 4

Selected Estimation Results for Gambling Outcomes Past Year

Explanatory Variables	Any Gambling Related Problems[a]	Number of Gambling-Related Problems (conditional)[b]	Number of Gambling-Related Problems (unconditional)[c]
Baseline Means/Proportions	0.030	2.275	0.069
Weekly or more frequent drinking			
Single-equation estimation	0.013*** [0.009,0.018]	**0.041 [-0.214,0.296]**	**0.036*** [0.021,0.051]**
Simultaneous-equation estimation	**0.065** [0.001,0.128]**	0.133 [-1.147,1.413]	0.044*** [0.020,0.067]
Wald test for independent equations	-0.299** [-0.535,-0.020]	-0.029 [-0.386,0.336]	-0.009 [-0.043,0.016]
Wald test for exclusion restrictions[d]	3.32	3.04	6.19
Any drinking to intoxication			
Single-equation estimation	0.021*** [0.015,0.028]	**0.442** [0.093,0.791]**	0.070*** [0.050,0.089]
Simultaneous-equation estimation	**0.066** [0.004,0.128]**	0.345 [-0.188,0.879]	**0.079*** [0.060,0.098]**
Wald test for independent equations	-0.240* [-0.461,0.009]	0.030 [-0.093,0.152]	-0.011* [-0.023,0.002]
Wald test for exclusion restrictions[d]	3.25	3.20	6.05
Alcohol abuse and/or dependence			
Single-equation estimation	**0.044*** [0.032,0.056]**	**0.570*** [0.222,0.917]**	**0.162*** [0.124,0.200]**
Simultaneous-equation estimation	0.029 [-0.039,0.097]	0.495* [-0.38,1.028]	0.166*** [0.129,0.204]
Wald test for independent equations	0.070 [-0.269,0.393]	0.023 [-0.077,0.122]	-0.004 [-0.012,0.003]
Wald test for exclusion restrictions[d]	3.82	3.48	8.00**
Observations	41,270	1,203	41,270

Notes: All coefficient estimates are marginal effects and were estimated at mean values for other regressors. All specifications include the same list of covariates as in Table 2. Bolded coefficient estimates correspond to the preferred model (single-equation or simultaneous-equation) based on the specification tests. 95% confidence intervals in brackets.

[a]Estimated with probit in single-equation estimation and recursive bivariate probit in simultaneous-equation estimation.

[b]Estimated with OLS in single-equation estimation and a treatment effects regression model in simultaneous-equation estimation. Sample includes respondents who experienced one or more gambling-related problems within the past year.

[c]Estimated with OLS in single-equation estimation and treatment effects regression in simultaneous-equation estimation.

[d]Just identified models were estimated following Bollen, Guilkey, and Mroz (1995) and Rashad and Kaestner (2004). The tests were preformed multiple times with each instrument selected as the excluded instrument. The most conservative test results (i.e., smallest p-values) are reported.

*Statistically significant, $p \leq 0.10$;

**Statistically significant, $p \leq 0.05$;

***Statistically significant, $p \leq 0.01$.