DOES PROBLEM GAMBLING INCREASE CRIME?

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We evaluate the connection between problem gambling and the incidence of crime outcomes using five years of survey panel data collected on 4,121 subjects for the Ontario Problem Gambling Research Centre. Problem gambling is statistically significantly associated with elevated rates of crime. This connection persists after controlling for extensive demographic and education characteristics, measures of alcohol use, drug use, plus mental health. In this study, the nearest casino is 105 kilometers—over sixty-four miles—away from the population studied. We estimate that being a problem gambler increases one's likelihood of committing crime by 4.3 to 7.6 percentage points.

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I.   INTRODUCTION

Does casino gambling increase crime? In 2006, Grinols and Mustard documented that counties that open casinos have crime rates about eight percentage points higher than their counterparts that do not open a casino.[1] They identified reasons why casinos could either raise or lower crime and estimated a total effect, which they could not disaggregate into specific causal factors.[2] Their finding, however, that crime rates in casino counties remain relatively stable for two or three years after casinos open and then increase over time suggests that problem gamblers, who might take a few years to gamble sufficiently to exhaust their resources and start committing crime, could play an important role.[3]

Although multiple studies suggest links between problem gambling and crime,[4] there remains little firm evidence because of several substantial and continuing issues. First, research from aggregate data frequently uses partial and nonrepresentative samples.[5] Nichols and Tosun,[6] for example, who are interested in the long run effect of casino gambling on crime remove Nevada from their data set, exclude counties and states in other parts of the U.S., and do not examine years prior to 1984.[7] Reliable evidence is also hard to find because many studies are agenda-driven, funded by the industry, and engaged in false reporting.[8]

Direct research to systematically investigate individual data connecting gambling behavior and criminal participation could bypass all of these problems. Where such studies have been contemplated, however, the lack of a comprehensive set of controls to allow researchers to net out other addictive characteristics

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1.   Earl L. Grinols & David B. Mustard, *Casinos, Crime, and Community Costs*, 88 REV. ECON. & STAT. 28, 28, 42, 44 (2006). This is a conservative lower bound. The precise estimates were that 8.6% of property crime and 12.6% of violent crime was due to casinos.

2.   *See id.* at 31–33.

3.   *Id.* at 40.

4.   For a review, see *id.* at 28.

5.   *See id.*

6.   Mark W. Nichols & Mehmet Serkan Tosun, *The Impact of Legalized Casino Gambling on Crime*, 66 REG'L SCI. & URB. ECON. 1 (2017).

7.   *See id.* at 2, 4 n.6. Grinols and Mustard studied years 1977–1996 and excluded no counties. *See* Grinols & Mustard, *supra* note 1. Excluding no counties and including years prior to 1984 would have made comparisons possible.

8.   For an example of such studies, see Earl L. Grinols & David B. Mustard, *Connecting Casinos and Crime: More Corrections of Walker*, 5 ECON. J. WATCH 156, 158 (2008).

when estimating the effect of problem gambling has been an impediment.[9] Omitted variable bias is significant and particularly nettlesome.[10] It cannot be ignored because there is a strong correlation between pathological gambling and other addictive behavior, such as alcohol and substance abuse.[11] The National Research Council (NRC) warns, "A relevant question to ask is whether, in the absence of legalized gambling, a pathological gambler would have engaged in some similarly destructive and costly addiction, such as alcoholism. To the extent that the answer is yes, the costs . . . represent transfer of costs from one problem category to another."[12] We present quantitative research in this Article using individual data that responds to this concern.

The null hypothesis is that by expanding the number of gambling locations and its availability, the cost of gambling to the user is lowered and its quantity increased. More gambling leads to more problem gamblers who engage in socially costly outcomes including crime. We therefore examine the relationship between problem gamblers and crime. Our data set consists of 4,121 people from Ontario, Canada who are interviewed each year over a five-year period.[13] This Quinte Exhibition Raceway (QER) Survey has a remarkable retention rate of ninety-four percent.[14] It reports criminal activity plus an array of gambling behaviors that determine whether respondents are problem gamblers.[15] In addition, the dataset has extensive information on personal characteristics, mental health, and alcohol and drug use that are correlated with gambling behavior but often absent in other research.[16] With these data, we can address the three problems that plague other studies.

The rest of this paper is organized as follows. Part II contrasts average differences between problem gamblers and people without gambling problems. Part III employs model-free nonparametric statistics to quantify comparisons of problem gamblers to those who do not have gambling problems. The evidence rejects the null hypothesis that the two groups derive from a common distribution.[17] We then test whether people who are problem gamblers and also exhibit alcohol abuse, drug abuse, or mental health issues, and those who exhibit none of the above are equally likely to commit crime.[18] Again, the data reject the null hypothesis that the two groups are drawn from the same distribution and suggest

9. *But see* Earl L. Grinols, *Problem Gambling, Mental Health, Alcohol and Drug Abuse: Effects on Crime*, *in* DUAL MARKETS: COMPARATIVE APPROACHES TO REGULATION 321 (Ernesto U. Savona, Mark A.R. Kleiman, Francesco Calderoni eds., 2017).

10. *See Omitted Variable Bias: Consequences*, ECON. THEORY BLOG (Feb. 23, 2018), https://economictheoryblog.com/2018/02/23/omitted-variable-bias-consequences/ [https://perma.cc/F8JS-QTCN].

11. NAT'L RSCH. COUNCIL ET AL., PATHOLOGICAL GAMBLING: A CRITICAL REVIEW 170 (1999).

12. *Id.* at 170–71.

13. ROBERT J. WILLIAMS ET AL., QUINTE LONGITUDINAL STUDY OF GAMBLING AND PROBLEM GAMBLING 36 (2015).

14. *Id.*

15. *Id.* at 11.

16. *Id.* at 12–13.

17. *See* discussion *infra* Section III.A.

18. *See* discussion *infra* Section III.A.

that the dominant causal factor regarding crime differences in the groups is problem gambling.[19] Part IV then uses parametric regressions to model the interaction of problem gambling, substance abuse, and mental health. We also correct for the possible endogeneity of problem gambling using propensity score matching methods and instrumental variable techniques.[20] Part V provides a series of robustness and reliability checks that involve different measures of problem gambling, substance abuse, and mental health. Part VI uses our estimates to make inferences about the magnitude of the crime effects. We estimate that being a problem gambler, on average, increases one's likelihood of committing crime by 4.3% to 7.6% when the nearest casino is 105 kilometers—over sixty-four miles—away.[21] Among those who are more likely to commit crime than the average respondent, such as twenty-five-year-old males with a high school degree, being a problem gambler can nearly double the incidence of committing a crime in the last twelve months.[22] Part VII summarizes and concludes.

II. DATA

We use data from the five-year Quinte Exhibition Raceway survey of individuals from Quinte in southern Ontario, Canada, which is located just north of Lake Ontario.[23] The Ontario Problem Gambling Research Centre did the survey, which was funded by a five-year $3.1 million grant.[24] The panel survey included 4,121 participants each year for five years, yielding 20,615 potential observations. 3,065 participants were randomly selected.[25] Because one of the main goals of the initiative was to examine problem gamblers, which most studies conclude constitute less than five percent of the population,[26] the remaining 1,056 participants were oversampled with respect to being problem gamblers.[27] Attrition reduced the final sample to 19,583 observations, or an impressive 94% retention rate.[28] For our empirical work, we excluded five additional observations that lacked complete information on some mental health variables. The final sample that we use for the empirical work has 19,578 observations.

19.   *See* discussion *infra* Section III.A.

20.   *See* discussion *infra* Section IV.C.

21.   *See* discussion *infra* Part VI.

22.   *See* discussion *infra* Section IV.B.

23.   *See generally* WILLIAMS ET AL., *supra* note 13.

24.   *Id.* at 252.

25.   *See id.* at 27–31.

26.   Rina Gupta & Jeffrey L. Derevensky, *Familial and Social Influences on Juvenile Gambling*, 13 J. GAMBLING STUD. 179, 179–80 (1997); Marc N. Potenza, *The Neurobiology of Pathological Gambling and Drug Addiction: An Overview and New Findings*, 363 PHIL. TRANSACTIONS ROYAL SOC'Y B 3181, 3181 (2008).

27.   WILLIAMS ET AL., *supra* note 13, at 31.

28.   *Id.* at 5, 56.

FIGURE 1: QUINTE, ONTARIO STUDY AREA AND GAMBLING ESTABLISHMENTS
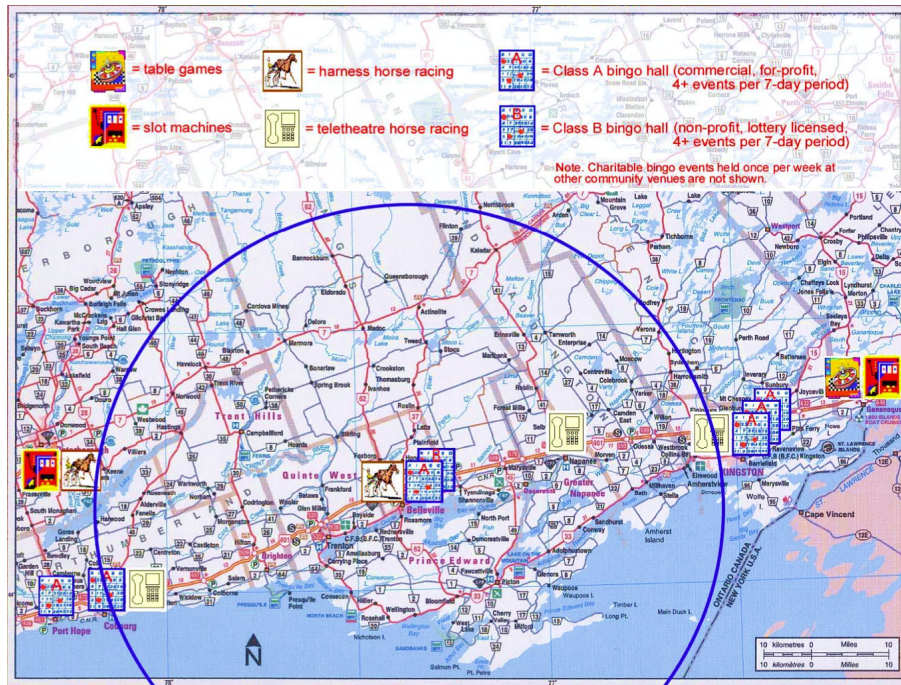
    The participants in this Quinte Longitudinal Survey (QLS) were recruited from an eligible population who resided within seventy kilometers of Belleville, Ontario.[29] The main communities represented in the sample are: Belleville (29.2%) and Trenton (12.2%) with 5% or less from a variety of surrounding towns such as Brighton, Napanee, Cobourg, Picton, and Stirling.[30] This seventy kilometer radius excluded the major urban areas of Kingston and Peterborough, which are eighty-two and 111 kilometers, respectively, away from Belleville.[31] According to the Canadian Census Program, the 2011 population of the Belleville census agglomeration (CA) in 2011 was 92,540, and 67.3% of its census families were married compared to 67.0% in Canada.[32] The median age in the Belleville CA was slightly older (43.5 years old) compared to the median age in Ontario (40.4) and Canada (40.6).[33]

    The QER survey was originally undertaken with the expectation that a casino with electronic gaming machines would open in Quinte mid-survey, providing a natural experiment to compare baseline gambling behavior with gambling

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29. *Id.* at 27.

30. *Id.*

31. *Id.*

32. *Census Profile*, STATS. CAN., https://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CMA&Code1=522&Geo2=PR&Code2=01&Data=Count&SearchText=Belleville (last visited Aug. 19, 2021) [https://perma.cc/45HG-GWU6].

33. *Id*.

behavior after the casino was opened.[34] A Quinte casino, however, never opened.[35] Although the original intent was not realized, the data became an ideal panel of observations on individuals who live between ten and 150 kilometers from the closest class III gambling facility.[36] The seventy kilometer area around Belleville included no class III gambling establishments and no slot machines or table games.[37] Legal gambling within the seventy kilometer radius included one harness horse racing facility, three bingo halls, and three tele-theatre horse racing locations.[38] Figure 1 provides a map showing the location of gambling establishments in the study area.[39]

The study provided respondents with strict guarantees of confidentiality, which was maintained.[40] Respondents were asked whether, in the past twelve months, they had committed any illegal activities that included assault, sexual assault, robbery, breaking and entering, theft, shoplifting, fraud or embezzlement, drug trafficking, arson, vandalism, and impaired driving.[41] Eight hundred and fourteen people admitted that they engaged in criminal activities in the previous year.[42]

The QER survey includes twenty-seven questions on demographics, 128 questions on gambling, 101 questions related to stress, health, and personality, and 156 questions concerning psychological and mental health factors in the previous twelve months.[43] The survey therefore captured social consequences related to gambling that no other study captures. This is a remarkable longitudinal data set due to its size, high retention rate, and detailed information about gambling pathology, criminal participation, mental health, and substance abuse. Consequently, we are able to control for an extensive set of characteristics that are unobserved in many studies.

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34. WILLIAMS ET AL., *supra* note 13, at 27.

35. *Id.*

36. *Id.*

37. *Id.* Fraserville, ON racetrack and slot machines and the Gananoque casino, 80 and 100 km, respectively, from the center of Belleville, are the closest facilities. Fraserville, ON racetrack and slot machines are 10 km from the 70 km radius around Belleville chosen for the study. The entire 70 km radius circle is within 150 km of Fraserville. The comparable figures for the casino in Gananoque are 30 km and 170 km.

38. *Id.* at 29 fig.2.

39. *See supra* Figure 1.

40. The grant document reports, "[t]he strict confidentiality of the information provided will be emphasized. Participants' data will be automatically converted to an SPSS file with only the Principal Investigators having access to that file. Participants will also be asked to identify 2 friends/relatives who would be in the best position to verify information the participant provided, as among the 4,000 participants a small percentage of randomly selected collaterals may be contacted to corroborate this information. Although it is unlikely that we will actually contact collaterals, the possibility of independent corroboration significantly improves validity of self-report (Babor et al., 1987; Roese and Jamieson, 1993; Williams and Nowatzki, 2005)." *See* Grinols, *supra* note 9, at 323 n.9.

41. WILLIAMS ET AL., *supra* note 13, at 246.

42. *Id.* at 246. Assault, sexual assault, robbery/mugging, break & enter, theft, shoplifting, fraud or embezzlement, drug trafficking, and arson are among the possible answers to the survey question, "[i]n the past 12 months, have you done any of the following?"

43. *See id.* at 179–247: "Appendix B: QLS Assessment 1 Questionnaire."

A. Problem Gambling

The American Psychiatric Association recognizes "pathological" or "disordered" gambling as an impulse control disorder "characterized by a loss of control over gambling, the chasing of losses, lies and deception, family and job disruption, financial bail outs, and illegal acts"[44] and provides guidelines in its Diagnostic and Statistical Manuals (DSMs III, IV, and now V).[45] Screening tools determine if a gambler suffers from pathological/disordered gambling or a lesser variant termed problem gambling. The most recognized test for identifying problem gamblers, the South Oaks Gambling Screen (SOGS), is a twenty-item questionnaire based on DSM-III criteria for pathological gambling.[46] The National Opinion Research Center Screen for DSM-IV Pathological Gambling (NORC Diagnostic Screen for Gambling Disorders, NODS) identifies gambling problems according to DSM-IV criteria and comprises a seventeen-item set of questions about lifetime gambling.[47] For every question that receives an affirmative answer, a corresponding question is asked about participation in gambling over the last year.

44. Rachel A. Volberg, *The Prevalence and Demographics of Pathological Gamblers: Implications for Public Health*, 84 AM. J. PUB. HEALTH 237, 237 (1994).

45. AM. PSYCHIATRIC ASS'N, DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS 312–31 (5th ed. 2013).

46. Henry R. Lesieur & Sheila B. Blume, *The South Oaks Gambling Screen (SOGS): A New Instrument for the Identification of Pathological Gamblers*, 144 AM. J. PSYCHIATRY 1184, 1185 (1987).

47. DEAN GERSTEIN ET AL., GAMBLING IMPACT AND BEHAVIOR STUDY: REPORT TO THE NATIONAL GAMBLING IMPACT STUDY COMMISSION 18 (1999).

TABLE 1: DESCRIPTIVE STATISTICS BY GAMBLING PATHOLOGY

		Non-Problem Gamblers	SOGS Problem Gamblers	Total
GAMBLING	# Obs. Class III Gambling	0.156	0.549	3423
	Mean Days Gambled	67.7	176.7	
STATUS	Mean Loss	$778.1	$5434.5	
	Medial Loss	$192	$1560	
CRIME	%Obs. Reporting Crime	3.4%	10.1%	3.8%
MENTAL	Substance Abuser	0.066	0.172	318
HEALTH	Daily Alcohol Abuse	0.057	0.056	236
ALCOHOL &	Mental Health Issues	0.175	0.339	795
DRUG USE	N	3677	443	4120
		(89.2%)	(10.8%)	
DEMOGRAPHICS	Average Age	46.6	45.8	
	Male	45.1%	46.7%	1867
	Never Married	11.2%	18.3%	491
	Married	59.1%	49.7%	2393
	Living Common Law	13.4%	13.5%	551
	Separated	5.0%	5.4%	207
	Divorced	7.5%	9.7%	318
	Widowed	3.9%	3.4%	160
	Some Elementary	0.4%	0.5%	17
	Elementary	0.7%	1.6%	31
	Some High Sch.	9.7%	13.1%	414
	High School	19.4%	24.2%	822
	Some Tech. Sch./ College	21.6%	23.7%	899
	Technical School	5.0%	5.4%	207
	College	39.0%	29.1%	1563
	Professional Degree	4.2%	2.5%	167

Notes: Problem gamblers are identified by the SOGS screen based on gambling in the previous year. Individuals in the Non-Problem group were not problem gamblers in any year of the sample.

For this survey, questions sufficient to construct both the SOGS and NODS as well as the Canadian Problem Gambling Index (CPGI) and the Problem and Pathological Gambling Measure (PPGM) were administered. All the questions from the NODS screen and most questions required for the SOGS screen were included directly. For the SOGS questions that were not directly asked, very similar equivalent questions were asked that generate a synthetic SOGS score.

For robustness reasons, we use both SOGS and NODS to identify people who have problems with gambling. This paper uses the term "problem" gambler to include both the "problem" and "pathological" gambler categories that are identified by SOGS and NODS.[48] Our conclusions do not depend on the particular screen selected.

Table 1 reports the descriptive statistics of nonproblem and problem gamblers as identified by the SOGS for the first sample year. Of the 4,121 individuals

48. *Id.* at viii–ix; *see* Lesieur & Blume, *supra* note 46, at 1185.

surveyed, 10.4% were problem gamblers and 89.2% were not.[49] Problem gamblers engage in Class III gambling more heavily than the nonproblem group. Their annual median losses ($1,560) are more than eight times those who are not problem gamblers ($192) and their average annual losses are $5,434 compared to $778.[50] Similarly, problem gamblers gambled 177 days in the previous year compared to an average of sixty-eight days for nonproblem gamblers.[51]

Table 1 also displays the share of gamblers who admitted to committing a crime in the past year.[52] Problem gamblers are 297% more likely to have committed a crime in the previous year than nonproblem gamblers (10.1% compared to 3.4%).[53]

One enormous advantage of our data set is that we have detailed information on many health and social factors, such as substance abuse and mental health. Problem gamblers frequently have "multiple overlapping personality disorders."[54] Welte et al. conclude that substance abuse is a good predictor of problem gambling.[55] Shaffer and Korn find that 25–63% of pathological gamblers satisfy criteria for lifetime substance abuse.[56] Mental health is also a complicating factor.[57] Table 1 reports the presence of these complicating factors.[58] SOGS problem gamblers are nearly three times as likely as nonproblem gamblers to have a substance abuse problem (17.2% compared to 6.6% and are nearly twice as likely to have mental health issues (33.9% compared to 17.5%).[59] The two groups do not differ in their alcohol consumption.[60]

The two groups also differ in some demographic characteristics. Problem gamblers are more likely to be in the never married group (18.3% compared to 11.2%), less likely to be married (49.7% compared to 59.1%) and are more likely to have no schooling, some elementary, some high school, or only a high school degree.[61] Problem gamblers are slightly younger (45.8 compared to 46.6 years old) and more likely to be male (46.7% compared to 45.1%).[62]

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49. *See supra* Table 1.
50. *See supra* Table 1.
51. *See supra* Table 1.
52. *See supra* Table 1.
53. *See supra* Table 1.
54. Alex Blaszczynski & Zachary Steel, *Personality Disorders Among Pathological Gamblers*, 14 J. GAMBLING STUD. 51, 60 (1998).
55. John W. Welte, William F. Wierczorek, Grace M. Barnes, Marie-Cecile Tidwell & Joseph H. Hoffman, *The Relationship of Ecological and Geographic Factors to Gambling Behavior and Pathology*, 20 J. GAMBLING STUD. 405, 422 (2004).
56. Howard J. Shaffer & David A. Korn, *Gambling and Related Mental Disorders: A Public Health Analysis*, 23 ANN. REV. PUB. HEALTH 171, 191 (2002).
57. *See* Blaszczynski & Steel, *supra* note 54, at 54.
58. *See supra* Table 1.
59. *See supra* Table 1.
60. *See supra* Table 1.
61. *See supra* Table 1.
62. *See supra* Table 1.

B.   Alcohol and Drug Use and Mental Health Conditions

As already noted, the consumption of alcohol and drugs and the presence of mental illness are often correlated with gambling and crime.[63] Questions from the World Health Organization's Composite International Diagnostic Interview Short Form (CIDI-SF) provide information on psychological and mental health factors.[64] They provide information on post-traumatic stress episodes and include mental health questions related to intense fear, persistent recollections, flashbacks, feelings of detachment, amnesia, major depressive episodes, manic episodes, generalized anxiety, panic attacks, agoraphobia, obsessive-compulsive disorder, bulimia, schizophrenia, and delusional disorders.[65] We coded an observation for the "mental health" variable (M) as zero if none of the illnesses were present, and '1' if one or more was indicated. Given the thoroughness of the underlying survey, individuals coded zero are free of a large list of issues that should include virtually all variables of a mental health nature that might be correlated with gambling and crime.

Following the same strategy of creating a cohort that is completely free of complicating factors, any observation indicating daily consumption of alcohol (variable A) for the previous year was coded '1' and zero otherwise. This does not mean that any individual coded 1 is alcoholic. On the contrary, no survey instrument identifies drinking problems. This variable captures those who have drinking problems and those who are heavy users along with those who simply have a daily beer or glass of wine.

Likewise, a '0' for our drug use variable indicates no consumption of illegal drugs or substance addiction in the last year. If an individual consumed any illegal drug in the previous twelve months or indicates any addiction to drugs or alcohol the drug use variable (D) was coded '1.' In addition, the survey contained a second set of questions that identified the individual as meeting the criteria for substance abuse or dependence. This alternate substance abuse variable was coded '0' if no substance abuse or dependence was present for the previous year, and '1' otherwise.

Table 2 reports data for eight mutually exclusive groups based on the respondent's mental health and alcohol and drug consumption. Most observations (13,544 or 69%) are associated with individuals who have no mental health issues, do not consume alcohol daily, and do not use drugs in the previous year (group non-ADM). There were 782 observations involving daily alcohol use (group A); 1,737 involving illegal drug use in the previous year (group D); and 2,409 reporting some mental illness issue (group M). Three groups contain individuals reporting two of the characteristics: alcohol and drug use (122, group AD), drug use and mental health issues (799, group DM), and alcohol and mental

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63.   *See supra* Section II.A.

64.   Ronald C. Kessler, Gavin Andrews, Daniel Mroczek, Bedirhan Ustun & Hans-Ulrich Wittchen, *The World Health Organization Composite International Diagnostic Interview Short-Form (CIDI-SF)*, 7 INT'L J. METHODS PSYCHIATRIC RSCH. 171, 171, 175 (1998).

65.   *See id.* at 172.

health issues (113, group AM). Only seventy-two observations reported all three problems (group ADM).

TABLE 2: GAMBLING STATUS BY COMPLICATING FACTORS

Group	N	#Gambling Class III	Mean Days Gambled	Median Loss	Mean Loss	StDev. Loss
No Alcohol, Drug, or Mental Illness (non-ADM)	13544	2372	70.1	$240	$1080	$23821
Daily Alcohol	782	143	79.0	$240	$1661	$14745
Drug Use in Past Year	1737	329	89.4	$240	$822	$6426
Mental Illness	2409	371	69	$180	$385	$15136
Alcohol & Drug	122	19	94.4	$240	$570	$904
Drug & Mental Illness	799	149	80.9	$276	$796	$3543
Alcohol & Mental Illness	113	19	81.8	$180	$903	$3248
Alcohol, Drug, & Mental Illness	72	21	110.8	$600	$4144	$21665
TOTAL	19578	3423				

Notes: Group categories are exhaustive and mutually exclusive.

The differences in gambling activity between these groups with different alcohol and drug consumption and mental illness conditions are much smaller than the differences between problem and nonproblem gamblers. Nonproblem gamblers gambled sixty-eight days in the previous year[66] and the people with no alcohol and drug consumption and no mental health issues gamble an average of seventy days.[67] Problem gamblers, however, gamble 177 days per year while daily alcohol users, annual drug users, and those with a mental illness gamble a noticeably smaller eighty-nine, seventy-nine, or sixty-nine days per year, respectively.[68] The average gambling losses are also more dramatic for the problem gambler ($5434) than when the individual is identified by those who have used alcohol or drugs in the last year or who reported a mental health problem ($1,661; $822; or $385; respectively).[69]

III. NONPARAMETRIC STATISTICS

To consider whether problem gambling impacts crime, we first examine the raw data and then apply nonparametric statistical tests to them. The numbers in Table 1 are the first evidence. If an observation applies to a nonproblem gambler, there is a 3.4% chance that a crime was committed in the previous year.[70] If the observation applies to a problem gambler, the probability rises to 10.1%. Problem gamblers are 297% more likely to engage in crime than are those who are not problem gamblers (10.1% compared to 3.4%).[71] Whether the observed

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66. *See supra* Table 1.
67. *See supra* Table 2.
68. *See supra* Table 1, Table 2.
69. *See supra* Table 1, Table 2.
70. *See supra* Table 1.
71. *See supra* Table 1.

increase rises to the level of statistical significance is the purpose of the tests reported next.

A.   Kruskal-Wallis and Wilcoxon-Mann-Whitney Tests

Nonparametric statistics provide information about the statistical significance of the observed differences between two or more distributions.[72] They are particularly valuable because they do not impose assumptions onto the populations from which the samples are drawn. If the null hypothesis that problem gambling does not matter to crime applies, then dividing the sample with respect to that status should not matter to the observed quantity of crime in the two sample groups. Kruskal-Wallis statistics test whether two or more samples are drawn from the same population.[73] When only two groups are present, Kruskal-Wallis is identical to the bilateral Wilcoxon-Mann-Whitney test.[74]

Table 3 reports the results of the Kruskal-Wallis test. The test rejects the null hypothesis that problem gamblers and nonproblem gamblers are drawn from the same distribution with respect to crime. The K-W score is 108.899 and has a P-value of 0.0001, which strongly rejects the hypothesis.[75] Thus, nonparametric statistics indicate that the elevated crime rates observed for problem gamblers are unlikely to have occurred by chance.

TABLE 3: NONPARAMETRIC TESTS: CONTROL V. PROBLEM GAMBLERS

	Sample Sub-Populations					
	Full Sample	Non-AMD	A	M	D	MD
Control v. Problem Gamblers	108.899	23.464	5.935	10.758	2.722	17.021
	0.0001***	0.0001***	0.0148***	0.001***	0.099*	0.0001***
N	19567	13539	782	2405	1737	799
Problem Gambler Observations	930	476	24	186	100	110

Notes: Kruskal-Wallis scores. P-values are reported underneath.

***= 1% or better significance; **=5% or better significance; *=10% or better significance.

A=Alcohol abuse, D=Drug abuse, M=Mental illness.

Table 3 also compares problem gamblers to nonproblem gamblers where the initial population is identified by alcohol abuse, drug abuse, and/or mental health issues. Within each of the five largest groups (Non-ADM, A, D, M, and MD) problem gamblers are more likely than nonproblem gamblers to engage in crime and this result is statistically significant.

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72.   Lincoln E. Moses, *Non-Parametric Statistics for Psychological Research*, 49 PSYCH. BULL. 122, 122 (1952).

73.   William H. Kruskal & W. Allen Wallis, *Use of Ranks in One-Criterion Variance Analysis*, 47 J. AM. STAT. ASS'N 584, 584 (1952).

74.   *Id.* at 604–605.

75.   We also compared three populations: Problem gamblers who are not pathological, pathological gamblers, and nonproblem, nonpathological gamblers. The Kruskal-Wallis score is 109.695, rejecting the null hypothesis of identical distribution with a P-value of 0.0001. *See infra* Table 3.

By distinguishing observations according to problem gambling status and running Kruskal-Wallis tests, we effectively ask whether taking account of that status matters with respect to observing higher crime in the relevant sub-group. The tests indicate that it does.[76] In the medical literature this might be discussed in terms of "treating" a subject with problem gambling.[77] For example, if we want to know whether a particular disease reduces life expectancy in mice, the medical profession might treat some mice with the disease and compare them to the control group with respect to life expectancy. The separation into two groups according to the disease is the "treatment." Of course, in the present case we do not have an experiment allowing us to decide who becomes a problem gambler, a topic to which we return later.

In the reverse direction, it is possible to start with a population of problem gamblers and treat them with alcohol, drug, or mental health issues to see if this results in higher crime. If any of alcohol abuse, drug abuse, or mental illness does increase crime it should increase crime for the treated observations. The results are that in no case does identifying observations exhibiting alcohol abuse, drug abuse, or mental health issues in a beginning population of problem gamblers reject the null hypothesis of no differential effect and lead to statistically significant Kruskal-Wallis scores.[78]

The implication from nonparametric statistics is that observing problem gambling in a starting population is associated with statistically significantly higher number of crime incidents. This is true whether the starting population is the control group (people with no alcohol or drug use and no mental health issues) or a group suffering from alcohol abuse, drug abuse, or mental health issues as shown in Table 3. The reverse is not true: individuals exhibiting problem gambling do not have discernibly higher crime outcomes when observed to suffer in addition from alcohol, drug, or mental health issues.[79] Thus, problem gambling appears to be a relevant factor. In the next section we apply parametric statistics to model problem gambling, alcohol, drugs, and mental health impacts on crime. Because we have a large sample that tests for the absence of alcohol, drug, or mental issues, we can estimate the pure effect of problem gambling on crime. We also report the contribution of the other factors.

IV. EMPIRICAL RESULTS

In this Part, modelling allows us to estimate the increase in crime due to problem gambling and the increase due to other factors.

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76. *See supra* Table 3.
77. *See, e.g.*, Tony Toneatto & Goldie Millar, *Assessing and Treating Problem Gambling: Empirical Status and Promising Trends*, 49 CAN. J. PSYCHIATRY 517, 517 (2004).
78. *See supra* Table 3.
79. *See infra* Table 4.

A.   Problem Gambling

Table 4 summarizes the results of probit regressions that predict the probability of crime conditional on demographic factors and the presence or absence of problem gambling. The demographic variables used are the same list of age, sex, marriage, and education variables reported in Table 1.

Column 2 reports results of a regression that restricts the sample to observations with no drug, no alcohol, and no mental health issues present. Problem gambling has a positive and statistically significant impact on crime. The coefficient is significant at better than the one percent level.

TABLE 4: PROBLEM GAMBLING, ALCOHOL, DRUGS, MENTAL ILLNESS, AND CRIME

(1)	(2) Control Sample	(3) Full Sample
SOGS Problem Gambler	.41246***	.38512***
	(0.000)	(0.000)
Alcohol Use		.5186***
		(0.000)
Drug Use		.4948***
		(0.000)
Mental Illness		.2834***
		(0.000)
Alcohol and Drug Use		1.1089***
		(0.000)
Alcohol Use and Mental Illness		1.0618***
		(0.000)
Drug Use and Mental Illness		.8827***
		(0.000)
ADM		1.2178***
		(0.000)
Demographic Variables	YES	YES
Constant	-1.7540***	-1.9759***
	(0.000)	(0.000)
Observations	13539	19567

Notes: The Control Sample (Non-ADM) suffers from no alcohol abuse, no drug abuse, or any mental health issues. The dependent variable is crime committed in the previous year. Standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.10.

B.   Alcohol, Drug Use, and Mental Illness

Column 3 reports the impact of problem gambling on crime when alcohol abuse, drug abuse, and mental health are taken into account and the regression is run on the full sample. All of the coefficient estimates are positive, indicating that problem gambling and each of the factors is associated with higher crime.[80] The coefficient estimates for two or more of the variables controlling for alcohol and drug use and mental illness are also positive and statistically significant at better than the one percent level.

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80.   *See supra* Table 4.

As expected, by including additional control variables, the magnitude of the estimated coefficient for problem gambling is slightly smaller (.3851 in column (3) compared to .4125 in column 2).[81] Importantly, however, in both regressions in Table 4, the probit regressions indicate that those who are designated as problem gamblers by SOGS are more likely to commit crime than those who are not problem gamblers. This is true for individuals who have no known related alcohol or drug use or mental health problems, and it is true for individuals who suffer from one or more problems related to alcohol and drug use and mental health. Alcohol abuse, drug abuse, and mental health problems are all associated with higher crime rates in the data, but when accounted for do not negate the connection between problem gambling and crime. For example, the Column 2 results imply that a twenty-five-year-old male with a high school degree and who is a SOGS problem gambler has an 18.5% probability of having committed a crime in the previous twelve months, which is nearly double the 9.5% probability applying to a person with the same demographic characteristics, but who is not a SOGS problem gambler. Similarly, the Column 3 results indicate that a twenty-five-year-old male who is a SOGS problem gambler and who has a high school degree, but who has not used drugs or alcohol and has no mental health issues has a 14.9% probability of having committed a crime compared to the 7.7% probability of a non-SOGS respondent who is similar in every other respect.

C.   Endogeneity

The way in which problem gambling can cause crime is natural and easy to explain. Individuals who previously engaged in no crime gamble away family savings and assets and then turn to crime such as theft, fraud, and embezzlement for money.[82] The Sheboygan, Wisconsin, sixty-four-year old grandmother and mother of seven who embezzled money from her employer, the Kettle Moraine Employees Credit Union, over a ten-year period and driving it out of business is an example of this type.[83] The former mayor of San Diego who was convicted of felony theft of over $2 million from a charitable foundation in consequence of problem gambling is another.[84] Marilyn Lancelot, who embezzled and served prison time said, "[t]here wasn't anything I wouldn't do to get more money to gamble."[85] In addition, people who previously engaged in crime may increase their crime in response to problem gambling.

The reverse direction is more problematic. That is, we do not believe that crime causes problem gambling. But to allow for this and other possibilities we

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81.   *See supra* Table 4.

82.   Colin May, *When Gambling is More Than a Game: Theft and Embezzlement that Fuel Gambling Addictions*, STEVENSON UNIV. ONLINE (Mar. 14, 2017), https://www.stevenson.edu/online/about-us/news/gambling-theft-embezzlement [https://perma.cc/M4EF-UEUS].

83.   Gretchen Schuldt, *Manager Pleads to Embezzlement that Forced Credit*, MILWAUKEE J. SENTINEL, Aug. 9, 2000, at 5.

84.   Peter Jaret & Bill Hogan, *Losing Everything to Gambling Addiction*, AARP BULL. (Jan./Feb. 2014), https://www.aarp.org/health/brain-health/info-01-2014/gambling-addiction.html [https://perma.cc/EEP4-6B65].

85.   *Id.* For other examples, see Earl L. Grinols & David B. Mustard, *Casinos, Crime, and Community Costs*, 88 REV ECON. & STAT. 28, 32 (2006).

applied propensity score matching and treatment effect methods to correct for endogeneity. Separately, we also used instrumental variable techniques. In each case, the positive connection between problem gambling and crime remains.

1.   *Treatment Effects*

Random sampling deals with the possibility that problem gambling does not have an independent impact on crime, but the underlying unobservables that cause problem gambling may also cause crime. Replicating the effects of a random experiment is the domain of the treatment effects literature. Propensity score-matching for causal studies is described by Dehejia and Wahba.[86]

Score-matching tries to replicate the effects of random sampling. Members of the control group are matched with comparable subjects that have the same propensity to be a problem gambler, but differ only with respect to the factor to be tested. The underlying factors that cause problem gambling and crime are used in producing the two groups. Under the null hypothesis, problem gambling is not a cause of higher crime and therefore taking account of it in the matched sample should have no impact on crime differences. This is a testable implication.

Score-matching uses a logit model to convert many variables that contribute to problem gambling into a propensity score on which observations are matched.[87] Higher values indicate a greater probability of problem gambling.[88] Included in the underlying variables are demographic variables and gambling-related variables. The dependent variable takes the value '1' if the individual satisfied the criteria for being a problem gambler and zero otherwise. Regressors are sex; age; age squared; eight education variables; five marital status variables; have children; employed fulltime; class III gambler; drivetime to the nearest casino; distance to the nearest casino; a gambler in childhood family; parents, brothers, or sisters gamble with you as a child; a problem gambler in childhood family; started gambling before age nineteen; frequency of gambling before age nineteen; big win or loss before age nineteen; family member with a history of addiction; family member with history of mental health problem. Including the constant, once the possible answers were coded there were over thirty coefficients estimated in the matching logistic regression. Using the estimated logit model, we identify a propensity score for each individual in the sample and introduce a new variable labeled problem gambler to indicate whether the individual is ever associated with problem gambling during our sample period. These individuals are matched with like individuals—same problem gambling propensity score—who did not develop problem gambling.

We identify 442 problem gambling individuals and each of them is then matched with another distinct individual who never had a gambling problem in

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86.   Rajeev H. Dehejia & Sadek Wahba, *Propensity Score-Matching Methods for Nonexperimental Causal Studies*, 84 REV. ECON. & STAT. 151, 151 (2002).

87.   *Id.* at 161.

88.   *See generally id.*

the sample period. This process uses the psmatch2 command in Stata, which finds one distinct first-year observation of a nongambling individual with the closest propensity score for each first year observation of an individual with gambling problem. Next, we keep all observations for matched individuals and delete unmatched individuals. Because some individuals are not observed in all time periods, the resulting data set contains 884 individuals with 4186 observations. This data set is used to reproduce the models of Table 4. The result is Table 5.

The results are very similar. Even though the two populations are similar in characteristics which under the null hypothesis should result in equal propensity to problem gambling, the presence of problem gambling leads to statistically significantly higher crime in that group.

TABLE 5: PROPENSITY SCORE MATCHED SAMPLE: PROBLEM GAMBLING EXPLAINS CRIME

(1)	(2) Non-ADM Sample	(3) Full Sample
SOGS Problem Gambler	.5318***	.4535***
	(0.000)	(0.000)
A, D, M Variables	NO	YES
Demographic Variables	YES	YES
Observations	2660	4164

Notes: The dependent variable is crime committed in the previous year.
Standard errors are in parentheses. ***p<0.01, **p<0.05, *p<0.10.

2. Instrumental Variable Techniques to Account for Possible Endogeneity

The South Oaks Gambling Screen incorporates questions implying a score that lies between zero and twenty.[89] We test the implications of replacing the binomial variable for problem gambling (SOGS total score of five or higher) with the original South Oaks Gambling Screen total and running two tests with correction for possible endogeneity. The results indicate that higher SOGS scores are associated with statistically significantly increased levels of crime, even after instrumental variable techniques are used.[90]

Table 6 reports the results. Column 2 reports the results of an instrumental variable probit. In addition to the exogenous right hand side variables (sex, age, age^2, marital status, education), we include as instruments the two family-history variables that indicate regular gambling in the individual's childhood family and problem gambling in the childhood family, respectively. Column 3 reports a two-stage alternative in which the SOGS total variable is replaced by the results of a first stage ordinary least squares regression estimate. The two-stage procedure is therefore the equivalent of standard two stage least squares estimation, except that the second stage is probit.[91]

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89. *See* Lesieur & Blume, *supra* note 46, at 1185.
90. *See infra* Table 6.
91. *See infra* Table 6.

In each case, the gambling screen total score coefficient is positively related to crime and is statistically significant at the one percent level. Both instrumental techniques produce estimates (.4880 and .4760) that are closer to one another than to the noninstrumented estimate (not shown). Both models distinguish the influence of alcohol, drug, and mental health issues. The conclusion of the instrumental variable probit techniques, therefore, agrees with the propensity score matching results that problem gambling is statistically significant in explaining higher crime, even after correcting for possible right hand side endogeneity.

TABLE 6: INSTRUMENTAL VARIABLE ESTIMATION USING SOGS TOTAL SCORE

(1)	(2) IV Probit Full Sample	(3) 2SLS Probit Full Sample
SOGS Total Score	.4880*** (0.000)	.4760*** (0.003)
Demographic Variable	YES	YES
A, D, M Variables	YES	YES
Constant	1.6020*** (0.000)	-1.8762*** (0.000)
Observations	19567	19567

Notes: The dependent variable is crime committed in the previous year.
Standard errors are in parentheses. *** p<0.01, **p<0.05, ***p<0.10.
In columns (2) the SOGS total coefficient was estimated using instrumental variable probit. In column (3) the SOGS total coefficient was estimated using a two stage estimator using OLS to instrument SOGS total in the first stage and probit in the second.

V.   RELIABILITY

The previous results are based on two assumptions: one is the reliability of the SOGS pathological gambling screen and the other is our choice of ADM group classifications. In this Part, we test whether these assumptions affect the results.

A.   SOGS versus NODS

To test the first assumption, we replace the South Oaks Gambling Screen (SOGS) with the National Opinion Research Center Screen for DSM-IV Pathological Gambling (NODS) and reproduce the results of Table 4. NODS is a more conservative screen. For example, SOGS identified 443 problem gamblers in our data set while NODS flagged only 316.[92]

Table 7 displays the same information as Table 4 with NODS replacing SOGS. Though the means vary for each category, the pattern is the same. The implied coefficients for the increase in crime are greater when problem gambling is identified by the more conservative NODS screen, which is expected because those identified with NODS gambling problems exhibit greater pathology.[93]

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92.   *See infra* Table 6, Table 7.
93.   *Compare supra* Table 6, *with infra* Table 7.

TABLE 7: NODS PROBLEM GAMBLING AND CRIME

(1)	(2) Non-ADM Sample	(3) Full Sample
NODS Problem Gambler	.4693***	.3794***
	(0.000)	(0.000)
Demographic Variables	YES	YES
A, D, M Variables	NO	YES
Constant	-1.7089***	-1.7564***
	(0.000)	(0.000)
Observations	13537	19565

Notes: The dependent variable is crime committed in the previous year. Problem gambling is identified by the NODS screen.

Standard errors are in parentheses *** p<0.01, ** p<0.05, *p<0.10.

Whether one relies on SOGS or NODS to identify problem gamblers is not critical to the central findings. The point estimates vary slightly in accordance with the more or less strict definitions and cut-offs of the screens, but the qualitative results are unchanged: non-ADM individuals exhibiting problem gambling engage in greater crime.[94] The same conclusion remains true when one expands the sample to include those who suffer from one or more problems related to alcohol abuse, drug abuse, and mental health. Alcohol abuse, drug abuse, and mental health problems are themselves all associated with higher crime rates in the data, as before.[95] The interaction of problem gambling with drug abuse, alcohol abuse, and mental health problems result in greater crime when NODS is used to identify problem gambling as it does when SOGS is used.[96]

B.   ADM versus "SAM"

The second assumption is that the ADM-based classification effectively measures substance use and mental health issues, which affect crime. We test the adequacy of the ADM methodology by employing an alternate measure of substance abuse and dependence. The QER survey asked a series of questions to determine if the participant met criteria for substance abuse or dependence based on two World Health Organization screens: the Composite International Diagnostic Interview (CIDI), and the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST).[97] Questions were asked about which specific substances were used and the corresponding amounts or frequency of each substance.[98] Questions were asked about financial, mental, relationship, work, and legal issues.[99] Their responses dictated whether one was categorized as a substance abuser or substance dependent.

The alternative categorization can be treated in the same way as the earlier classification for alcohol, drugs, and mental health. Following the earlier

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94.   *See supra* Table 7.
95.   *See infra* Table 8.
96.   *Compare supra* Table 7, *with supra* Table 5.
97.   WILLIAMS ET AL., *supra* note 13, at 53–54, 195–247.
98.   *Id.* at 228–29.
99.   *Id.* at 228–30.

method,[100] observations were divided into mutually exclusive and exhaustive groups fitting into one of four categories: no-substance-abuse-no-mental-health-issues (Non-SAM), substance-abuse-no-mental-health-issues (SA), mental-health-issues-no-substance- abuse (M), substance-abuse and mental-health-issues (SAM). The Column 2 probit models used in Tables 4 and 7 were rerun using these new classifications and pathological gambler classifications generated by the original SOGS screen and by the alternative NODS screen.

Figure 2 reports the results that indicate that the problem gambling variable was significant at greater than the one percent level for the SAM group classifications, just as it was for the ADM group classifications. This was true both for SOGS and for NODS screens measuring problem gambling.

FIGURE 2: COMPARING ALTERNATIVE SUBSTANCE ABUSE AND MENTAL HEALTH MEASURES: POINT ESTIMATES OF THE EFFECT OF PROBLEM GAMING ON CRIME WITH 95% CONFIDENCE BOUNDS
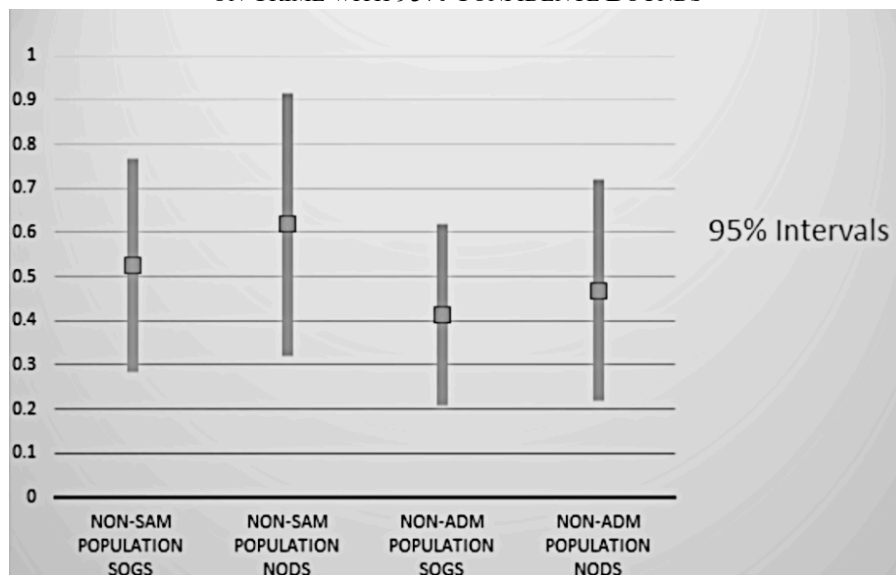

Figure 2 compares the relevant crime coefficients for the four alternatives based on Non-ADM versus Non-SAM groups and SOGS versus NODS classifications of problem gamblers. Displayed are the regression point estimates plus the associated ninety-five percent confidence intervals as shaded vertical bars. First, all bars are well above the zero horizontal axis, consistent with the statistical significance at the one percent level or better for each coefficient estimate. Second, as we found earlier, the effect of NODS problem gambling on increased crime is greater than the effect of SOGS problem gambling, because it is a more conservative and more restrictive screen. If you are a problem gambler as identified

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100. *See supra* Section IV.B.

by NODS, you are more likely to engage in criminal activity.[101] Third, all point estimates are similar to one another, and lie within the confidence bounds of each of the others.

In summary, our reliability checks show robustness with respect to changes in the measure of problem gambling used, to changes in the measures of substance abuse and mental illness, and to the point estimates of the variable of interest, which is the impact of problem gambling as a cause of crime.

C. Sample Attrition

It is also possible that sample attrition may affect the results. We therefore reran the preferred models presented in Table 4, but this time restricted observations to only the first year of the sample. The results are presented in Table 8.

TABLE 8: PROBLEM GAMBLING, ALCOHOL, DRUGS, MENTAL ILLNESS AND CRIME

(1)	(2) Control Sample	(3) Full Sample
SOGS Problem Gambler	.3660***	.3425***
	(0.027)	(0.001)
Demographic Variables	YES	YES
Alcohol Use		.5458***
		(0.000)
Drug Use		.4931***
		(0.000)
Mental Illness		.1753***
		(0.000)
Alcohol and Drug Use		.9028***
		(0.000)
Alcohol Use and Mental Illness		1.0269***
		(0.000)
Drug Use and Mental Illness		0.9414***
		(0.000)
ADM		1.5259***
		(0.000)
Constant	-2.0298***	-1.5982***
	(0.000)	(0.000)
Observations	2700	4120

Notes: Estimates in Table 8 are based on year 1 data only. The Control Sample (Non-ADM) suffers from no alcohol abuse, no drug abuse, or any mental health issues. The dependent variable is crime committed in the previous year. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

All of the relevant coefficients remain statistically significant and of similar magnitude and sign.[102] The same is true with just two exceptions among the nineteen coefficients if one further restricts the sample to just the randomly selected population. No variable changes sign, but the alcohol and drug use variable drops in significance to the 7.9% level in the full regression and the estimate for mental illness is no longer statistically significant in that regression. We also ran Table 4 regressions on the base data after omitting just the first year of the

101.   *See supra* Table 7.
102.   *See supra* Table 8.

sample (hence the remainder of the data used in Table 8), the last year of the sample, and omitting both the first and last year of the sample (*i.e.*, retaining just the middle years of the sample). The regressions on these subsets of the data show the same pattern of coefficient estimates linking problem gambling to crime.[103] The coefficient of interest relating the impact of problem gambling to crime, therefore, is robust to these changes.

VI. CRIME EFFECTS

We have three samples from which to infer the overall effect of problem gambling on crime. The first is the paired sample described in Section IV.C.1 in which a nonproblem gambler is paired with a problem gambler, both of whom were chosen to have the same propensity to problem gambling. Running an ordinary least squares regression of crime in this sample on problem gambling and a constant produces a coefficient estimate of .0635, which is statistically significant at better than the one percent level.[104] Alternately, we apply the treatment effects nearest-neighbor match methodology to the entire sample with and without correction for sample attrition bias. We use the teffects nnmatch command available in Stata. Exogenous variables were sex, age, age squared, marital status (five variables), education status (eight variables), drivetime to nearest casino, distance to nearest casino, family history of gambling, family history of problem gambling and the eight alcohol, drug, and mental health variables. Using the entire sample (valid if there is no attrition bias) produces an average treatment effect estimate of .0428 with a P-value of 0.000.[105] Using just the first year randomly selected sample population (this removes the possibility of sample selection bias and of attrition bias) produces an average treatment effect estimate of .0763 with P-value of 0.045.[106] These three estimates suggest that crime is higher by a number in the range between 4.28 to 7.63 percentage points (428 and 763 basis points), respectively, due to the presence of problem gambling.

From these estimates we can infer the impact of the presence of casino (Class III) gambling on crime if we have a base crime rate, a base problem gambling rate and an estimate of its rise when gambling is adopted. In the randomly sampled portion of our data, the share of observations associated with problem gambling is 3.44%, and the share of observations reporting having committed a crime when no problem gambling is present is 3.54%.[107] The earliest estimate of the prevalence of problem gambling in the general population in the United States was 0.77% when the only casinos available were in Nevada.[108]

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103. *Compare supra* Table 8, *with supra* Table 4.
104. *See supra* Section IV.C.1.
105. *See supra* Section IV.C.1.
106. *See supra* Section IV.C.1.
107. *See supra* Section IV.C.1.
108. HATHITRUST, GAMBLING IN AMERICA: FINAL REPORT OF THE COMMISSION ON THE REVIEW OF THE NATIONAL POLICY TOWARD GAMBLING 73 (1976) ("As a result of this clinical examination, it was estimated that 0.77 percent of the national sample could be classified as 'probable' compulsive gamblers, with another 2.33 percent as 'potential' compulsive gamblers.").

We can now perform the following armchair calculation: presume that problem gambling rises from 0.77% of the population to 3.44% when casino gambling changes from no availability to availability 105 km away as in the Quinte population. Assume also that the prevalence of crime rises from 3.54% of the population if they are nonproblem gamblers to $(3.54 + x)$ % if they are problem gamblers, where x is between 4.28 and 7.63. Now compare the number of crime incidents for 100,000 population consisting of the appropriate proportion of problem gamblers and nonproblem gamblers in the two situations of casino availability. One finds that crime rises by 3.2% to 5.6%. A sensitivity calculation can also be performed. If the base rate estimate of problem gambling is reduced to 0.5% or raised to 1.0%, the associated ranges become (3.5-6.3) and (2.9-5.1), respectively, in each case centering somewhere in the 4% range.

We began this Article by reporting that counties that opened casinos were found to have crime rates about 8 percentage points higher than their counterparts that did not open a casino.[109] Collar counties in the cited study had higher crime rates by about half this rate.[110] Since the nearest casino in the present study was 105 km distant, comparable distance-wise to a collar county, the crime effect of 3.2-5.6 percentage points should be comparable to the four percentage-point collar county estimate found earlier. The fact that it does gives some assurance of the reasonableness of the estimates.

It is a short step to derive social cost estimates, and from them policy recommendations, by finding cost figures for crime as a whole and charging 3.2% to 5.6% of this to the presence of casino gambling and associated gambling, where the availability matches the distances of this study.

VII. CONCLUSION

Researchers identify ten forms of gambling-related social consequences,[111] the most prominent of which is crime. Increased access to gambling lowers its cost to the user, increases the number of gamblers and raises the number of problem gamblers.[112]

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109. *See supra* Part I.

110. Grinols & Mustard, *supra* note 1, at 26–28.

111. Crime (e.g., apprehension, adjudication, incarceration, corrections), Business and Employment Costs (e.g., lost productivity, job termination, lost work days), Bankruptcy, Illness (e.g., stress-related illness, mental illness), Suicide, Social Service Costs (e.g., welfare, treatment costs, unemployment- related costs), Regulatory Costs (e.g., government oversight expenditures), Family Costs (e.g., divorce, spousal separation, child abuse and neglect, domestic violence), Abused Dollars (e.g., money inappropriately acquired from family, friends, or employer that would be a crime but is not reported), Social Connections (e.g., reduction of social capital), Political Costs (e.g., increase in economic power resulting in disproportionate political influence). *See, e.g.*, ANDREW E. LIETZ, JOSEPH A. FOSTER & GAIL WOLEK, NEW HAMPSHIRE GAMING STUDY COMMISSION: FINAL REPORT OF FINDINGS 48 (2010) ("Theoretically, many of these impacts have a financial cost to society one way or another and should be considered in an evaluation of the costs and benefits of expanded gambling.").

112. *See id.* at 45.

Our research suggests that even at a distance of 105 km to the nearest casino, problem gambling is associated with elevated crime. The estimates reported here suggest that problem gamblers commit 2.2 to 3.2 times the crime of a nonproblem gambler.[113] Our estimates suggest that the availability of casino and racino gambling in the Quinte area is responsible for a 3.2-5.6 percentage point rise in crime. This agrees with our earlier work which found that crime was on the order of 8 percentage points higher in the counties themselves with operating casinos older than three to four years due to the casino presence, with elevated crime roughly half that rate in the neighboring counties.[114] Quinte is comparable to a neighboring location.

As explained in the introduction, quality data on the effects of problem gambling is difficult to obtain and mostly nonexistent with respect to complicating "comorbid" factors.[115] The present study provides a unique first look into the impact of this singular activity on what many view to be the most significant of gambling's social costs. This study finds that problem gambling is linked to higher crime, its effect remains even after accounting for complicating factors, and it shows up in nonparametric as well as parametric indicators. On a preponderance of evidence basis, the conjecture that increased problem gambling leads to higher crime is confirmed in our data.

We close by touching just briefly on the policy relevance of our results. State-sponsored gambling has come to be viewed in many quarters as a tax collection device.[116] Yet state-sponsored regulated monopolies for the purpose of raising public dollars raises policy concerns.[117] First, such action represents a controversial insertion of the State into the private market and what has traditionally been the role of the private sphere.[118] Second, the presence of crime effects and other social costs raises the question of whether this is the best way for government to raise revenues. To answer, one must compare the social costs of raising taxes by conventional means to the alternative "tax-by-gambling." This Article provides information relevant to the second question.

APPENDIX: DEFINITIONS OF GAMBLING

The following definitions are from 25 U.S.C. 2703: (6)-(8):

(6) The term "class I gaming" means social games solely for prizes of minimal value or traditional forms of Indian gaming engaged in by individuals as a part of, or in connection with, tribal ceremonies or celebrations.

(7) (A) The term "class II gaming" means –

(i) the game of chance commonly known as bingo (whether or not electronic, computer, or other technologic aids are used in connection therewith) –

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113. $(3.54+x)/3.54 = 2.2$ to 3.2 where $x = 4.28$ to 7.63.
114.   Grinols & Mustard, *supra* note 1, at 26–28.
115.   *See supra* Part I.
116.   *See e.g.*, HATHITRUST, *supra* note 108, at 151.
117.   *See e.g.*, *id.* at 1.
118.   *See id.* at 79.

(I) which is played for prizes, including monetary prizes, with cards bearing numbers or other designations,

(II) in which the holder of the card covers such numbers or designations when objects, similarly numbered or designated, are drawn or electronically determined, and

(III) in which the game is won by the first person covering a previously designated arrangement of numbers or designations on such cards, including (if played in the same location) pull-tabs, lotto, punch boards, tip jars, instant bingo, and other games similar to bingo, and

(ii) card games that –

(I) are explicitly authorized by the laws of the State, or

(II) are not explicitly prohibited by the laws of the State and are played at any location in the State, but only if such card games are played in conformity with those laws and regulations (if any) of the State regarding hours or periods of operation of such card games or limitations on wagers or pot sizes in such card games.

(B) The term "class II gaming" does not include

(i) any banking card games, including baccarat, chemin de fer, or blackjack (21), or

(ii) electronic or electromechanical facsimiles of any game of chance or slot machines of any kind.

(C) Notwithstanding any other provision of this paragraph, the term "class II gaming" includes those card games played in the State of Michigan, the State of North Dakota, the State of South Dakota, or the State of Washington, that were actually operated in such State by an Indian tribe on or before May 1, 1988, but only to the extent of the nature and scope of the card games that were actually operated by an Indian tribe in such State on or before such date, as determined by the Chairman.

(D) Notwithstanding any other provision of this paragraph, the term "class II gaming" includes, during the 1-year period beginning on October 17, 1988, any gaming described in subparagraph (B)(ii) that was legally operated on Indian lands on or before May 1, 1988, if the Indian tribe having jurisdiction over the lands on which such gaming was operated requests the State, by no later than the date that is 30 days after October 17, 1988, to negotiate a Tribal-State compact under section 2710(d)(3) of this title.

(E) Notwithstanding any other provision of this paragraph, the term "class II gaming" includes, during the 1-year period beginning on December 17, 1991, any gaming described in subparagraph (B)(ii) that was legally operated on Indian lands in the State of Wisconsin on or before May 1, 1988, if the Indian tribe having jurisdiction over the lands on which such gaming was operated requested the State, by no later than November 16, 1988, to negotiate a Tribal-State compact under section 2710(d)(3) of this title.

(F) If, during the 1-year period described in subparagraph (E), there is a final judicial determination that the gaming described in subparagraph (E) is not

legal as a matter of State law, then such gaming on such Indian land shall cease to operate on the date next following the date of such judicial decision.

(8) The term "class III gaming" means all forms of gaming that are not class I gaming or class II gaming.