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The Effect of Recreational Gambling on Regional Health Outcomes: Evidence from Canadian Provinces

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Abstract

The relationship between gambling and health has important economic and public policy implications. We develop causal evidence on this relationship using data from the Canadian Community Health Survey and exploiting regional variation in access to legal gambling. Empirical models treat gambling as an endogenous regressor in explaining regional variation in health outcomes. Results from instrumental variable and bivariate probit models show recreational gambling has no or a negative impact on the probability of having certain chronic conditions and a positive impact on life satisfaction, differing from past studies that find a positive association between problem gambling and adverse health outcomes.

Keywords: gambling, health outcomes, bivariate probit, instrumental variables

JEL Codes: I18, L83, R28
I18: Health: Government Policy
L83: Sports; gambling; recreation; tourism
R28: Regional Government Policy

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1 Introduction

In the US and Canada, states and provinces regulate access to legal gambling, including casinos, video lottery terminals, poker rooms, and lotteries, generating substantial variation across regions in access to gambling opportunities. Increased access to legal gambling generates economic benefits in the form of local increases in income, wages, tax revenues, employment, and well-being (Friedman et al., 1989; Wenz, 2008; Nichols et al., 2015) as well as local costs, primarily in the form of increased crime and bankruptcy (Grinols and Mustard, 2006; Garrett and Nichols, 2008).

Access to legal gambling can affect individuals in a number of ways, including affecting individual health. Relatively little research about the effect of gambling on individual health currently exists, and much of the research that does exist focuses on the adverse health consequences of problem gambling, consistent with the prevailing presumption that individuals who gamble habitually experience adverse consequences as a result of their actions. Little attention has been paid to the behavior of gamblers who wager recreationally. This narrow focus on problem gamblers seems misplaced, since problem gambling rates appear to be very low in most populations, and the vast majority of gamblers participate responsibly and derive consumption benefits from gambling.

This paper focuses on recreational gamblers and develops causal evidence about the relationship between participation in gambling activities and regional health outcomes using data from the Canadian Community Health Survey (CCHS). Using these data, we investigate the relationship between gambling and several indicators of health and well-being: self-assessed health status; change in self-assessed health status; life stress; life satisfaction; stroke; migraines; stomach ulcers; high blood pressure; heart disease; and diabetes. If gambling serves as a social activity and social support that contributes to improved health, then we might expect that recreational gambling to be associated with lower levels of life stress, greater life satisfaction, larger improvements in self-assessed health status, and lower probability of having a stroke. We also analyze the effect of recreational gambling on several chronic conditions (high blood pressure, heart disease, migraines, stomach ulcers, and diabetes) because these types of chronic conditions are thought to be associated with problem gambling (Afifi et al., 2010). However, we posit that recreational gamblers differ from problem gamblers and are less likely to suffer from these chronic conditions.

Because of the lack of consensus in the econometrics literature regarding a preferred approach

for dealing with endogeneity, and because this is one of the first studies to address the potential endogeneity of gambling, we compare the results obtained from three alternative estimators. First a baseline single equation probit model in which gambling participation is treated as exogenous covariate. We address the potential endogeneity of gambling first using an instrumental variables (IV) approach and second using a recursive bivariate probit model with a reduced form gambling equation and a structural health outcome equation. The maintained assumption is that the error terms of the two equations are correlated. We exploit variation in the number of gambling opportunities across provinces and time to identify gambling in the first stage regression of the IV estimator and as an exclusion restriction for the bivariate probit estimator.

Results from an instrumental variables (IV) probit and bivariate probit model show that recreational gamblers report lower levels of stress, are less likely to report low levels of life satisfaction, are more likely to report improvements in their health status, and are less likely to suffer strokes and ulcers. However, recreational gamblers were more likely to report their health status as fair or poor. Recreational gambling was not associated with changes in chronic health conditions like migraine headaches, high blood pressure, heart disease, and diabetes. Recreational gambling causes improvements in health and well-being, so regional variation in access to legal gambling contributes to observed variation in regional health outcomes.

Our results contribute to the empirical literature on gambling and health in several important ways. Our results provide the first causal evidence that recreational gamblers enjoy some health benefits relative to non-gamblers. Our results are somewhat sensitive to estimation methods but generally indicate that it is important to treat recreational gambling as an endogenous regressor in the health and well-being equations. Taken together, the estimates indicate that recreational gamblers are more likely to report being in fair or poor health; less likely to report having a lot of life stress or being dissatisfied with life; and less likely to have a stroke. Recreational gamblers also report a larger improvement in health status relative to non-gamblers. As expected there is little evidence of an effect of gambling on the probability of having high blood pressure, heart disease, and diabetes. The paper also contributes to the growing literature analyzing individual level data on health and happiness using variation in regional characteristics (Guettabi and Munasib, 2014; Herbst and Lucio, 2016).

2 Why People Gamble: Theory

Understanding the motivation behind participation in gambling represents a conceptual challenge for economic theory. On one hand, expected utility theory suggests that individuals should not purchase fair gambles if they possess utility functions that are positive but diminishing in income, the type of utility that economists assume is most common. On the other hand, we know that gambling is a widespread consumer activity that has been practiced since ancient times. Solutions to this puzzle have focused on either identifying a gain from gambling in addition to the winnings (Conlisk, 1993) or in hypothesizing a "wiggle" (Friedman and Savage, 1948) or a discontinuity in the utility function that makes the expected winnings from gambling greater than the expected losses (Eden, 1979). From the reviews of this literature (Starmer, 2000), however, it appears that none of these approaches has yet to dominate the field.

A more recent contribution to this theoretical literature asserts that people gamble to obtain "something for nothing" (Nyman, 2004). This approach posits that recreational (as opposed to problem or habitual) gamblers view the wager from a labor market context and see the potential winnings not merely as additional income, but as additional income for which they do not need to work. This theory implies that people who are disadvantaged in the labor market – either because they do not like their jobs, or they find their jobs difficult to perform, or they live in areas where employment opportunities are reduced – are more likely to gamble and to gamble more than those not so disadvantaged. Empirically, the initial studies have tested for evidence in support of this theory by regressing a variable representing gambling on a series of individual and market characteristics that are associated with being disadvantaged in some way in the labor market. These studies have found empirical responses across a broad range of explanatory variables that are consistent with the theory (Nyman et al., 2008, 2012).

Because these studies were broad in scope and designed to raise the possibility of a labor market connection to casual gambling, they have not focused on some of the more refined econometric issues associated with the individual variables used in the analyses. Among the more important of these is the relationship between health status and gambling. From the perspective of this theoretical model (Nyman, 2004), those in poor health are hypothesized to have fewer employment opportunities and are compelled to take jobs they do not like or that are unpleasant in some way. Or their health status

makes performing work more burdensome, therefore, they are more likely to look for alternative ways of gaining income that do not require working. Thus those with poorer health statuses are more likely to gamble or to gamble more than those in better health statuses. In support of this hypothesis, Nyman et al. (2008) found that those with "poor" or "fair" self-reported health status wagered more dollars during the year than those in "good" or "excellent" health. Nyman et al. (2012) found that those who indicated their health status was worse than "excellent" (except for the "poor" category) were more likely to gamble at all, also in support of this theory.

Alternatively, those who gamble, or gamble more, may have reduced health statuses because they engage in the potentially unhealthy activity of gambling. In other words, it is possible that reverse causality exists and that gambling causes poor health because; for example, gamblers spend time in unhealthy environments and, as a consequence, engage in some complementary behaviors – smoking, drinking, and not exercising – that are deleterious to health. Such a causal relationship would not be supportive of the "something for nothing" theory because it would substitute a reverse etiological explanation for the relationship between poor health and gambling for the behavioral one hypothesized in theory. Therefore, the relationship between gambling and health requires a more nuanced analysis, one that attempts to sort out the causal relationship that exists between these two variables.

3 Empirical Analysis

We develop evidence about the causal relationship between gambling and health. Causality is difficult to establish because of the possibility of endogeneity of gambling variables in empirical models explaining variation in health status. Gambling may be an endogenous regressor due to unobservable individual-level heterogeneity driving both gambling and health outcomes, omitted variables correlated with both gambling and health, or reverse causality. Gamblers may be either more likely to engage in, or engage in more frequently, a variety of detrimental or stressful behaviors such as smoking, excessive drinking, lack of sleep, lack of physical activity, etc. that can result in diminished health status. We address the potential endogeneity of gambling using instrumental variables and bivariate probit approaches. Taken together, our empirical analysis requires measures of gambling behavior, measures of health, and an instrument for gambling in the instrumental variables

estimation which can also serve as the exclusion restriction for the bivariate probit estimation.

3.1 Data and Variables

We use data from 5 cycles of the CCHS. The CCHS is a cross-sectional, nationally representative survey containing detailed data on health status, health care utilization and health determinants. The CCHS also contains variables on the demographic and economic characteristics for survey respondents and their households. The CCHS target population is all Canadians over the age of 12, excluding those living on First Nations reserves and in institutions and serving in the armed forces. Data are collected through a random digit dial telephone survey. We use data from the 2002 (Cycle 1.2 - Mental Health and Well-being), 2003 (Cycle 2.1), 2005 (Cycle 3.1), 2007 (Cycle 4.1), and 2009 surveys. Prior to 2007, data collection occurred every two years but now occurs annually.

The CCHS contains a module with questions about gambling that was administered in all provinces in 2002 and then became an optional module that some provinces chose to administer irregularly in the other years. Our analysis sample contains data from all provinces in 2002 and from 5 provinces thereafter that administered the gambling module: Ontario and Saskatchewan in 2003; New Brunswick in 2005; and Quebec, Ontario and Saskatchewan in 2007; and New Brunswick and Alberta in 2009. The full sample contains 184,221 observations; however, due to missing observations in the gambling module, we lose 48,726 observations. We also lose observations due to missing data for some of the other variables resulting a final analysis sample of 118,141 observations.

The measure of gambling participation is constructed from the detailed questions in the gambling module. A sample question is:

> *In the past 12 months, how often have bet or spent money on instant win/scratch tickets or daily lottery tickets (Keno, Pick 3, Encore, Banco, Extra)?*

The respondents then select a frequency category:

> *1=Daily; 2=Between 2 and 6 times a week; 3=About once a week; 4=Between 2 to 3 times a month; 5=About once a month; 6=Between 6 to 11 times a year; 7=Between 1 to 5 times a year; 8=Never; DK (do not know); R(refused).*

The next set of questions in the gambling module asks about attitudes and experiences with gambling and the extent to which gambling interferes with the respondents' lives. The responses to these questions are intended to measure characteristics of gamblers and are used to identify types of gamblers. The characteristics of the gamblers are based on a modified version of the Canadian Problem Gambling Index (CPGI). The CPGI is based on a 31-item inventory that assigns all CCHS survey participants into one of five groups. The CPGI accounts for both behavioral problems associated with gambling, like financial problems, feelings of guilt, and inability to stop gambling, and correlates to gambling problems like alcohol and drug abuse. The CPGI is intended to reflect the likelihood that an individual has experienced adverse consequences as a result of gambling, and is similar to other measures of problem gambling behavior like the DSM criteria. Gamblers (called "non-problem gamblers" in the CPGI) report no behavioral problems associated with their gambling although they may gamble frequently, and "probably will not have experienced any adverse consequences of gambling." Low risk gamblers respond positively to at least one of the indicators of behavioral problems in the 31-item measure. Moderate risk gamblers respond affirmatively to more of the questions about adverse consequences of gambling, and problem gamblers have experienced most of the adverse consequences of gambling.

Table 1 shows the characteristics of gamblers in the sample, and the participation rate in gambling. 51.5% of the sample reported not participating in any type of gambling activity in the previous year and 48.5% reported participating in some type of gambling.

Table 1: Characteristics of Gamblers and Gambling Behavior, n=135,495

Gambler Classifiaction	**% of Sample**	**% of Participants**
Non-Gambler	51.46	—-
Non-problem Gambler	44.92	92.55
Low Risk Gambler	2.23	4.59
Moderate Risk Gambler	1.04	2.14
Problem Gambler	0.35	0.73

Among the gamblers in the sample, the vast majority of them, just over 92%, fall into the "non-problem gambler" category that we refer to as "gamblers" or "recreational gamblers". We use this CPGI classification of gamblers to construct our measure of gambling participation in this

study, which is an indicator variable that takes on the value of one if the individual gambles and is a "non-problem" gambler and 0 if the individual does not gamble. Just over 6.5% of gamblers fall into the "low" or "moderate" risk categories and about three quarters of one percent are classified as "problem gamblers". The very small percentage of gamblers who are even considered at risk for becoming problem gamblers or are classified as "problem gamblers" provides our rationale for focusing our analysis on "non-problem" or "recreational" gamblers.

A further rationale for restricting our analysis to recreational gamblers is the paucity of studies about the health effects of recreational gambling. The vast majority of gambling research has focused on the adverse health consequences of pathological or problem gambling. However, from a public health perspective, in which gambling is viewed along a behavioral continuum that can range from none to healthy gambling to unhealthy gambling, gambling has both costs and benefits (Shaffer and Korn, 2002). On the "cost" side, pathological gambling has been associated with psychiatric comorbidities such as anxiety and depressive disorders, as well as addictive behaviors like alcohol and substance abuse, and cigarette smoking. These disorders and addictive behaviors are also associated with medical conditions including hypertension, heart diseases, cirrhosis, and diabetes. Individuals diagnosed with pathologic gambling may also be at risk of developing medical conditions that are associated with stress such as hypertension, peptic ulcer disease, migraines, and stroke (Morasco et al., 2006). On the "benefit" side, recreational gambling may be viewed as a social activity or adult play which can have a positive effect on overall life satisfaction or happiness and the ability to manage stress (Shaffer and Korn, 2002). From this perspective, recreational gambling may have health benefits but should not affect the likelihood of having chronic conditions associated with problem gambling.

Our health status measures are constructed using information in the CCHS about overall health and well-being and chronic health conditions. The overall health and well-being measures we use are self-assessed health status, change in health status, stress, and life satisfaction. The chronic conditions we study are those that have been associated with pathologic gambling or stress and are available in the CCHS in all years. These include high blood pressure, stroke, stomach ulcers, migraines, heart disease and diabetes. Each health outcome is measured as a binary variable taking on the value of 1 if the individual reported having one of these conditions and zero otherwise. The introductory statement to the chronic conditions module of the CCHS is:

Now I'd like to ask about certain chronic health conditions which you may have. We are interested in "long-term conditions" which are expected to last or have already lasted 6 months or more and that have been diagnosed by a health professional.

This statement is followed by a number of questions regarding chronic conditions, such as:

Do you have high blood pressure?

The measures of health and well-being are also binary variables. For example, the variable *stress* is constructed from the responses to the following question:

Thinking about the amount of stress in your life, would you say that most days are: "not at all stressful", "not very stressful", "a bit stressful", "quite a bit stressful", or "extremely stressful"?

It takes on the value of 1 if the respondent said most days are quite a bit stressful or extremely stressful and 0 otherwise. The summary statistics based on the analysis sample for the health measures are shown in Table 2.

Table 2: Sample Statistics: Health Outcomes

Health Outcome Measure	**Mean**	**Std. Dev.**
Life Stress: Quite a Bit or Extremely Stressful	0.210	0.407
Life Satisfaction: Dissatisfied or Very Dissatisfied	0.038	0.192
Self-Assessed Health Status: Fair or Poor	0.142	0.349
Change in Health Status: Much or Somewhat Better	0.181	0.385
Migraines	0.105	0.307
Stomach Ulcers	0.036	0.187
High Blood Pressure	0.220	0.414
Stroke	0.015	0.122
Heart Disease	0.075	0.263
Diabetes	0.072	0.258

The most commonly reported health condition is high blood pressure which affects 22.02% of the analysis sample. The percentage of the sample reporting having the other chronic conditions ranged from a low of 1.5% for stroke to 10.5% for migraines. 21% of the analysis sample reported

most days being quite a bit or extremely stressful while only 3.8% of the sample reported being dissatisfied or very dissatisfied with their lives.

We augment the individual-level CCHS data with province-level data about the types and number of gambling facilities per 1,000 population in the provinces in each of the five CCHS waves in our sample. The gambling opportunities variables exhibit both cross-sectional and time variation.[1] The regulation of gambling in Canada takes place at the province and region level. We collected data on the number of gambling facilities in each province, including casinos, video lottery terminals (VLTs), lottery outlets and poker halls. Casinos, poker halls and VLT numbers and location are regulated by provinces. Lotteries are operated by regional lottery corporations: the Atlantic Lottery Corporation (Newfoundland and Labrador, Nova Scotia, Prince Edward Island and New Brunswick), the British Columbia Lottery Corporation, Ontario Lottery and Gaming Corporation, Loto-Quebec, and the Western Canada Lottery Corporation (Manitoba, Saskatchewan, Alberta, Nunavut, Northwest Territories, and Yukon). This generates regional and provincial variation in opportunities to gamble across Canada.

Table 3: Provincial Characteristics, Gambling Opportunities

		Number of Gambling Facilities per 1,000 population				
Province	**% Sample**	**2002**	**2003**	**2005**	**2007**	**2009**
Newfoundland/Labrador	1.15	4.62				
Prince Edward Island	0.75	2.66				
Nova Scotia	2.07	2.56				
New Brunswick	8.47	2.86		2.72		2.01
Quebec	20.96	2.43			1.83	
Ontario	43.29	1.14	1.12		1.05	
Manitoba	1.61	1.66				
Saskatchewan	8.35	1.20	1.20		1.88	
Alberta	10.48	1.43				1.23
British Columbia	2.87	1.30				

We posit the existence of a relationship between the number of gambling opportunities in a province and individual participation in gambling. Rassen et al. (2009) document the extensive use of regional-level variables as instruments in IV regressions involving health outcomes. We

[1]Data on gambling opportunities by province can be found on the web site of the Canadian Partnership for Responsible Gambling (www.cprg.ca).

Figure 1: Gambling Facilities per 1000 Population by Province in 2002

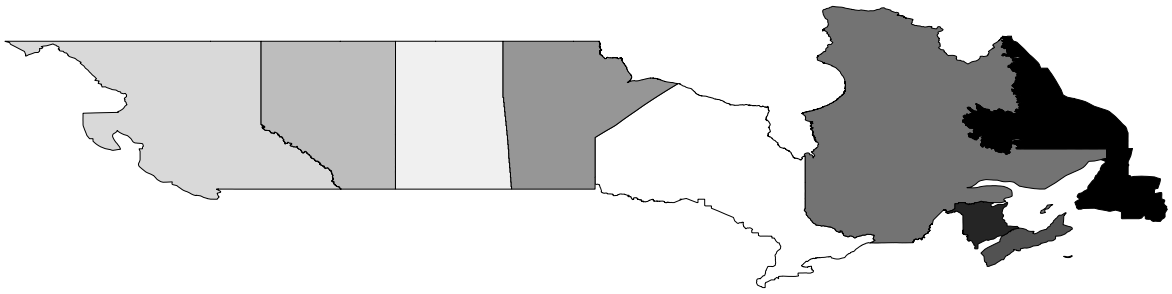

Figure 1 shows regional variation in access to gambling facilities in Canada in 2002. Darker shading of a province indicates more casinos, bars and taverns with VLTs, lottery outlets, and poker halls per capita in that province.

exploit the cross-sectional and time variation in gambling opportunities to identify participation in gambling in the empirical analysis. Access to gambling opportunities in the provinces varies over time, because of changes in the number of facilities and population growth. However, the extent of time variation is somewhat limited in our sample since only New Brunswick, Quebec, Ontario, Saskatchewan, and Alberta administered the gambling module in multiple waves of the CCHS. Table 3 shows the fraction of the sample from each of the provinces and the opportunities to gamble in each of the provinces.

Figure 1 shows the regional variation in availability of legal gambling across Canadian provinces in 2002, the year when we have full CCHS data. We have data from Prince Edward Island, but that province is not shown on Figure 1 because it is too small to see. We obtained data on the total number of casinos, bars and taverns with VLTs, lottery outlets, and poker halls in each province and normalized these counts by total provincial population in 2002. On Figure 1, darker shading means more gambling facilities per capita in that province. Figure 1 shows substantial regional variation in legal gambling opportunities. Provinces in eastern Canada, especially Newfoundland/Labrador and Nova Scotia, have relatively larger numbers of gambling facilities. Ontario, in the center of the country, has relatively few establishments per capita. Two of the provinces on the prairies, Manitoba and Alberta, also have a relatively large number of gambling establishments per capita.

We also include a number of socio-economic and demographic characteristics that are commonly included in determinants of gambling and health studies in our empirical analysis. Positive

relationships between income and education and health have been widely documented in numerous studies. In the CCHS, household income is measured in categories. The categorical income variables allow us to account for differences in the relative income position of the households in the analysis. It also allows for a nonlinear relationship between income and gambling and health. Households earning less than $15,000 per year comprise the excluded category. Education is also measured in discrete categories: less than high school, high school, some college and college graduate. Less than high school is the excluded category. We include employment status (full-time and part-time), home ownership and welfare as the primary source of income as additional measures of the economic environment. Home ownership can be thought of as a measure of social class. Individual characteristics included are age, marital status, gender, presence of young children in the household, and native born Canadian. All empirical models include province and year dummy variables. Finally, we include height as a continuous exogenous variable to control for individual mortality and morbidity risks and capture heterogeneity in initial health endowments.

Table 4 contains summary statistics for the demographic and economic characteristics of individuals in the sample. The age of individuals in the sample ranged from 18 to 85 with an average age of 50. The sample skews female, with only 44% males. Just under 10% of the sample is single. 20% of the sample reported having children in the home. Just over half of the sample graduated from college and 50% reported working full-time. The majority of the sample (85%) are native Canadians. A small number, 4%, received social assistance.

3.2 Econometric Methods

We seek to develop evidence about the causal connection between gambling and health. Causality is difficult to establish because of the possibility of endogeneity within a model of health status that includes gambling participation as a covariate. In addition, since we estimate the impact of a binary treatment (gambling) variable on binary outcomes (presence of chronic health conditions, physical health status, change in health status, stress and life satisfaction), our estimation approaches must account for this distributional characteristic. Two approaches that have been widely employed in health economics in applications where there are *a priori* reasons to expect a binary dependent variable to be simultaneously determined with a binary explanatory variable are instrumental variables methods and recursive bivariate probit models with endogenous regressors. We discuss

Table 4: Summary Statistics, Other Covariates - Analysis Sample, n=119,399

Variable	**Mean**	**Std. Dev.**
Age	50.2	18.33
Male	0.440	0.496
Single	0.097	0.295
Full Time Employment	0.501	0.500
Part Time Employment	0.089	0.274
Household income $0-$15k	0.082	0.274
Household income $15-$30k	0.170	0.376
Household income $30-$50k	0.175	0.380
Household income $50-$80k	0.162	0.369
Household income >$80k	0.247	0.431
On welfare	0.040	0.197
Less than High School	0.207	0.370
High School Graduate	0.163	0.369
Some College	0.071	0.257
College Graduate	0.545	0.498
Children in Home	0.200	0.400
Native Canadian	0.834	0.369
Height (in inches)	66.38	3.90

these alternative approaches next.

The instrumental variables approach entails first estimating a reduced form equation in which the endogenous regressor is the dependent variable. The predicted values from the first stage regression replace the endogenous regressor in the second stage. Adopting a two stage least squares method in our study means that we first estimate a gambling equation:

$$y^g_{ijt} = \beta^g X_{ijt} + \delta Z_{jt} + \gamma_j + \lambda_t + u^g_{ijt} \tag{1}$$

where y^g_{ijt} is a dichotomous gambling participation indicator variable for individual i living in province j in year t, X^g_{ijt} is a vector of individual characteristics that affect gambling participation, Z_{jt} is the instrumental variable, γ_j is a province-specific effect, λ_t is a year-specific effect, β and δ are unknown parameters to be estimated, and u^g_{ijt} is the error term. Angrist and Krueger (2001) argue that it is preferable to treat the dichotomous dependent variable as a linear probability and estimate Equation (1) using ordinary least squares using the linear probability model. Using the predicted probability from a non-linear probit model as an instrument for gambling in the second

stage is not recommended because the first stage functional form must be correctly specified in order to generate consistent estimates in the second stage. We follow Angrist and Krueger and estimate Equation (1) via the linear probability model, since consistency of the estimates from the second stage IV regression does not require that the first stage functional form be correctly specified. We then estimate a health outcome equation:

$$y^h_{ijt} = \alpha \hat{y}^g_{ijt} + \beta^h X_{ijt} + \gamma_j + \lambda_t + u^h_{ijt} \tag{2}$$

where y^h_{ijt} is the binary health outcome variable for individual i living in province j in year t, $\hat{y}^g_{ijt}$ are the fitted values of y^g_{ijt} obtained from estimating Equation (1) using OLS, X^h_{ijt} is a vector of individual characteristics that affect health outcomes, γ_j is a province-specific effect, λ_t is a year-specific effect, α and β^h are unknown parameters to be estimated, and u^h_{ijt} is the error term. We specify Equation (2) as a probit equation and estimate it using maximum likelihood.

In order for the parameters of the health outcomes equation (Equation (2)) to be consistently estimated, a variable must be included in the first-stage gambling equation (Equation (1)) that is not included in Equation (2). This variable Z_{jt} should explain variation in gambling participation but be uncorrelated with the error terms in the health outcome equations. As discussed in 3.1, our instrumental variable is based on the number of gambling facilities per capita in a province and exploits variation in access to regional gambling. We posit that the number of gambling facilities per capita in a province is likely to be correlated with gambling because individuals living in provinces with more gambling facilities have better access to gambling opportunities than those living in provinces with fewer gambling facilities. The standard errors in the first stage gambling equation are cluster-corrected at the provincial level since the gambling facilities per capita variable varies at the provincial, rather than individual, level.

An alternative to IV approaches to dealing with the endogeneity of gambling is to estimate a bivariate probit model. In this setting, consider a recursive bivariate probit model, a two equation binary outcome model with correlated error disturbances, defined as:

$$y^{*g}_{ijt} = \beta^g X^g_{ijt} + \gamma_j + \lambda_t + u^g_{ijt}, \tag{3}$$

$$y^{*h}_{ijt} = \alpha^g y_{ijt} + \beta^h X^h_{ijt} + \gamma_j + \lambda_t + u^h_{ijt}, \tag{4}$$

where y^{*h}_{ijt} represents the latent stock of health of individual i living in province j in year t, and y^{*g}_{ijt} represents the latent benefit that individual i derives from gambling activity g. Since y^{*m}_{ijt}, $m = (g, h)$, is unobservable, we only observe y^m_{ijt}, where $y^m_{ijt} = 1$ if $y^{*m}_{ijt} > 0$, and zero otherwise. X^g_{ijt} and X^h_{ijt} are vectors of explanatory variables that affect participation in gambling activities and health outcomes. These variables include demographic and socio-economic characteristics of individuals in the sample. γ_j is a province-specific effect, λ_t is a year-specific effect, and β^g, β^h, and α^g and are unknown parameters to be estimated. The error terms (u^g_{ijt} and u^h_{ijt}) are assumed to be distributed bivariate normal (with probability density function ϕ_2 and cumulative density function Φ_2), mean zero, constant variance, and $\text{corr}(u^g_{ijt}, u^h_{ijt}) = \rho$. The error terms capture all other factors that affect gambling activity and health outcomes.

The correlation between the error terms (u^g_{ijt} and u^h_{ijt}) comes from the assumption that each error term is comprised of two components: (i) unobserved individual heterogeneity (η_{ijt}); and (ii) a constant part unique to each model (ϵ^g_{ijt} and ϵ^h_{ijt} respectively):

$$\begin{aligned} u^g_{ijt} &= \eta_{ijt} + \epsilon^g_{ijt}, \\ u^h_{ijt} &= \eta_{ijt} + \epsilon^h_{ijt}. \end{aligned}$$

If $\rho = 0$, then the bivariate probit model is equivalent to two independent probit models. We estimate a recursive bivariate probit model using maximum likelihood. The bivariate probit model is recursive in that health outcomes depend on the exogenous variables X^h_{ijt} and participation in gambling, y^g_{ijt}. In this context the gambling equation (Equation (3)) is a reduced form equation which depends on the exogenous variables, X^g_{ijt}. The health outcome equation (Equation (4)) is a structural equation which depends on the exogenous variables, X^h_{ijt}, and gambling participation, y^g_{iht}.

Maddala (1983) described methods for estimating recursive systems of equations like Equations

(3) and (4). In order for the parameters to be consistently estimated, the system must be identified. In this case, an explanatory variable must appear in X_{ijt}^{g} that does not appear in X_{ijt}^{h}. Following this approach, we need to exclude a regressor in y_{ijt}^{*h} that affects gambling behavior but does not directly affect health outcomes. However, Wilde (2000) shows that an exclusion restriction is not required to identify the parameters in Equation (3), as long as X_{ijt}^{g} and X_{ijt}^{h} each contain one varying explanatory variable. This approach is commonly referred to as "identification by functional form" and relies heavily on the assumption of bivariate normality. Since bivariate normality may be a strong assumption, exclusion restrictions are often imposed to improve identification (Jones, 2007). Our exclusion restriction is the same as the instrumental variable used to identify the gambling equation in the IV approach, that is, the number of gambling facilities per capita in a province.

We also estimate a single equation probit model. This model assumes that gambling is an exogenous regressor in the health outcome equation. The rationale for estimating this model is to provide a basis for evaluating the extent to which our results are sensitive to the assumption that gambling is an exogenous regressor. As discussed in Section 1, many studies in the public health literature find that gamblers, and problem gamblers in particular, have lower health status than non-gamblers. However, since these studies do not treat gambling as an endogenous regressor in the health status equation, these findings can only be interpreted as correlations or associations rather than causal.

Bhattacharya et al. (2006) use a Monte Carlo simulation to compare the performance of four estimators commonly used to estimate the effect of a binary treatment variable on a binary outcome variable: single equation probit; two-step probit; two-stage least squares linear probability model; and bivariate probit. They find that the bivariate probit model performs best in generating consistent estimates of the treatment effect (in our case, the effect of gambling on health outcomes). The linear probability model produces good estimates of the treatment effect when there is a single, binary treatment variable and the data generating process is normal.

3.3 Empirical Results and Discussion

Since the relationship between recreational gambling and health outcomes is the primary focus of this investigation, we do not report full regression results for each gambling and health outcome model in the body of the paper. Instead, we report the estimated marginal effects of gambling on

health outcomes in Table 5. The full set of parameter estimates from all models are presented in the Appendix.

We estimate separate models for each health outcome/gambling combination. Recall that y^g_{ijt} is an indicator variable that is equal to one if individual i gambles and zero otherwise. We restrict our analysis to one class of gambler, "recreational gamblers" in this study. A "recreational gambler" is an individual who gambles and is not identified as having any risk of being a problem gambler. "At risk" gamblers (n=4,901) are excluded from the analysis. For each health outcome, Table 5 reports the partial marginal effect, evaluated at sample means, of participation in gambling on health outcomes. The partial marginal effect is the effect of a change in gambling status from 0 to 1 on the probability of reporting a particular health outcome. This is approximately equivalent to the the difference between $E[Pr(y^h_{ijt} = 1, y^g_{ijt} = 0)]$ and $E[Pr(y^h_{ijt} = 1, y^g_{ijt} = 1)]$. Z-statistics are reported in parentheses. We refer to the partial marginal effect as the marginal effect when discussing the results.

Table 5: Marginal Effects: Alternative Estimators for Chronic Health Conditions

	(1) Single Eq. Probit	(2) IV Probit	(3) Bivariate Probit
Life Stress: Quite a Bit or	-0.006*	-0.508***	-0.093***
Extremely Stressful (N=117,731)	(-2.565)	(-3.362)	(-5.010)
Life Satisfaction: Dissatisfied	-0.002*	-0.245***	-0.071***
or Very Dissatisfied (N=118,141)	(-2.320)	(-3.570)	(-4.952)
Self Assessed Health Status:	-0.006**	0.322**	0.039***
Fair or Poor (N=118,020)	(-3.204)	(2.745)	(7.029)
Health Status Change:	0.005*	0.334*	0.070***
Much or Somewhat Better (N=118,001)	(2.412)	(1.974)	(17.6)
Stroke	-0.0005	-0.0661*	-0.032***
(N=118,141)	(-1.331)	(-2.442)	(-8.478)
Stomach Ulcers	0.0006	-0.233***	-0.027
(N=118,141)	(0.527)	(-3.352)	(-1.92)
Migraines	-0.0009	-0.220	-0.023
(N=118,141)	(-0.528)	(-1.730)	(-0.959)
High Blood Pressure	0.0131***	-0.189	-0.024
(N=118,141)	(5.638)	(-1.274)	(-0.387)
Heart Disease	0.001	-0.0236	-0.003
(N=118,141)	(0.987)	(-0.385)	(-0.884)
Diabetes	0.0014	-0.16	-0.022
(N=118,141)	(1.093)	(-1.898)	(-0.954)

z statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
All regressions include province and year dummies, Z-statistics are in parentheses
Standard errors are cluster corrected at province level in gambling participation equations
Standard errors are bootstrapped in IV probit 2nd stage health outcome equations

The results shown in Table 5 reveal some interesting and novel findings. First consider Column (1) of Table 5, the marginal effects from a single equation probit model. Here, gambling has no effect on stroke, stomach ulcers, migraines, heart disease and diabetes. However, gambling is positively associated with the probability of reporting having high blood pressure and a change in health status but negatively associated with reporting fair or poor health, having high levels of life stress and being dissatisfied with life. The estimated marginal impacts are small. The maintained assumption of the single equation probit model is that gambling is an exogenous regressor in the health outcome equations. However, the single equation probit is a reduced form equation and the results are suggestive of only an association between gambling and health. They cannot be interpreted as providing causal evidence that gambling adversely impacts health and they are inconsistent when gambling participation is endogenous.

The instrumental variables and bivariate probit results shown in Columns (2)-(3) of Table 5 can be interpreted as causal evidence of a relationship between gambling and health outcomes. After accounting for endogeneity, a slightly different picture of the effect of recreational gambling on overall health and well-being and chronic conditions emerges. First consider the estimated marginal effects of gambling on overall helth and well-being. Recreational gamblers still report having lower levels of stress, being more satisfied with life, and experiencing an improvement in health status but they are more likely to report being in fair or poor health than non-gamblers. Next, the estimated marginal effects for chronic conditions reported are uniformly negative suggesting that recreational gambling generally decreases the probability of having chronic health conditions but are statistically significant in both the IV and bivariate probit models only for stroke. The marginal effects of gambling on migraines, high blood pressure, heart disease, and diabetes are insignificant in both models and significant in the IV model only for stomach ulcers.

Bhattacharya et al. (2006) perform a Monte Carlo simulation to compare the performance of the single equation probit model, the instrumental variables model in which the first stage equation is specified as a linear probability model, and the bivariate probit model. Of interest for our results are the findings with respect to the bias in the estimated partial marginal effects (or treatment effects) of the estimators. Bhattacharya et al. find that the single equation probit estimator is uniformly worse than the alternatives. The bivariate probit estimates of the treatment effect appear to be unbiased over the range of the true treatment effects. The instrumental variables

estimator generally performs well but does exhibit some upward bias in the estimates of the true treatment effects when the true treatment effect increases. Altonji et al. (2005) also find that the linear instrumental variables estimator produced parameter estimates and standard errors that were larger than those generated by the bivariate probit model. These findings suggest that the estimates of the marginal effects from the bivariate probit model are closest to the true marginal effects and that the instrumental variables estimates may be overstated. Thus, the bivariate probit model is our preferred specification.

We find no evidence that recreational gamblers are more likely to suffer from chronic conditions found to be associated with problem gambling. Since these conditions are associated with problem gambling, it is not surprising that they do not seem to be associated with recreational gambling. Our results are broadly consistent with Afifi et al. (2010) who use data from the 2002 CCHS to assess the relationship between various health correlates, including chronic conditions, and problem gambling among women. They find that problem gamblers are no more likely to suffer from heart disease, high blood pressure, stroke, diabetes, or stomach ulcers than non-problem (recerational) gamblers. Our findings that recreational gamblers are less likely to report have high levels of life stress and are less likely to have had a stroke relative to non-gamblers are plausible in light of Truelsen et al. (2003). They find a strong link between high self-reported stress and the risk of fatal stroke using data from the Copenhagen Heart Study from 1981-1983.

Our findings that recreational gamblers are more likely to report being in fair or poor health than non-gamblers yet are more likely to report a positive change in health status contribute to the mixed evidence of the effect of gambling on self-assessed health status. Some studies find that recreational gambling is not associated with better physical health status yet other studies find the opposite (Morasco et al., 2006). In general, recreational participation in gambling affects individual health and well-being, so regional variation in access to legal gambling affects observed regional differences in health and well-being.

The reliability of our estimates of the effect of gambling on overall health, well-being, and chronic conditions depends on the strength of the correlation between the instrument (gambling facilities per capita) and the endogenous gambling variable. We test for the presence of weak instruments using the Kleibergen-Paap Wald rk F-statistic discussed in Baum et al. (2007). Following Baum et al. (2007), we use this statistic rather than the usual Cragg-Donald F-statistic because the

standard errors in the first-stage gambling equation are cluster-corrected at the provincial level. The value of the test statistic varied slightly from 17.77 to 18.48 across the health and well-being measures with a p-value of 0.002. The test statistics exceed the Stock-Yogo weak ID F-test critical value for a single endogenous regressor with 10% maximal IV relative bias of 16.38 indicating that we do not have a weak instrument.

4 Conclusions

Very little is known about the causal relationship between gambling and health among recreational gamblers, despite evidence that the majority of gamblers fall into this category; most of the existing research on gambling and health focuses on problem or pathological gamblers, who constitute a small fraction of the population. Since gambling represents a common economic activity, and gambling opportunities are heavily regulated, information about the health effects of gambling can help to inform policy makers when deciding how much legal gambling should be permitted.

We develop some of the first causal evidence about the effect of gambling on a broad set of regional health outcomes that includes measures of overall health and well-being and chronic conditions. We treat gambling as an endogenous regressor in the health outcome models since there may be unobservable individual heterogeneity contributing to both decisions about gambling and health outcomes. We address this potential endogeneity by estimating instrumental variables and bivariate probit models, two standard endogeneity corrections in the literature. We exploit regional variation in access to gambling opportunities to identify the effect of gambling on health. The results indicate that recreational gambling has a positive effect on overall well-being in that recreational gamblers have less stress and are more satisfied with life in general. With respect to chronic conditions, we find no evidence that recreational gambling affects the prevalence of migraines, high blood pressure, heart disease, and diabetes but find that recreational gamblers are less likely to have a stroke or suffer from stomach ulcers.

Taken together, these results offer support for the notion that recreational gambling can be thought of as "healthy gambling" (Shaffer and Korn, 2002). Shaffer and Korn argue that gambling is a form of "adult play" that has the potential to produce health benefits. Gambling is not only a fun and exciting activity but also one that can enhance one's ability to manage stress which, in

turn, can reduce the likelihood of developing stress-related chronic diseases.

We also find that recreational gamblers experience larger improvements in health status relative to non-gamblers but this is somewhat mitigated by the finding that recreational gamblers are more likely to report being in fair or poor health. These results are consistent with Nyman et al. (2008, 2012) and are suggestive of competing relationships: a negative one represented by the "something for nothing" theory that those in poor health are more likely to gamble because they are disadvantaged in the labor market, and a positive one represented by the health-improving effect of gambling. The finding that recreational gamblers report much or somewhat better health status relative to non-gamblers is consistent with the notion that gambling may be a vehicle by which the disadvantaged are able to maintain an optimistic, hopeful perspective, and that perspective might also contribute to better health.

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A Appendix

Table A.1: Marginal Effects: Single Equation Probit for Health & Well-Being

	(1) Life Stress	(2) Life Satisfaction	(3) Self-Assessed Health Status	(4) Health Status Change
Gambler	-0.0061*	-0.0023*	-0.0060**	0.0054*
	(0.002)	(0.001)	(0.002)	(0.002)
Age	-0.0016***	-0.00022***	0.0013***	-0.0026***
	(0.000)	(0.000)	(0.000)	(0.000)
Male	-0.041***	0.0025	0.035***	-0.025***
	(0.003)	(0.001)	(0.003)	(0.003)
Single	-0.034***	0.0080***	-0.017***	0.0079
	(0.005)	(0.002)	(0.004)	(0.004)
Full Time Employment	0.10***	-0.017***	-0.092***	-0.020***
	(0.003)	(0.001)	(0.003)	(0.003)
Part Time Employment	0.0072	-0.016***	-0.077***	0.0038
	(0.005)	(0.002)	(0.004)	(0.004)
Household income 15k-30k	-0.0067	0.0042**	0.015***	0.0076*
	(0.004)	(0.001)	(0.003)	(0.004)
Household income 30k-50k	-0.017***	-0.0048***	-0.014***	-0.00057
	(0.004)	(0.001)	(0.003)	(0.004)
Household income 50k-80k	-0.025***	-0.011***	-0.028***	-0.0091*
	(0.004)	(0.002)	(0.003)	(0.004)
Household income 80k+	-0.0068	-0.025***	-0.050***	-0.0063
	(0.004)	(0.002)	(0.003)	(0.003)
On Welfare	0.13***	0.046***	0.13***	0.0097
	(0.006)	(0.002)	(0.004)	(0.006)
High School Grad	-0.012**	-0.0055***	-0.054***	-0.0087*
	(0.004)	(0.002)	(0.003)	(0.004)
Some College	0.021***	0.0051*	-0.038***	0.021***
	(0.005)	(0.002)	(0.004)	(0.005)
College Grad	0.023***	-0.0025	-0.062***	0.017***
	(0.003)	(0.001)	(0.002)	(0.003)
Children in Home	0.021***	-0.011***	-0.039***	-0.0084**
	(0.003)	(0.002)	(0.003)	(0.003)
Height in Inches	0.00033	0.000021	-0.0035***	0.00054
	(0.000)	(0.000)	(0.000)	(0.000)
Native Canadian	-0.0086*	-0.0036**	0.0094***	0.020***
	(0.003)	(0.001)	(0.003)	(0.003)
Observations	117731	118141	118020	118011

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.2: Marginal Effects: Single Equation Probit for Chronic Conditions

	(1) High Blood Pressure	(2) Stroke	(3) Stomach Ulcers	(4) Migraines	(5) Heart Disease	(6) Diabetes
Gambler	0.013***	-0.00053	0.00057	-0.00090	0.0011	0.0014
	(0.002)	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)
Age	0.0080***	0.00030***	0.000098*	-0.0019***	0.0024***	0.0019***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male	0.015***	0.0048***	0.0040*	-0.076***	0.026***	0.028***
	(0.003)	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)
Single	-0.030***	-0.0026*	-0.0061**	-0.016***	-0.011***	-0.012***
	(0.005)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Full Time Employment	-0.028***	-0.0080***	-0.0071***	0.0081***	-0.022***	-0.019***
	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Part Time Employment	-0.026***	-0.0046***	-0.011***	0.0012	-0.013***	-0.012***
	(0.005)	(0.001)	(0.002)	(0.003)	(0.002)	(0.003)
Household income 15k-30k	0.019***	0.000077	0.0057***	0.0019	0.0031*	0.0041*
	(0.003)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)
Household income 30k-50k	0.011**	-0.00073	0.00070	-0.0027	-0.000078	0.0020
	(0.004)	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)
Household income 50k-80k	0.012**	-0.0041***	-0.0025	-0.0013	-0.0013	-0.0036
	(0.004)	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)
Household income 80k+	0.00056	-0.0044***	-0.0070***	-0.0039	-0.0098***	-0.0086***
	(0.004)	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)
On Welfare	0.056***	0.0051***	0.033***	0.076***	0.025***	0.036***
	(0.006)	(0.001)	(0.002)	(0.004)	(0.003)	(0.003)
High School Grad	-0.0058	-0.0014*	-0.012***	-0.0069*	-0.0082***	-0.013***
	(0.004)	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)
Some College	-0.016**	0.000050	-0.010***	-0.0041	-0.0042	-0.0067*
	(0.005)	(0.001)	(0.002)	(0.004)	(0.002)	(0.003)
College Grad	-0.020***	-0.00073	-0.011***	-0.00038	-0.0064***	-0.014***
	(0.003)	(0.000)	(0.001)	(0.002)	(0.001)	(0.002)
Children in Home	-0.063***	-0.0033***	-0.0072***	-0.0045*	-0.016***	-0.020***
	(0.004)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Height in Inches	-0.0039***	-0.00032***	-0.0011***	-0.00098**	-0.00092***	-0.0016***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Native Canadian	0.0055	0.0014*	-0.0012	0.0015	0.0088***	-0.0016
	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
Observations	118141	118141	118141	118141	118141	118141

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.3: Coefficients: IV Probit 1st Stage Linear Probability Model

	(1) Gambler	
Age	-0.0016***	(0.000)
Male	-0.015***	(0.002)
Single	-0.017	(0.010)
Full Time Employment	0.043**	(0.010)
Part Time Employment	0.027***	(0.003)
Household income 15k-30k	0.0073	(0.006)
Household income 30k-50k	0.034***	(0.004)
Household income 50k-80k	0.047***	(0.006)
Household income 80k+	0.075***	(0.007)
On Welfare	-0.026*	(0.008)
High School Grad	0.034***	(0.006)
Some College	0.046***	(0.008)
College Grad	0.033***	(0.006)
Children in Home	-0.021**	(0.006)
Height in Inches	0.00077*	(0.000)
Native Canadian	0.11***	(0.009)
Gambling Facilities per Capita	0.076**	(0.018)
Constant	-0.077	(0.086)
Observations	118141	

Standard errors in parentheses

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

Table A.4: Marginal Effects: IV Probit, 2nd Stage Health Outcome Equation for Health & Well-Being

	(1) Life Stress	(2) Life Satisfaction	(3) Self-Assessed Health Status	(4) Health Status Change
Gambler	-0.508***	-0.245***	0.322**	0.334*
	(0.151)	(0.069)	(0.117)	(0.169)
Age	-0.00242***	-0.000604***	0.00182***	-0.00212***
	(0.000)	(0.000)	(0.000)	(0.000)
Male	-0.0491***	-0.00118	0.0396***	-0.0195***
	(0.004)	(0.002)	(0.003)	(0.004)
Single	-0.0420***	0.00408	-0.0116**	0.0133*
	(0.005)	(0.002)	(0.004)	(0.006)
Full Time Employment	0.124***	-0.00628*	-0.105***	-0.0336***
	(0.008)	(0.003)	(0.005)	(0.007)
Part Time Employment	0.0206**	-0.00905***	-0.0861***	-0.00493
	(0.007)	(0.002)	(0.004)	(0.006)
Household income 15k-30k	-0.00275	0.00620**	0.0120***	0.00498
	(0.004)	(0.002)	(0.003)	(0.004)
Household income 30k-50k	0.000480	0.00372	-0.0253***	-0.0121
	(0.005)	(0.003)	(0.005)	(0.007)
Household income 50k-80k	-0.000371	0.000414	-0.0435***	-0.0249**
	(0.008)	(0.004)	(0.007)	(0.008)
Household income 80k+	0.0315**	-0.00648	-0.0754***	-0.0314*
	(0.012)	(0.006)	(0.009)	(0.013)
On Welfare	0.115***	0.0397***	0.134***	0.0180*
	(0.007)	(0.003)	(0.006)	(0.008)
High School Grad	0.00528	0.00271	-0.0649***	-0.0198*
	(0.006)	(0.003)	(0.005)	(0.008)
Some College	0.0437***	0.0160***	-0.0527***	0.00624
	(0.008)	(0.004)	(0.006)	(0.010)
College Grad	0.0389***	0.00530	-0.0721***	0.00697
	(0.005)	(0.003)	(0.004)	(0.007)
Children in Home	0.0110*	-0.0159***	-0.0327***	-0.00160
	(0.004)	(0.002)	(0.004)	(0.005)
Height in Inches	0.000710	0.000204	-0.00376***	0.000297
	(0.000)	(0.000)	(0.000)	(0.000)
Native Canadian	0.0463**	0.0229**	-0.0263*	-0.0157
	(0.017)	(0.007)	(0.012)	(0.020)
Observations	117731	118141	118020	118011

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.5: Marginal Effects: IV Probit, 2nd Stage Health Outcome Equation for Chronic Conditions

	(1) High Blood Pressure	(2) Stroke	(3) Stomach Ulcers	(4) Migraines	(5) Heart Disease	(6) Diabetes
Gambler	-0.189	-0.0661*	-0.233***	-0.220	-0.0236	-0.161
	(0.148)	(0.027)	(0.069)	(0.127)	(0.061)	(0.085)
Age	0.00772***	0.000198***	-0.000269*	-0.00223***	0.00240***	0.00162***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male	0.0116**	0.00375***	0.000475	-0.0793***	0.0254***	0.0259***
	(0.004)	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)
Single	-0.0334***	-0.00361**	-0.00986***	-0.0194***	-0.0114***	-0.0142***
	(0.006)	(0.001)	(0.002)	(0.003)	(0.003)	(0.002)
Full Time Employment	-0.0192**	-0.00522***	0.00275	0.0175**	-0.0211***	-0.0118***
	(0.007)	(0.001)	(0.003)	(0.006)	(0.003)	(0.003)
Part Time Employment	-0.0207***	-0.00280*	-0.00509	0.00707	-0.0118***	-0.00773*
	(0.006)	(0.001)	(0.004)	(0.005)	(0.003)	(0.003)
Household income 15k-30k	0.0205***	0.000584	0.00760***	0.00361	0.00330*	0.00542**
	(0.004)	(0.000)	(0.002)	(0.003)	(0.001)	(0.002)
Household income 30k-50k	0.0187**	0.00156	0.00889**	0.00493	0.000797	0.00769
	(0.006)	(0.001)	(0.003)	(0.005)	(0.002)	(0.004)
Household income 50k-80k	0.0219*	-0.000963	0.00874*	0.00927	-0.000112	0.00419
	(0.009)	(0.001)	(0.004)	(0.007)	(0.004)	(0.005)
Household income 80k+	0.0160	0.000631	0.0108*	0.0129	-0.00794	0.00369
	(0.013)	(0.002)	(0.005)	(0.010)	(0.005)	(0.007)
On Welfare	0.0512***	0.00345***	0.0270***	0.0708***	0.0241***	0.0317***
	(0.006)	(0.001)	(0.003)	(0.004)	(0.002)	(0.003)
High School Grad	0.00109	0.000846	-0.00411	0.000558	-0.00742**	-0.00759*
	(0.007)	(0.001)	(0.003)	(0.005)	(0.002)	(0.003)
Some College	-0.00676	0.00301*	0.0000385	0.00577	-0.00309	0.000577
	(0.009)	(0.001)	(0.004)	(0.006)	(0.004)	(0.005)
College Grad	-0.0136*	0.00138	-0.00373	0.00667	-0.00558*	-0.00901**
	(0.006)	(0.001)	(0.002)	(0.004)	(0.002)	(0.003)
Children in Home	-0.0675***	-0.00467***	-0.0120***	-0.00906**	-0.0163***	-0.0230***
	(0.006)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Height in Inches	-0.00371***	-0.000274***	-0.000911***	-0.000812*	-0.000905***	-0.00144***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Native Canadian	0.0274	0.00853**	0.0243**	0.0255	0.0115	0.0161
	(0.016)	(0.003)	(0.008)	(0.014)	(0.007)	(0.009)
Observations	118141	118141	118141	118141	118141	118141

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.6: Coefficients: Bivariate Probit Reduced Form Gambling Equation for Health & Well-Being

	(1) Life Stress	(2) Life Satisfaction	(3) Self-Assessed Health Status	(4) Health Status Change
Age	-0.00401***	-0.00405***	-0.00405***	-0.00405***
	(0.001)	(0.001)	(0.001)	(0.001)
Male	-0.0387***	-0.0396***	-0.0396***	-0.0393***
	(0.004)	(0.004)	(0.005)	(0.004)
Single	-0.0439	-0.0442	-0.0445	-0.0443
	(0.027)	(0.027)	(0.027)	(0.027)
Full Time Employment	0.110***	0.108***	0.109***	0.109***
	(0.026)	(0.026)	(0.026)	(0.026)
Part Time Employment	0.0675***	0.0674***	0.0685***	0.0679***
	(0.008)	(0.008)	(0.007)	(0.008)
Household income 15k-30k	0.0171	0.0202	0.0205	0.0195
	(0.014)	(0.014)	(0.015)	(0.014)
Household income 30k-50k	0.0857***	0.0886***	0.0885***	0.0874***
	(0.011)	(0.010)	(0.011)	(0.011)
Household income 50k-80k	0.118***	0.121***	0.121***	0.120***
	(0.015)	(0.015)	(0.015)	(0.016)
Household income 80k+	0.189***	0.191***	0.191***	0.190***
	(0.018)	(0.018)	(0.018)	(0.018)
On Welfare	-0.0658**	-0.0659**	-0.0662**	-0.0664**
	(0.021)	(0.021)	(0.021)	(0.020)
High School Grad	0.0878***	0.0887***	0.0889***	0.0874***
	(0.014)	(0.014)	(0.014)	(0.014)
Some College	0.118***	0.117***	0.118***	0.118***
	(0.019)	(0.019)	(0.019)	(0.019)
College Grad	0.0836***	0.0849***	0.0848***	0.0841***
	(0.015)	(0.014)	(0.014)	(0.014)
Children in Home	-0.0522***	-0.0532***	-0.0532***	-0.0529***
	(0.015)	(0.015)	(0.016)	(0.016)
Height in Inches	0.00182*	0.00199*	0.00198*	0.00197*
	(0.001)	(0.001)	(0.001)	(0.001)
Native Canadian	0.280***	0.280***	0.280***	0.280***
	(0.021)	(0.021)	(0.021)	(0.022)
Gambling Facilities per Capita	0.212***	0.213***	0.209***	0.201***
	(0.046)	(0.048)	(0.046)	(0.042)
Constant	-1.549***	-1.563***	-1.546***	-1.511***
	(0.221)	(0.226)	(0.210)	(0.198)
Observations	117731	118141	118020	118011

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.7: Coefficients: Bivariate Probit Reduced Form Gambling Equation for Chronic Conditions

	(1) High Blood Pressure	(2) Stroke	(3) Stomach Ulcers	(4) Migraines	(5) Heart Disease	(6) Diabetes
Age	-0.00405***	-0.00404***	-0.00405***	-0.00405***	-0.00405***	-0.00405***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Male	-0.0392***	-0.0389***	-0.0391***	-0.0391***	-0.0391***	-0.0392***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Single	-0.0440	-0.0436	-0.0441	-0.0439	-0.0439	-0.0439
	(0.027)	(0.026)	(0.027)	(0.027)	(0.027)	(0.027)
Full Time Employment	0.109***	0.109***	0.109***	0.109***	0.109***	0.109***
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Part Time Employment	0.0679***	0.0685***	0.0677***	0.0681***	0.0680***	0.0680***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Household income 15k-30k	0.0198	0.0194	0.0197	0.0197	0.0198	0.0198
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Household income 30k-50k	0.0883***	0.0884***	0.0882***	0.0882***	0.0883***	0.0882***
	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)
Household income 50k-80k	0.121***	0.120***	0.120***	0.121***	0.121***	0.121***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Household income 80k+	0.191***	0.191***	0.191***	0.191***	0.191***	0.191***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
On Welfare	-0.0661**	-0.0662**	-0.0662**	-0.0661**	-0.0662**	-0.0662**
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
High School Grad	0.0885***	0.0880***	0.0883***	0.0883***	0.0884***	0.0884***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Some College	0.118***	0.118***	0.118***	0.117***	0.118***	0.118***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
College Grad	0.0844***	0.0845***	0.0844***	0.0844***	0.0844***	0.0843***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Children in Home	-0.0531***	-0.0534***	-0.0531***	-0.0532***	-0.0532***	-0.0531***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Height in Inches	0.00199*	0.00198*	0.00199*	0.00197*	0.00198*	0.00199*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Native Canadian	0.280***	0.280***	0.280***	0.280***	0.280***	0.280***
	(0.022)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Gambling Facilities per Capita	0.198***	0.205***	0.206***	0.200***	0.196***	0.200***
	(0.045)	(0.046)	(0.045)	(0.043)	(0.046)	(0.048)
Constant	-1.496***	-1.528***	-1.535***	-1.503***	-1.488***	-1.507***
	(0.216)	(0.221)	(0.216)	(0.206)	(0.220)	(0.224)
Observations	118141	118141	118141	118141	118141	118141

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.8: Marginal Effects: Bivariate Probit, Structural Health Equation for Health & Well-Being

	(1) Life Stress	(2) Life Satisfaction	(3) Self-Assessed Health Status	(4) Health Status Change
Gambler	-0.093***	-0.071***	0.039***	0.00057
	(0.019)	(0.014)	(0.006)	(0.001)
Age	-0.0014***	-0.00037***	0.00027***	0.000098*
	(0.000)	(0.000)	(0.000)	(0.000)
Male	-0.029***	0.0013	0.0089**	0.0040*
	(0.001)	(0.002)	(0.003)	(0.002)
Single	-0.025***	0.0067*	-0.0059***	-0.0061**
	(0.003)	(0.003)	(0.002)	(0.002)
Full Time Employment	0.073***	-0.013***	-0.024***	-0.0071***
	(0.006)	(0.002)	(0.004)	(0.001)
Part Time Employment	0.012	-0.013***	-0.020***	-0.011***
	(0.007)	(0.002)	(0.004)	(0.002)
Household income 15k-30k	-0.0020	0.0051	0.0047*	0.0057***
	(0.002)	(0.003)	(0.002)	(0.002)
Household income 30k-50k	-0.00018	-0.0017	-0.0018	0.00070
	(0.002)	(0.004)	(0.002)	(0.002)
Household income 50k-80k	-0.00086	-0.0072*	-0.0051***	-0.0025
	(0.003)	(0.003)	(0.001)	(0.002)
Household income 80k+	0.018***	-0.019***	-0.0099***	-0.0070***
	(0.004)	(0.004)	(0.002)	(0.002)
On Welfare	0.068***	0.045***	0.034***	0.033***
	(0.009)	(0.003)	(0.008)	(0.002)
High School Grad	0.0031	-0.0024	-0.013***	-0.012***
	(0.002)	(0.002)	(0.002)	(0.002)
Some College	0.026***	0.0095***	-0.0080***	-0.010***
	(0.002)	(0.001)	(0.001)	(0.002)
College Grad	0.023***	0.00051	-0.016***	-0.011***
	(0.002)	(0.001)	(0.002)	(0.001)
Children in Home	0.0066***	-0.013***	-0.013***	-0.0072***
	(0.002)	(0.002)	(0.003)	(0.002)
Height in Inches	0.00040	0.000091	-0.00095*	-0.0011***
	(0.000)	(0.000)	(0.000)	(0.000)
Native Canadian	0.027***	0.0066**	0.0095***	-0.0012
	(0.003)	(0.002)	(0.003)	(0.001)
Observations	117731	118141	118020	118141

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.9: Marginal Effects: Bivariate Probit, Structural Health Equation for Chronic Conditions

	(1) High Blood Pressure	(2) Stroke	(3) Stomach Ulcers	(4) Migraines	(5) Heart Disease	(6) Diabetes
Gambler	-0.024	-0.032***	-0.027	-0.023	-0.0031	-0.022
	(0.062)	(0.004)	(0.014)	(0.024)	(0.004)	(0.023)
Age	0.0040***	0.00041***	-0.000028	-0.0013***	0.0012***	0.0011***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male	0.0048	0.0068***	0.0020**	-0.045***	0.013***	0.017***
	(0.004)	(0.001)	(0.001)	(0.005)	(0.001)	(0.003)
Single	-0.020**	-0.0046***	-0.0055***	-0.011***	-0.0065***	-0.0086***
	(0.007)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Full Time Employment	-0.0061	-0.011***	-0.0026***	0.0097***	-0.0096***	-0.0086***
	(0.005)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Part Time Employment	-0.0085	-0.0062***	-0.0066***	0.0038**	-0.0053***	-0.0056***
	(0.005)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Household income 15k-30k	0.012***	0.00044	0.0047*	0.0020	0.0020	0.0032*
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Household income 30k-50k	0.013***	0.00012	0.0027*	0.0026	0.0015	0.0039**
	(0.004)	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)
Household income 50k-80k	0.016***	-0.0046***	0.0012	0.0049*	0.0014	0.0013
	(0.004)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Household income 80k+	0.016**	-0.0043***	-0.00039	0.0067*	-0.0017*	0.00021
	(0.006)	(0.000)	(0.001)	(0.003)	(0.001)	(0.002)
On Welfare	0.025***	0.0070***	0.022***	0.040***	0.012***	0.021***
	(0.005)	(0.002)	(0.003)	(0.003)	(0.001)	(0.005)
High School Grad	0.0040	-0.00085	-0.0066***	0.00018	-0.0028*	-0.0057***
	(0.003)	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)
Some College	0.00092	0.0016	-0.0048***	0.0031	-0.00012	-0.00079
	(0.003)	(0.001)	(0.000)	(0.003)	(0.001)	(0.002)
College Grad	-0.0040*	0.000053	-0.0061***	0.0037**	-0.0018*	-0.0065***
	(0.002)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)
Children in Home	-0.038***	-0.0058***	-0.0066***	-0.0050***	-0.0092***	-0.014***
	(0.008)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)
Height in Inches	-0.0019***	-0.00047***	-0.00074***	-0.00046*	-0.00045***	-0.00093***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Native Canadian	0.025***	0.0059***	0.0060***	0.014***	0.0095***	0.0073***
	(0.007)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
Observations	118141	118141	118141	118141	118141	118141

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$