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The Income and Health Effects of Tribal Casino Gaming on American Indians

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Abstract The legalization of American Indian casino gaming in the late 1980s allows examination of the relationship between income and health in a quasi-experimental way. Revenue from gaming accrues to individual tribes and has been used both to supplement tribe members' income and to finance tribal infrastructure. We assembled annual data from 1988–2003 on tribal gaming, health care access (from the Area Resource File), and individual health and socioeconomic characteristics data (from the Behavioral Risk Factors Surveillance System). We use this information within a structural, difference-in-differences framework to study the effect of casino gaming on tribal members' income, health status, access to health care, and health-related behaviors. Our difference-in-differences framework relies on before-after comparisons among American Indians whose tribe has at some time operated a casino and with-without comparisons between American Indians whose tribe has and those whose tribe has not initiated gaming. Our results provide identified estimates of the positive effect of gaming on American Indian income and on several indicators of American Indian health, health-related behaviors, and access to health care.

Keywords Income gradient · Health · American Indian health · Social determinants

Introduction

Inequalities in health status and mortality across income, education, and occupation groups are persistent and well documented. Differences in socioeconomic status,

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regardless of measure, are associated with large gaps in health status, mortality, health risk behaviors, stress and psychological well-being, access to care and health information (House 2002; Link and Phelan 1996; Wilkinson 1990; Williams and Collins 1995). Although a strong link between low income/wealth and poor health has been demonstrated in numerous studies (e.g., Currie and Lin 2007; Menchik 1993; Smith and Kington 1997), less is known about the causal effects of an exogenous increase in income. Issues of reverse causality and the presence of unobserved factors related to both income and health plague efforts to reliably estimate the causal effect of socioeconomic status on health.

Recent research on the income-health gradient has primarily focused on children, or has exploited natural experiments to establish the income-to-health linkage; these studies find a positive income-health gradient, but the exact nature of the estimated relationship varies across studies. In an important early study, Case et al. (2002) reported a positive health-income gradient among children that becomes steeper as children age. This study prompted several additional studies designed to investigate the income-health gradient among children and its change over the life course. For example, Currie and Stabile (2003) found that the income-health gradient among Canadian children is robust despite access to universal health coverage. Condliffe and Link (2008) explored the determinants of gradient steepening, including health shocks or cumulation of disadvantage as children age. Murasko (2008) attempted to differentiate the influence of permanent from current income, and Khanama et al. (2009) studied the extent to which factors such as parental health and education reduce the income gradient among children.

Research using natural experiments to assess the effect of income on health is more varied; it includes studies that explore health differences related to unexpected increases in pension income in South Africa (Case 2004), regional income effects resulting from the reunification of Germany (Frijters et al. 2005), the use of conditional income transfers in the experimental *Opportunidades* study in Mexico (Fernand et al. 2008), winning an Academy Award relative to being nominated (Redelmeier and Singh 2001), being involuntarily unemployed (Ruhm 2005),[1] and the presence of a casino on low-income children's mental health (Costello et al. 2003, 2010).

With the exception of the Ruhm study, all found evidence of a positive influence of an unexpected or exogenous income shock on health-related variables. However, the effect of income appears to vary depending on the population group studied, the data and variables chosen, the estimation method employed, the perceived permanence of the income change, and the presence of unobserved factors that may be associated with exogenous income changes.

The legalization and institution of Class III (casino-style) gaming in American Indian communities provides a unique opportunity both to assess the income-health relationship among a particularly impoverished and vulnerable population (Rutter 2007) and to analyze the effectiveness of this form of income growth and economic development as an antipoverty, health-improving policy strategy. We present

[1] Ruhm (2005) suggested that it is not only income that matters, but also the additional time due to being unemployed that enables one to conduct health-producing activities; under certain conditions, the latter effect may exceed the negative effect of the income change.

estimates of the effects of legalized casino gaming (and the income increases that derive from gaming) on adult self-reported physical and mental health status, health care utilization, and health-related behaviors of American Indians. We conjecture that American Indians who are members of tribes with gaming facilities have higher levels of income and better health access/status/behaviors than those who are members of tribes without gaming. Using a difference-in-differences framework, we compare these outcomes between individuals in tribes *with* gaming (treated group) and those in tribes *without* gaming facilities (control group), and differences from *before* to *after* the initiation of casino gaming for members of tribes who are observed having a casino for at least two years at some point during the observation period.

Background and Prior Research

Relative to the general U.S. population, American Indians, on average, have much lower levels of income, education, and other indicators of socioeconomic position. Nearly one-quarter of American Indians 25 years of age and older did not complete high school (a rate that is more than double that of non-Hispanic whites), and they have a poverty rate that is double the national poverty rate (U.S. Census Bureau 2007). They also face a health and mortality disadvantage at every life stage, with acute disparities in infant mortality, life expectancy, and age-specific mortality resulting from higher rates of infectious and chronic diseases (Lillie-Blanton and Roubideaux 2005).

In the early 1980s, in part to assist American Indian economic development efforts, the U.S. government allowed American Indian tribes to initiate gaming enterprises consisting largely of Class I (social gaming for minimal prizes) and Class II (bingo and other games similar to bingo) activities. The 1988 Indian Gaming Regulatory Act (IGRA) enabled development of more lucrative casino-style gaming facilities (Class III); after that date, the prevalence of these facilities increased rapidly.

As of 2005, American Indian gaming statistics indicate that there were approximately 360 American Indian gaming establishments in the United States. These casinos are operated by approximately 220 federally recognized tribes (of 562 such tribes) and offer Class I, Class II, and Class III gaming opportunities.[2] The National Indian Gaming Commission (NICG), the federal regulatory agency charged with overseeing tribal gaming, estimates that the revenue from all tribal gaming operations grew from $9.8 billion in 1999 to $25.1 billion in 2006. From 2001 to 2003, the largest 12% of American Indian gaming operations accounted for approximately 65% of total American Indian gaming revenue; the mean operation had revenue of $17 million. Most Class III gaming operations are located on a reservation or tribal trust land subject to variations in state-negotiated compact regulations (see top map, Fig. 1). There is broad regional variation in the duration of established gaming operations, with the upper Midwest having the majority of casinos in existence for more than 10 years; recent casino growth is concentrated in Western states (see bottom map, Fig. 1).[3]

[2] Statistics from the National Indian Gaming Commission (NICG) (see http://www.nigc.gov/).

[3] When Congress passed the Indian Gaming Regulatory Act (IGRA) in 1988, state regulatory rights were recognized over Class III gaming. Class III excludes Class II gaming (primarily bingo, which tribes themselves regulate) and traditional Indian games (Class I).

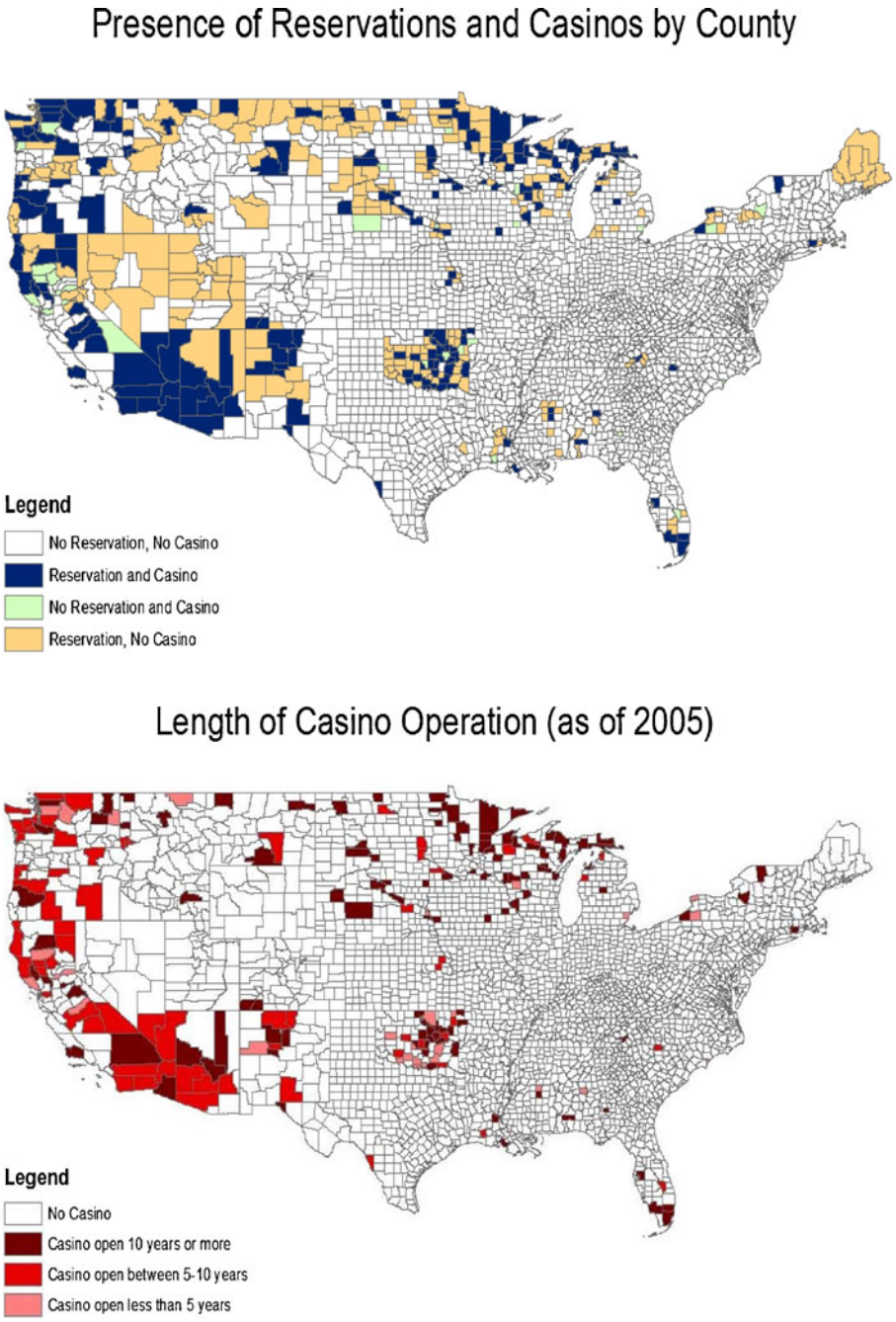

Fig. 1 Reservations, casinos, and duration, by county

Tribal budgets, spending on social services, and (for some tribes) direct income transfers to members have increased because of the net revenue from gaming enterprises (Gonzales 2003). These impacts appear to be reflected in the income of tribal

members; from 1990 to 2000, real median income on non-Navajo American Indian reservations with gaming increased by 35% compared with 14% on those without gaming (Taylor and Kalt 2005). The National Indian Gaming Association (2008) reported that American Indian gaming has created 636,000 jobs, of which most are filled by non–American Indian employees. In 2000, total American Indian employment related to gaming (about 150,000 persons) was about 7% of the total American Indian labor force (Taylor and Kalt 2005).[4]

Beyond anecdotal reports of potential health-promoting benefits of casino-related income increases (e.g., funding of health centers and new health initiatives), only a few studies have attempted to quantitatively estimate the relationship between the presence of tribal gaming and health-related outcomes for American Indians. In these studies, authors have sought to relate income changes believed to be exogenous to health status and behaviors. For example, Costello et al. (2003, 2010) reported improvement in some psychiatric outcomes in a North Carolina cohort of American Indian children following the opening of a nearby tribal casino; these improvements were found to continue into adulthood. Akee et al. (2008), studying the same cohort of North Carolina children and using a difference-in-differences approach, found higher educational outcomes among adolescents experiencing casino gaming. Evans and Topoleski (2002), using national county-based self-collected casino data, found that four or more years after a tribal casino opened, all-cause mortality rates significantly declined by approximately 2% in counties with tribal casinos, while counties less than 50 miles from a casino showed a mortality decline of approximately one-half that amount.

Data Used in Estimation

We assemble multilevel, multisource data to support our estimation of the potential effects of casino gaming on American Indian income and health-related variables. Data on individual American Indians—such as information on health, socioeconomic, and demographic characteristics—are linked to information on American Indian tribes, tribal gaming operations, and broader community health resources using information from the following sources. (See the Appendix for a more comprehensive description of the data.)

1. *Individual-level data:* Information on a large sample of American Indians (N = 24,079) was obtained from the Behavioral Risk Factors Surveillance System (BRFSS) (CDC 1988–2003), which contains annual cross-sectional information on income and health-related variables, basic sociodemographic and economic characteristics, as well as the county of residence. We assigned tribal affiliation based on any tribe or tribes with reservation land located in the BRFSS respondent's county of residence.
2. *Tribal-level data:* Data on American Indian tribes with Class III gaming were collected by Evans and Topoleski (2002). We then supplemented these data with:

[4] Gaming has also benefitted states, both directly through payments agreed upon in state compacts and through lowering of payments tied to poverty. For example, in Minnesota, which established 22 compacts in 1989 and has casinos on all 11 reservations, welfare expenditures were reduced in counties with a casino by about 16% within two years of the casino's establishment. See American Indian Policy Center (2005).

(a) An exhaustive census of tribally owned casinos indicating facility-specific information on tribal affiliation, county of location, the presence of a Class III gaming compact or casino-style gaming, and date of facility opening through 2005; and (b) Additional information on the geographic location of all tribal reservation land (U.S. Census Bureau 2008). See the Appendix and Online Resource 1 for an explanation of the assumptions used to tie BRFSS respondents to tribal-level data.

3. *County-level data:* Contextual data were assembled from the Area Resource File (ARF 2008) and contain information on the availability and aggregate utilization of health resources and facilities, population, and economic data for each county. Most of the data that are included in the analysis were collected in 1990 for 1989.

We use these data to estimate the exogenous relationship between American Indian gaming and American Indian income, and in turn, the effect of the casino-generated income on a variety of health status, health care utilization, and health behavior indicators.

These data have several distinct advantages over other data sets commonly used to study American Indians: (1) our data measure individual-level, rather than aggregate population-level, health-related indicators; (2) individual-level measures are collected using a random-digit-dial sampling procedure that captures both American Indians who live on tribal land and American Indians who do not live on tribal land but may be tribally and/or geographically connected to a gaming facility as long as they live in the same county as gaming tribe; (3) our data are not limited to American Indians who use the Indian Health Service; and (4) the data include individual-level variables that are collected at frequent intervals and annually aggregated to allow for a dynamic data analysis.[5]

Estimation Model

We identify the effects of the presence of Class III gaming activities on the income and health-related behaviors and outcomes of American Indians using a structural, two-stage multiple regression model. Our model assumes that the effect of casino gaming on health-related variables operates through the exogenous increase in income that is associated with the presence of a casino; the presence of a casino is assumed to have no independent effect on the health-related outcomes. Hence, we first identify the link from gaming to income, and then the linkages from the casino-generated increase in income to a variety of health indicators.

The first equation in our model specifies that individual income is a function of the presence of a casino and a set of exogenous individual variables. We hypothesize that household income (Y) is positively related to the presence of a casino (I):

$$Y = Y(I, \mathbf{X}, U). \tag{1}$$

$\mathbf{X}$ is a vector of exogenous variables that affect Y, including individual, county, and year dummy variables; and U is an unmeasured third factor or error term that is assumed to be uncorrelated with $\mathbf{X}$ and I.

[5] However, because BRFSS uses telephone sampling, results may be biased by omitting households without phones. As of 1990, 23% of American Indian households did not have telephones (U.S. Census Bureau 1994). We expect that telephone usage in this population has increased over the period of our analysis.

The second equation is a structural equation that relates our health-related variables (H) to the *predicted* value of household income from Eq. 1 ($\widehat{Y}$), and the exogenous variables:

$$H = H\left(\widehat{Y}, \mathbf{X}, U\right). \tag{2}$$

Our model controls for both individual- and county-level characteristics that may be associated with income and health. We also include year-specific dummy variables to account for any historical trends associated with income or health characteristics in the American Indian population. Estimation of both Eqs. 1 and 2 is based on the full sample of American Indians, both with and without gaming. We have also estimated a variety of other models and present these as sensitivity tests.

We expect that the presence of tribal casino gaming will be positively associated with household income, and that the income increase associated with the presence of tribal casino gaming will be associated with better health, fewer risky health behaviors, and fewer barriers to health care utilization. We suggest that the health effects that we are estimating are related either to a direct change in household income through payments by tribes to members or to improvements in tribal health infrastructure, such as tribal health facilities, nutrition programs, and the provision of community health workers. We find no evidence of increased employment associated with the presence of a casino; thus, work and earnings are unlikely to contribute to the measured effects.[6]

Variables Used in Analysis

Table 1 (column 1) shows summary statistics (means and standard deviations) for the individual variables used in estimating Eqs. 1 and 2, for the Full Sample of 24,079 annual American Indian observations included in the BRFSS data during the 1988–2003 period. Household income is available for 21,342 observations. Not all questions regarding health outcomes were asked in all years in all states—hence the differing sample sizes for the health-related variables.

Column 2 provides summary statistics for a subsample of 8,973 observations from the Full Sample living in a county with a tribe that *at some point during our years of observation* is observed to have a casino; we refer to this sample as the Restricted Sample. In our estimation, we use an indicator variable indicating presence in this sample, thereby distinguishing observations who lived in a county with a gaming tribe during the 1988–2003 period from those without a casino during this entire period. Thus, the Full Sample includes tribes with and without gaming. Use of this *Restricted Sample = 1* variable in estimation also serves to control for potential selectivity into the pursuit of economic development through gaming. There are no statistically significant differences in socioeconomic characteristics between the Restricted Sample and the Full Sample, although slightly better health and health-related behaviors are indicated for those in the former sample.

[6] We find a negative and statistically insignificant relationship between employment and Class III tribal gaming, controlling for gender, age, marital status, survey year, and the full set of county contextual variables. Results are available from the authors upon request.

Table 1 Descriptive statistics, BRFSS American Indian sample and corresponding gaming and county contextual information

	(1)			(2)			(3)		
	All American Indians (Full Sample)			Tribal Gaming in County by 2003 (Restricted Sample)			Tribal Gaming for 2+ Years (After Gaming Sample)		
Variable	*N*	Mean	SE	*N*	Mean	SE	*N*	Mean	SE
Income									
Household income (1988–2003)	21,342	$33,206.50	183.43	7,993	$31,819.27[b]	279.43	3,312	$33,376.52	456.64
Tribal Gaming for Two or More Years (1988–2003)	24,079	0.15	—	8,973	0.41[a]	—	3,701	1.00	—
Health Risk Behaviors									
Smoking (1988–2003)	24,021	0.36[a]	—	8,954	0.34[a]	—	3,694	0.33	—
Heavy drinking (1988–2003)	19,378	0.05	—	7,510	0.05	—	3,020	0.05	—
Binge drinking (days last month; 1988–2003)	3,425	4.75	0.11	1,432	4.26	0.15	604	4.32	0.23
Health Indicators									
Obesity (1988–2003)	23,304	0.54[a]	—	8,696	0.57	—	3,581	0.58	—
Overweight (1988–2003)	23,309	0.63[a]	—	8,698	0.66	—	3,582	0.67	—
Poor/fair health (1993–2003)	21,763	0.24[a]	—	8,090	0.22	—	3,523	0.22	—
Hypertension (1988–2003)	20,357	0.21	—	7,547	0.21	—	3,097	0.20	—
Diabetes (1988–2003)	24,029	0.10	—	8,952	0.12	—	3,691	0.11	—
High cholesterol (1989–2003)	10,843	0.30	—	4,039	0.29	—	1,639	0.29	—
Asthma (1999–2003)	13,949	0.11[a]	—	5,397	0.10	—	2,329	0.09	—
Disability (1995–1998, 2000–2003)	4,760	0.24[a]	—	1,833	0.21	—	860	0.19	—
Health Care Utilization									
Health plan (1990–2003)	22,904	0.75[a]	—	8,490	0.73	—	3,608	0.73	—
Forgone care (1991–2003)	20,006	0.17[a]	—	7,367	0.15	—	3,151	0.14	—

Table 1 (continued)

Variable	(1) All American Indians (Full Sample)			(2) Tribal Gaming in County by 2003 (Restricted Sample)			(3) Tribal Gaming for 2+ Years (After Gaming Sample)		
	N	Mean	SE	*N*	Mean	SE	*N*	Mean	SE
Mental Health (days last month)									
Poor mental health (1993–2003)	19,163	4.63[b]	0.06	7,010	4.15	0.10	3,137	4.16	0.15
Depression (1995–1998, 2000–2002)	2,038	4.45[b]	0.18	795	3.47	0.26	444	3.41	0.33
Anxiety (1995–1998, 2000–2002)	3,275	6.73[b]	0.18	1,381	5.83	0.25	682	5.73	0.36
Sociodemographic Variables (1988–2003)									
Age	24,079	43.12[b]	0.10	8,973	42.38	0.16	3,701	42.17	0.25
Age, squared	24,079	2,110.41[b]	9.85	8,973	2,037.97	15.57	3,701	2,014.60	23.74
Female	24,079	0.57	—	8,973	0.59[a]	—	3,701	0.57	—
Education									
Less than high school	24,079	0.08[a]	—	8,973	0.06[a]	—	3,701	0.06	—
High school diploma or GED	24,079	0.16	—	8,973	0.16[a]	—	3,701	0.15	—
Some college/tech school	24,079	0.61[a]	—	8,973	0.63[a]	—	3,701	0.64	—
College degree	24,079	0.16	—	8,973	0.15	—	3,701	0.16	—
Marital Status									
Married	24,079	0.46[a]	—	8,973	0.44	—	3,701	0.43	—
Divorced	24,079	0.18	—	8,973	0.18	—	3,701	0.18	—
Widowed	24,079	0.08	—	8,973	0.08	—	3,701	0.07	—
Separated	24,079	0.04[a]	—	8,973	0.04	—	3,701	0.03	—
Never married	24,079	0.20[a]	—	8,973	0.21[a]	—	3,701	0.22	—
Cohabiting	24,079	0.05[a]	—	8,973	0.05	—	3,701	0.06	—

Table 1 (continued)

	(1)			(2)			(3)		
	All American Indians (Full Sample)			Tribal Gaming in County by 2003 (Restricted Sample)			Tribal Gaming for 2+ Years (After Gaming Sample)		
Variable	*N*	Mean	SE	*N*	Mean	SE	*N*	Mean	SE
Employment Status									
Working	24,079	0.60	—	8,973	0.61	—	3,701	0.62	—
Not working, economically active	24,079	0.12	—	8,973	0.12	—	3,701	0.12	—
Not working, economically inactive	24,079	0.28[a]	—	8,973	0.26	—	3,701	0.26	—
County-Level Contextual Variables									
Percentage white collar workers (1990)	24,079	52.75[b]	0.06	8,973	51.72[b]	0.09	3,701	53.27	0.14
Median gross rent (1990)	24,079	$367.98[b]	0.73	8,973	$341.26[b]	1.01	3,701	$357.32	1.87
Percentage of population with telephone (1990)	24,079	89.50[b]	0.07	8,973	86.97[b]	0.12	3,701	85.74	0.24
Percentage female-headed families (1990)	24,079	16.35[b]	0.04	8,973	16.01[b]	0.05	3,701	17.31	0.10
Five-year infant mortality rate (1990)	24,079	9.04[b]	0.02	8,973	9.04[b]	0.04	3,701	8.74	0.06
Unemployment rate (1990)	24,079	6.67[b]	0.02	8,973	7.32[b]	0.03	3,701	7.75	0.06
Income per capita (per $10,000; 1990)	24,079	$1.56[b]	0.00	8,973	$1.45	0.00	3,701	1.45	0.01
Percentage below poverty level (1989)	24,079	18.36[b]	0.07	8,973	20.43[b]	0.11	3,701	21.68	0.21
Doctors per 100,000 (1990)	24,079	0.0016[b]	0.00001	8,973	0.0013[b]	0.00001	3,701	0.0015	0.00002

[a] Chi-squared test for mean differences between full sample or tribal gaming sample and gaming for 2+ years sample in current interview year, $p < .05$.

[b] *t* test for mean differences between full sample or tribal gaming sample and gaming for 2+ years sample in current interview year, $p < .05$.

Column 3 presents summary statistics for the 3,701 observations in the Restricted Sample living in a county that had tribal gaming for two or more years *at the time of interview.*[7] We refer to these observations as the After Gaming Sample; this sample composes 15% of observations in the Full Sample and 41% of observations in the Restricted Sample. We use an indicator variable (*After Gaming Sample = 1*) in estimation to distinguish those observations in the Restricted Sample (i.e., those living in a county with a casino at some point during our 1988–2003 observation period) *after* a casino is established from observations in this sample *before* a casino has been established.[8]

Dependent Variables

Household Income

Household income is the dependent variable in Eq. 1 of our estimation model. Values for this variable are constructed from information in BRFSS; household income is measured as a continuous variable for each of the years from 1988–2003, recorded in constant 2000 dollars.[9] As Table 1 shows, during the 1988–2003 period, pooled mean household incomes for the Full Sample, the Restricted Sample, and the After Gaming Sample, were $33,207, $31,819, and $33,377, respectively.[10] The difference in household income between those in the Restricted Sample (Y = $31,819) and those in the Full Sample who did not live in a county with a gaming tribe during the 1988–2003 period (Y = $33,175) is $1,356; this difference is not statistically significant. The difference in household income between those in the After Gaming Sample ($33,376) and those in the Restricted Sample observed before the presence of a casino (Y = $30,717) is $2,659; this difference is significantly different from zero ($p < .05$).

Health, Health Care, and Health Risk Behaviors

The health-related variables serve as dependent variables in the set of estimations indicated in Eq. 2. BRFSS contains detailed information on several

[7] Specifically, this sample is defined as American Indian respondents whose county of residence has a tribe with Class III gaming for two or more years as of the year the respondent was interviewed. Summary statistics for respondents whose tribe did not have a gaming facility at the time that they were interviewed are not shown in the table but are available from the authors. We omit observations whose affiliated tribe established a gaming facility during the year of interview or the subsequent year. This lag allows time for the casino to become a going enterprise with the opportunity to generate income.

[8] There are no counties with a casino for two or more years that then subsequently lose the casino.

[9] BRFSS gathers information on household income levels for all years of our analysis. Income is recorded by class interval, with an open category at the top. We adjust all class intervals for inflation (year 2000 dollars) and use the midpoint of all categories. Respondents with income in the open-ended top income category are assigned an income equal to the lower limit (inflation-adjusted income) × 1.5. In an alternative analysis reported below, we also estimate interval regressions in which we make no assumption regarding the nature of the underlying income distribution within each category or for the top-coded interval.

[10] Although not shown, the Restricted Sample is likely to have fewer American Indians living in metropolitan areas because individuals must live in the same county as a reservation in order to be included in the Restricted Sample.

self-reported health-related indicators; we estimate the effects of casino gaming on the following:

1. Risk taking
   (a) Smoking = 1
   (b) Heavy drinking = 1 (2 or more drinks per day for men and 1 or more drinks per day for females)
   (c) Days of binge drinking in past month

2. Health indicators
   (a) Obesity (BMI>30) = 1
   (b) Overweight (BMI>25) = 1
   (c) Poor/fair health = 1
   (d) Hypertension = 1
   (e) Diabetes = 1
   (f) High cholesterol = 1
   (g) Asthma = 1
   (h) Self-reported disability = 1

3. Access indicators
   (a) Having health insurance = 1
   (b) Forgone health care = 1

4. Mental health indicators
   (a) Days of poor mental health in past month
   (b) Days of depression in the past month
   (c) Days of anxiety in the past month

Relative to other population groups in the United States, American Indians in general have poorer health and higher rates of participation in activities with health risks (U.S. National Center for Health Statistics 2007). This pattern also exists in our Full Sample; Table 1 indicates that about 36% of the Full Sample smoke, 63% are overweight, and 24% are in either poor or fair health. Among our Full Sample of BRFSS respondents, 75% reported having some sort of health insurance, while 17% indicated that they had forgone medical care because of cost. For comparison, year 2000 general population estimates of all BRFSS variables included in our analysis are presented in Online Resource 2.

Independent Variables

A key independent variable is an indicator variable (= 1) attached to observations in the Restricted Sample, indicating observations living in a county with Class III gaming at any time during the 1988–2003 observation period. It distinguishes with-casino observations in the Full Sample from without-casino observations. A second important variable is an indicator variable (= 1) attached to observations in the After

Gaming Sample, indicating living in a county with a Class III gaming establishment at the time a respondent is interviewed. It distinguishes observations in a county after a casino has been established from observations in a county before a casino is in place.

Individual control variables used in our analysis include respondent age, gender, education, marital status, and employment status, all from BRFSS (see Table 1). Educational attainment is broken into four indicator variables: less than high school, high school diploma or GED, some college or technical school, and college degree. We distinguish six marital status variables: married, divorced, widowed, separated, never married, and cohabiting. Finally, there are three binary employment status variables: working, not working but economically active, and not working and economically inactive.

We use county data from the Area Resource File (ARF) in an attempt to control for possible tribal selectivity into the successful negotiation of a gaming compact. Control variables include income; poverty rate; unemployment rate; proportion of employment that is white collar; average rent; proportion of households headed by a female; proportion of households with telephones; and two indicators of health: the five-year infant mortality rate and the number of medical doctors per capita (see Table 1). All variables are measured as of 1989 or 1990 (prior to the establishment of most casinos), thereby accounting for any systematic differences among tribes in factors such as economic conditions and the prevalence of medical care providers that might be related to the establishment of a casino.

Estimation and Results

Tribal Gaming and Income of American Indians

We hypothesize that the presence of casino gaming in a county is positively related to the level of household income of the American Indians living in the county. To estimate this relationship, we construct a third indicator variable, which is the product of the *Restricted Sample = 1* variable (indicating the presence of an observation in the Restricted Sample) and the *After Gaming Sample = 1* variable (indicating the presence of an observation in the After Gaming sample). This forms a difference-in-differences variable that serves as our gaming variable, I, in Eq. 1 and captures both the with-without effect and the before-after effect; we refer to this variable as the casino gaming indicator.

Such difference-in-differences estimators are commonly used, primarily in economics, to evaluate the effects of a treatment when a random assignment experiment has not been used. The approach is designed to minimize the possibility that the distribution of outcomes in the "treated population" might differ from those in the "control population" because of underlying differences in the two populations. The difference-in-differences approach makes the assumption that differences in the outcomes between the two populations would have remained generally constant without treatment so that observed differences prior to treatment (e.g., establishing a casino) can be used to account for any such differences, thus allowing the researcher to isolate the influence of the treatment on the outcome(s).

Table 2 presents our OLS estimate of the with-without and before-after impacts of the presence of Class III gaming on household income (in thousands of dollars); it is fit over all observations in the Full Sample reporting a value for household income (n = 21,342, or 89% of the total sample of 24,079 observations). The coefficient on the difference-in-differences casino gaming indicator captures the total effect of casino gaming on income (which is equal to the sum of the with-without and the before-after effects). Our estimate controls for individual socioeconomic

Table 2 OLS regression of reported household income on tribal gaming, all American Indians

	Household Income in $1,000[b]	
Covariates[a]	*b*	SE
Difference-in-Differences Casino Gaming Indicator	1.7495	0.6230**
Age	0.4707	0.0600***
Age, Squared	–0.0040	0.0006***
Female	–3.0588	0.3567***
Education (ref. = high school diploma)		
Less than high school	–2.1505	0.7418**
Some college/technical school	5.8672	0.3939***
College degree	22.1181	0.6891***
Marital Status (ref. = married)		
Divorced	–14.7404	0.3990***
Widowed	–12.2005	0.6252***
Separated	–15.0633	0.7130***
Never married	–11.6678	0.4775***
Unmarried couple	–9.7536	0.7602***
Employment Status (ref. = employed)		
Not working, economically active	–6.9042	0.5429***
Not working, economically inactive	–14.0534	0.3846***
County–Level Variables		
Class III gaming by 2003	–1.2336	0.5367*
Percentage white collar, 1990	0.0438	0.0381
Median gross rent, 1990	0.0198	0.0043***
Percentage with telephone, 1990	–0.0653	0.0398
Percentage female-headed households, 1990	0.1640	0.0694*
Five-year infant mortality rate, 1990	0.1066	0.0661
Unemployment rate, 1990	0.0829	0.0901
Per capita income, 1990 (per $10,000)	3.2438	1.1705**
Percentage poverty, 1989	–0.2612	0.0554***
Doctors per 100,000, 1990	–723.9827	444.1663
Constant	20.7417	5.2256***
N	21,342	
df	39	
R^2	.27	

[a]All models control for survey year (not shown).
[b]BRFSS measures income as an interval variable. We take the midpoint of the interval and adjust all to year 2000 dollars. The open-ended top category = (interval midpoint × 1.5).

*p < .05; **p < .01; ***p < .001

variables, year of interview, and an extensive set of county-level variables, including the *Restricted Sample =1* variable, to control for any unobserved differences in the motivation to pursue economic development through gaming; hence, we adjust the standard errors for clustering at the county level.

The coefficient on the casino gaming indicator is statistically significant and indicates that the mean effect of the presence of gaming on household income is $1,750, or 5.3% of average household income in the Full Sample. This estimate supports our hypothesis that the presence of tribal casino gaming is associated with higher income for American Indians.[11] The coefficient on the *Restricted Sample = 1* variable is marginally significant and suggests that tribes in counties with a casino at some point over the observation period have about $1,233 less income per household than those in counties never observed to have a casino.[12]

Tribal Gaming, Health, Health Care, and Health Risk Behaviors

Equation 2 of our two-stage model is estimated separately for each health-related variable and is fit over all American Indians. The models include an individual-specific predicted value of each observation's household income from the first-stage regression ($\widehat{Y}$ from Eq. 1), individual socioeconomic characteristics, county variables (including the *Restricted Sample = 1* variable), and year. The coefficient on the predicted income variable ($\widehat{Y}$) is interpreted as the effect of an exogenous increase in income attributable to casino gaming on these health-related variables, and as such, it addresses a basic question that has motivated this research. We use logistic regression to estimate the relationships between tribal gaming and binary health outcomes (e.g., smoking), and negative binomial regression for those variables measured as discrete counts (e.g., days of binge drinking in past month), and adjust each Stage 2 estimated equation for the joint error term.

Table 3 presents the effect of casino gaming operating through the estimated income variable on the health-related variables in this structural model. Column 3 presents the coefficient of the predicted income variable, and column 4 shows the standard errors for these coefficients. In column 5, we multiply the income coefficient by the average change in income ($1,750) and report this value in percentage terms.

[11] An interesting question concerns the pattern of income changes across the income distribution associated with the presence of casino gaming. In the Restricted Sample, the largest income increase is recorded for the second quartile, suggesting that the income increases occur primarily in the lower-middle- to middle-income groups. Moreover, the lower bound of the third quartile increases more than the upper bound. A two-sample Wilcoxon rank sum (Mann-Whitney) test of differences across the entire income distribution indicates statistical significance. This is consistent with calculated income changes at same quantiles of the distributions. We find an increase in income of $947 at the 25th percentiles of the with-without distributions (6%), $4,946 at the medians (21%), and $1,819 at the 75th percentiles (4.4%).

[12] One reader suggested that we estimate the following year and county fixed-effects model:

$$Y_{ijt} = \alpha I_{jt} + \sum_{t-1}^{T-1} \beta_t Z_t + \sum_{j-1}^{N-1} \delta_j D_j \,.$$

In this equation, Z_t are year dummy variables, and D_j are county dummy variables. Individual characteristics are also included. We are unable to estimate county fixed effects because of lack of within-county variation for some counties (1,173 counties, of a total of 2,130 counties, have three or fewer observations, and 619 counties contain only one American Indian in the data set).

Table 3 Regression of health outcomes on income ($\widehat{Y}$ and Y), all American Indians

			Structural Model[a]				Reduced-Form Model		
Outcome[b]	*N* (1)	Mean (2)	*b*[c] (3)	SE[d] (4)	% Change[e] (5)	% Change × $6,000[f] (6)	*b*[g] (7)	SE[d] (8)	% Change[h] (9)
Risk Behaviors									
Smoking	24,021	0.3583	–0.0197	0.0043***	–9.6126	–32.9574	–0.0013	0.0002***	–0.3535
Heavy drinking	19,378	0.0533	–0.0016	0.0007*	–5.1963	–17.8158	0.0000	0.0001	0.0865
Binge drinking (days last month)	3,425	4.7454	–0.0070	0.0474	–0.2569	–0.8807	0.0101	0.0045*	0.2121
Health Indicators									
Obesity	23,304	0.5353	–0.0083	0.0018***	–2.6981	–9.2508	–0.0006	0.0001***	–0.1116
Overweight	23,309	0.6267	–0.0081	0.0017***	–2.2673	–7.7736	–0.0006	0.0001***	–0.0918
Poor/fair health	21,763	0.2387	–0.0025	0.0014	–1.7989	–6.1676	–0.0022	0.0002***	–0.9410
Hypertension	20,357	0.2065	–0.0037	0.0014**	–3.1326	–10.7404	–0.0004	0.0001***	–0.1916
Diabetes	24,029	0.1044	–0.0020	0.0008*	–3.3130	–11.3590	–0.0006	0.0001***	–0.5808
High cholesterol	10,843	0.3014	–0.0018	0.0021	–1.0210	–3.5005	–0.0005	0.0002**	–0.1715
Asthma	13,949	0.1104	–0.0005	0.0014	–0.7188	–2.4646	–0.0004	0.0001**	–0.3388
Disability	4,760	0.2408	–0.0033	0.0037	–2.3749	–8.1426	–0.0011	0.0003***	–0.4500
Health Care Utilization									
Health plan	22,904	0.7460	0.0044	0.0024	1.0236	3.5095	0.0036	0.0002***	0.4809
Forgone care	20,006	0.1652	0.0002	0.0014	0.2212	0.7585	–0.0023	0.0002***	–1.4182

Table 3 (continued)

			Structural Model[a]				Reduced-Form Model		
Outcome[b]	*N* (1)	Mean (2)	*b*[c] (3)	SE[d] (4)	% Change[e] (5)	% Change × $6,000[f] (6)	*b*[g] (7)	SE[d] (8)	% Change[h] (9)
Mental Health (days last month)									
Poor mental health	19,163	4.6304	–0.0049	0.0380	–0.1837	–0.6297	–0.0089	0.0029**	–0.1927
Depression	2,038	4.4480	–0.0800	0.0852	–3.1474	–10.7912	–0.0246	0.0081**	–0.5529
Anxiety	3,275	6.7298	–0.2821	0.0936**	–7.3369	–25.1549	–0.0192	0.0084*	–0.2853

[a]OLS regression of income on gaming and standard covariates yields a coefficient on the casino gaming indicator of 1.75, with a standard error of 0.62. See Table 2.

[b]Covariates include $\widehat{Y}$ (structural model) or Y (reduced-form model); age; age, squared; female; education; marital status; employment status; county gaming by 2003 (reduced-form model); county unemployment rate, 1990; county per capita income, 1990; county percentage poverty, 1990; county doctors per capita; and survey year.

[c]Coefficients on $\widehat{Y}$.

[d]Robust standard errors.

[e]$\left[\left(b\left[\widehat{Y}\right]/\text{Mean}\right) \times 100\right] \times 1.75$.

[f]$\left[\left(b\left[\widehat{Y}\right]/\text{Mean}\right) \times 100\right] \times 6$.

[g]Coefficients on Y.

[h]$(b[Y] / \text{Mean}) \times 100$.

*$p < .05$; **$p < .01$; ***$p < .001$

Column 6 indicates the percentage change in the health-related variables associated with an alternative gain in income attributed to the presence of a casino—a $6,000 change in income—reflecting the estimated average income increase from the initiation of gaming in the Great Smoky Mountains Study area in North Carolina (Akee et al. 2008).[13] Online Resource 3 shows the full estimated model for two of the health-related variables: smoking and binge drinking.

The relationship of the casino-induced increase in income to physical health is positive for each measure. The effect is statistically significant for obesity, being overweight, or having hypertension or diabetes. Among the health-related behaviors, the coefficients on both smoking and heavy drinking are negative, large, and statistically significant. We also find that the predicted income increase associated with gaming ($\widehat{Y}$) is associated with improved mental health; the coefficients on days of poor mental health, depression, and anxiety last month are all negative, although only the coefficient on days of anxiety last month is statistically significant. We find a positive association between tribal gaming and having health insurance and, unexpectedly, on forgone care; however, the coefficients are not significant.

Overall, the results clearly suggest that the exogenous increase in income from casino gaming is tied to an improvement in health, mental health, and health-related behaviors. The largest percentage improvements are for smoking (an average decrease of 9.6%) and anxiety (an average decrease in days anxious of 7.3%). The income produced by casino gaming reduces the probability of heavy drinking by about 5.2%, and those of being obese or overweight, being hypertensive, or having diabetes by between 2% and 4%.

Sensitivity Tests

In a first sensitivity test, we substitute actual reported income for the predicted income ($\widehat{Y}$) values. Second, we test our model using only those American Indians living in nonmetropolitan areas; these estimates are more likely to accurately measure the influence of belonging to a tribe that has casino gaming because American Indians living in an urban area are likely to live apart from the reservation and may therefore be misidentified as not belonging to a tribe with casino gaming. Finally, we test for the sensitivity of using midpoints of the income categories by estimating an income equation using intervals.

Estimates from Reduced-Form Health Models

We estimated a one-stage direct model of the influence of income on health, using reported income:

$$\mathbf{H} = \mathbf{H}(Y, \mathbf{X}, U), \tag{3}$$

where $\mathbf{H}$ is a vector of health outcomes, Y is reported income, $\mathbf{X}$ is a vector of exogenous variables that affect health, and U is an unmeasured third factor or error term that is assumed to be uncorrelated with $\mathbf{X}$ and Y. This estimate does not account

[13] We use this value because the Akee study better identified members of eligible tribes than we are able to do. Alternatively, it is an estimate based on only one tribe.

for the potential endogeneity of income (Y). We include individual and county (before the introduction of most casinos) variables, year dummy variables, and the *Restricted Sample = 1* variable. These results are reported in Table 3, columns 7–9, and are compared with those of the two-stage structural model described in Table 3, columns 3–6.

In general, reported income has effects on the health-related variables that are similar to those using predicted income. However, the levels of statistical significance are greater using Y rather than $\widehat{Y}$. For example, although nearly all the estimated Y and $\widehat{Y}$ coefficients have the hypothesized signs, the coefficients on Y are strongly statistically significant for all health indicators, while only about one-half of the coefficients on $\widehat{Y}$ reach this level of statistical significance.

Estimates of Income Effects by Urban/Rural Residence

Many American Indian tribes are located in nonmetropolitan areas, and many of these tribes have lower incomes than those based in metropolitan areas, raising the question of whether Eq. 1 applies to both urban and rural American Indians. *A priori*, we expect the model to more accurately measure the relationship between casino gaming and income in rural areas because we are able to more accurately identify membership in a tribe with or without a casino in rural areas. Hence, we separately estimate Eq. 1 for rural and urban American Indians. Our findings (available from the authors upon request) suggest that the effect of casino gaming on income is larger for the 30% of our observations who live in rural areas ($2,792; $n = 5{,}532$) than for those who live in metropolitan areas ($631; $n = 15{,}810$).[14]

Estimates of Health Effects for Rural Residents

The strong results for the nonmetropolitan income estimates suggest that estimating health effects for this population will also enable us to better measure the income effects on the health-related variables. In Table 4, columns 3–6, we show the two-stage structural model results for those American Indians in nonmetropolitan areas; these are to be compared with the estimates in Table 3, columns 3–6. With this smaller sample (30% of the total), the results from both the structural and reduced-form estimates (columns 7–9) are consistent with our primary full sample estimates, although there are fewer statistically significant findings for both models. In particular, for this population, we find a negative and significant relationship between $\widehat{Y}$ and obesity and overweight (about 5%); and between $\widehat{Y}$ and diabetes (nearly 13%). The only other outcomes significantly associated with $\widehat{Y}$ suggest a modest increase in diabetes, poor mental health days, and forgone care. The signs of the remaining outcomes, although not statistically significant, are generally of the expected sign, suggesting an improved health-related outcome as income increases.

[14] We conjecture that part of the reason for this difference is the greater difficulty in associating those residing in metropolitan areas with whether their tribe has one or more casinos, or whether they are official members of a tribe.

Table 4 Regression of health outcomes on income ($\widehat{Y}$ and Y), nonmetropolitan American Indians

			Structural Model[a]				Reduced-Form Model		
Outcome[b]	*N* (1)	Mean (2)	*b*[c] (3)	SE[d] (4)	% Change[e] (5)	% Change × $6,000[f] (6)	*b*[g] (7)	SE[d] (8)	% Change[h] (9)
Risk Behaviors									
Smoking	6,196	0.4254	–0.0015	0.0049	–0.9556	–2.0551	–0.0009	0.0003**	–0.2047
Heavy drinking	4,809	0.0530	0.0011	0.0015	5.6358	12.1199	0.0000	0.0001	0.0311
Binge drinking (days last month)	949	4.6544	0.1462	0.1145	8.7634	18.8460	–0.0058	0.0088	–0.1239
Health Indicators									
Obesity	6,044	0.6085	–0.0113	0.0038**	–5.1989	–11.1805	–0.0006	0.0004	–0.0978
Overweight	6,045	0.6882	–0.0119	0.0033***	–4.8419	–10.4126	–0.0007	0.0003*	–0.1055
Poor/fair health	5,706	0.2574	–0.0026	0.0032	–2.8503	–6.1296	–0.0026	0.0004***	–1.0242
Hypertension	5,159	0.2345	–0.0027	0.0038	–3.1535	–6.7818	–0.0004	0.0003	–0.1517
Diabetes	6,195	0.1400	–0.0064	0.0023**	–12.7722	–27.4670	–0.0008	0.0002***	–0.5553
High cholesterol	2,907	0.3189	0.0100	0.0049*	8.7323	18.7791	–0.0006	0.0004	–0.1728
Asthma	3,948	0.1006	0.0045	0.0024	12.4903	26.8609	–0.0006	0.0003	–0.5784
Disability	1,079	0.2753	0.0022	0.0073	2.2502	4.8392	–0.0011	0.0009	–0.4128
Health Care Utilization									
Health plan	5,929	0.7183	0.0057	0.0064	2.2292	4.7939	0.0043	0.0004***	0.6030
Forgone care	5,068	0.1507	0.0056	0.0026*	10.3834	22.3298	–0.0022	0.0003***	–1.4554

Table 4 (continued)

			Structural Model[a]				Reduced-Form Model		
Outcome[b]	*N* (1)	Mean (2)	*b*[c] (3)	SE[d] (4)	% Change[e] (5)	% Change × $6,000[f] (6)	*b*[g] (7)	SE[d] (8)	% Change[h] (9)
Mental Health (days last month)									
Poor mental health	4,912	4.3294	0.2127	0.0659**	13.7072	29.4777	–0.0062	0.0071	–0.1424
Depression	242	5.2149	–0.1276	0.3253	–6.8255	–14.6785	–0.0374	0.0203	–0.7178
Anxiety	471	7.2442	–0.4055	0.2876	–15.6187	–33.5886	–0.0223	0.0385	–0.3078

[a] OLS regression of income on gaming and standard covariates for nonmetropolitan subsample yields a coefficient on the casino gaming indicator of 2.79, with a standard error of 1.12. The full set of coefficients and standard errors is available from the authors upon request.

[b] Covariates include $\widehat{Y}$ (structural model) or Y (reduced-form model); age; age, squared; female; education; marital status; employment status; county gaming by 2003 (reduced-form model); county unemployment rate, 1990; county per capita income, 1990; county percentage poverty, 1990; county doctors per capita; and survey year.

[c] Coefficients on $\widehat{Y}$.

[d] Robust standard errors.

[e] $\left[\left(b\left[\widehat{Y}\right]/\text{Mean}\right) \times 100\right] \times 2.79$.

[f] $\left[\left(b\left[\widehat{Y}\right]/\text{Mean}\right) \times 100\right] \times 6$.

[g] Coefficients on Y.

[h] $(b[Y] / \text{Mean}) \times 100$.

*$p < .05$; **$p < .01$; ***$p < .001$

Income Intervals Versus Midpoints

Finally, in order to address whether our use of interval midpoints of the income categories reported in the BRFSS data biased our estimate of Eq. 1, we also estimated this equation using income intervals instead of midpoints.[15] The results from this interval estimation show an increase in income owing to the presence of a casino to be $1,395, or an increase of 4.2%, similar to the 5.3% estimate using midpoints. In both cases, the coefficient on gaming is significant at the $p < .01$ level.

Conclusion

Our estimates contribute to the ongoing debate regarding the impact of an important and publicly contentious social policy—the stimulation of local economic development through casino gaming—on the income and health of American Indians. Overall, our results suggest that association with a tribe with Class III gaming leads to higher income, fewer risky health behaviors, better physical health, and perhaps increased access to health care.

Our findings also provide evidence regarding the link between income and health. Using the natural experiment, which links an exogenous increase in income attributable to casino gaming to health and health-related behaviors, we find clear evidence of improvements in health and health-related behaviors associated with increases in income. Additional income appears to lead to decreases in smoking, heavy drinking, obesity, hypertension, diabetes, and days of anxiety. These results are consistent with those of other studies (noted earlier) that focus on the effect of exogenous income increases on particularly vulnerable or low-income populations.

To suggest the potential magnitude of the effect of the increase in income associated with gaming, consider the implications of the change in income related to gaming—$6,000—found in the Great Smoky Mountains Study (Costello et al. 2003) (see column 6 in Table 3). These results suggest that the income generated by casino gaming is likely to have a substantial influence in changing risk-taking behaviors, reducing the probability of smoking by more than 32% and of heavy drinking by nearly 18%; to influence numerous indicators of health (including diabetes (–11%), obesity, overweight (–8%–9%), and hypertension (nearly –11%)); and to improve mental health (fewer days with anxiety (–25%)). The small estimated effect on access to health care is perhaps related to a small increase in employer-related health insurance (because of the relatively small American Indian employment effect of casino gaming), and to the important role of the Indian Health Service in providing access to health care.

These estimated results suggest that an exogenous increase in income in poor communities through policies that promote economic development may improve both health status and overall well-being. To the extent that communities use the

[15] The intervals used in this analysis, based on the data collected in BRFSS, are <$10,000; $10,000–$15,000; $15,000–$20,000; $20,000–$25,000; $25,000–$35,000; $35,000–$50,000; and >$50,000 for those first observed in the 1998–1993 period. For those first observed in the 1994–2003 period, the highest interval is broken in two: $50,000–$75,000 and >$75,000. All these intervals are converted to year 2000 dollars in the interval regression analysis.

income growth and economic development to initiate investments in social and economic infrastructure, to promote culturally appropriate wellness strategies, and invest in human capital, effective economic development programs may foster long-run and dynamic improvements in health and well-being. Moreover, the income increases from effective economic development policies may reduce anxiety and stress, lead to improved diets, encourage the location of medical providers in or close to the community,[16] and improve choices that may also lead to long-term improvements in health and well-being.

Two caveats remain. First, because of the conventions adopted in the BRFSS data set, we had to use categorical information rather than continuous data to measure income. Second, we assigned American Indians to tribes with gaming according to county of residence. Both conventions suggest the possibility of measurement error and could lead to an underestimation of the influence of the income induced by gaming on both household income and health/health-related behaviors.

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Appendix: Construction of the Data Set

Gaming and American Indian Tribes

To identify American Indian tribes with Class III gaming, we begin with the extensive tribal gaming data collected by Evans and Topoleski (2002).[17] We then supplement this information with the following:

1. Exhaustive casino-by-casino data with specific information on the locations and characteristics of nearly all American Indian gaming facilities in the contiguous

[16] For example, during the 1989–2003 period, the number of medical providers per capita increased in counties that established a casino compared with the counties with American Indians in our sample that had no casino.

[17] The Evans-Topoleski data consisted of a complete list of nongaming tribes and gaming tribes both with and without compacts (including dates of gaming compacts, opening dates of tribes' first casinos, number of slots in tribes' first casinos, and square footage of tribes' first casinos), compiled from several Internet sources (i.e., Bureau of Indian Affairs website, National Indian Gaming Commission website, Gamblinganswers.com, and Casinocity.com), as well as popular press articles, phone correspondence, and tribal casino websites. The U.S. Census Bureau's publication *General Population Characteristics: American Indian and Alaska Native Areas* (based on the 1990 census; U.S. Census Bureau 1990) was used to determine the state and county location(s) of federally recognized tribal land; county data (rather than individual data) were used in analyzing the economic impacts of legalizing gambling among American Indians. Evans and Topoleski found that four years after tribes opened casinos, employment had increased by 26%, and the fraction of adults who worked but were poor declined by 14%. They were able to study only limited health effects.

48 states that have survived to 2005, providing gaming facility–specific information on tribal affiliation, county of location, the presence of a Class III gaming compact or casino-style gaming, and date of facility opening.[18]

2. A tribal-level data set containing summary gaming data for each tribe, including the opening year of the first tribal gaming facility, constructed from the detailed gaming facility data plus additional information on the geographic location of all tribal reservation land to the tribal level data. By matching tribes to BRFSS respondents' county of residence, we obtain the county of residence of each individual observation.[19]

Individual-Level Health, Income, and Socioeconomic Data

We use the Behavioral Risk Factors Surveillance System (BRFSS), sponsored by the U.S. Centers for Disease Control and Prevention, to obtain information on income and health-related variables of both American Indian and non–American Indian individuals.[20] In addition to health information, BRFSS respondents report basic sociodemographic and socioeconomic characteristics, as well as the county of residence.[21] BRFSS gathers information on household income levels for all years of our analysis. Income is recorded by class interval, with an open category at the top. We adjust all class intervals for inflation (year 2000 dollars) and use the midpoint of all categories. Respondents with income in the open-ended top income category are assigned an income equal to the lower limit (inflation-adjusted income) × 1.5. We compiled cross-sectional BRFSS data for the 16 years from 1988 to 2003. When aggregated, these data provide us with a large sample of American Indians ($N = 24{,}029$).

Because BRFSS does not identify the specific tribe to which an American Indian respondent belongs, we linked individual BRFSS respondents to tribes and tribal gaming by assuming tribal affiliation based on county of residence. Using this information, we match tribal information on the existence and nature of gaming to the county in which the tribal reservation is located and then to the BRFSS data containing information on American Indian status; county of residence; and individual income, health status, utilization, and behavior information. Through this procedure, we establish a geographic link between individual observations in

[18] Evans and Topoleski (2002) collected information only on tribes' first casinos. Although we include this information in our data set, we also included information on additional casinos that may be associated with gaming tribes. We excluded extremely small gaming operations, such as those at laundromats and trading posts.

[19] Information for this data set was collected from the National Indian Gaming Commission (NIGC) and the National Indian Gaming Association (NIGA) (for tribal affiliation).

[20] BRFSS is a source of timely cross-sectional prevalence data for common health status indicators, health care utilization, health care insurance coverage, health-related behaviors, and health risk factors for adults in the United States. Because the BRFSS is designed to collect prevalence data for individual states, each state conducts its own monthly random-digit-dial telephone survey. These state-by-month data are then aggregated yearly by the Centers for Disease Control and Prevention.

[21] We use the restricted-access BRFSS data in order to include respondents living in rural or sparsely populated counties. Due to confidentiality concerns, BRFSS does not allow public access to data from respondents living in a county where the annual sample is small.

the BRFSS sample and county-specific federally recognized tribal reservations and/or American Indian casinos.

County Data on Population, Health, and Economic Characteristics

We also use county-level data using the Area Resource File (ARF), available from the U.S. Department of Health and Human Services.[22] ARF contains information on the availability and aggregate utilization of health resources and facilities, population, and economic data for each county. We employ nearly all available data on economic/employment conditions for each county as of 1990, which is prior to the beginning of casino gaming for most tribes. We link these data to individual BRFSS respondents based on their county of residence. These indicators allow us to control for the environmental and economic conditions, including health care availability, in the counties in which American Indians live, and thus to avoid issues of selectivity in which tribes establish casinos.

References

Akee, R., Copeland, W., Costello, E. J., Angold, A., & Keeler, G. (2008). *Educational attainment, drug use and casino payments: Young adult outcomes from a quasi-experiment in Indian country* (Working paper). Retrieved from http://www.eea-esem.com/files/papers/EEA-ESEM/2008/2230/Akee_Draft.pdf

American Indian Policy Center (AIPC). (2005). *Tribal governments in 2010—Tribal gaming*. St. Paul, MN: AIPC. Retrieved from http://www.americanindianpolicycenter.org/projects/f96gaming.html

Area Resource File (ARF). (2008). Rockville, MD: U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions.

Case, A. (2004). Does money protect health status? Evidence from South African pensions. In D. Wise (Ed.), *Perspectives on the economics of aging* (pp. 287–305). Chicago, IL: University of Chicago Press.

Case, A., Lubotsky, D., & Paxson, C. (2002). Economic status and health in childhood: The origins of gradient. *American Economic Review, 92,* 1308–1334.

Centers for Disease Control and Prevention (CDC). (1988–2003). *Behavioral Risk Factor Surveillance System Survey Data*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

Condliffe, S., & Link, C. R. (2008). The relationship between economic status and child health: Evidence from the United States. *American Economic Review, 98,* 1605–1618.

Costello, E. J., Compton, S. N., Keeler, G., & Angold, A. (2003). Relationship between poverty and psychopathology: A natural experiment. *Journal of the American Medical Association, 290,* 2023–2029.

Costello, E. J., Erkanli, A., Copeland, W., & Angold, A. (2010). Association of family income supplements in adolescence with development of psychiatric and substance use disorders in adulthood among an American Indian population. *Journal of the American Medical Association, 303,* 1954–1960.

Currie, J., & Lin, W. (2007). Chipping away at health: More on the relationship between income and child health. *Health Affairs, 26,* 331–344.

[22] The Area Resource File is a "national county-level health resources information system designed to be used by planners, policymakers, researchers, and other analysts interested in the nation's health care delivery system and factors that may impact health status and health care in the United States. The ARF database contains statistics on the following categories of health resources: health professions, health training programs, health facilities, measures of resource scarcity, and health status. The system contains information on more than 6,000 variables for each of the nation's counties." See the Health Resources and Services Administration website (http://www.arfsys.com) for details on this data source.

Currie, J., & Stabile, M. (2003). Socioeconomic status and child health: Why is the relationship stronger for older children? *American Economic Review, 93,* 1813–1823.

Evans, W. N., & Topoleski, J. H. (2002). *The social and economic impact of Native American casinos* (NBER Working Paper No. 9198). Cambridge, MA: National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w9198

Fernand, L. C. H., Gertler, P. J., & Neufeld, L. M. (2008). Role of cash in conditional cash transfer programmes for child health, growth, and development: An analysis of Mexico's *Opportunidades*. *Lancet, 371,* 828–837.

Frijters, P., Haisken-DeNew, J. P., & Shields, M. A. (2005). The causal effect of income on health: Evidence from German reunification. *Journal of Health Economics, 24,* 997–1017.

Gonzales, A. A. (2003). Gaming and displacement: Winners and losers in American Indian Casino development. *International Social Science Journal, 55,* 123–133.

House, J. (2002). Understanding social factors and inequalities in health: 20th century progress and 21st century prospects. *Journal of Health & Social Behavior, 43,* 125–142.

Khanama, R., Nghiemb, H. S., & Connelly, L. B. (2009). Child health and the income gradient: Evidence from Australia. *Journal of Health Economics, 28,* 805–817.

Lillie-Blanton, M., & Roubideaux, Y. (2005). Understanding and addressing the health care needs of American Indians and Alaska natives. *American Journal of Public Health, 95,* 759–761.

Link, B. G., & Phelan, J. C. (1996). Understanding sociodemographic differences in health—The role of fundamental social causes. *American Journal of Public Health, 86,* 471–472.

Menchik, P. L. (1993). Economic status as a determinant of mortality among black and white older men: Does poverty kill? *Population Studies, 47,* 427–436.

Murasko, J. E. (2008). An evaluation of the age-profile in the relationship between household income and the health of children in the United States. *Journal of Health Economics, 27,* 1489–1502.

National Indian Gaming Association (NIGA). (2008). *National Indian Gaming Association 2008 economic impact report.* Retrieved from http://www.indiangaming.org/info/pr/press-releases-2009/NIGA_08_Econ_Impact_Report.pdf

Redelmeier, D. A., & Singh, S. M. (2001). Survival in Academy Award–winning actors and actresses. *Annals of Internal Medicine, 134,* 955–962.

Ruhm, C. J. (2005). Healthy living in hard times. *Journal of Health Economics, 24,* 341–363.

Rutter, M. (2007). Proceeding from observed correlation to causal inference: The use of natural experiments. *Perspectives on Psychological Science, 2,* 377–395.

Smith, J. P., & Kington, R. (1997). Demographic and economic correlates of health in old age. *Demography, 34,* 159–170.

Taylor, J., & Kalt, J. (2005). *American Indians on reservations: A databook of socioeconomic change between the 1990 and 2000 censuses*. Cambridge, MA: The Harvard Project on American Indian Economic Development.

U.S. Census Bureau. (1990). *General population characteristics: American Indians and Alaska native areas* (Census Report CP-1-1A). Washington, DC: U.S. Census Bureau. Retrieved from http://www.census.gov/prod/cen1990/cp1/cp-1.html

U.S. Census Bureau. (1994). *Phoneless in America* (Statistical Brief SB/94-16). Washington, DC: U.S. Census Bureau.

U.S. Census Bureau. (2007). *The American community—American Indians and Alaska Natives: 2004 (American Community Survey Report ACS-07)*. Washington, DC: U.S. Census Bureau.

U.S. National Center for Health Statistics (NCHS). (2007). *Health, United States, 2007 with chartbook on trends in the health of Americans*. Hyattsville, MD: NCHS. Retrieved from http://www.cdc.gov/nchs/data/hus/hus07.pdf#058

Wilkinson, R. G. (1990). Income distribution and mortality: A natural experiment. *Sociology of Health and Illness, 12,* 391–412.

Williams, D. R., & Collins, C. (1995). U.S. socioeconomic and racial differences in health: Patterns and explanations. *Annual Review of Sociology, 21,* 349–386.