CASINOS, CRIME, AND COMMUNITY COSTS

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Abstract—We examine the relationship between casinos and crime using county-level data for the United States between 1977 and 1996. Casinos were nonexistent outside Nevada before 1978, and expanded to many other states during our sample period. Most factors that reduce crime occur before or shortly after a casino opens, whereas those that increase crime, including problem and pathological gambling, occur over time. The results suggest that the effect on crime is low shortly after a casino opens, and grows over time. Roughly 8% of crime in casino counties in 1996 was attributable to casinos, costing the average adult $75 per year.

I. Introduction

PRIOR to 1978, there were no casinos in the United States outside Nevada. Since 1990, casinos have expanded to the point where the vast majority of Americans now have relatively easy access to one. This paper utilizes the natural experiment created by casino openings to examine how casinos affect crime. There are many reasons why understanding this link is particularly valuable. First, the casino industry has grown rapidly in the last decade and has become one of the most controversial and influential industries. Commercial casino revenues increased 203% from $8.7 billion to $26.3 billion between 1990 and 2000. Including Class III American Indian casinos, revenues were $38.8 billion, or $200 per adult, in 2001. Casino industry revenues are comparable to those of the cigarette market, and all forms of gambling total more than seven times the amount spent on theater tickets.[1] From 1982 to 2000, GDP increased 201% while casino revenues increased more than 660%. This rapid expansion generated extensive debate about the impact of casinos on many social, economic, and political issues.[2]

Second, the casino industry has become a major lobbying presence. Between 1992 and 1997, $100 million was paid in lobbying fees and donations to state legislators (Harvard Medical School, 1997). Concerns were sufficiently pronounced that the U.S. Congress established the National Gambling Impact Study Commission (NGISC) in 1996 to study casinos exhaustively. Its final report called for additional research about the effects of casinos and a moratorium on further expansion.

Third, research suggests that on a national basis casino gambling generates externality costs in the range of $40 billion annually,[3] and crime is one of the biggest components of these social costs.

Last and most important, in spite of the substantial attention devoted to the casino-crime link, there is a paucity of convincing research about it. Economists have been virtually silent, and studies from other disciplines typically exhibit many fundamental weaknesses. First, no study has examined the intertemporal effect of casinos, which we contend is essential to understanding the relationship. Second, nearly every study used small samples, most frequently Las Vegas, Atlantic City, Reno, and Deadwood (Albanese, 1985; Lee & Chelius, 1989; Friedman, Hakim, & Weinblatt, 1989; Buck, Hakim, & Spiegel, 1991; Chiricos, 1994; Margolis, 1997) or Wisconsin (Thompson, Gazel, & Rickman, 1996a; Gazel, Rickman, & Thompson, 2001), or a selection of a handful of casino markets (Albanese, 1999). Four of these studies conclude that casinos increase crime, two argue that there is no effect, and one maintains that Florida regions with casinos have lower crime rates than selected Florida tourist cities if visitors are included in the population base denominator.

Another problem with the existing research is that some studies (Albanese, 1999; Hsing, 1996) reached conclusions about crime rates without actually examining crime rates. Instead of analyzing offenses, they used arrests, but did not discuss the problems inherent in using arrest rates to infer anything definitive about crime rates.

A fourth criticism is that most studies are subject to substantial omitted variable bias because they rarely controlled for variables that affect crime. Margolis (1997), Florida Department of Law Enforcement (1994), and Florida Sheriffs Association (1994) included no control variables. Nearly all of the other studies control for very few factors.

Fifth, the literature has generally neglected discussing the theoretical links between casinos and crime, as Miller and Schwartz (1998) document in detail.

Last, many studies were agenda-driven, conducted or funded by either progambling or law enforcement organizations. Nelson, Erickson, and Langan (1996), Margolis (1997) and Albanese (1999) were funded by explicitly progambling groups. As expected, they concluded that gambling had no impact on crime. The Florida Department of Law Enforcement (1994) and Florida Sheriffs Association (1994), which both opposed casinos, concluded that crime and drunk driving increased in Atlantic City and Gulfport, MS, as a result of casinos.

The General Accounting Office (GAO) and NGISC concluded that definitive conclusions cannot yet be reached

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[1] 1997 cigarette sales were $45 billion. 2002 theater ticket and gambling revenues were $9.3 and $68.7 billion.

[2] Kindt (1994), Grinols (1996), Henriksson (1996), and Grinols and Omorov (1996) discussed a number of these.

[3] See, for example, Grinols and Mustard (2001, p. 155) and Grinols (2004, p. 170).

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about the casino-crime link. According to the GAO (2000, p. 35), "In general, existing data were not sufficient to quantify or define the relationship between gambling and crime. . . . Although numerous studies have explored the relationship between gambling and crime, the reliability of many of these studies is questionable." This paper contributes to the literature on this important issue by addressing each of the above limitations.

The paper is organized as follows. Section II explains the data we use. Section III analyzes the theoretical links between casinos and crime, and section IV outlines our estimation strategy. Section V discusses our basic empirical results, and section VI extends the results to border counties. Section VII concludes. We find that crime increases over time in casino counties, and that casinos do not just shift crime from neighboring regions, but create crime. We estimate the crime-related social costs in casino counties at approximately $75 dollars per adult per year.

II. Data

Our sample covers all 3,165 U.S. counties from 1977 to 1996. The Federal Bureau of Investigation's (FBI) Uniform Crime Report[4] provided the number of arrests and offenses for the seven FBI Index I offenses: aggravated assault, rape, robbery, murder, larceny, burglary, and auto theft.[5] With the exception of Alaska, the county jurisdictions remained unchanged over our sample period.

We used U.S. Census Bureau data for demographic control variables, including population density per square mile, total county population, and population distributions by race, age, and sex.[6] The Regional Economic Information System, of the Bureau of Commerce, provided data on income, unemployment, income maintenance transfers, and retirement.[7]

The natural operating measure for casinos is gross revenue or profits. Unfortunately, such panel data do not exist—American Indian casinos are not required to report revenues. We therefore used the year a county first had an operating Class III[8] gambling establishment, including riverboat casinos, American Indian casinos, land-based casinos, and, in the case of Florida and Georgia, "boats to nowhere"—cruises that travel outside U.S. boundary waters so passengers can gamble. Not all forms of gambling qualify as casinos. For example, Montana has hundreds of small gambling outlets that offer keno or video poker, many in gas stations along the highway. Also, California has many card houses, some of which were illegal. These establishments are distinct from casinos in size and type of play.

To obtain casino opening dates we first contacted state gaming authorities. In cases like Washington, this was an expeditious way to ascertain the first year a casino opened. However, even the central gaming authorities and Indian affairs committees often lacked information on Indian casinos. Therefore, in most states we called each casino to obtain its opening date or first date of Class III gambling if it had previously operated other forms of gambling.[9] We also used lists from the Casino City Web site, www.casinocity.com, which lists casinos in every state, and verified it against the annually produced *Casinos: The International Casino Guide* (B.D.I.T., 1997).

Table 1 presents summary statistics for casino and noncasino counties. Noncasino counties had no casino in any year of the sample. Casino counties had a casino in operation during one or more years of the period. Casino counties had higher population, land area, income, and crime rates. The regressions later in the paper show no statistically significant differences between casino and noncasino preopening crime rates when control variables are included.

[4] U.S. Department of Justice, FBI, *Uniform Crime Reports: County-Level Detailed Arrest and Offenses Data, 1977–1996*, Washington, DC: U.S. Department of Justice, FBI; Ann Arbor, MI: Inter-university Consortium for Political and Social Research (ICPSR, distributor).

[5] The definitions are listed in *Crime in the United States: 1993* (U.S. Department of Justice, Federal Bureau of Investigation), Appendix H, pp. 380–381.

[6] ICPSR (8384): "Intercensal Estimates of the Population of Counties by Age, Sex and Race (U.S.): 1970–80, "U.S. Department of Commerce, Bureau of the Census, Winter 1985, ICPSR, Ann Arbor, MI 48106. "Intercensal Estimates of the Population of Counties by Age, Sex and Race: 1970–1980 Tape Technical Documentation," U.S. Bureau of the Census, Current Pop. Reports, Series P-23, 103, "Methodology for Experimental Estimates of the Population of Counties by Age and Sex: July 1, 1975." U.S. Bureau of the Census, Census of Population, 1980: "County Population by Age, Sex, Race and Spanish Origin" (preliminary OMB-consistent modified race).

[7] Income maintenance includes Supplemental Security Insurance (SSI), Aid to Families with Dependent Children (AFDC), food stamps, and other income maintenance (which includes general assistance, emergency assistance, refugee assistance, foster home care payments, earned income tax credits, and energy assistance). Unemployment insurance benefits include state unemployment insurance compensation, Unemployment Compensation for Federal Civilian Employees (UCFE), Unemployment for Railroad Employees, Unemployment for Veterans (UCX), and other unemployment compensation (which consists of trade readjustment allowance payments, Redwood Park benefit payments, public service employment benefit payments, and transitional benefit payments). Retirement payments included old age survivor and disability payments, railroad retirement and disability payments, federal civilian employee retirement payments, military retirement payments, state and local government employee retirement payments, federal and state workers' compensation payments, and other forms of government disability insurance and retirement pay.

[8] According to the Indian Gaming Regulatory Act of 1988, Class I gambling consists of "social games solely for prizes of minimal value." Included in Class I gambling are traditional Indian games identified with tribal ceremonies and celebrations. Class II gambling includes bingo and "games similar to bingo." Class III gambling includes "all forms of gaming that are not Class I gaming or Class II gaming," such as blackjack, slot machines, roulette, and other casino-style games.

[9] We distinguish the operation date of Class III casinos from other dates such as the legislation date to authorize casinos and the operation date of Class I or II establishments. Within a state, different counties acquired casinos at different times. Also, bingo halls operated by American Indians converted to Class III gambling during our sample. Nevada legalized commercial casino gambling (in 1931) prior to the start of our sample. Excluding Nevada from our sample slightly increased the magnitude of the estimated casino-crime effect. For example, when Nevada was excluded from the table 4 regressions, 39 of the 42 post-opening coefficient estimates became more positive or less negative. Excluding New Jersey, whose Atlantic City casinos opened in 1978, produced similar results.

TABLE 1.—DEMOGRAPHIC AND CRIME DATA: CASINO VERSUS NONCASINO COUNTIES

Variable	Casino Counties			Noncasino Counties		
	Mean	Std. Dev.	Sample Size	Mean	Std. Dev.	Sample Size
Population	145,330	288,149	3,533	73,209	252,381	59,053
Population density (pop./sq. mi.)	204	491	3,533	217	1,462	59,045
Area (square miles)	2,021	3.056	3,533	1,008	2,883	59,060
Per capita personal income	$11,306	$2,689	3,533	$10,808	$2,618	59,040
Per capita unemployment ins.	$78	$54	3,533	$65	$51	59,024
Per capita retirement comp.	$10,771	$6,544	3,538	$9,831	$6,243	59,028
Aggravated assault rate	259	276	3,245	188	245	54,551
Rape rate	29	28	3,182	20	32	53,882
Robbery rate	82	136	3,254	44	143	54,623
Murder rate	5.9	9.3	3,254	5.5	10.5	54,628
Larceny rate	2,548	1,423	3,254	1,738	1,940	54,622
Burglary rate	1,056	666	3,254	770	1,110	54,619
Auto theft rate	267	264	3,254	167	276	54,627

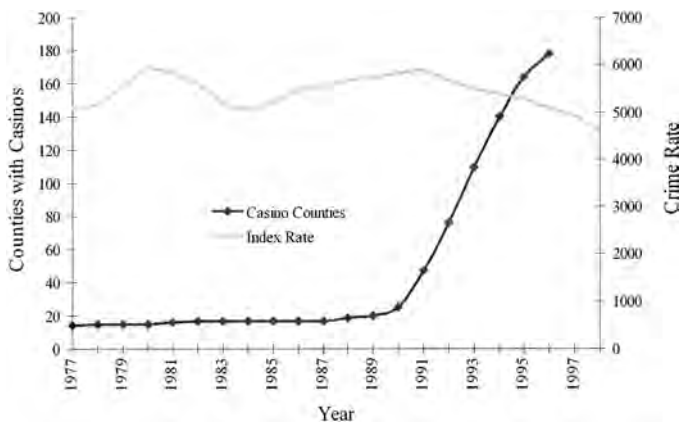
Notes: Crime rates are annual incidents per 100,000 population. Monetary amounts are in 1982–1984 dollars.

The differences in the crime rates are due to the postopening differences between casino and noncasino counties.

Between 1977 and 1996 the number of states with some form of casino gambling rose from 1 to 29. Counties with casinos grew from 14 (all in Nevada) to nearly 180. The Indian Gaming Regulatory Act of 1988 increased the number of Indian casinos by mandating that states allow American Indian gambling on trust lands if the state sanctioned the same gambling elsewhere. The semisovereign status of Indian tribes and their management by the Federal Bureau of Indian Affairs gave them greater leverage with the states. By 1996, 21 states permitted casinos on Indian reservations.

Figure 1 shows the relationship between the number of counties with casinos (left scale) and the crime rate (right scale). The crime rate fluctuated between 1977 and 1990 when the number of casinos was relatively constant. However, between 1990 and 1996, when the number of counties with casinos increased rapidly, the crime rate dropped substantially. This contemporaneous casino growth and crime reduction is important. Some have used these data to suggest that casinos reduced crime. For example, Margolis (1997) stated. "Crime rates in Baton Rouge, LA have decreased every year since casino gaming was introduced." However, most regions experienced falling crime rates after 1991. Therefore, it is more appropriate to compare the magnitude of the decreases between casino and noncasino counties. We provide two comparisons of this type. Each suggests that crime rates in counties that opened casinos during our sample increased relative to crime rates in noncasino counties.

FIGURE 1.—INDEX CRIME RATE AND NUMBER OF COUNTIES WITH CASINOS: UNITED STATES, 1977–1998



The first example, shown in figure 2, contrasts the crime rate for casino and noncasino counties between 1991 and 1996. FBI Index I offenses were summed by year for casino counties. Average crime rates for 1991–1996 were calculated by dividing these totals by the populations of the counties in the corresponding years. The series was then scaled to take the value 100 in the year 1991. The same procedure was applied to noncasino counties.[10] Though crime dropped in both sets of counties, crime dropped 12.0 percentage points more in counties without casinos than in casino counties. The absolute reduction in crime in noncasino counties (90.3 offenses per 100,000) was approximately 3 times as large as the reduction (30.6 offenses per 100,000) in counties that opened a casino.

The second example, shown in figure 3, presents casino-county crime data centered on the year of opening, where the average crime rate for the two years prior to casino opening and the year of opening is set to 100. Crime rates were stable prior to opening, were slightly lower in the year of casino introduction, returned to approximately average levels for the next two or three years, and increased thereafter. By the fifth year after introduction, robbery, aggravated assaults, auto theft, burglary, larceny, rape, and murder were 136%, 91%, 78%, 50%, 38%, 21%, and 12% higher, respectively. These effects by year after introduction

[10] Data on Florida are excluded from figure 2 because it changed its crime reporting from summary-based to incident-based on January 1, 1988, and switched back to summary-based in 1995. Crime data are missing in the transition years. However, a Florida-only analysis is consistent with figure 2. Between 1977 and 1995 Florida counties that opened casinos experienced greater growth than noncasino counties in murder, rape, robbery, aggravated assault, burglary, larceny, and auto theft (19.9, 29.3, 27.3, 33.6, 7.7, 16.9, and 81 percentage points higher, respectively).

suggest the need to estimate lead and lag structures to identify the relevant time dependencies.

III. Theory

Previous studies focused on the empirical relationship between casinos and crime, but neglected theoretical explanations of how casinos affect crime. We present two reasons why crime could decrease and five reasons why crime could increase. We then discuss their different effects over time, an essential, but previously ignored issue. These factors are not mutually exclusive, and our empirical results estimate the total effect of these factors.

A. Theoretical Connections between Casinos and Crime

Casinos might reduce crime directly by improving legal earning opportunities, or indirectly through development effects.

Wage Effects: Grogger (1997) argued that increases in wages reduce crime, and Gould, Weinberg, and Mustard (2002) showed that increased employment and wages of low-skilled individuals reduce crime. Therefore, if casinos provide greater labor market opportunities to low-skilled workers, they should lower crime. Evans and Topoleski (2002) contend that when casinos are opened by American Indians, the fraction of adults who are poor, who are more likely to commit crime, declines by 14% and that employment increases significantly.

Development: Casinos may reduce crime indirectly through development effects. In the Midwest, for example, legislation decriminalizing casino gambling cited economic development as its rationale. Decaying waterfronts and derelict sections of town that once harbored crime may be less amenable to it when renovation occurs, streetlights appear, and resident presence increases. The streets near Las Vegas casinos, even at night, are often cited as some of the safest.

FIGURE 2.—CASINO-COUNTY VERSUS NONCASINO-COUNTY CRIME RATES

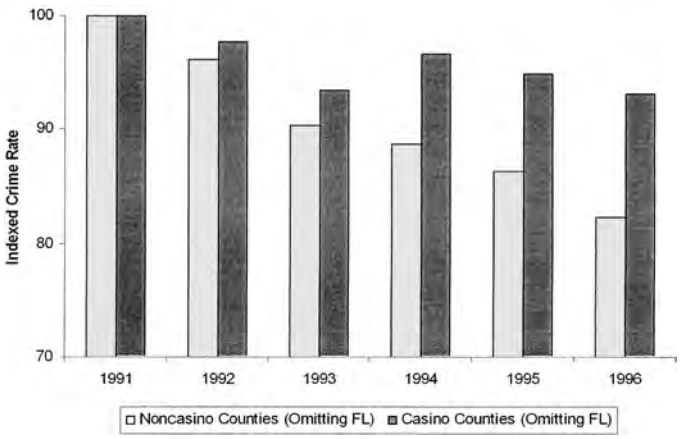
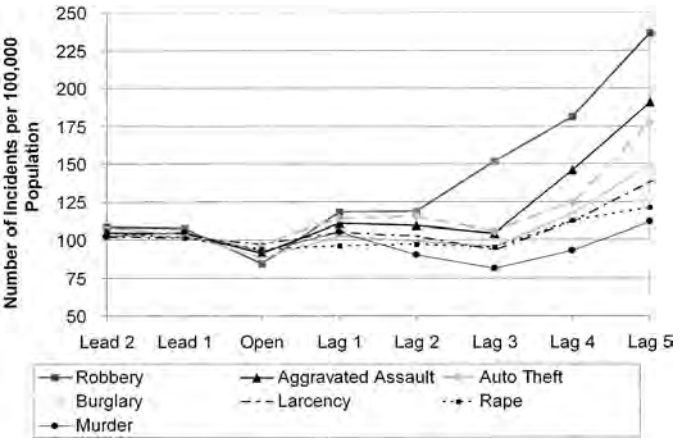


FIGURE 3.—CRIME BEFORE AND AFTER CASINO OPENING: CASINO COUNTIES, OMITTING FLORIDA IN 1988, 1996



Likewise, casinos may increase crime through direct and indirect channels.

Development: Casinos may raise crime by harming economic development, the opposite of the indirect effect discussed above. While some commend casinos for bringing growth, others criticize them for draining the local economy, for attracting unsavory clients, and for leading to prostitution and illegal gambling-related activities.

Increased Payoff to Crime: Casinos may increase crime by lowering the information costs and increasing the potential benefits of illegal activity. Travelers are often more vulnerable to crime victimization, and because casinos attract gamblers and money, there is an increased payoff to crime from a higher concentration of cash and potential victims. A 1996 Kansas City case is illustrative: a local restaurant owner was followed home, robbed, and murdered in his garage after winning $3,000 at a casino (Reno, 1997). Similar stories exist in other locations with casinos.

Problem and Pathological Gambling: Crime may increase through problem and pathological gamblers. Pathological gambling is a recognized impulse control disorder of the Diagnostic and Statistical Manual (DSM-IV) of the American Psychiatric Association. Pathological gamblers (often referred to as "addicted" or "compulsive" gamblers) are identified by repeatedly failing to resist the urge to gamble, relying on others to relieve the desperate financial situations caused by gambling, committing illegal acts to finance gambling, and losing control over their personal lives and employment. Problem gamblers have similar problems, but to a lesser degree. Compared to those arrested for crime, problem and pathological gamblers are more likely to be female, are older, and have higher incomes.[11]

[11] See NGISC (1999, Tables 4–2, 4–5) and Bureau of Justice Statistics (2002, Tables 4.7–4.10, 6.13, 6.16, 6.17).

The geographical spread of casinos lowers the cost of buying the addictive good, which increases the quantity consumed by problem gamblers, as evidenced by the rapid increase in Gamblers Anonymous programs after casinos open. For example, the number of Wisconsin communities holding Gamblers Anonymous meetings grew from 6 to 29 in the seven years after Indian tribes initiated agreements with the state to open casinos in 1992. Eleven people who contacted the Wisconsin group in 1997 committed suicide because of gambling (*Chicago Tribune,* August 2, 1999). The NGISC also reported a large increase in Gamblers Anonymous from 650 chapters in 1990 to 1,328 in 1998, "a period of rapid legalized gambling expansion" (NGISC, 1999, p. 4–17).

Conversely, when gambling is restricted, the cost of consuming the addictive good increases. Beginning July 1, 2000, South Carolina banned slot machines by court order. Six months later, the number of Gamblers Anonymous groups had dropped from 32 to 11, and the attendance fell from a typical size of approximately 40 to as few as 1 or 2 (Bridwell & Quinn, 2002, p. 718). During the same time, the number of help-line calls in Horry County (Myrtle Beach) dropped from 200 per month to 0 (ibid.)

An often-cited Maryland study found that 62% of the Gamblers Anonymous group studied committed illegal acts because of their gambling (Maryland Department of Health and Mental Hygiene, 1990); 80% had committed civil offenses, and 23% were charged with criminal offenses. A similar survey of nearly 184 members of Gamblers Anonymous showed that 56% admitted stealing to finance their gambling. The average amount stolen was $60,700 (median $500), for a total of $11.2 million (Lesieur, 1998).

Visitor Criminality: Crime may also rise because casinos attract visitors who are more prone to commit and be victims of crime. Chesney-Lind and Lind (1986) suggested that one reason tourist areas often have more crime is that tourists are crime targets. However, in the following section we show that visitors to national parks do not increase crime. Therefore, if casino visitors induce crime, it is because they are systematically different from national park visitors or visitors to other attractions. The three largest single tourist attractions in the United States in 1994 were the Mall of America (Bloomington, MN), Disney World (Orlando, FL), and Branson, MO (country and western music) receiving 38, 34, and 5.6 million visitors, respectively. For comparison, Hawaii received approximately 6 million and Las Vegas received 30.3 million visitors in 1994. Visitors per resident were 1,345 for Branson, 436 for Bloomington, 188 for Orlando, and 40 for Las Vegas. If visitors of any type are the predominant mechanism for crime, Branson and Bloomington should be among the most crime-ridden places in North America. Even adding visitors to residents in the denominator to calculate diluted crime rates, the crime rate per 100,000 visitors-plus-residents was 187.3 for Las Vegas, 64 for Orlando, 16.4 for Branson, and 11.9 for Bloomington. Bloomington received 7.7 million more visitors than Las Vegas, but had a diluted crime rate less than $\frac{1}{15}$ of Las Vegas's. One indication of the different clientele casinos attract is the large increases in pawnshops that occur when casinos open. Other tourist areas do not experience similar increases.

A few of the numerous press examples that explicitly link casino gambling to crime are as follows:

> Authorities linked a woman arrested in Bradenton, FL to one of the largest and most profitable burglary rings in the country. Baton Rouge, La., police Detective Jonny Dunham said that Barbara Dolinska and her cohorts like to gamble, and they committed many crimes in areas that either had riverboat gambling operations or other kinds of gaming. (*Sarasota* [FL] *Herald-Tribune,* December 23, 1999)
>
> A man arrested in the armed robbery of a [New Orleans] bar told deputies of his motive for the hold up: he wanted to recover the several hundred dollars he lost playing the lounge's video poker machines. (*Las Vegas Sun,* June 14, 1999)
>
> Former San Jose police officer, Johnny Venzon Jr., was imprisoned for stealing from people on his own beat while in uniform. Venzon, who blamed his actions on a gambling addiction, often burglarized homes and then investigated the crimes. (*San Francisco Chronicle,* February 25, 1999)
>
> Daniel Blank confessed to stealing over $100,000 and killing six Louisiana residents from October 1996 to July 1997. Blank's motivation for his brutality was to obtain cash to support almost daily trips to video poker halls and casinos. Sometimes Blank headed for casinos right after committing the crimes. ([New Orleans] *Times-Picayune,* January 28, 1999)

Casino-Induced Changes in Population Composition: Gambling, along with gambling-related industries such as hotels and restaurants, is one of the few growth sectors with a high demand for unskilled labor. An increase in demand for unskilled and lower-income employees may alter the composition of the underlying labor force and residents toward those who are more apt to engage in criminal activity.

B. Effects across Types of Crime

Different crime mechanisms need not have the same effects across crimes. For example, improvements in the legal sector reduce property crime more than violent crime (Gould et al. 2002). Although murder has been tied to casino activities as described above, the statistical connection is harder to detect, because murder is rare in comparison with other crimes and because other causes predominate. For this reason we expect casinos to contribute less to the overall explanation of murder rates.

Pathological gamblers generally commit crimes to generate money either to deal with their debts or to gamble. Peoria and Tazewell counties, surrounding one of Illinois's oldest riverboats, have documented a significant increase in casino-related embezzlement, theft, and burglary, much of it committed by professionals like teachers and lawyers (Copley News Service, June 28, 1999). Burglary, larceny, and auto theft, and the violent crime of robbery, have pecuniary payoffs. Casinos may affect aggravated assault because assault often occurs in the context of a crime with an economic payoff. Because the FBI classifies each incident involving multiple offenses under the most serious offense, property crimes and robberies that become assaults are categorized as assaults.

Identifying the link between casinos and rape is less obvious. Casinos may attract visitors more likely to commit rape or to be its victims, and have an indirect effect through the population composition effect and social climate. Changed population might be related to casino-generated growth in adult entertainment, escort services, and related industries, which show significant increases as measured by advertising or the number of listings in the yellow pages. Many law enforcement officials have testified that prostitution increased dramatically after casinos opened (FBI Conference on Casino Gaming, 1999). Pinnacle Entertainment was fined $2.26 million by the Indiana Gaming Commission for supplying prostitutes and gambling money to attendees at a golf outing sponsored by its Beltera Casino Resort (Piskora, 2002).

C. Intertemporal Effects on Crime

The theory importantly predicts that the effects of casinos will vary over time. Reduction of crime through improvements in labor market opportunities is observed prior to and shortly after the casino opening as low-skilled people may be hired by the casino or casino-related industries. The economic development theories (whether positive or negative) imply that a casino's effect after opening will grow until the casino market reaches equilibrium. Likewise, the visitor effect and the effect of changing composition of the population appear with the casino's opening and grow as people are attracted to the area.

Effects operating through problem and pathological (P&P) gamblers will not be felt until a gambling problem has developed. Breen and Zimmerman (2002) studied the time to pathology. "We found that the men and women who 'got hooked' on video gambling became compulsive gamblers in about one year. Those who got hooked on other kinds of gambling (such as horses, sports betting, blackjack, etc.) became compulsive gamblers after about three and a half years" (RI Gambling Treatment Program, 2002). According to gambling treatment specialists, "Many addicted gamblers follow essentially the same course. . . . [T]hey enter a desperation stage, [the treatment specialist] said, and when they've used up their own money and lines of credit they often turn to stealing" (Schneider, 2003). In the same article, police and prosecutors "told the newspaper that in recent years, with the arrival of casino gambling in the area, they have seen an increase in exactly the kinds of crimes [the convicted subject of the story] has acknowledged committing" (ibid.). The successful Evansville attorney Allan Lossemore's case (Rohrig, 2002) is symptomatic of the role of time lags. He began going to the Casino Aztar in July 1997 and for the first three or four months won enough money to subsidize his fledgling law practice. But by early 1998 he began to lose. "I started to draw from charge cards and from a line of credit in an attempt to get even," he reported. He tried to get back on track by barring himself from the casino and staying away from gambling, but late in 1999 he gambled again and lost. After a series of personal and professional financial circumstances, in mid-2000 he misappropriated clients' funds. "From there, I was just robbing Peter to pay Paul. I was gambling at that point pretty heavily—I was really trying to make up the difference." He was arrested in November 2000 and later jailed.

Research conducted for the NGISC reported that the population percentage of problem gamblers rose from 0.3% to 1.1% when the distance to the nearest casino fell from more than 250 miles to less than 50 miles, and rose from 0.4% to 1.3% for pathological gamblers (National Opinion Research Center, 1999, pp. 28–29). Distances less than 50 miles were not studied; thus a difference of 1.7% in P&P gambling probably understates the actual fraction. Research on the degree of P&P gambling in Las Vegas found the rate was 6.6% (Strow, 1999), suggesting that a difference of 5.9% is closer to an upper bound. If problem and pathological gamblers are an important explanation of crime, we expect to observe crime increase over time as more people start to gamble, develop gambling problems, and eventually commit crimes to fund their losses. Because different causes are at work, and may operate differently for different crimes, there is no presumption that intertemporal effects must be identical.

IV. Estimation Strategy

Our empirical strategy addresses many limitations of the current research. First, by conducting the most exhaustive investigation and utilizing a comprehensive county-level data set that includes every U.S. county, we eliminate sample selection concerns. Second, by analyzing crime effects over time we exploit the time series nature of our data. Third, we are the first to articulate a comprehensive theory about how casinos could increase or decrease crime. Last, we use the most exhaustive set of control variables, most of which are commonly excluded from other studies.

A. Direct and Indirect Effects

As noted, casinos may affect crime rates directly through their effects on the resident local population and indirectly

by increasing the number of casino visitors. The total includes both direct and indirect effects, as expressed in the following equations, where crime (C_{it}) in county i in year t is a function of the presence of a casino, the number of casino visitors (V_{it}) to the county, and other variables that affect crime (summarized in the term *Other*), and where a, b, c, and d are unknown coefficients:

$$C_{it} = a\ Casino_{it} + bV_{it} + Other_{it}, \quad (1)$$

$$V_{it} = c\ Attractions_i + d\ Casino_{it}. \quad (2)$$

Casino visitors in (2) depend on both the visitor attractiveness of the county ($Attractions_i$) and the presence of the casino. The coefficient a measures the direct effect of the casino on crime. The coefficients b and d measure the indirect effect via casino visitors. Substituting from (2) into (1) gives

$$C_{it} = \beta_i + \delta\ Casino_{it} + Other_{it} \quad (3)$$

where $\delta = a + bd$, and $\beta_i = bc\ Attractions_i$. The total effect of the casino on crime, δ, in (3) includes the effects on both the local population and casino visitors. Estimating a in (1) would give only a partial effect, because it would not take into account the visitor effect.[12] The key to our being able to estimate the full effect is having panel data. Because many studies of the casino-crime relationship used cross-sectional data, they were limited to estimating only a partial effect.

B. Visitors

Although distinguishing direct and indirect effects is important, it is also important to avoid the assumption that anything that attracts the same number of visitors will have the same crime effects. Different types of visitors may have systematically different effects on crime even if the effect for all types of visitors is positive. The presence of a casino in (3) proxies for direct effects on crime and for an increased number of casino visitors. It does not necessarily follow that the same number of visitors for another purpose would generate the same crime outcomes. Visitors for other purposes appear in the variable $Other_{it}$, which we now address.

Time series visitor data do not exist at the county level and certainly do not distinguish visitors for different purposes. Running the regression (3) without such information, therefore, risks omitted variable bias. In partial defense, no other crime studies have been run with these data either. However, more importantly, in the case of casinos the omitted variables are likely uncorrelated with a new casino. Fortunately, for at least one type of tourist, data *are* available that we can use to test the hypotheses of being uncorrelated with openings and having an effect on crime different from the effect of casinos. We obtained National Park Service time series data from 1978 to 1998 on all visitors to national parks, monuments, historic sites, recreation areas, and so on. These parks and attractions, scattered across the country, receive millions of visitors annually—some as many as 14 million. Some, such as Yellowstone National Park, are in counties with sparse population; others are in highly populated areas. In most cases the correlation between park visitors and the casino variables used in the study was well below 1%, and in no case was a correlation above 1.7%. This is consistent with the view that this type of omitted variable bias is likely to be small or zero. Although it is always preferable to include such variables when possible, we are confident that in the case of casinos the procedure employed in (3) of treating data on other visitors as part of the constant term and the error term is not a problem for the coefficients of interest.[13]

A second analytical issue is whether to use *diluted* or *undiluted* crime rates. Should the number of crimes be divided by population—the conventional way to generate the crime rate (undiluted)—or by population *plus* visitors (diluted)? Four possibilities exist, depending on whether one considers total or partial effects, and studies diluted or undiluted crime rates. Some have argued for one combination or another without realizing that the choice is not methodological, but depends on what questions the researcher wants to answer. A common but invalid claim is that the diluted crime rate should be used to determine the change in probability that a resident would be the victim of a crime. However, knowing what happens to the diluted crime rate does not give the needed information and could even move the answer in the wrong direction. To illustrate, let s_1 be the share of the resident population P victimized by residents, and let s_2 be the share of the resident population victimized by V visitors. Similarly, let σ_1 be the share of visitors victimized by residents, and σ_2 the share of visitors victimized by visitors. Then the crime rate is $s_1 + s_2 + (\sigma_1 + \sigma_2)\frac{V}{P}$; the diluted crime rate is $(s_1 + s_2)w_P + (\sigma_1 + \sigma_2)w_V$ where w_P and w_V are the shares of visitors plus residents made up by residents and visitors, respectively; and the probability of a resident's being a crime victim is $s_1 + s_2$. If residents do not victimize visitors ($\sigma_1 = 0$), then $P = V$, and $s_2 + \sigma_2$ is smaller than s_1. The

[12] Ideally we would like to know both a and b. Because of data constraints, we must estimate only the total effect δ. Casino visitor data do not exist at the county level. Both a and b might be estimated using other variables to proxy for the number of casino visitors, but no annual time-series data exist at the county level.

[13] When visitors to National Park Service sites were included, the regressions (3) showed that an additional one million park visitors annually were associated with statistically significantly *fewer* crime incidents for rape, murder, robbery, and burglary, and had a statistically insignificant effect on auto thefts. The effects of park visitors on larceny and assaults were statistically significant but socially insignificant compared to the crime effects found for casinos (coefficient δ) and reported in section V. For example, we estimated the long-run effect of a casino on larcenies to be 615, which was roughly 60 times larger than the effect of one million national park visitors. This means that if the crime consequences of casino visitors and national park visitors were identical, a casino would have to attract over 59 million visitors annually to account for 615 additional larcenies. Las Vegas, the single largest casino gambling destination in the United States, attracted 30.3 million visitors in 1994.

probability of a resident being victimized is s_1 without visitors, and it rises to $s_1 + s_2$ with visitors. The diluted crime rate is s_1 without visitors and falls to $(s_1 + s_2 + \sigma_2)/2$ with visitors. Thus in this case the diluted crime rate falls while the probability of a resident being victimized rises.

In this study we are interested in the costs to the host county associated with a change in crime from whatever source. We are therefore interested in the total effect of casinos on crime, and thus use the undiluted crime rate based on equation (3).

C. *Timing: Separating Casino Effects from Other Effects*

The version of equation (3) that we estimated is

$$C_{it} = \alpha + \beta_i X_i + \gamma_t T_t + \delta L_{it} + \theta A_{it} + \varepsilon_{it}, \quad (4)$$

where C_{it} is the crime rate (offenses per 100,000 people) of county i in year t, α is a constant, and β_i is the vector of estimated coefficients on the county-level fixed effects that control for unobserved characteristics across counties. The time fixed effect, T_t, controls for national crime rate trends. Our base specification of L_{it} is a vector of the casino-opening dummy variables that includes two leads and five lags of the opening variable and captures the important intertemporal effects outlined earlier. The opening dummy variable takes the value 1 in the year the casino began operation and 0 in other years. In the reported regressions we used two years of leads, because it is unlikely that a casino would affect the crime rate more than two years prior to its opening. We stopped at five years of lags because the numbers of counties with casinos open three to five years, not counting Nevada counties, were 91, 59, and 35, respectively. Twelve counties (26 including Nevada counties) had casinos open for 6 or more years, and seven (21 including Nevada counties) had casinos open 7 or more years. For each group, however, observations are scattered widely across the decades and geography of our sample.

A_{it} is a vector of 22 control variables. It includes population density, the percentage of the population that was male, the percentage that was black, the percentage that was white, and the percentages in the age ranges 10–19, 20–29, 30–39, 40–49, 50–64, and over 65.[14] Economic variables in A_{it} are real per capita personal income, real per capita unemployment insurance payments, real per capita retirement compensation per old person, and real per capita income maintenance payments. All income figures were adjusted to a 1982–1984-dollar basis. A_{it} also includes a dummy variable indicating whether the county honored a shall-issue right allowing citizens to carry a concealed firearm upon request, and two years of leads and five years of lags on the shall-issue dummy. ε_{it} is the regression error. Including leads and lags, the regression had 50 explanatory variables plus one constant for each county (3,165) for a total of 3,215 explanatory variables. This set was expanded to 58 variables plus county constants when we analyzed the effects of casinos on adjacent counties. Excluding observations with missing data reduced the sample size in most regressions to approximately 58,000, leaving more than adequate degrees of freedom for estimation.

We independently estimated each lead and lag of the casino opening year (describing the timing of crime effects) without cross restrictions. We weighted regression observations by county population.

V. Results

Before reporting the more sophisticated lag structure discussed above, we begin with a simple dummy variable for whether a county has a casino. Table 2 reports two such regressions for each crime. The left column for each crime reports the estimated coefficient for the casino dummy variable. The variable *Casino* takes the value of 1 if a casino is operating in the county for the year in question and 0 otherwise. No other explanatory variables are present in the leftmost regression. The regressions all show large, statistically significant elevated crime rates for counties with operating casinos. For example, according to table 2 such counties experience 157 more aggravated assaults annually per 100,000 population. This compares to average aggravated assault crime rates of 188 per 100,000 population for counties without casinos in any year of the sample reported in table 1. The right column for each crime reports the estimate of the casino dummy when year and county fixed effects are the only other explanatory variables included in the regression. In each case the effect attributed to an operating casino declines. Aggravated assault, for example, falls from 157 to less than 18. The coefficient estimates are positive and statistically significant for five crimes. The estimated effect is positive for murder and negative for burglary; neither is statistically significant. To summarize the two regressions, when a simple dummy variable specification is used for a casino being open, the estimated casino effect is positive and statistically significant in twelve of the fourteen regressions. The other two results are not statistically different from 0. These before-after results obscure the intertemporal effects, so we now turn our attention to the model that includes leads and lags.

Tables 3 and 4 report coefficient estimates and *t*-statistics for specifications of (4) that allow for the timing of the effects of casino opening. Table 3 includes year fixed effects and county fixed effects but excludes the control variables A_{it}, whereas table 4 includes these regressors.[15] For example, the estimated coefficient of lag 4 in the table 3 column labeled "Aggravated Assault" indicates that the aggravated

[14] The remaining groups were Hispanics and those between 0 and 9 years.

[15] We report casino variables. Results for the 588 other coefficient estimates for the seven crime regressions are omitted for lack of space, because they are used as controls, and because we are primarily interested in the casino variables.

TABLE 2.—CASINO CRIME RATE REGRESSIONS EMPLOYING CASINO DUMMY VARIABLE ONLY

	Violent Crime							
	Aggravated Assault		Rape		Robbery		Murder	
Casino	157.254	17.825	11.521	0.973	86.905	34.175	1.522	0.117
	(23.04)	(4.29)	(17.91)	(2.04)	(12.09)	(10.07)	(6.88)	(0.75)
Year fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
County fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
N	57,796	57,796	57,064	57,064	57,877	57,877	57,882	57,882
F	530.68	754.52	320.88	126.60	146.06	212.39	47.30	81.94
Prob. > *F*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.0091	0.8147	0.0056	0.7234	0.0025	0.8861	0.0008	0.7506

	Property Crime					
	Larceny		Burglary		Auto Theft	
Casino	1128.547	218.850	144.373	−23.927	266.582	217.416
	(31.88)	(9.44)	(7.58)	(−1.58)	(21.72)	(30.87)
Constant	Yes	No	Yes	No	Yes	No
Year fixed effects	No	Yes	No	Yes	No	Yes
County fixed effects	No	Yes	No	Yes	No	Yes
N	57,876	57,876	57,873	57,873	57,881	57,881
F	1016.63	138.15	57.45	635.32	471.71	472.89
Prob. > *F*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.0173	0.7839	0.0010	0.6699	0.0081	0.8328

Notes: Coefficient estimates are additional annual crime incidents per 100,000 population. *t*-statistics are in parentheses.

assault rate was higher by 62.153 offenses per 100,000 population four years after a casino opened in the county. The number of observations for each regression varied from 57,023 to 57,841. The R^2 was between 0.67 and 0.89.

The patterns in both tables show that casino effects tend to increase over time after a lag of 2–3 years. In table 3, which does not include control variables, the estimates on the casino leads are often positive and statistically significant, consistent with the common belief that casinos are more likely to be placed in high-crime areas. However, when control variables are included, all of the leads are statistically indistinguishable from 0 except for those on auto theft.

Another key difference is that table 3 shows much larger increases in crime in the lagged years. When the control variables are included in table 4, these larger positive

TABLE 3.—CASINO CRIME RATE REGRESSIONS EXCLUDING CONTROL VARIABLES.

	Aggravated Assault	Rape	Robbery	Murder	Larceny	Burglary	Auto Theft
Lead 2	4.325	1.189	13.178	.725	113.498	33.865	114.440
	(0.61)	(1.42)	(2.26)	(2.73)	(1.64)	(0.79)	(9.46)
Lead 1	4.455	0.708	19.067	1.270	160.828	28.071	142.864
	(0.64)	(0.86)	(3.32)	(4.85)	(1.82)	(0.57)	(11.98)
Open	8.799	.250	19.142	1.251	229.687	−19.609	182.095
	(1.19)	(0.29)	(3.15)	(4.53)	(2.61)	(−0.55)	(14.47)
Lag 1	16.656	1.765	47.031	1.360	315.990	54.171	236.103
	(2.24)	(2.06)	(7.72)	(4.91)	(2.99)	(0.76)	(18.69)
Lag 2	3.647	0.684	56.089	1.305	193.729	3.025	225.876
	(0.46)	(0.76)	(8.63)	(4.41)	(0.89)	(0.03)	(16.75)
Lag 3	29.953	3.436	81.467	0.801	201.816	13.797	253.046
	(3.22)	(3.23)	(10.67)	(2.30)	(1.51)	(0.25)	(15.98)
Lag 4	62.153	7.021	75.755	0.429	460.681	153.209	246.417
	(4.76)	(4.72)	(7.08)	(0.88)	(2.74)	(2.74)	(11.11)
Lag 5	124.683	7.076	76.725	−1.496	715.031	236.992	376.278
	(7.80)	(3.87)	(5.84)	(−2.50)	(2.65)	(2.97)	(13.80)
Control variables A_i	No	No	No	No	No	No	No
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	57,755	57,023	57,836	57,841	57,835	57,832	57,840
F	562.01	95.50	163.79	63.83	19.25	79.81	358.19
Prob. > *F*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.8149	0.7236	0.8865	0.7511	0.7843	0.6730	0.8334

Notes: Coefficient estimates are additional annual crime incidents per 100,000 population. *t*-statistics are in parentheses. We used robust standard errors for larceny and burglary, which the Breush-Pagan test indicated had heteroskedasticity.

TABLE 4.—CASINO CRIME RATE REGRESSIONS INCLUDING CONTROL VARIABLES

	Aggravated Assault	Rape	Robbery	Murder	Larceny	Burglary	Auto Theft
Lead 2	−3.843	0.157	6.924	0.438	37.710	16.481	97.006
	(−0.55)	(0.19)	(1.21)	(1.00)	(0.63)	(0.43)	(8.43)
Lead 1	−8.498	−0.815	8.164	0.969	47.645	−6.164	113.656
	(−1.24)	(−1.01)	(1.44)	(1.34)	(0.61)	(−0.14)	(10.00)
Open	0.376	−0.644	11.218	1.103	148.279	−23.625	152.659
	(0.05)	(−0.77)	(1.88)	(1.37)	(1.74)	(−0.72)	(12.72)
Lag 1	2.613	0.955	32.588	1.188	173.836	30.661	183.735
	(0.36)	(1.14)	(5.43)	(1.68)	(1.83)	(0.55)	(15.24)
Lag 2	−9.739	−0.267	39.137	1.181	−0.447	−51.987	161.791
	(−1.25)	(−0.30)	(6.08)	(1.46)	(−0.00)	(−0.68)	(12.53)
Lag 3	20.306	3.339	70.427	1.099	4.132	−48.495	206.769
	(2.22)	(3.20)	(9.30)	(1.32)	(0.03)	(−0.89)	(13.60)
Lag 4	42.844	6.503	52.188	0.572	184.855	64.367	161.641
	(3.34)	(4.47)	(4.93)	(0.54)	(1.41)	(0.92)	(7.60)
Lag 5	99.982	9.979	65.240	−0.458	614.695	325.147	271.848
	(6.38)	(5.59)	(5.02)	(−0.55)	(1.98)	(2.30)	(10.43)
Control variables A_i	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	57,724	56,992	57,805	57,810	57,804	57,801	57,809
F	393.15	129.78	143.37	13.34	42.97	121.18	346.19
Prob. $> F$	0.0000	0.00000	0.0000	0.0000	0.00000	0.00000	0.0000
R-squared	0.8252	0.7410	0.8913	0.7623	0.7992	0.6997	0.8504

Notes: Coefficient estimates are additional annual crime incidents per 100,000 population. t-statistics are in parentheses. We used robust standard errors for larceny and burglary, which the Breush-Pagan test indicated had heteroskedasticity.

estimates are reduced. Because the table 4 estimates have better fit in the lead variables and the added control variables reduce omitted variable bias, we emphasize these results, that show smaller casino effects on crime.

A. Violent Crime

Figure 4 displays the information on violent crime from table 4. The horizontal axis plots the casino opening leads and lags, and the vertical axis plots the coefficient estimates. The vertical lines show the 95% confidence intervals, the range within which the regression indicates the true coefficient should lie with 95% probability.

For aggravated assault, only estimates for the third and subsequent year after opening are significantly above 0, and the trend rises. The estimated high occurs in the fifth year after opening, when the aggravated assault rate is 100 assaults higher per year. This pattern of crime increase is unlike the typical pattern of visitor increases after casino opening. Grinols and Omorov (1996) showed that the number of visitors to Illinois casinos typically rose immediately after opening and reached equilibrium after 6 months or less.[16]

Figure 4 for rape shows coefficient estimates that are not significantly different from 0 prior to the opening. However, they are positive and significant in the third and subsequent years after the casino opened, rising from the third year on. A county that introduces a casino might expect a negligible effect in the first two years after opening, but a higher rape rate by 6.5 to 10 incidents per 100,000 population in the fourth and fifth years after opening.

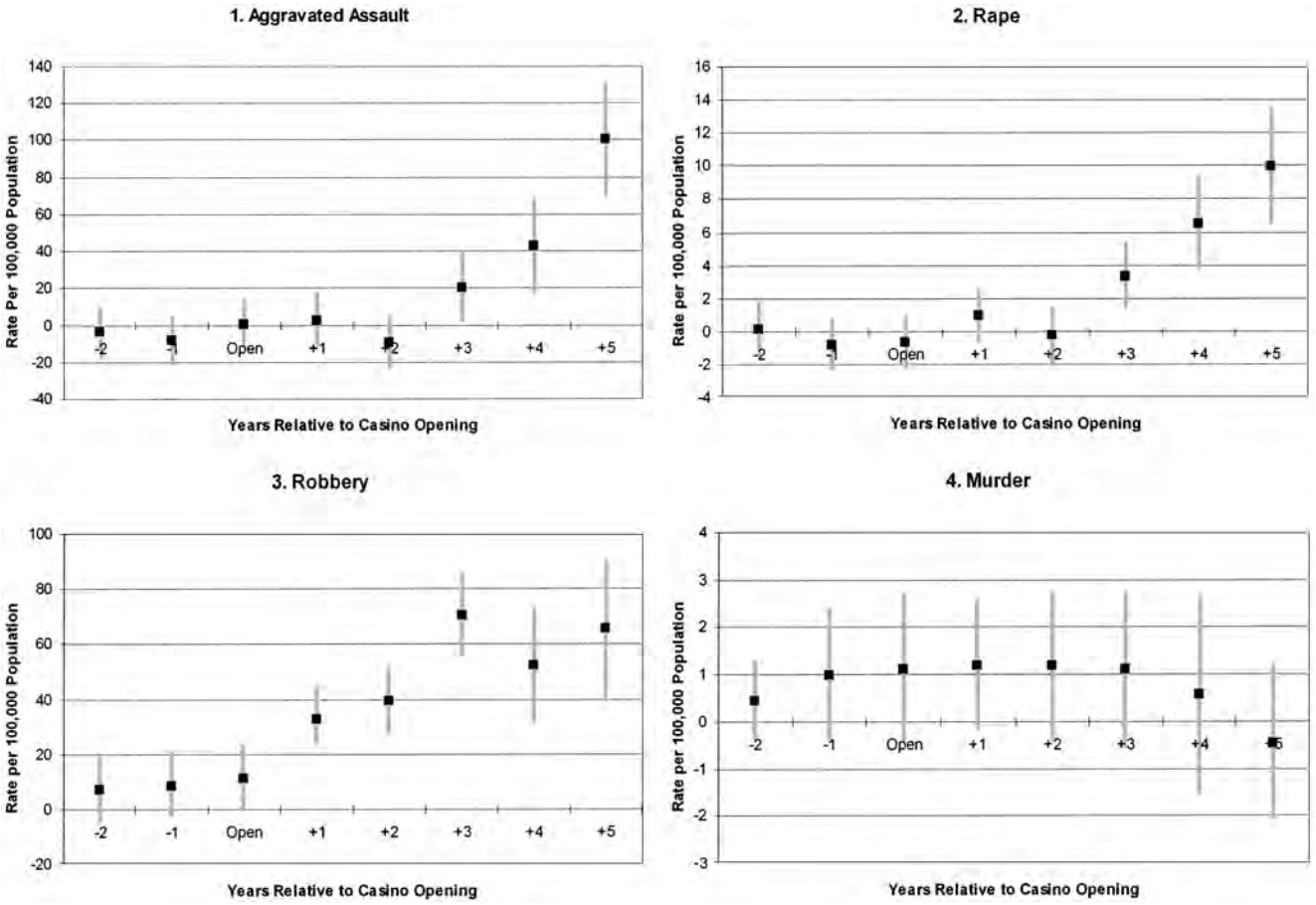
The pattern for robbery in figure 4 is similar to the patterns for aggravated assault and rape, with one important exception—the increase in robbery begins immediately. In the first year there were approximately 35 more robberies per 100,000 people, which increases to over 60 three years after opening.

As expected, the impact of casinos on murder is the smallest among all offenses. Figure 4 shows that casino counties have slightly higher murder rates than noncasino counties both before and after opening. However, murder shows no statistically significant coefficient estimates for any of the casino leads or lags, and the change from before to after is not statistically significant. Gambling-related murders include incidents such as the disgruntled gambler who killed a casino teller when he tried to retrieve his gambling losses, a spouse who fought over the other's gambling losses and was murdered, a parent's gambling leading to the death of her child, murder for insurance, and similar tales.[17] However, because murder is the least fre-

[16] In addition to the regressions reported, we ran regressions that included as many as 4 leads and 7 years of lags of the casino opening variable. With few exceptions, leads continued the pattern of being statistically indistinguishable from 0, and later lags showed comparable or greater estimated effects to the fifth year lag. In the case of murder, the sixth and seventh lags continued the pattern of being statistically indistinguishable from 0.

[17] See Jeffry Bloomberg, Prepared Statement, Hearing Before the Committee on Small Business, House of Representatives, 103rd Congress, Second Session, 21 September 1994, Serial No. 103–104, Washington, DC: USGPO, p. 47. Accounts of the more spectacular gambling-related murders and deaths (most often suicides) frequently appear in the press. *USA Weekend*, February 10–12, 1995, p. 20, for example, describes a man

FIGURE 4.—CASINO EFFECTS—VIOLENT CRIME



quently committed crime and most counties have zero murders, murder rates typically have high variance, which makes it difficult to identify effects.

B. Property Crime

Figure 5 displays the coefficient estimates in table 4 for property crimes. The larceny estimates increase from 0 in the second year after opening, to 4.1 in the third, 185 in the fourth, and over 615 in the fifth year after opening. Burglary increases from negative estimates in the second and third years after opening, to 64 in the fourth, to 325 in the fifth. Only the fifth-year estimates are individually statistically significant, so we investigated further the significance of the rising third-, fourth-, and fifth-year coefficient estimates. We checked whether the rising patterns of coefficient estimates in the last three years with the lag 5 estimated coefficients positive and significant persisted or disappeared after the fifth year. Estimates of the sixth- and seventh-year lags were 745 and 1,069 for larceny and 201 and 229 for burglary, respectively. Moreover, lags 5 through 7 pass a 5% *F*-test for significance for both offenses.

Figure 5 for auto theft presents a different picture. It is the only crime that showed statistically significant leads, which were positive. After opening, the rates increase slightly for a few years and increase substantially after five years. The data indicate that casino counties did not experience the same decreases in auto thefts that noncasino counties did after 1991, when the number of casinos increased rapidly.[18]

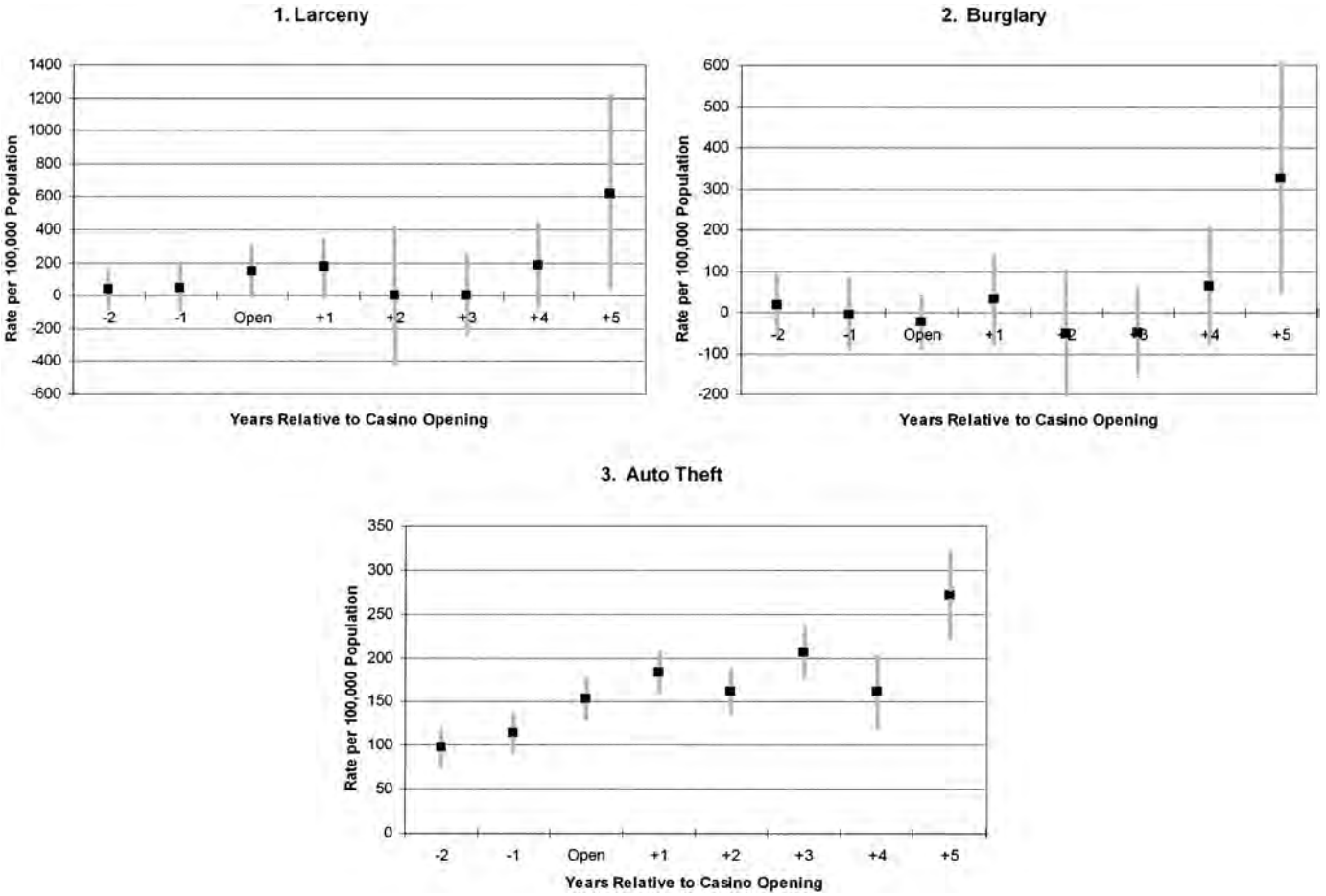
A second factor may be that we were unable to control for Lojack, an electronic tracking system that allows police to quickly locate and recover stolen autos. Ayres and Levitt (1998) found that Lojack accounted for a significant reduction in auto thefts in the 1990s. Because cities that implemented Lojack generally do not have casinos, we may overstate the effect of casinos on auto theft.[19] It is also

killing his wife and beating up his daughter in a fight over his gambling away thousands of dollars. The Associated Press, September 3, 1997, reported on a 10-day-old infant in South Carolina who died of dehydration after being left in a warm car for approximately 7 hours while her mother played video poker. A mother in Illinois was convicted of killing her infant children for insurance money because of her gambling.

[18] A similar divergence in Florida started in 1984 and grew after that, consistent with Florida casino openings. The first Florida casinos opened in two counties in 1982, two more opened in 1988, and the rest opened between 1990 and 1995.

[19] Ayres and Levitt (1998) showed that Lojack had little effect on other offenses, so our results for the other crimes will not be affected.

FIGURE 5.—CASINO EFFECTS—PROPERTY CRIME



possible that Lojack's use is not yet sufficiently widespread to greatly affect our estimates.

C. *Additional Robustness Checks*

The precisely correct model of crime is not known. Thus, in addition to the comparison of tables 3 and 4, we considered several additional formulations to test the robustness of the results.

Law Enforcement Variables: All the regressions reported to this point omit law enforcement variables. Although including them reduces omitted variable bias, it also introduces sample bias by significantly limiting the number of counties with available data.[20] To examine this tradeoff we included two additional sets of law enforcement control variables. When we included the arrest rate as an explanatory variable, the estimated casino effects for almost every year after opening and for almost all crimes were higher than those reported in table 4. Therefore, the table 4 results that we emphasize are biased against the finding that casinos increase crime.

Although arrest rates are often undefined, the problem is even bigger for other law enforcement variables. County-level conviction rates and sentence lengths are available for only four states (Mustard, 2003), and annual police employment is unavailable at the county level.

We also included explanatory variables that estimated the probability of capital punishment, which we estimated in four different ways.[21] When these variables are included, the results are qualitatively the same as for the base regression. There are slight differences of the estimated effects for

[20] For example, the arrest rate is undefined when there are 0 offenses for a given crime type. Many small counties record no offenses even for property crimes for a given year, and even large counties frequently record no offenses for murder and rape, which consequently produce a large number of missing observations for the arrest rate. For some offenses including the arrest rate eliminated over 30,000 observations. See Lott and Mustard (1997) and Levitt (1998) for more detailed discussions.

[21] The first was a prorated number of executions in the previous and current year divided by the number of people sentenced to death six years ago. The second was the number of executions in the first three quarters of the current year and last quarter of the previous year divided by the number of people sentenced to death six years ago. The third is a prorated count of executions in the previous and current year divided by the number of persons on death row at that time. The last was the number of executions in the first three quarters of the current year and the last quarter of the previous year, divided by the number of persons on death row at that time. Gittings and Mocan (2003) provided the first two variables, and Gittings and Mocan (2001) explain the last two in more detail.

different crimes in different postopening years, but the general qualitative trends are similar.

That the inclusion of law enforcement variables generally increases the estimated casino effects is consistent with reports from law enforcement officials that enforcement expenditures increased substantially when casinos opened. Stephen Silvern (FBI in Atlantic City) documented that expenditures for the Atlantic City Police Department and Prosecutor's Office grew much more rapidly in the late 1970s and early 1980s than similar expenditures in the rest of the state and nation (Federal Bureau of Investigation Conference on Casino Gaming, 1999). The director of the Indiana Gambling Commission reported that Indiana hired an additional 120 state troopers when the casinos opened in 1995.[22] Allocations for police services also rose substantially in New Orleans upon introduction of casinos.[23] Law enforcement officials emphasize that to maintain public safety, spending on enforcement resources must increase when casinos open. Because we cannot measure all these additional resources that reduce crime, our estimates without enforcement variables tend to understate the effect of casinos on crime.

Casino–Population-Density Interactions: A natural question is whether the effect of casinos on crime varies with the type of county, such as a rural-urban difference related to population density. To test for a population-density interaction, we multiplied each of the eight casino-opening lead and lag variables by the county population density and reran the original regressions including these eight new variables. The density interaction coefficient estimates were statistically significant as a group at the 1% or better level for all regressions except aggravated assault and larceny, which were significant at the 11% and 46% levels, respectively. With the exception of murder and auto theft, the same rising pattern of crime after casino introduction was observed as found in the original regressions. Crime is not statistically different from zero in the years before casino introduction and immediately thereafter, but begins to rise three or four years after introduction. By the fifth year after casino introduction, a statistically significantly elevated crime rate for both low- and high-density counties appears. Introducing a density effect does not change the prediction of the model. These results give us confidence that the effect of casinos on crime is similar in large and small counties. For auto theft the casino effect is largest for less densely populated counties.

[22] John Thar, director of the Indiana Gambling Commission, report at Federal Bureau of Investigation Conference on Casino Gaming (1999).

[23] Lt. Joseph P. Lopinto, Jr., commander of the Gambling Section of the New Orleans Police Department, reported that his department has been significantly resource-constrained since the opening of New Orleans's casinos and the resulting increase in demand for police services (Federal Bureau of Investigation Conference on Casino Gaming, 1999).

D. Summary

We summarize the results in table 4 and figures 4 and 5. First, the casino-opening lead variables suggest that after controlling for other variables casinos were not more likely to be placed in areas that had systematically different crime environments than other regions.

Second, after casinos opened, casino-county crime rates increased relative to the noncasino-county rates. Of the 42 estimated casino effects (one opening and five lags for each of seven offenses), 34 are positive, of which 19 are statistically significant at the 0.05 level, and others are significant at the 0.10 level. In contrast, none of the 8 negative estimates are statistically significant. As expected, murder exhibits no relation to casino gambling.

Third, the time pattern of estimated coefficients implies that the casino effects may change over time. With the exception of murder, all crimes show higher estimates for the last two coefficients (lags 4 and 5) than for the first two (leads 2 and 1). For most offenses, the statistically significant differences tend to appear two or three years after casino opening. Only one estimated coefficient for the year of opening is statistically significant. Estimates of the sixth and seventh lags (run but not reported) are typically positive and statistically significant.

Fourth, the increase over time in casino effect is consistent with the effects outlined in the theory. For example, the crime-mitigating influences through increased wages and employment should occur before and shortly after opening. In contrast, the crime-increasing factors are more long-term. Casino-induced changes in population and the effects of negative development grow over time. Also, clinical research shows that problem and pathological gamblers typically take approximately 2 to 4 years to start gambling, become addicted, exhaust alternative resources, and eventually commit crimes. Studies that did not have large data sets or a sufficient number of years of observations after casino opening, and that did not allow for the effects of casinos to change over time, missed these effects. An additional potential explanation of the time pattern is that casinos have an immediate impact on crime, but that impact is ameliorated by a large increase in police resources, which are typically significantly increased when casinos open, but do not maintain the same rate of growth over time. The slightly more immediate impact of casinos on violent crime may be explained in terms of *imported* criminals. It may take less time to habituate to a new casino's location than for people to exhaust their resources.

E. Evaluation

The regressions in table 4, of course, cannot decompose the net number of offenses to assign them to each alternative explanation. Nevertheless, it is instructive to ask how many crimes table 4 would imply per additional P&P gambler if all estimated additional crime incidents were arbitrarily

assigned to this one source. The coefficient estimates report additional crime incidents per 100,000 population. If x is the coefficient, and y is the change in P&P share of the population, then

$$\frac{x}{10^5}\frac{\text{Offenses}}{\text{Capita}} \times \frac{10^{-5}}{10^{-5}} \times \frac{1}{y}\frac{\text{Capita}}{\text{Problem and Pathological}} = \frac{x}{y} \times 10^{-5}\frac{\text{Offenses}}{\text{Problem and Pathological}}. \quad (5)$$

The total number of crime incidents estimated in table 4 in the fifth year after casino opening is $x = 1{,}386.4$. If $y = 0.059$ (as in the numbers reported for Las Vegas, for example), then the average additional P&P gambler would have to commit 0.23 crime incidents per year to account for all additional crime, so that roughly one in four P&P gamblers would have to commit a crime annually. This figure rises to 0.82 if $y = 0.017$ at the other extreme. Thus 20%–80% are reasonable proportions relative to the information reported above that 80% of problem gamblers studied committed civil offenses, 56% had stolen, and 23% were charged with criminal offenses. In contrast, if the calculation suggested that each P&P gambler would be required to commit a dozen crime incidents per year, the numbers would be of a different magnitude.

The estimated coefficients in table 4 also allow us to gauge the fraction of observed crime due to casinos. Summing the estimated number of crimes attributable to casinos for each county, taking into account how many years the casino was in operation, and dividing by the casino counties' total population measures the contribution of casinos to observed crime. Estimates of the share of crime attributable to casinos in 1996 for individual crimes ranged between 5.5% and 30%. Auto theft was the highest, followed by robbery at 23%. The values for the rest of the offenses were between 5.5% and 10%.

We provide three estimates of the implied cost of additional crime. First, we use the cost per victimization figures adjusted to 2003 dollars using the CPI-U to calculate the total social cost of crimes committed in casino counties that are attributable to the casino presence according to the estimated coefficients in table 4 (Miller, Cohen, & Wiersema, 1996, column 4 of Table 9, p. 24). We also report the total social cost for casino counties on a per adult basis. Finally, although the social cost of property crime is not synonymous with the value of the lost property, the latter is nevertheless useful in describing the effect of casinos. The *Sourcebook of Criminal Justice Statistics* (Bureau of Justice Statistics, 2002, table 3.112, p. 298) contains data about the average property loss for four of the offenses in this paper—robbery, larceny, burglary, and auto theft. For those offenses we took the fifth-year lag coefficient estimates for each crime and multiplied them by the average loss per crime adjusted to 2003 dollars using the CPI-U. This produced property loss numbers per 100,000 population, which can be aggregated to the entire adult population.

In 1996 the total costs for the 178 casino counties exceeded $1.24 billion per year. If the estimated coefficients from table 4 are applied to a representative county of 100,000 population, 71.3% of which are adults (as is representative of the United States as a whole), then the social costs per adult are $75 in 2003 dollars. These costs reflect the profile of the lagged effect on crimes experienced by the particular sample of casino counties making up our data set. The value of lost property from the four property crimes is $2.905 million for a population of 100,000 ($29.05 per adult), which becomes $5.91 billion when aggregated to the national level for 2003.

We can compare these costs with other estimates that relied on a different methodology. Social costs of casinos have commonly been estimated in terms of the average cost imposed on society by a P&P gambler[24] multiplied by their number. In the most recent comprehensive study of this type of which we are aware, Thompson, Gazel, and Rickman (1996b) found that total social costs were $135 per adult in 1996 dollars, of which $57 (40%) were due to police and judicial-related costs and to thefts.[25] Thompson et al. reported that they intentionally "projected numbers believed to be very conservative," and that the crime costs in their sample (Wisconsin) were probably lower than similar costs in other locations. Adjusting crime costs to 2003 dollars, their estimate is $67. Taking into account the different samples and methodologies, their estimate is remarkably close to the direct costs estimated here for 1996 ($75).

Corrective taxes reflect the costs that an industry imposes on society. Assuming crime costs no lower than $75 (there are crimes other than FBI Index I, such as embezzlement, not considered here), crime costs equal to 40% of total social costs, and revenues for a representative casino of $400 per adult[26] each year implies tax rates above 47% of revenues. In a few cases tax schedules for high-end casinos include portions where average tax rates reach these levels.[27] Having applied proper taxes, continued operation would be efficient in a Kaldor-Hickes sense.[28] If it is feasible to offer gambling in an altered manner that causes fewer P&P

[24] Some studies group problem gamblers with pathological gamblers; some treat the two groups separately. Costs are computed by learning the behavior of P&Ps through direct questionnaires and surveys.

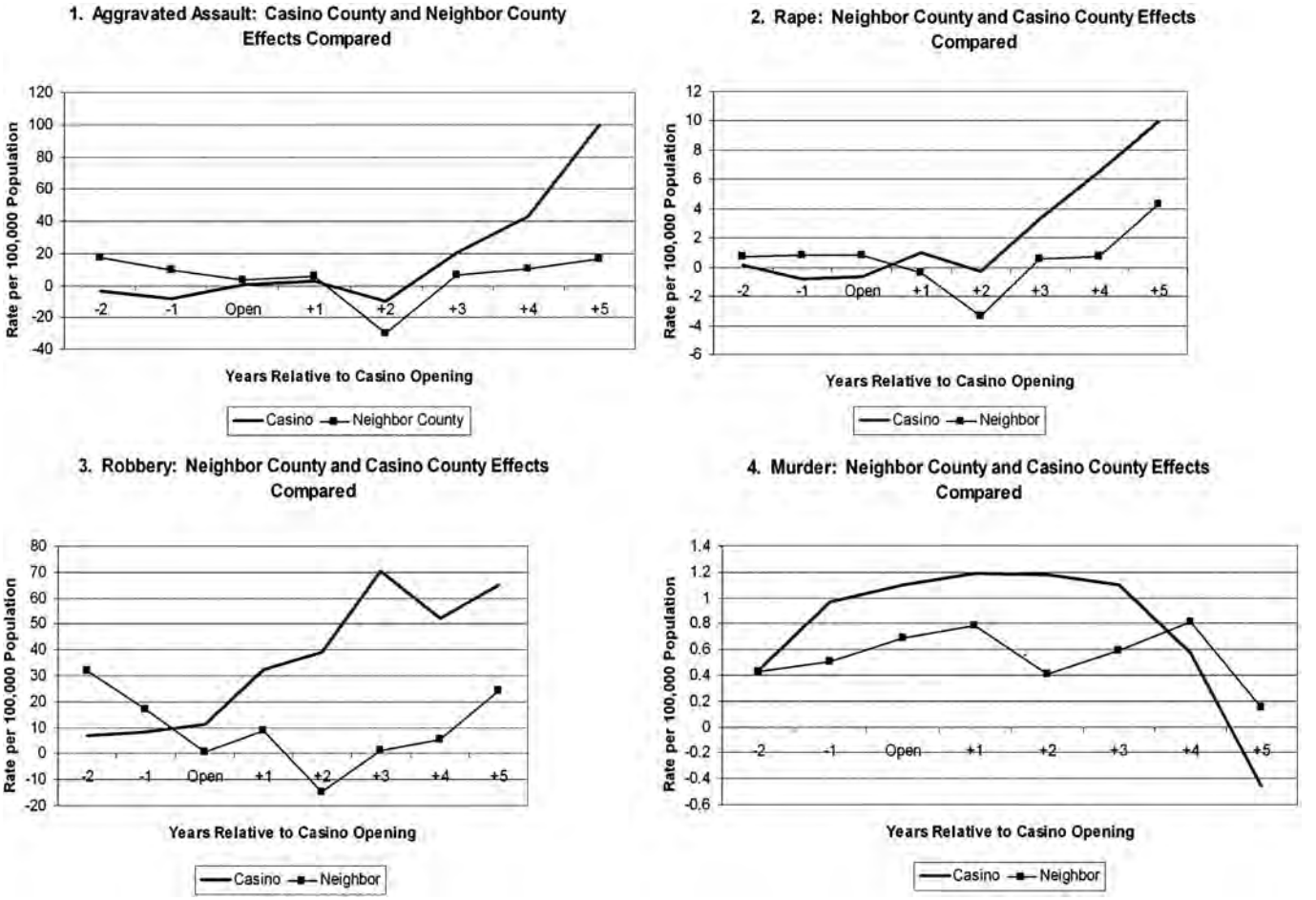
[25] The social-cost effect of casino-related serious problem gamblers was $138,453,113. Dividing this by the number of adults over 20 in the counties with casinos gives the per adult figure in the text. The proportion of costs due to police, theft, and judicial-related costs is determined from their tables A-2 and A-5.

[26] Research for the NGISC estimated that average losses by adults living near a casino might be in the $400–$600 range per year. Other estimates, including some by the gambling industry for losses by residents in Las Vegas and Atlantic City to casinos, are lower than $400, even after adjusting upward for price level changes.

[27] In Illinois the average tax rate rises from 43% to 50% as casino annual gross revenues rise from $250 to $340 million. Revenues this large imply a very successful casino.

[28] This observation is due to the anonymous referee. Whether casinos expand, shrink, or disappear will be immaterial, because whatever out-

FIGURE 6.—HOME AND NEIGHBOR CASINO-CRIME EFFECTS: VIOLENT CRIME RATES



gamblers and less crime, then this may be better for society than a response based on taxes.

VI. Do Casinos Simply Attract Crime from Elsewhere?

The estimates suggest that after five years, 8.6% of the observed property crime and 12.6% of the violent crime in casino counties are due to casinos.[29] However, do casinos create crime, or merely move it from elsewhere? If the casino-induced increases in crime come only from neighboring regions, casinos produce no new crime. This untested hypothesis is first tested here. To address this question we examine the crime rates of counties that border casino counties. When casinos open, neighboring county crime rates could either decrease, remain the same, or increase. The first possibility supports the idea that casinos move crime from adjacent counties but do not create crime. In the second and third cases, adjacent counties experience no change or an increase in crime, both of which indicate that total crime rises and that casinos create crime.

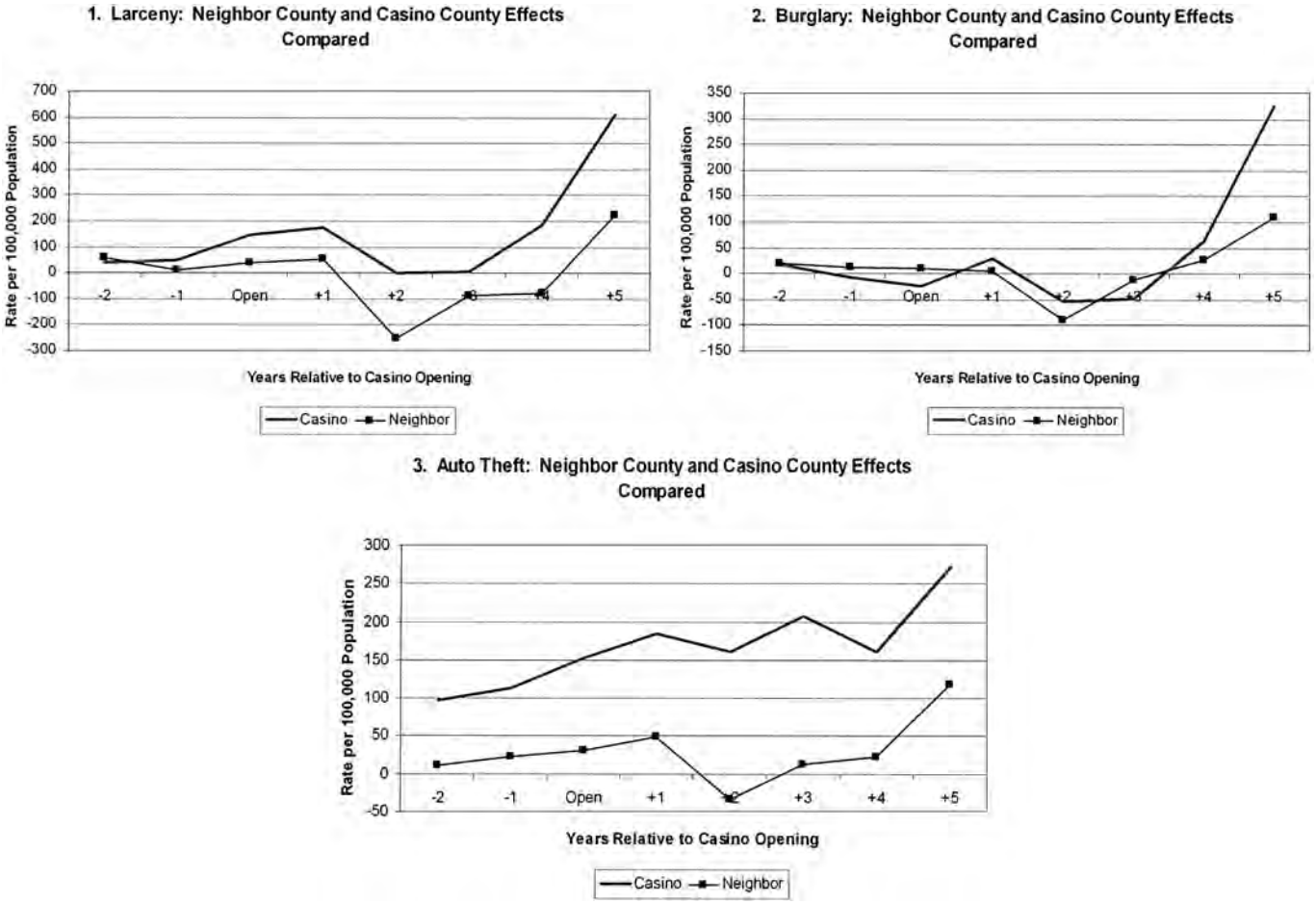
To implement a test strategy we reestimate the table 4 regressions with neighbor leads and lags as additional control variables. We define neighbor lead, opening, and lag variables, similar to those in tables 3 and 4 for the host county. The neighbor opening variable took a value of 1 if a casino opened in an adjacent county in the given year. Adjacent counties are the relevant unit of measurement, because the vast majority of casino patrons come from the local region surrounding the casino. For example, in Illinois over 92% of casino customers come from within 75 miles (Gazel & Thompson, 1996). A few casinos, mainly in Nevada, draw their customers from outside their immediate area. However, our estimates do not rely on these casinos to identify the effects, because these casinos opened prior to the beginning of our sample.

Figures 6 and 7 summarize the estimated casino effect for neighboring and home counties for violent and property crimes, respectively. When the neighbor variables were included, the host-county crime coefficient estimates were virtually unchanged, in terms of both point estimates and statistical significance. For the years before casinos open, there is virtually no effect of the casino on crime rates in neighboring counties. Of the 42 opening and postopening

come occurs will be the result of socially optimal decisions by the firms themselves.

[29] Section V C explains the computation of these numbers.

FIGURE 7.—HOME AND NEIGHBOR CASINO-CRIME EFFECTS: PROPERTY CRIME RATES



coefficient estimates on the neighbor variables, 32 are positive, of which 15 are statistically significant at the 0.05 level. Of 21 estimated coefficients for lags 3–5, 18 are positive, of which 8 are individually statistically significant. None of the three negative coefficients for lags 3–5 are statistically significant. All crimes but murder display elevated and rising lags 3, 4, and 5.

For all offense types the data reject the contention that the increase in crime in the casino counties can be attributed to decreases in neighboring counties, and thus support the contention that casinos create crime. *F*-tests reject at the 5% level for all crimes the hypothesis that host-county opening- and lag-coefficient estimates are matched with negative estimates of equal size in neighboring counties. On the contrary, a simple correlation of host- and neighbor-county coefficient estimates for opening and lags ranges from 0.61 to 0.82, with the exception of robbery (0.14). However, there is ambiguity about the extent to which casinos increase crime in neighbor counties. Murder clearly exhibits no spillover effects. For the other offense types the neighbor time pattern is similar to the home-county time pattern. Crime typically increases in later lags, but at half or less the magnitude of the home-county effect, and many of these neighbor-county effects are not statistically significant until the very last lags. *F*-tests of the proposition that neighbor county coefficient estimates equal their host-county counterparts are rejected at the 5% level for aggravated assault, rape, robbery, and auto theft, but not for the other three crimes.

In our discussion of host-county auto theft rates we speculated as to why the host-county estimated coefficients displayed a different pattern of continually growing crime. This pattern of host-county coefficient estimates did not appear closely related to the introduction of casinos. However, auto theft for neighbor counties displays the pattern of crime increases observed for other crimes. There is a statistically significant, discernibly different crime rate three or more years after the opening of the neighboring casino, but not in the years before. The neighbor-county effect suggests possible spillover of auto theft crimes due to the casino.

VII. Conclusions

Our analysis of the relationship between casinos and crime is the most exhaustive ever undertaken in terms of the number of regions examined, the years covered, and the

control variables used. Using data from every U.S. county from 1977 to 1996 and controlling for over 50 variables to examine the impact of casinos on the seven FBI Index I crimes (murder, rape, robbery, aggravated assault, burglary, larceny, and auto theft), we concluded that casinos increased all crimes except murder, the crime with the least obvious connection to casinos. Most offenses showed that the impact of casinos on crime increased over time, a pattern very consistent with the theories of how casinos affect crime. The crime-ameliorating effects of casinos through increased employment opportunities and wages for low-skilled people will be concentrated shortly after opening. Also, law enforcement agencies can frequently use casino openings to leverage greater immediate staffing increases, but are unable to sustain this growth. This effect further reduces the immediate impact of casinos on crime. However, over time these effects are dominated by casino-related factors that increase crime. Specifically, problem and pathological gamblers commit crimes as they deplete their resources, nonresidents who visit casinos may both commit and be victims of crime, and casino-induced changes in the population start small but grow. The data show that these crime-inducing and crime-mitigating effects offset each other shortly after opening, but over time the crime-raising effects dominate, and crime increases in subsequent years. Furthermore, we believe these estimates to be lower bounds on the true effect because they omit measures of law enforcement, which is typically increased substantially when casinos open. When we include law enforcement measures, the estimated effects are larger.

According to the estimates, between 5.5% and 30% of the different crimes in casino counties can be attributed to casinos. This translates into a social crime cost associated with casinos of $75 per adult in 1996. This figure does not include other social costs related to casinos, such as crime in neighboring counties, direct regulatory costs, costs related to employment and lost productivity, and social service and welfare costs. Overall, 8.6% of property crime and 12.6% of violent crime in counties with casinos was due to the presence of the casino. Although robbery, the offense that exhibited the largest increase, is classified as a violent crime, it is similar to property crime in that its motivation is financial.

We also investigated whether the crime in casino counties is attracted (moved) from other regions or is created. Counties that neighbor casino counties did not experience compensating crime reductions, indicating that crime was created in casino counties, rather than simply being shifted from one area to another. There is mixed evidence about whether casino openings increase neighbor-county crime rates. Murder rates in neighbor counties are unaffected. The other offenses exhibit increasing neighbor rates, but are generally not statistically significant until the fourth and fifth year after opening.

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