CARROTS, STICKS, AND BROKEN WINDOWS*

HOPE CORMAN and *NACI MOCAN*
Rider University *University of Colorado at Denver*

ABSTRACT

This paper investigates the effect of economic conditions (carrots) and sanctions (sticks) on murder, assault, robbery, burglary, motor vehicle theft, grand larceny, and rape in New York City, using monthly time-series data spanning 1974–99. Carrots are measured by the unemployment rate and the real minimum wage; sticks are measured by the number of felony arrests, size of the police force, and number of New York City residents in prison. In addition, the paper tests the validity of the "broken windows" hypothesis. Consistent with its implementation by the New York Police Department, we use misdemeanor arrests as a measure of broken-windows policing. The broken-windows hypothesis has validity in the case of robbery, motor vehicle theft, and grand larceny. While both economic and deterrence variables are important in explaining the decline in crime, the contribution of deterrence measures is larger than those of economic variables.

I. INTRODUCTION

In the decade ending in 1999, there were significant decreases in serious crime throughout the United States. From 1990 to 1999, violent crime rates fell by about 28 percent, and property crime rates fell by about 26 percent nationally.[1] Many metropolitan areas fared even better than national trends in crime reduction. The decrease in violent crime rates in Atlanta, Boston, Chicago, Los Angeles, Miami, and San Diego ranged from 33 percent to 53 percent.[2] Although it followed the general trends, New York City (NYC) experienced even more dramatic declines in crime: violent crimes declined by over 56 percent, and property crimes fell by about 65 percent. Many

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[1] U.S. Department of Justice, Bureau of Justice Statistics, Sourcebook of Criminal Justice Statistics, 2000 (2001).

[2] *Id.;* and U.S. Department of Justice, Bureau of Justice Statistics, Sourcebook of Criminal Justice Statistics, 1991 (1992).

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attribute NYC's crime reduction to specific policies carried out by Mayor Rudolph Giuliani's administration with its "get tough" approach to crime fighting. The most prominent of the policy changes was the aggressive policing of lower-level crimes, a policy that has been called the "broken windows" approach to law enforcement. Skeptics believe that NYC's experience was attributable to other factors such as the economic boom of the 1990s, enjoyed both in NYC and nationally. For example, the national unemployment rate declined by 25 percent between 1990 and 1999, and it declined by 39 percent between 1992 and 1999 in NYC.[3]

The question of whether economic conditions or deterrence policies are more effective tools of crime control has become an important political issue in other countries as well. For example, crime control has been one of the most important policy issues in the United Kingdom recently, and it was the number one issue in the 2002 presidential election campaign in France.[4]

The aim of this paper is twofold. First, it analyzes the effect of economic conditions (carrots) and various deterrence measures (sticks) on seven felony crimes in NYC between 1974 and 1999. The ability to include these variables jointly in a crime supply equation allows us to determine the relative magnitudes of economic and deterrence measures in a coherent framework. The second contribution of the paper is the investigation of the validity of the broken-windows hypothesis, which is summarized in a 1998 press conference by Giuliani, where he alluded to an oft-cited article by James Wilson and George Kelling:[5]

[3] Another explanation offered as a factor contributing to the decrease in crime is reduction in the cohort size owing to decline in fertility because of the legalization of abortion in the United States following the 1973 Supreme Court decision in *Roe v. Wade* (410 U.S. 959 (1973)). John J. Donohue III & Steven D. Levitt, The Impact of Legalized Abortion on Crime, 116 Q. J. Econ. 379 (2001). If most of the averted pregnancies are for women with economically disadvantaged backgrounds, then the legalization of abortion reduces the number of crime-prone children, and this would have an impact on crime 16–20 years after the legalization. We do not directly address the impact of legalized abortion on crime in New York City (NYC). However, in note 62 *infra*, we discuss the potential relevance of this issue.

[4] Jim Bittermann, Crime Tops French Election Issues (April 17, 2002) (http://www.CNN.com/2002/WORLD/europe/03/26/france.crime/index.html), France's prime minister, Lionel Jospin, indicated that he was "naïve" to believe that lowering unemployment would solve the crime problem in France, and in both Britain and France, conservative as well as liberal politicians are proposing "get-tough" policies in addition to economic ones to battle their rising crime rates (Stephen Baker, Kerry Cappel, & Kate Carlisle, Crime and Politics, Bus. Wk., March 18, 2002, at 50). British Prime Minister Tony Blair was quoted in the *Observer* as intending to pursue radical reforms of the criminal justice system (to implement tougher penalties, such as on-the-spot fines for antisocial behavior such as public drunkenness). Kamel Ahmed, Blair Pledge to Wage New Crime War: PM Admits Public Feel Unsafe as Criminals Walk Free, Observer, November 10, 2002, at 1.

[5] Rudolph W. Guiliani, The Next Phase of Quality of Life: Creating a More Civil City (February 24, 1998) (http://www.nyc.gov/html/rwg/html/98a/quality.html), citing James Q. Wilson & George L. Kelling, Broken Windows, Atl. Monthly, March 1982, at 29.

We have made the "Broken Windows" theory an integral part of our law enforcement strategy. This theory says that the little things matter. As James Q. Wilson describes it, "If a factory or office window is broken, passersby observing it will conclude that no one cares or no one is in charge. In time, a few will begin throwing rocks to break more windows. Soon all the windows will be broken, and now passersby will think that, not only no one is in charge of the building, no one is in charge of the street on which it faces . . . so more and more citizens will abandon the street to those they assume prowl it. Small disorders lead to larger ones, and perhaps even to crime." . . . There's a continuum of disorder. Obviously, murder and graffiti are two vastly different crimes. But they are part of the same continuum, and a climate that tolerates one is more likely to tolerate the other.

We use monthly time-series data between 1974 and 1999 from NYC to investigate the extent to which carrots (the unemployment rate and the real minimum wage), sticks (arrests, size of the police force, and prison population), and the broken-windows approach to crime control are responsible for the decrease in NYC crime from the early to late 1990s. We use misdemeanor arrests as a measure of the extent of the broken-windows approach to policing and find support for the broken-windows hypothesis in the case of robberies, motor vehicle thefts, and grand larcenies. Although carrots and sticks both explain crime fluctuations in NYC, the impact of sticks was found to be stronger than the impact of carrots during the 1990s.[6]

In Section II, we briefly summarize recent literature on the economics of crime and provide a description of the broken-windows hypothesis. Sections III and IV present the empirical model and the data, respectively. Section V contains the results, Section VI discusses the interpretation and robustness of the results, Section VII presents the relative impacts of carrots and sticks, and Section VIII concludes.

II. Literature Review and the Broken-Windows Theory

A. The Effect of Sanctions and Economic Conditions on Crime

Recent research has demonstrated a significant effect of sanctions on criminal activity.[7] Although varied in both choice of variables and econometric

[6] Most of the recent crime research relied on panel data of states, cities, or counties. Although we employ high-frequency time-series data from one city, our basic results are consistent with those obtained by earlier studies.

[7] David B. Mustard, Reexamining Criminal Behavior: The Importance of Omitted Variable Bias, 85 Rev. Econ. & Stat. 205 (2003); H. Naci Mocan & Robert Kaj Gittings, Getting off Death Row: Commuted Sentences and the Deterrent Effect of Capital Punishment, 46 J. Law & Econ. 453 (2003); Hope Corman & H. Naci Mocan, A Time-Series Analysis of Crime, Deterrence, and Drug Abuse in New York City, 90 Am. Econ. Rev. 584 (2000); Steven D. Levitt, Why Do Increased Crime Arrest Rates Appear to Reduce Crime: Deterrence, Incapacitation, or Measurement Error? 36 Econ. Inquiry 353 (1998); Steven D. Levitt, Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime, 87 Am. Econ. Rev. 270 (1997); and Steven D. Levitt, The Effect of Prison Population Size on Crime Rates: Evidence from Prison Overcrowding Litigation, 111 Q. J. Econ. 319 (1996). What these articles have

technique, each of these papers addresses previous empirical problems (mainly the simultaneity between deterrence and crime), and all find that variables associated with expected punishment are more significantly related to crime than found in the previous studies. Even though earlier work on joblessness and crime and on wages and crime did not provide conclusive evidence, recent papers have demonstrated a stronger effect of labor market conditions on crime.[8] However, whether economic conditions or deterrence measures have a larger impact on crime is an unresolved issue. Data limitations prevented most research from simultaneously controlling for the impact of labor market variables and deterrence measures. Microlevel data sets may contain information on individuals' criminal behavior and their wages and unemployment spells, but they typically lack information on deterrence measures.[9] Researchers who employed aggregate data sets did not always include extensive deterrence and economic variables.[10] As a result, much of the current inference about the relative impact of economic conditions and

in common is an attempt to address some of the empirical issues that have made identification of the crime supply function so difficult. Two articles by Steven Levitt (Using Electoral Cycles in Police Hiring, *supra,* and The Effect of Prison Population Size on Crime Rates, *supra*), for example, use election- or litigation-related variables as instruments to help identify the crime supply function. Another article by Levitt (Why Do Increased Crime Arrest Rates Appear to Reduce Crime, *supra*) used cross-crime arrest rates to distinguish between deterrence and incapacitation effects. Corman & Mocan, *supra,* uses high-frequency data and modern time-series techniques to circumvent the simultaneity issue between deterrence and crime. Mocan & Gittings, *supra,* uses panel data that contain detailed information on death row inmates to assess the impact of executions and removals from death row on homicide. Mustard, *supra,* includes convictions and length of imprisonment to investigate the extent of the omitted-variable bias.

[8] Examples of earlier work are Hope Corman, Theodore Joyce, & Norman Lovitch, Crime Deterrence and the Business Cycle in New York City: A VAR Approach, 69 Rev. Econ. & Stat. 695 (1987); Richard B. Freeman, Crime and Unemployment, in Crime and Public Policy 89 (James Q. Wilson ed. 1983); Richard B. Freeman, The Labor Market, in Crime 171 (James Q. Wilson & Joan Petersilia eds. 1995). Examples of more recent work are Eric D. Gould, Bruce A. Weinberg, & David B. Mustard, Crime Rates and Local Labor Market Opportunities in the United States: 1979–1997, 84 Rev. Econ. & Stat. 45 (2002); Steven Raphael & Rudolf Winter-Ebmer, Identifying the Effect of Unemployment on Crime, 44 J. Law & Econ. 259 (2001); Richard B. Freeman & William M. Rodgers III, Area Economic Conditions and the Labor Market Outcomes of Young Men in the 1990s Expansion, in Prosperity for All? The Economic Boom and African Americans 50 (Robert Cherry & William M. Rodgers III eds. 2000); and Jeff Grogger, Market Wages and Youth Crime, 16 J. Lab. Econ. 756 (1998).

[9] For example, Grogger, *supra* note 8, investigated the impact of wages on youth crime, but the National Longitudinal Survey of Youth data used did not include measures of sanctions. Masanori Hashimoto, The Minimum Wage Law and Youth Crimes: Time-Series Evidence, 30 J. Law & Econ. 443 (1987), used arrests as a proxy for crime and investigated the effect of minimum wages on youth crime with no controls for deterrence.

[10] For example, in its investigation of the effect of unemployment on crime, Raphael & Winter-Ebmer, *supra* note 8, included only state prison population as a control. Gould, Weinberg, & Mustard, *supra* note 8, focuses on the effect of local labor market conditions on crime, adding county arrest rates and state-level per capita police spending and police employment in county-level crime regressions in one of the specifications but excluding them from the analysis in other models.

sanctions relies on information obtained from multiple papers that use different data sets and employ different empirical methods.[11]

B. The Broken-Windows Theory

We measure the extent of broken-windows policing by using misdemeanor arrests as a measure of police signaling in a model that controls for the number of police as well as felony arrests.[12] This implementation is consistent with how Giuliani and Police Commissioner William Bratton interpreted the broken-windows hypothesis and with the way the NYC police administered it. For example, in his account of the implementation of the broken-windows policing, Bratton wrote that following the increase in arrests for misdemeanor offenses such as disorderly conduct, public drunkenness, and damaging property, "the word would get out" regarding the increased police vigilance to change the behavior of individuals.[13] Similarly, Bratton wrote that crime and disorder in New York subways went down following a significant increase in the arrests of fare beaters. He indicated that "crime, disorder, and fare evasion began to go down. . . . All from arresting people for a buck-fifteen crime. We were proving the Broken Windows theory."[14]

[11] See Richard B. Freeman, The Economics of Crime, in 3C Handbook of Labor Economics 3529 (Orley Ashenfelter & David Card eds. 1999), for a recent summary.

[12] The small number of empirical studies that investigate the impact of aggressive policing on felony crime do not shed substantial light on the issue because of their empirical shortcomings. In addition to standard identification difficulties, these papers suffer from potential omitted-variable biases. This is because they include a measure of police aggressiveness in the model without controlling for other deterrence measures. Robert J. Sampson & Jacqueline Cohen, Deterrent Effects of the Police on Crime: A Replication and Theoretical Extension, 22 Law & Soc'y Rev. 163 (1988), investigated the effects of "aggressive" policing on serious-crime rates, where police aggressiveness is measured as the sum of the number of arrests for disorderly conduct and driving while intoxicated per police officer. Using a cross-sectional data set of 156 cities, in a model that did not control for felony arrests, the study reported an inverse relationship between police aggressiveness and the robbery crime rate. David Giacopassi & David R. Forde, Broken Windows, Crumpled Fenders, and Crime, 28 J. Crim. Just. 397 (2000), tests the broken-windows hypothesis using motor vehicle fatality rates as a measure of social disorder. In a cross section of two time periods, the study finds that traffic fatalities are significantly related to homicides after controlling for the number of police (but not the homicide arrest rate) and population and concludes that social disorder, captured by motor vehicle fatalities, causes homicide. George L. Kelling & William H. Sousa, Jr., Do Police Matter? An Analysis of the Impact of New York City's Police Reforms (Civic Rep. No. 22, Manhattan Inst. 2001), examines the effect of misdemeanor arrests on police precincts for 2 years in NYC and concludes that broken-windows policing works. In the study, however, both felony arrests and the size of the police force are omitted from the analysis, and number of misdemeanor arrests is the only criminal-justice-related variable.

[13] William Bratton & Peter Knobler, Turnaround: How America's Top Cop Reversed the Crime Epidemic 229 (1998).

[14] *Id.* at 156. Increased misdemeanor arrests may reduce felony crimes by incapacitating individuals who would have committed those crimes. We document later in the paper that incapacitation is not a plausible explanation for a negative relationship between misdemeanor arrests and felony crimes.

III. Empirical Model

We estimate crime equations of the following form:

$$\begin{aligned} CR_{it} = {} & \lambda_i + \Sigma\alpha_{ij}CR_{i,t-j} + \Sigma\delta_{ik}ARR_{i,t-k} + \Sigma\Phi_{ip}POL_{t-p} \\ & + \Sigma\eta_{im}MISARR_{t-m} + \Sigma\pi_{in}PRIS_{t-n} + \Sigma\beta_{iq}UR_{t-q} \\ & + \Sigma\gamma_{ir}RMINW_{t-r} + \Sigma\mu_{t-s}TEENS_{t-s} + \Sigma\varphi_{iw}SEAS_{w} + \varepsilon_{it}, \end{aligned} \tag{1}$$

where $CR_{i,t}$ stands for ith crime in month t ($i = 1$, murder; $i = 2$, burglary, and so on). The two variables that capture economic conditions in NYC are the NYC unemployment rate (UR) and the real minimum wage (RMINW). The arrest rate (arrests per crime) is a standard measure of deterrence. However, it is well known that the use of arrest rate as an explanatory variable creates biased estimates. This is because crime, which is the dependent variable, appears in the denominator of the arrest rate as an explanatory variable. Potential solutions are to deflate arrests by population or to substantially lag the arrest rate.[15] In our case, none of these strategies are feasible because population figures are available only at census dates and in any case change little from month to month. Furthermore, it is unclear exactly how many lags to impose with the high-frequency data we employ.[16] Therefore, we use arrests (ARR) as an explanatory variable as we have done elsewhere[17] but convert the estimated arrest elasticity of crime to the arrest rate elasticity of crime.

The term PRIS stands for the number of NYC residents incarcerated in state correctional facilities. The term POL is the size of the NYC police force. Adding police to the model in addition to felony and misdemeanor arrests allows us to investigate whether police presence has an additional effect on crime, after controlling for police actions. The term MISARR stands for the number of misdemeanor arrests. If the broken-windows hypothesis has merit, then after controlling for economic conditions and deterrence measures (including crime-specific arrests), an increase in misdemeanor arrests should have a negative effect on crime.

To control for the impact of changing demographics on crime, we include the number of 14–17-year-olds in NYC (TEENS). The term SEAS represents a vector of 11 monthly dichotomous variables to control for the impact of seasonality on crime.

The use of monthly data allows us to address the simultaneity between

[15] Levitt, Why Do Increased Crime Arrest Rates Appear to Reduce Crime, *supra* note 7; Mustard, *supra* note 7.

[16] In models that use panel data with annual frequency, the arrest rate is typically lagged 1 year (Mustard, *supra* note 7; Mocan & Gittings, *supra* note 7; Levitt, Why Do Increased Crime Arrest Rates Appear to Reduce Crime, *supra* note 7).

[17] Corman & Mocan, *supra* note 7.

crime and deterrence. As in our earlier work[18] in equation (1), $j \geq 1$, $k \geq 1$, $m \geq 1$, $n \geq 1$. Put differently, it is postulated that the number of crimes committed in month t depends on the past dynamics of the same criminal activity (represented by j), the past number of arrests for that crime (k), and the past number of misdemeanor arrests (m) and incarcerations (n). These variables are lagged 1 month to avoid reverse causality from crime. On the other hand, $q \geq 0$, $r \geq 0$, $p \geq 0$, $s \geq 0$; that is, the contemporaneous values for the unemployment rate (when $q = 0$), the minimum wage (r), and the number teens (s) and police (p) are included. This means that variations in crime cannot affect the current values of these variables. This is obvious for monthly data regarding economic and demographic variables, and it also applies to the number of police, because as we have explained elsewhere,[19] it takes at least 6 months to increase the size of the police force. Thus, an increase in crime in a given month cannot generate an increase in the police force in the same month.[20]

IV. Data

The data are compiled from a number of different sources. Crime and arrest data were obtained from the Crime Analysis Unit of the NYC Police Department. Monthly crime data are available for seven Federal Bureau of Investigation index crimes: murder, assault, robbery, burglary, motor vehicle theft, grand larceny, and rape.[21] Crimes are measured as reported complaints.[22] Because data on prison population and the number of 14–17-year-olds are available starting in 1974, empirical analyses are conducted for the period 1974–99. Figure 1 displays the trends for the sum of all seven crimes in

[18] *Id.*

[19] *Id.*

[20] If an increase in arrests in a given month influences crimes in that same month through the incapacitation effect, lagging arrests by 1 month would be a specification error. However, Steven D. Levitt, Juvenile Crime and Punishment, 106 J. Pol. Econ. 1156 (1998), and Corman & Mocan, *supra* note 7, demonstrated that the incapacitation effect is insignificant.

[21] The nominal value of a grand-larceny crime was increased from $250 to $1,000 in November 1986. This resulted in a decrease in reported grand larcenies and recorded grand-larceny arrests. To create consistency between pre– and post–November 1986 grand-larceny figures, we ran grand-larceny crime and arrest regressions on time dummies and a structural change dummy. The estimated coefficient of the dummy was added to the post–November 1986 series. The reporting rate for rape has fluctuated significantly between 1980 and 1999 (U.S. Department of Justice, Bureau of Justice Statistics, Criminal Victimization in the United States (1982–2000)). If the same pattern holds in NYC, this would induce measurement error in reported rape cases, adding noise to the values of the dependent variable. Thus, rape results must be interpreted with caution.

[22] The census estimates for NYC population are 7.9 million in 1970, 7.1 million in 1980, 7.3 million in 1990, and 8 million in 2000. Thus, on the basis of census data, NYC population was fairly stable during the study period. Because neither monthly nor annual population information is available, interpolation of monthly population values from 4 census years would not be sensible. For this reason, and because the size of the population was rather stable, we did not deflate crimes by population.

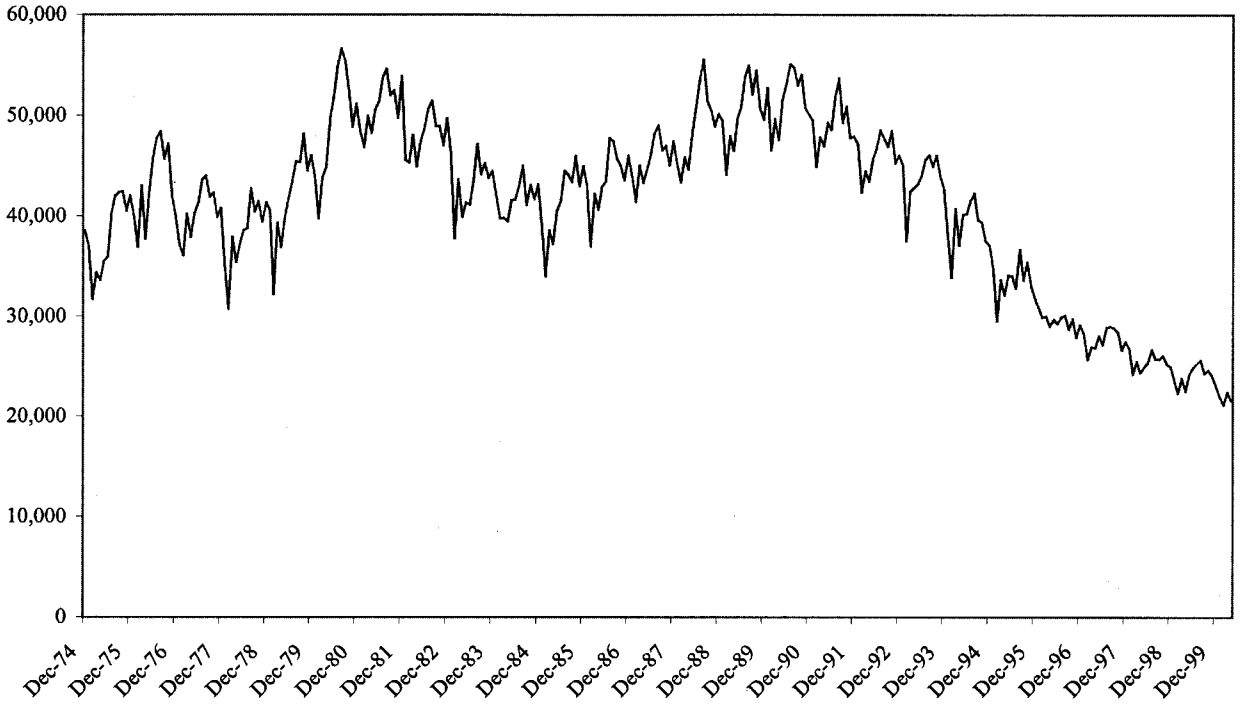

FIGURE 1.—Total felony crimes, New York City

NYC during this time period and demonstrates that the total number of crimes declined substantially, reaching its minimum in 1999.[23] Later in the paper we investigate the extent to which our models explain the decline in crime between 1990 and 1999. Figure 2 displays the total number of felony arrests and total misdemeanor arrests. The total number of felony arrests exhibits a slight decline between 1990 and 1999, which is not surprising because crime declined during the same period. Arrest rates (arrests per crime) increase over the same time period because the percentage decrease in arrests is smaller than the percentage decrease in crime.[24]

We include misdemeanor arrests in the analysis to capture the changing nature of policing policies during the 1990s, which is related to the broken-windows hypothesis. Misdemeanor arrests are arrests made for crimes such as petty larceny, assault in the third degree, prostitution, criminal mischief, and theft of services. Figure 2 shows that the number of misdemeanor arrests increased somewhat in the early 1980s and then experienced a large, sustained increase around 1994.

It is difficult to find a single, consistent measure of the overall economic health of NYC and its residents. We use the unemployment rate and the real minimum wage as measures of economic conditions facing potential criminals in NYC. Each of these indicators measures a different aspect of the economy; therefore, each has a different pattern over the 3 decades. The rate of unemployment among young men or among low-skilled and less educated workers should be more closely linked to crime than overall unemployment. However, such more refined measures are not available.[25] Figure 3 presents the real minimum wage in NYC, computed as the New York State or federal (whichever was higher) minimum wage and adjusted for inflation using the NYC Consumer Price Index (base years, 1982–84).[26] After an erosion in the value of the minimum wage in 1980s, there were two nominal wage increases in 1990 and 1991, and two other increases were implemented in 1996 and 1997. Overall, the real minimum wage remained rather stable during the 1990s. Figure 4 displays the city's unemployment rate, which was in double-digit levels for sustained periods during both the mid-1970s and the early

[23] The behavior of each individual crime is similar to the trend shown in Figure 1. Time-series graphs of individual crimes can be seen in Hope Corman & Naci Mocan, Carrots, Sticks and Broken Windows (Working Paper No. 9061, Nat'l Bur. Econ. Res., July 2002).

[24] The arrest rates of individual crimes are presented in *id.*

[25] In Section VI, we report results from models in which the total number of recipients of public assistance is used instead of the unemployment rate.

[26] Minimum wage data were obtained from the State of New York Department of Labor, Division of Research and Statistics (personal correspondence, October 9, 2001). The Consumer Price Index represents prices for all urban consumers (CPI-U) for the New York–Northern New Jersey metropolitan area and were obtained from the Middle Atlantic Regional Office of the Bureau of Labor Statistics (personal correspondence, September 6, 2001).

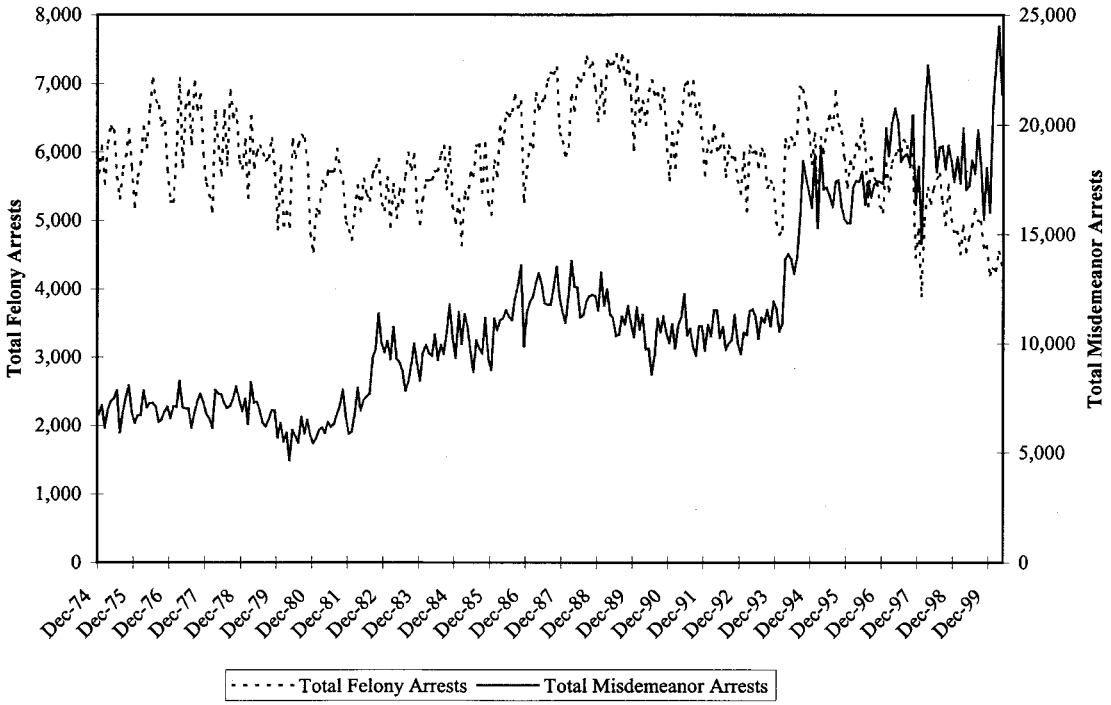

FIGURE 2.—Total felony and misdemeanor arrests, New York City

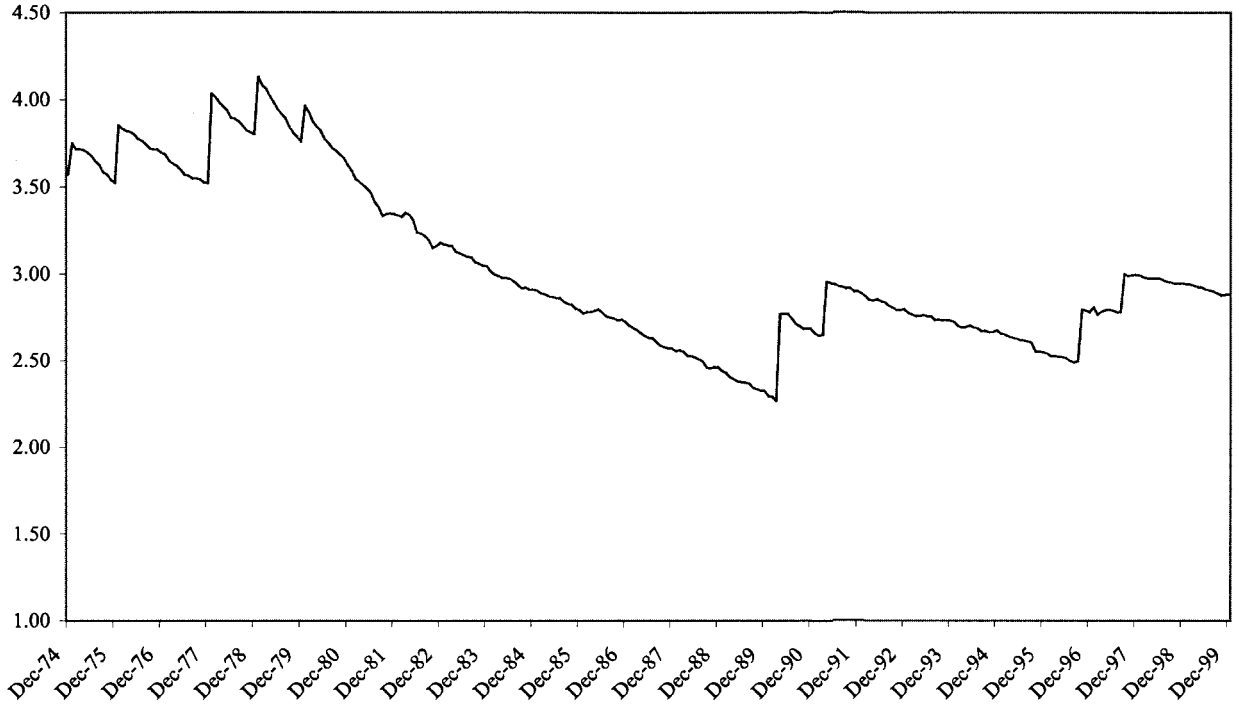

FIGURE 3.—Real minimum wage, New York City (base years, 1982–84)

FIGURE 4.—Unemployment rate, New York City

1990s. According to the unemployment rate, economic conditions were worse toward the early to mid-1990s and improved in the latter half of that decade.[27]

Figure 5 presents the number of uniformed officers at all ranks, measured on the left vertical axis. In April 1995, the Transit Police were merged with the New York Police Department, and in May, the Housing Police were added. To account for this merger, and to have a consistent series, we subtracted the number of Transit and Housing Police from the total number of officers after April 1995.[28] The size of the police force varied considerably over the 3 decades under consideration. In 1970, there were around 32,000 uniformed officers in the New York Police Department. In conjunction with NYC's 1970s fiscal crisis, the number of officers fell dramatically between 1970 and 1980, attaining an annual low point in 1980—a decrease of almost 30 percent. Since 1980, the overall trend has been one of growth in the number of officers, ending in 1999 with almost 35,000. This represents a quite modest change from the level in early 1970s, but it is a dramatic (more than 50 percent) increase from the lowest level in 1980.

Data sources allow an annual count of prison inmates from NYC who are in state correctional facilities from December 1974 through December 1988. We interpolated the monthly figures from the annual ones up to January 1988, when prison population data began to be recorded monthly. As Figure 5 demonstrates, the prison population from NYC grew through most of the sample period and then leveled off during the last half of the 1990s.[29]

Consideration of the population's demographic composition is important; however, most demographic data rely on the decennial censuses, with yearly values interpolated in between. Rather than use census-based data, we proxy the number of teens by the total number of students entering ninth grade in the current and previous 3 years for both public and private schools in NYC.[30] Because we have only September counts for each year, we used the Hodrick-Prescott filter to obtain the trend of the data (Figure 6), which is employed

[27] These data represent seasonally unadjusted unemployment rates for NYC and were obtained from the Middle Atlantic Regional Office of the U.S. Bureau of Labor Statistics (personal correspondence, September 6, 2001).

[28] We have subtracted rather than added because we were not able to obtain separate Transit and Housing Police numbers beginning in January 1970. Police data were obtained from the Office of Management and Planning at the New York City Police Department.

[29] Prison population data were obtained from the Independent Budget Office of New York City.

[30] Data on arrests from the New York State Division of Criminal Justice Services are consistent with the observation that teens generally commit more crimes than young or older adults. In 1999, arrest rates for index crimes in New York State per 100 teens aged 16 and 17 were 3.15–16 percent higher than arrest rates for youth aged 18–20 and were 60 percent higher than arrest rates for adults aged 21–22. (Population data were derived from the 2000 census.) Similarly, in 2001, teens aged 15–17 composed 16.5 percent of the arrestees for felony index crimes in the United States (U.S. Department of Justice, Bureau of Justice Statistics, Sourcebook of Criminal Justice Statistics, 2001 (2002) (http://www.albany.edu/sourcebook/)), while according to the 2000 census, this age group composed only 4 percent of the U.S. population.

FIGURE 5.—Number of police officers and number of New York City residents in state prisons

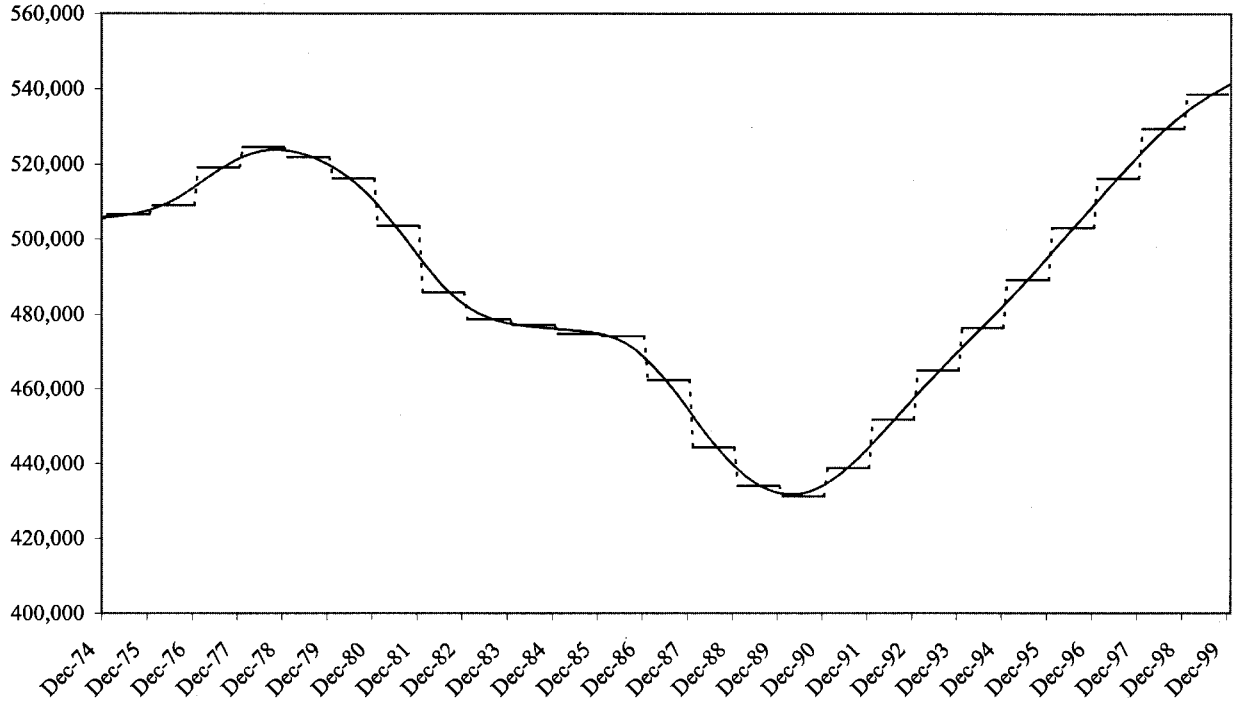

FIGURE 6.—Actual and smoothed values of number of youths aged 14–17, New York City

TABLE 1

DESCRIPTIVE STATISTICS, DECEMBER 1974–DECEMBER 1999

Variable	Mean	Standard Deviation
Arrests:		
Total misdemeanor	11,149.33	4,131.30
Motor vehicle	742.10	281.31
Burglary	1,116.04	445.09
Grand larceny	1,124.64	221.19
Assault	1,534.62	302.70
Murder	95.87	19.42
Rape	120.73	25.78
Robbery	1,851.90	329.35
Incidence of crime:		
Motor vehicle theft	7,790.27	2,357.92
Burglary	10,697.71	4,130.67
Grand larceny	13,172.66	2,960.88
Assault	2,777.89	703.37
Murder	130.69	40.26
Rape	268.74	67.83
Robbery	6,554.41	1,663.83
Number of police officers	27,426.92	3,612.21
Number of prisoners from NYC	29,708.17	13,406.24
NYC unemployment rate	8.59	1.61
Youth population	486,920.74	30,923.23
Real minimum wage ($)	3.05	.47

NOTE.—NYC = New York City.

in empirical analysis.[31] Table 1 presents the descriptive statistics of the variables over the sample period.

V. EMPIRICAL IMPLEMENTATION

Estimated Effects

Following our earlier work and the literature cited there, we applied unit root tests to investigate the trend behavior of the variables using standard augmented Dickey-Fuller tests.[32] The results provide evidence for unit roots (stochastic trends) in all variables except for prison population and teen

[31] We used the Hodrick-Prescott filter (Robert J. Hodrick & Edward C. Prescott, Postwar U.S. Business Cycles: An Empirical Investigation, 29 J. Money Credit & Banking 1 (1997)) to obtain the slowly evolving trend component. In this procedure, the trend component in the variable under investigation, Γ, is obtained by solving the following convex minimization problem: $\min \Sigma_{t=1}^{T}(X_t - \Gamma_t)^2 + \lambda\Sigma_{t=1}^{T}(X_t - 2\Gamma_{t-1} + \Gamma_{t-2})^2$, where X is the variable of interest and λ is the weight on the squared second difference of the growth component, which penalizes acceleration in the trend. Following previous examples (for example, Keith Blackburn & Morten O. Ravn, Business Cycles in the United Kingdom: Facts and Fictions, 59 Economica 383 (1992); and H. Naci Mocan, Structural Unemployment, Cyclical Unemployment, and Income Inequality, 81 Rev. Econ. & Stat. 122 (1999)), λ is set to 1,600, but the decomposition was not sensitive to the variations in the value of λ.

[32] Corman & Mocan, *supra* note 7; Mocan, *supra* note 31.

population. This means that the proper specification of equation (1) should involve regressing the first difference of the crime variables on the first difference of the right-hand-side variables with unit roots and should not include a time trend as a regressor.[33] Cointegration tests suggest that there is evidence of cointegration between the crime and the right-hand-side variables in all cases, indicating that the estimated regressions should include an error correction term. This means that even though crime and its determinants are governed by random trends, there exists an equilibrium relationship between them, which keeps them together in the long run. The lag length of each variable is determined by the Akaike Information Criterion (AIC). The natural logarithms of the variables are taken before differencing, and estimations are carried out using a heteroskedasticity and serial correlation robust covariance matrix with serial correlation up to lag 24.

Table 2 displays a summary of the results of the estimation of equation (1) for the seven different crimes. It reports summed coefficients and standard errors.[34] The sum of the coefficients represents the long-run impact of the explanatory variables on crime. The numbers in parentheses after the variables represent the range of the lag length. For example, "Arrests (1–5)" in the murder regression indicates that murders are influenced by five past values of murder arrests as determined by the AIC. The sensitivity of the results to alternative lag lengths is discussed below. Because the prison population variable was measured beginning in December 1974, regressions span from December 1974 through December 1999.

As Table 2 demonstrates, felony arrests have a negative and statistically significant impact on all seven index crimes analyzed. An increase in prison inmates from NYC has a negative effect on all crimes but assault and rape. When other measures of deterrence are controlled for, the size of the police force has an effect only on motor vehicle theft and grand larceny.

Misdemeanor arrests have a significant negative effect on robbery, motor vehicle theft, and grand larceny. This indicates that, holding constant their own arrests, the size of the police force, and the prison population, the growth rates in robberies, motor vehicle thefts, and grand larcenies decline as the growth rate of misdemeanor arrests increases. This result provides support for the broken-windows hypothesis in the case of these three crimes.

It can be argued that the effect of misdemeanor arrests on robbery, motor vehicle theft, and grand larceny is observed because of an incapacitation effect. However, there is evidence that, for most misdemeanor arrests, incarcerations occur in a small minority of cases and tend to be short term. James Nelson studied misdemeanor arrests occurring in New York State

[33] The teen population variable and the prison variable do not contain unit roots, and therefore these variables enter the models in levels rather than first differences.

[34] Because the summed coefficients of teen population were never significant, they are not reported in Table 2.

TABLE 2

RESULTS OF THE ESTIMATION OF EQUATION (1): SUM OF COEFFICIENTS

Crime	Coefficient	Standard Error
Murder:		
Arrests (1–5)	−.668**	.226
Police (0–2)	−.508	1.035
Total misdemeanor arrests (1–5)	−.618	.405
Number of prisoners from NYC (1–8)	−.075*	.036
NYC unemployment rate (0–3)	.432	.328
NYC minimum wage (0)	−.660**	.228
Burglary:		
Arrests (1–21)	−.471*	.199
Police (0–1)	−.276	.227
Total misdemeanor arrests (1–2)	−.054	.058
Number of prisoners from NYC (1–18)	−.058**	.023
NYC unemployment rate (0–2)	.162^{+}	.083
NYC minimum wage (0–2)	.327	.321
Assault:		
Arrests (1–4)	−.247*	.121
Police (0–1)	−.031	.218
Total misdemeanor arrests (1–2)	.075	.090
Number of prisoners from NYC (1–5)	−.007	.010
NYC unemployment rate(0–1)	.078	.105
NYC minimum wage (0–1)	.181	.189
Robbery:		
Arrests (1–12)	−1.322**	.340
Police (0–2)	−.390	.453
Total misdemeanor arrests (1–2)	−.247**	.050
Number of prisoners from NYC (1–11)	−.029*	.008
NYC unemployment rate (0–2)	−.150	.099
NYC minimum wage (0–1)	−.374^{+}	.205
Motor vehicle theft:		
Arrests (1–14)	−1.043**	.250
Police (0–2)	−.577*	.254
Total misdemeanor arrests (1–2)	−.157*	.065
Number of prisoners from NYC (1–8)	−.028**	.008
NYC unemployment rate (0)	.124*	.041
NYC minimum wage (0–2)	−.267	.359
Grand larceny:		
Arrests (1–2)	−.107**	.035
Police (0–1)	−.673**	.247
Total misdemeanor arrests (1)	−.049**	.019
Number of prisoners from NYC (1–4)	−.020*	.010
NYC unemployment rate (0–4)	−.022	.083
NYC minimum wage (0–1)	−.401^{+}	.216
Rape:		
Arrests (1–4)	−.425*	.193
Police (0–1)	−.133	.525
Total misdemeanor arrests (1–3)	−.052	.201

TABLE 2 (*Continued*)

Crime	Coefficient	Standard Error
Number of prisoners from NYC (1)	−.029	.019
NYC unemployment rate (0)	−.068	.138
NYC minimum wage (0–2)	−.144	.222

NOTE.—Results presented are the sum of the effect of lagged (and, in some cases, current) values of the variables listed on the number of each type of felony crime. The numbers in parentheses next to each variable represent the number of current (0) and lagged (1 or more) values in the regressions. Also included in the regressions were teen population and monthly dummies. For all variables except teens and prison population, variables are employed in first differences. NYC = New York City.

+ Significant at the 10% level.

* Significant at the 5% level.

** Significant at the 1% level.

between January 1, 1985, and December 31, 1986.[35] During this period, the total number of misdemeanor arrests for the largest four counties in NYC (excluding Richmond) was 122,797. Of these arrests, 9.4 percent resulted in a conviction with a jail sentence. For those sentenced to a jail term, the average length of stay was 27.5 days. Thus, the expected jail sentence for misdemeanor arrest was 2.6 days.[36]

Some defendants who were convicted of a misdemeanor offense received a sentence of "time served," meaning that they spent some time in jail prior to their conviction. Approximately 13 percent of those arrested for a misdemeanor received a sentence of time served. The average time between arrest and arraignment for December of that year was slightly over 24 hours, down from the 40 hours in 1989.[37] This information indicates that misdemeanor arrests result in negligible incarceration effects for most offenders. Therefore, it is unlikely that the effect of misdemeanor arrests on robbery, motor vehicle theft, and grand larceny is due to incapacitation.

Increases in the real minimum wage are found to significantly reduce

[35] James F. Nelson, Racial and Ethnic Disparities in Processing Persons Arrested for Misdemeanor Crimes: New York State, 1985–1986 (1991), examined the first arrest during the period for any individual and only lower-court processing, since almost all persons arrested for misdemeanor charges were disposed in the lower courts. The study excluded prostitution and driving-while-intoxicated arrests. There is specific information for four of the five NYC counties: New York, Kings (Brooklyn), Queens, and the Bronx. Richmond (Staten Island) is not reported as a separate county and is therefore excluded from these results.

[36] Note that this number will be considerably lower than the expected incarceration for those convicted of a misdemeanor or the expected incarceration for those in jail. This is because many individuals arrested for more serious (felony) crimes are convicted of lesser offenses and/or are sentenced to jail terms (rather than prison). In a study of felony-case processing in New York between 1990 and 1992, James F. Nelson, Disparities in Processing Felony Arrests in New York State, 1990–1992 (1995), found that individuals convicted of a felony were more likely to be sent to jail than to prison, and about 40 percent of those who were arrested for a felony and were convicted had been convicted of (most likely plea bargained) a misdemeanor offense.

[37] Michael Cooper, You're under Arrest, N.Y. Times, December 1, 1996, sec. 13, at 1.

robberies, murders, and grand larcenies, and higher unemployment is significantly related to increased burglaries and motor vehicle thefts. Thus, although it is not always the same economic indicator, there is evidence that economic conditions affect all felony crimes except assault and rape.[38]

The lack of very robust evidence on the effect of economic conditions on crime is well documented in the literature.[39] As summarized by Richard Freeman, this could be because although potential criminals may be responsive to their own unemployment or wage prospects, these prospects may be only weakly linked to measures of aggregate unemployment rate and wages.[40] Furthermore, the phenomenon of joint participation in legal and criminal activities, especially for younger individuals, is well documented.[41] Because crime and legal work are not exclusive activities, the elasticity of the supply of crime is expected to be high, which in turn suggests that it would take substantial swings in the unemployment rate and wages to register significant changes in criminal activity.[42]

B. Magnitudes

To assess the magnitudes of the effects of each variable on crime, we used the sum of the coefficients reported in Table 2 and calculated the elasticities of own felony arrest rates, misdemeanor arrest rates, prison population, unemployment rate, and real minimum wage. The calculated elasticities are reported in Table 3. Note that we have converted the results from number of felony arrests to the felony arrest rate to allow our results to be compared with similar elasticity estimates.[43]

Table 3 includes elasticities only for statistically significant variables. The first row in each column reports the elasticity calculated using a zero-growth steady-state scenario for the variables in the system. The elasticities reported in the second row are calculated using the average of the year-to-year growth rates of the explanatory variables. Table 3 demonstrates, for example, that a 10 percent increase in the murder arrest rate generates about a 4 percent

[38] Although the estimated models include a large number of deterrence variables, there are other potentially important variables, such as conviction rates, which are not included. Mustard, *supra* note 7, shows that conviction rates are negatively correlated with arrest rates, which suggests that the true effect of the arrest rates may be larger than reported here.

[39] Freeman, Labor Market, *supra* note 8.

[40] Freeman, Crime and Unemployment, *supra* note 8.

[41] Grogger, *supra* note 8; Richard B. Freeman, Why Do So Many Young American Men Commit Crimes and What Might We Do About It? 10 J. Econ. Persp. 25 (1996).

[42] Freeman, *supra* note 11.

[43] We calculate the elasticity of crime with respect to the arrest rate as follows: $ARRT = AR/CR$, where ARRT is the arrest rate, AR is the number of arrests, and CR is crime. That means that $\ln(ARRT) = \ln(AR) - \ln(CR)$ and $\partial\ln(ARRT)/\partial\ln(CR) = \partial\ln(AR)/\partial\ln(CR) - 1$. Let E denote the elasticity of crime with respect to its own arrest rate, and let K represent the elasticity of crime with respect to arrests. Then $E = K/(1 - K)$.

TABLE 3

ELASTICITY OF CRIME ESTIMATES

Explanatory Variable	Murder	Assault	Burglary	Robbery	Motor Vehicle Theft	Grand Larceny	Rape
(Own) felony arrest rate	−.40	−.20	−.32	−.57	−.51	−.14	−.32
	−.39	−.24	−.27	−.59	−.50	−.10	−.30
Total misdemeanor arrests				−.25	−.16	−.06	
				−.32	−.21	−.05	
Number of police officers					−.56	−.67	
					−.59	−.70	
NYC unemployment rate			.16		.13		
			.19		.16		
Real minimum wage	−.69			−.37		−.40	
	−.63			−.34		−.36	
Number of prisoners from NYC	−.08		−.06	−.03	−.03	−.02	

NOTE.—Elasticity estimates are calculated only for significant variables. The top estimate uses a zero-growth steady-state scenario, and the bottom estimate is calculated using the average of the year-to-year growth rate of the explanatory variable. NYC = New York City.

reduction in murders, and a 10 percent increase in the real minimum wage results in a 6.3–6.9 percent decrease in murders.

Robberies and motor vehicle theft rates are more responsive than other crimes to changes in their own arrest rates. Also, robberies and motor vehicle theft rates are affected more significantly by misdemeanor arrests than is grand larceny, another crime affected by misdemeanor arrests. A 10 percent increase in misdemeanor arrests generates a 1.6–2.1 percent decline in motor vehicle theft, a 2.5–3.2 percent decline in robbery, and a .5–.6 percent decline in grand larceny.[44]

The average unemployment rate between 1974 and 1999 was 8 percent in NYC. Using the unemployment rate elasticities reported in Table 3, we see that a 1-percentage-point decline in the unemployment rate (a 12.5 percent decline) generates about a 2.2 percent decline in burglaries and 1.8 percent decline in motor vehicle thefts. These magnitudes are remarkably similar to those reported in previous research.[45]

The mean values for felony arrest rates are 65.6 percent for murder, 56 percent for assault, 9.5 percent for burglary, 24.2 percent for robbery, 8.6 percent for motor vehicle theft, 8.3 percent for grand larceny, and 44.8 percent for rape. Thus, a 1-percentage-point increase in each arrest rate would generate the following declines: .6 percent decline in murder, .4 percent decline in assault, 3.1 percent decline in burglary, 2.4 percent decline in robbery,

[44] These results underscore the fact that robbery is affected more strongly than any other crime category. Studies that infer the effects of misdemeanor arrests on all crimes on the basis of the results for robberies will, most likely, overstate the effects of broken-windows policing.

[45] Gould, Weinberg, & Mustard, *supra* note 8; Freeman & Rodgers, *supra* note 8.

5.9 percent decline in motor vehicle theft, 1 percent decline in grand larceny, and .7 percent decline in rape.

Although prison population is statistically significantly related to five of the crimes, the magnitudes of the elasticities are low, ranging from −.02 to −.08. Thomas Marvell and Carlisle Moody report similarly low incapacitation elasticities for violent crimes; their elasticity for all index crimes is −.16.[46] Levitt estimates larger incapacitation elasticities, although John Donohue and Peter Siegelman argue that these elasticities may be too high.[47]

VI. Interpretation and Sensitivity Analysis

A. Shifts in Police Productivity and/or Morale

In our empirical specification, consistent with the rhetoric of the Giuliani administration, we used misdemeanor arrests as a measure of broken-windows policing. It can, however, be argued that pursuing low-level crimes (increased misdemeanor arrests) has an effect on more serious crimes, not because of a signaling effect as claimed by the broken-windows hypothesis, but because it captures some other influence. For example, it may be the case that police morale increased after Giuliani became mayor in January 1994. If improved morale makes police more vigilant against misdemeanors as well as serious crimes, the observed relationship between misdemeanor arrests and felony crimes may not imply a signaling-related broken-windows effect. Rather, in this scenario, misdemeanor arrest would act as a proxy for police morale. Along the same lines, new policing procedures may have improved police productivity across the board.[48]

To entertain the possibility that improved police morale and/or productivity may have confounded the estimated relationship between misdemeanor arrests and felony crimes, we reestimated the models with a dichotomous indicator variable, which takes the value of one after January 1994, to capture the time span of the Giuliani administration in the data. This Giuliani indicator variable was negative and statistically significant for the violent crimes of

[46] Thomas B. Marvell & Carlisle E. Moody, Prison Population Growth and Crime Reduction, 10 J. Quantitative Criminology 109 (1994).

[47] Levitt, Effect of Prison Population Size on Crime Rates, *supra* note 7; John J. Donohue III & Peter Siegelman, Allocating Resources among Prisons and Social Programs in the Battle against Crime, 27 J. Legal Stud. 1 (1998).

[48] One such example is the computer statistics (Compstat) process, which was implemented in 1994. Under Compstat, twice weekly meetings were held at the police headquarters, where precinct commanders, detective squad commanders, and other command staff analyzed district-level data on district maps regarding criminal activity ranging from shootings to car thefts and narcotics. Precinct commanders were expected to be knowledgeable about the details of criminal activity and police reaction and to come up with a plan to attack crime. Bratton, *supra* note 13, at 233.

murder and robbery.[49] However, adding the Giuliani indicator did not influence the effect of misdemeanor arrests on robbery, motor vehicle theft, and grand larceny reported in Table 2.[50] These results suggest that although there was a negative "Giuliani" effect on the growth rates of robbery and murder, misdemeanor arrests have an additional, separate effect on robbery, motor vehicle theft, and grand larceny. When we estimated the models using data ending in December 1993, we obtained the same significant effect of misdemeanor arrests on robbery and motor vehicle theft, although the magnitude of the effect was somewhat smaller in the case of motor vehicle theft.[51,52]

B. Lag Lengths and Incarceration Effects

The lag lengths are determined by a statistical procedure (AIC), which suggested short lags for misdemeanor arrests (see Table 2). However, it can be argued that broken-windows policing would have beneficial impacts with longer lags because it takes time for people to observe and react to signals. Furthermore, the theoretical discussion in Section I suggests path dependence in the behavior of breaking windows, which would again imply that longer lags would be important. Similarly, if low-level policing builds social capital, which then reduces crime, one would expect an impact on crime of broken-windows policing with a relatively longer lag. To address this issue, we reestimated the models by extending the lags of misdemeanor arrests. Specifically, we estimated the model with 6, 9, 12, 15, 18, 21, 24, 27, and 30 lags for misdemeanor arrests. The results are presented in Table 4, where the sums of the coefficients of lagged misdemeanor arrests are reported. The effect of misdemeanor arrests on robbery and motor vehicle theft is very robust. The sum of the coefficients is no longer statistically significant in the case of grand larceny when the number of lags exceeds 9. On the other hand, misdemeanor arrests with increased lag lengths have a significant impact in

[49] Specifically, the coefficient of the Giuliani indicator was estimated as $-.13$ ($p = .00$) in the murder regression, and it was $-.02$ ($p = .05$) in the robbery equation.

[50] The sum of the misdemeanor arrest coefficients was $-.236$ ($p = .00$) in the robbery regression, $-.159$ ($p = .01$) for motor vehicle thefts, and $-.047$ ($p = .01$) for grand larceny.

[51] That is, $-.106$ ($p = .07$) for motor vehicle theft, $-.262$ ($p = .00$) for robbery, and $-.040$ ($p = .10$) for grand larceny.

[52] Steven D. Levitt, Understanding Why Crime Fell in the 1990s: Four Factors That Explain the Decline and Six That Do Not, 18 J. Econ. Persp. 163 (2004), voiced skepticism regarding the impact of NYC's policing strategy on crime. Levitt asserts that crime started to decline before Guiliani became mayor and suggests that the increase in the size of the police force since the early 1990s might be primary reason for the decline in crime. Our analyses address these concerns. First, our results are obtained holding constant the change in the police force. Furthermore, the impact of broken-windows policies changes little when the models are estimated with a post-Guiliani dummy or for the period before Guiliani.

TABLE 4

EFFECT OF MISDEMEANOR ARRESTS WITH LONG LAGS

Lags	Murder	Assault	Robbery	Burglary	Motor Vehicle Theft	Grand Larceny	Rape
6	−.845*	.399	−.385^{+}	−.217	−.228	−.265^{+}	−.254
9	−.915*	.547*	−.693**	−.228	−.460*	−.302*	−.273
12	−.937*	.512*	−.981**	−.524*	−.606	−.257	.439
15	−.960*	.188	−.964**	−.561*	−.700**	−.274	.035
18	−.964*	.127	−.811**	−.403	−.523*	−.175	.073
21	−1.034*	−.037	−.952**	−.602^{+}	−.476*	−.302	.057
24	−1.030*	.029	−1.232**	−.871*	−.560*	−.232	.040
27	−1.010*	−.084	−1.272**	−.828^{+}	−.746**	.034	−.285
30	−1.055*	.252	−1.460**	−.645	−.633*	−.029	.105

NOTE.—Values presented are the sums of the estimated coefficients of lagged misdemeanor arrests.
$^{+}$ Significant at the 10% level.
* Significant at the 5% level.
** Significant at the 1% level.

the case of murder. Furthermore, in some cases burglary is also affected by misdemeanor arrests, although the statistical significance is spotty.[53]

To investigate further the robustness of the results, we performed a number of exercises. First, we subtracted drug-related misdemeanor arrests from total misdemeanor arrests and obtained total nondrug misdemeanor arrests. Using this measure of misdemeanor arrests, we obtained very similar results. Second, we replaced the unemployment rate with total number of recipients of public assistance in NYC.[54] The results remain unchanged, and an increase in total recipients was positively related to robberies and motor vehicle thefts. Finally, we imposed the same arbitrary lag length to each variable and tried lag lengths of 3, 6, 9, and 12. The results, which are not reported here, were reasonably consistent with those obtained from the earlier specifications.[55]

[53] Note that the sum of the lagged coefficients reported in Table 4 represents the long-run effect of misdemeanor arrests. Consistent with expectations, the effect of misdemeanor arrests increases with longer lag lengths (with the exception of assault and rape, where there is no significant relation to misdemeanor arrests). We also estimated these models in the pre-1994 period. Because the sample is shorter, we employed up to 24 lags. Even in this case, the effect of misdemeanor arrests on robbery and to some extent on burglary and motor vehicle theft was evident. The point estimates were reasonably similar to those reported in Table 4 for a given lag length in the cases of robbery, motor vehicle theft, and grand larceny.

[54] These numbers were obtained from the Office of Data Analysis and Research of the New York City Human Resources Administration. Public assistance recipients include those receiving Family Assistance Program (formerly under the Aid to Families with Dependent Children program) and those receiving Safety Net Assistance (formerly under the Home Relief program). Note that the welfare programs were changed by the New York State Welfare Reform Act of 1997 (1997 N.Y. Laws, ch. 436(B) (August 20, 1997)).

[55] There were some interesting similarities between these results and those reported in Table 4. Specifically, misdemeanor arrests had a negative and significant effect in some lag length specifications for murder and burglary, which suggests that broken-windows policing may have an effect on these crimes as well.

As discussed previously, the incarceration effect for misdemeanor arrests is small, given that time served for such arrests is short. The results in Table 4 give further evidence that the incarceration effect does not drive the effect of misdemeanor arrests. This is because misdemeanor arrests have an influence on both robberies and motor vehicle thefts 12–30 months later, but almost no misdemeanor arrest results in incarceration of 1 year or more.[56]

VII. What Accounted for the Large Decreases in Felony Crimes?

To put these results into perspective, we examined the effect of each of our variables in reducing felony crime in NYC in the 1990s. Using the elasticity estimates reported in Table 3 and the actual percentage changes in the deterrence and economic variables between 1990 and 1999, we calculated the percent change in the number of crimes between 1990 and 1999 attributable to each variable. The results are presented in Table 5. Felony arrest rates (except for motor vehicle thefts) increased dramatically during the 1990s, with a range of about 50–70 percent. Similarly, misdemeanor arrests increased more than 70 percent.[57] The size of the police force increased about 35 percent during the same period, and the number of imprisoned NYC residents also showed a substantial increase during this period as well (24 percent). Economic variables did not show the same magnitude of change as the criminal justice variables. The unemployment rate declined 3 percent, and real minimum wage increased 12 percent between 1990 and 1999.

As depicted in Table 5, the model is able to explain a sizable fraction of the actual decrease in the number of felony crimes in NYC during the 1990s. For example, the actual decrease in murders between 1990 and 1999 is 73 percent. Our model suggests that the observed increase in the murder arrest rate accounts for 29 percent of this decline. The increased prison population

[56] It can be argued that by arresting more individuals, even for lesser crimes, police can capture more known felons. For example, by stopping an individual consuming a small amount of drugs, police may, in fact, find a major drug dealer carrying kilos of drugs. If this were the case, however, the individual would be charged with a felony and there would be no record of a misdemeanor arrest, since only the most serious arrest charge is recorded. Another possibility is that by arresting individuals for misdemeanor offenses, police can later identify that the individual has an outstanding arrest warrant for a felony crime. Although this is possible, it does not occur frequently enough to provide an explanation for the impact of misdemeanor arrests on felony crimes. According to Freda Solomon, senior research fellow at the New York City Criminal Justice Agency, few individuals who are arrested for misdemeanor offenses are later identified as individuals wanted by the police for having committed a felony offense (telephone conversation, March 13, 2002). It is possible that some misdemeanor arrests become upgraded to felonies because of the number of such crimes committed. For example, a first offense of driving under the influence may be a misdemeanor, whereas a third offense may be a felony. This possibility of upgrade does not, however, apply to the current analysis, since the five crimes we analyze are all felony offenses, independent of the number of times committed.

[57] The increase is measured as the percentage change between the 12-month average in 1990 and the 12-month average in 1999.

TABLE 5

CONTRIBUTION OF VARIABLES TO THE DECREASE IN CRIME, 1990–99

Predicted Decrease in Crime due to Actual Changes in:	Murder	Burglary	Assault	Motor Vehicle Theft	Robbery	Grand Larceny	Rape
Felony arrest rate[a]	29	19	11	1	32	3	16
Misdemeanor arrest rate (increased 72%)				14	21	4	
Number of police officers (increased 35%)				20		23	
Number of prisoners from NYC (increased 24%)	2	1		1	1	<.5	
NYC unemployment rate (decreased 3%)		1		<1			
Real minimum wage (increased 12%)	8				4	4	
Total predicted decrease in crime	39	21	11	36	58	34	16
Actual decrease in crime	73	66	40	73	67	29	46
Predicted decrease/actual decrease	53	32	28	49	86	117	35
Contribution of economic variables (carrots) to the actual decrease in crime	11	1.5	0	1	6	14	0
Contribution of deterrence variables (sticks) to the actual decrease in crime	42	30	27.5	49	81	103	35
Share of deterrence measures in explained decrease in crime	79	95	100	98	93	88	100

NOTE.—Values are percentages. NYC = New York City.

[a] Increases in annual arrest rates from 1990 to 1999 were as follows: murder, 72%; burglary, 65%; assault, 49%; robbery, 56%; motor vehicle theft, 2%; grand larceny, 23%; and rape, 52%.

accounts for 2 percent of the decline in murders, and the increase in the real minimum wage explains 8 percent of this decrease. Thus, these three factors together predict a 39 percent decline in murders between 1990 and 1999. The actual decline is 73 percent; thus we are able to explain 53 percent of the decrease in murders between 1990 and 1999 (39 percent of the observed 73 percent decline). Similarly, arrests, police, prison population, and economic variables account for 86 percent of the actual decrease in robberies and between a third and a half of the decrease in burglaries, rapes, and motor vehicle thefts.[58] As Table 5 demonstrates, the primary reason for the decrease in felony crimes in the decade of the 1990s is due to felony arrests and misdemeanor arrests. Although the size of the prison population and economic variables were found to be significant, their effect is not as large. Increased police presence accounts for 20 percent of the decline in motor vehicle thefts and 23 percent of the decline in grand larcenies but has no direct influence on other crimes.

The reason for the weak effect of economic variables is that their elasticities are relatively smaller and the actual change in the unemployment and minimum wage in the 1990s was not big enough to generate a large effect on crime.[59] For example, the minimum wage increased from an average of $2.77 in 1990 to $3.09 in 1999, which is a 12 percent increase. The mean value of real minimum wage was $3.86 in the first half of the 1970s. Had the real minimum wage been increased to that level from 1990 to 1999, its effect on the decline in murders would have been 26 percent and its effect on the declines in robberies and grand larcenies would have been 14 percent and 15 percent, respectively.[60]

VIII. Summary and Discussion

While U.S. crime rates declined in the 1990s, the reverse is true for most European Union countries.[61] In both cases, scholars and policy makers try to understand the relative importance of economics factors and deterrence measures on criminal activity. For example, it has been debated whether the remarkable decline in criminal activity in NYC between 1990 and 1999 is

[58] The model predicts a larger decrease in grand larceny than that actually realized.

[59] Most accounts of drug usage in NYC indicate that the increase of cocaine-related drug use in the early 1990s was more dramatic than the subsequent decline later in the decade, so cocaine drug usage increased from 1990 to 1999. Thus, a dramatic decrease in drug usage could not account for the decrease in crime.

[60] Also, if we were to select 1994–99 as the comparison years for unemployment, the unemployment rate in NYC fell by 30 percent, and the decrease in unemployment would have accounted for 5–6 percent of the decrease in burglaries and motor vehicle thefts.

[61] Gordon Barclay, Cynthia Tavares, & Arsalaan Siddique, International Comparisons of Criminal Justice Statistics 1999 (2001); Christian Pfeiffer, Trends in Juvenile Violence in European Countries (Nat'l Inst. Just. Res. Preview 1998); John Vinocur, Candidates Skirt Facts on Crime in France, Int'l Herald Trib., April 3, 2002, at 1.

attributable to improved economic conditions or to "get tough" policies.[62] More specifically, Giuliani and Bratton implemented a strategy in NYC in which the police department aggressively pursued misdemeanor public-order offenses such as vandalism, public intoxication, and prostitution. Public officials reiterated numerous times that increased misdemeanor arrests were being used as a tool for broken-windows policing.[63] Consistent with the statements of the New York Police Department and Giuliani, in this paper we use misdemeanor arrests as a measure of broken-windows strategy and investigate its effect, along with those of economic conditions (carrots) and sanctions (sticks) on seven index crimes in NYC using monthly data spanning 1974–99.

The unemployment rate has an effect on burglary and motor vehicle theft, while real minimum wage has an effect on murder, robbery, and grand larceny. An increase in the number of NYC residents in state correctional facilities reduces all crimes but assault, but the magnitude of the influence is not large.

When economic conditions and deterrence (real minimum wage, unemployment rate, felony arrests, prison population, and the size of the police force) are controlled for, misdemeanor arrests have an impact on motor vehicle theft, robbery, and grand larceny. A 10 percent increase in misdemeanor arrests decreases motor vehicle thefts by 1.6 to 2.1 percent, robberies by 2.5 to 3.2 percent, and grand larcenies by .5 to .6 percent. We do not find strong evidence to support the contention that a broken-windows policing strategy affects the other crimes. We present evidence that shows that the effect of misdemeanor arrests is not likely due to an unobserved increase in police morale or efficiency that may have been experienced in NYC after 1993, when Giuliani became mayor.

Our models explain from about one-third to all of the observed decline in index crime in NYC between 1990 and 1999. While both economic and deterrence variables are important in explaining the decline, the contribution of deterrence measures is larger than those of economic variables. It is important to emphasize that arrests for felonies have the largest effect on felony crimes and that the effects of broken-windows policing, although significant

[62] Another potential explanation is legalized abortion. Donohue & Levitt, *supra* note 3, shows that legalized abortion had an effect on crime rates with a 20-year lag. The study finds that crime was 15–25 percent lower in 1997 in comparison with what would have been observed had abortion remained illegal. New York City liberalized its abortion law in July 1970. Theodore J. Joyce & Naci H. Mocan, The Impact of Legalized Abortion on Adolescent Childbearing in New York City, 80 Am. J. Pub. Health 273 (1990), shows that legalization of abortion had a significant impact on adolescent childbearing in NYC. Thus, it is likely that some of the residual decrease in observed crime in NYC (one that is not explained by our model) is attributable to legalized abortion.

[63] Bratton writes, "If you [urinated] in the street, you were going to jail. We were going to fix the broken windows and prevent anyone from breaking them again." Bratton, *supra* note 13, at 156.

for some crimes, are not universally significant, nor are they of great magnitude. To put the broken-windows hypothesis in perspective, note that other cities also experienced significant decreases in crime during the 1990s, without the dramatic increase in misdemeanor arrests. In California, for example, Los Angeles, San Diego, and San Francisco experienced decreases in index crime rates of 50 percent, 56 percent, and 41 percent, respectively, compared with the 58 percent decline in NYC.[64] In contrast, misdemeanor arrests declined in the three counties containing these cities.[65] According to our results, if these three California cities had increased misdemeanor arrests by 70 percent, crime rates would have fallen another 10 percent (or 4–6 percentage points),[66] making the decrease in crime more comparable to that of NYC.

One final point that needs to be considered is that significant increases in misdemeanor arrests may be costly not only in terms of police resources but also because of the potential social costs. For example, some analysts argue that increased police vigilance has a dimension that negatively affects civil liberties, especially for minorities. Furthermore, given the evidence that an arrest record diminishes the future labor market potential of the arrestee, excessive misdemeanor arrests may impose additional costs on the individual and the society.

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[64] U.S. Department of Justice, *supra* note 1. Crime rates for all index crimes are used for purposes of comparison.

[65] California Department of Justice, Division of California Justice Information Services, Crime and Delinquency in California, 2001 (2002). We chose California for comparison because of the availability of misdemeanor arrest data.

[66] New York City's misdemeanor arrest rate increased by about 70 percent between 1990 and 1999. A weighted average of the elasticity of crime to misdemeanor arrests for the seven crimes (based on the number of crimes in the three California cities in 1990 and elasticity values from Table 2) yields a value of about −.10.

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