Getting Off Death Row: Commuted Sentences and the Deterrent Effect of Capital Punishment

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> "I have inquired for most of my adult life about studies that might show that the death penalty is a deterrent, and I have not seen any research that would substantiate that point."
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> Former U. S. Attorney General Janet Reno at a Justice Department Press Briefing; January 20, 2000.

I. Introduction

Empirical studies of the economics of crime have established credible evidence regarding the impact of sanctions on criminal activity. In particular, it has been demonstrated that increased arrests and police have deterrent effects on crime (Corman and Mocan 2000, Levitt 1997, Grogger 1991). The analysis of the determinants of homicide is especially important because it poses an interesting test for economic theory. According to the standard economic model of crime, a rational offender would respond to perceived costs and benefits of committing crime. Murder is an important case to test this behavioral hypothesis because murder may be considered a crime which can be committed without regard to costs or benefits of the action. However, empirical tests reveal that even murder responds to costs of crime. For example, Corman and Mocan (2000, 2002) show that an increase in murder arrests decreases murders in New York City. Capital punishment is particularly significant in this context, because it represents a very high cost for committing murder (loss of life). Thus, the presence of capital punishment in a state, or the frequency with which it is used should unequivocally deter homicide. Yet, it has been a difficult empirical task to identify the impact of capital punishment on homicide simply because there is not much variation in the execution

rates in a cross-section of states, or over time to estimate its impact on homicide with precision.

The statement of former U.S. Attorney General Janet Reno cited above highlights the mixed scientific evidence on the deterrent effect of the death penalty. Ehrlich (1975) and Ehrlich (1977a) found a significant deterrent effect of capital punishment on murder rates using aggregate time series, and cross-sectional data, respectively. Ehrlich's findings were challenged by subsequent work (Leamer 1983; Hoenack and Weiler 1980; Passell and Taylor 1977; Bowers and Pierce 1975) based on the identification of the murder supply equation, functional form of the equations estimated, the sample period investigated and the choice of variables. Ehrlich and others responded to these criticisms (Ehrlich and Liu 1999; Ehrlich and Brower 1987; Ehrlich 1977b). Nevertheless, the issue of whether the death penalty deters murder is still debated in the media,[1] as well as in academia (Dezhbakhsh, Rubin and Shepherd 2002, Sorensen et al. 1999; Cameron 1994; Cover and Thistle 1988; McManus 1985; McFarland 1983; Layson 1983; Forst 1983).

Because of the ethical, moral and religious aspects of capital punishment, executing death row inmates generates repercussions, even from outside the United States. For example, Pope John Paul II appealed to then-Governor George W. Bush to stop an execution scheduled for January, 2000. Recently, state lawmakers have been

1 Recent examples are: CNN Live Today, June 27, 2001, "Gallup Poll: Americans and the Death Penalty;" Meet the Press, NBC, June 10, 2001 hosting former New York Governor Mario Cuomo and Oklahoma Governor Frank Keating; The O'Reilly Factor on Fox New Network, June 11, 2001, "Death Penalty as a Deterrent."

reacting to the sentiment that there is arbitrariness and possibly a racial bias in the implementation of the death penalty by proposing legislation to either abolish it, or instate a moratorium.[2] Similarly, a bill was introduced in United States Congress recently to abolish the death penalty under Federal law.[3]

In this paper we investigate whether the death penalty is a deterrent for homicide. An inherent difficulty in uncovering an impact of deterrence on crime is to find appropriate data sets to overcome the issue of simultaneity between criminal activity and deterrence measures. Low-frequency time series data or cross-sectional data are not satisfactory to address the issue (Corman and Mocan 2000, Levitt 1997). We use a state-level panel data set that contains information on homicide and other crimes, deterrence variables, relevant capital punishment measures along with a number of state characteristics.

An innovation of this paper is the use of a Department of Justice data set, which is new to the literature. This data set contains detailed information on the entire 6,143 deaths sentences between 1977 and 1997 in the United States. For example, the reason and exact month of removal from death row is identified for each prisoner. This information is valuable as it allows us to link executions to criminal activity in the proper time frame. More specifically, previous studies linked the crime rate in a given

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2 Legislators in at least 21 states have recently proposed legislation to modify their current capital punishment laws. Illinois imposed a moratorium in 2000.

3 Federal Death Penalty Abolition Act of 2001, introduced by Senator Russell Feingold; January 25, 2001, S191.

year to the number of executions in the same year. However, if an execution takes place towards the end of a year, it cannot considerably effect crime rates in that same year (as the number of crimes for that year have been committed since January). Rather, such an execution is expected to impact the crime rate of *the following year*. This issue is potentially significant because 47 percent of all executions, 53 percent of all removals from death row for reasons other than executions and other deaths, and 51 percent of all commutations (reductions in sentence) between 1977 and 1997 took place between the months of July and December.

Another innovation of this paper is to investigate the impact on homicide of removals from death row. A removal from death row takes place if capital sentence is declared unconstitutional by state or U.S. supreme court, or conviction is affirmed but sentence is overturned by appellate court, or conviction and sentence are overturned by appellate court, or if the prisoner is commuted.[4] In this paper we investigate the impact of removals, and also the impact of commutations (a subset of removals) on homicide. Both of these represent a decrease in the expected cost of committing the crime, and should have a positive impact on the homicide rate. The impact of commutations and removals from death row on homicide or other crimes have not been investigated before.

4 If the inmate is deceased on death row or executed, this is not considered a removal from death row for the purposes of this paper. Thirty-five cases where the removal is "for other reasons" were not included in the analysis.

We find statistically significant relationships between homicide and executions, commutations and removals. Specifically, each additional execution (commutation) reduces (increases) homicides by about 5, while an additional removal from death row generates about one additional murder.

Section II gives the background on death penalty in the United States. Sections III and IV describe the methodology and the data, respectively. Section V presents the results. Section VI consists of the extensions, and Section VII is the conclusion.

II. Recent History of Capital Punishment and the Data Set

In the late 1960s 40 states had laws authorizing use of the death penalty in the United Sates. However, strong pressure by those opposed to capital punishment resulted in few executions. For example, there were 145 executions between 1960 and 1962. In 1963 and 1964 there were 21 and 15 executions, respectively. Between 1965 and 1967 there were a total of 10 executions, and nobody was executed between 1968 and 1972. All executions were halted and hundreds of inmates had their death sentences lifted by a Supreme Court decision in 1972. In *Furman v. Georgia,* 408 U.S. 153 (1972) the Supreme Court struck down federal and state laws that had allowed wide discretion resulting in arbitrary and capricious application of the death penalty. Three of the Supreme Court justices voiced concerns that included an appearance of racial bias against black defendants. Furthermore, laws that imposed a mandatory death penalty and those that allowed no judicial or jury discretion beyond the determination of

guilt were declared unconstitutional in 1976 [Woodson v. North Carolina, 428 U.S. 280 (1976), Roberts v. Louisiana, 428 U.S. 325 (1976)].

Starting in the mid-1970s, many states reacted by adopting new legislation to address the concerns of the Supreme Court, and these new state laws were later upheld by the Supreme Court [e.g. *Gregg v. Georgia,* 428 U.S. 153 (1976), Jurek v. Texas, 428 U.S. 262 (1976), and Proffitt v. Florida, 428 U.S. 242 (1976)]. New state statutes created two-stage trials for capital cases, where guilt/innocence and the sentence were determined in two different stages. The first post-Gregg execution took place in 1977 in Utah, and the number of executions has since continued to rise. Currently, only 12 states and the District of Columbia do not have capital punishment, although a number of states consider abolishing death penalty.[5]

Figure 1 displays the murder rate in the United Sates per 100,000 people between 1977 and 1997, along with the number of executions during the same time period. Following the first post-Gregg execution in 1977, the number of executions increased to an average of about 20 per year around mid-1980s. After remaining stable until the early 1990s, the number of executions started rising in 1993, reaching 74 executions in 1997. The homicide rate was 8.8 murders per 100,000 people in 1977. It reached 10.2 in 1980, and then started declining continuously until 1984. When the number of executions was relatively stable in late 1980s, the murder rate rose again,

[5] The twelve states are Alaska, Hawaii, Iowa, Maine, Massachusetts, Michigan, Minnesota, North Dakota, Rhode Island, Vermont, West Virginia and Wisconsin.

reaching 9.8 murders per 100,000 people in 1991. It began declining after 1991 and went down 6.8 in 1997.

III. Empirical methodology

To investigate the impact of capital punishment and other forms of deterrence on homicide, we estimate regressions of the following form:

(1) $$MURDER_{it} = \mathbf{DETER}_{it-1}\,\beta + \mathbf{X}_{it}\,\Omega + \mu_i + \eta_t + \psi_{it} + \varepsilon_{it,}$$

where $MURDER_{it}$ is the homicide rate in state *i* and year *t*, and ***DETER*** stands for the vector of deterrence variables. Following Ehrlich (1975) and the literature that follows, ***DETER*** consists of the subjective probabilities that potential offenders are apprehended, convicted and executed. The first one of these probabilities is measured by the murder arrest rate (the proportion of murders cleared by an arrest). The second probability is calculated as the ratio of death sentences in year *t* divided by murder arrests in year *t-2*.[6] Following Levitt (1998), and Katz, Levitt and Shustorovich (2001), incapacitation is calculated as the number of prisoners per violent crime.[7] Following the results of Katz, Levitt and Shustovich (2001) we also included the prison death rate, a measure of prison conditions, as another deterrence measure.

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6 Dezhbakhsh, Rubin and Shepherd (2002) use the same measure. In our inmate-level data set, the annual average duration between a murder arrest and the day the inmate is sentenced is about 1.3 years. Using sentences in year *t* to arrests in year *t-1* gave identical results. To be comparable to Dezhbakhsh, Rubin and Shepherd (2002), we reports results with arrests lagged two periods.

7 As Levitt (1998) notes, the number of individuals in custody as a fraction of the population may correspond more closely to the theoretical notion of incapacitation. Thus, as an alternative measure we also employ the number of prisoners per population.

The fifth variable in ***DETER*** pertains to the probability of execution given conviction. Following Dezhbakhsh, Rubin and Shepherd (2002) we calculate the risk of execution as the number of executions in year *t* to death sentences in year *t-6*.[8] [9] The data set also contains information on death row inmates who are commuted. An increase in this type of clemency implies a decrease in the probability of execution, which economic theory predicts should have a positive impact on murder rates. We use the number of commutations divided by death sentences six years ago as an (inverse) deterrence measure. As an alternative measure of inverse deterrence we use a more comprehensive measure of removals from death row. This pertains to all removals other than executions and other deaths on death row. These include inmates who received a commuted sentence and those who are removed from death row because the capital sentence is declared unconstitutional by the state or U.S. supreme court, conviction is affirmed but sentence is overturned by an appellate court, or conviction and sentence are overturned by an appellate court.[10]

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8 In an earlier version, we calculated this probability as the number of executions per death row inmates in the same year. Although this is a measure of a flow over a stock, we obtained very similar results.

9 Dezhbakhsh, Rubin and Shepherd (2002) perform their analysis at the county level. Another difference between their paper and ours is that we employ a larger number of deterrence variables.

10 Following Katz, Levitt and Shustorovich (2001), Mocan and Corman (2000), and Levitt (1998), deterrence variables are lagged once to minimize the impact of simultaneity between the murder rate and deterrence measures. Because the number of homicides appear in the numerator of the independent variable and in the denominator of the homicide arrest rate and prisoners per violent crime, measurement error in homicides generates biased estimates. Unlike other types of crimes, measurement error in the homicide variable is unlikely to be

The vector **X** contains state characteristics that may be correlated with criminal activity. It includes information on the unemployment rate, real per capita income, the proportion of the state population in the following age groups: 20-34, 35-44, 45-54 and 55 and over, the proportion of the state population in urban areas, the proportion which is black, the infant mortality rate, and the legal drinking age in the state. Theoretical and empirical justification for the inclusion of these variables can be found in Levitt (1998), and Lott and Mustard (1997). The variable μ_i represents unobserved state-specific characteristics that impact the murder rate and η_t represents year effects. To control for the impact of the 1995 Oklahoma City bombing, we included a dummy variable, which takes the value of one in Oklahoma in 1995 and zero elsewhere. The models also include state-specific time-trends represented by ψ_{it}.

IV. Data

We use data from *Capital Punishment in the United States, 1973-1998*, complied by the Department of Commerce and the Bureau of Census, and published by Bureau of Justice Statistics of the U.S. Department of Justice. The data set contains information on the exact month and year of the prisoner's sentencing, and the month and year when the prisoner is removed from death row. These data provide information on the history of 6,143 death sentences between 1977 and 1997 in the United States.

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consequential. Nevertheless, lagging the deterrence measures also helps minimize this potential bias as well (Levitt 1998).

This data set allows us to analyze, for the first time in this literature, the impact of commutations and total removals from death row on the homicide rate. An increase in the number of commutations handed to death row inmates implies a decrease in the risk of execution. Thus, an increase in the commutation rate is expected to be positively related to murders. The same is true for total removals from death row.[11]

Second, as mentioned earlier, an advantage of our data set is the availability of the date of each execution and removal. This information enables us to create execution, commutation and removal measures that are more consistent with theory. More specifically, if executions, commutations or removals from death row send signals to potential criminals, then the timing of the signal is important. For example, an execution which took place in January of 1980 can have an impact on the homicide rate for the full year. However, if the execution took place in December 1980, it will have a trivial impact on the 1980 homicide rate. Rather, the impact of this December execution on murder will be felt in 1981. The distribution of executions are relatively uniform over the year. An investigation of the 432 executions that took place between 1977 and 1997 shows that approximately 8 percent took place in each month. Given this, we prorated the executions, commutations and removals based on the month in which they occurred. As above, an execution that took place in January 1980 is expected to impact the state homicide rate for the entire twelve months in 1980.

Therefore we count this execution as a full execution in 1980. By contrast, if an execution took place in November 1980, it is assumed that its deterrent impact on homicide is felt during the subsequent 12-month period. Thus, this November execution counts as 2/12 of an execution for 1980 and 10/12 of an execution for 1981. The same algorithms are applied for commutations and removals. As a second measure, we created the following algorithm: If an execution took place within the first three quarters of a year, we attributed that execution to the same year. If the execution took place in the last quarter of a year (October-December) we attributed that execution to the following year under the assumption that the relative impact on murders would be felt in the following year. The same was done for removals and commutations.

Table 1 presents the descriptive statistics of the data. The top-section of the table presents information on the homicide rate, homicide arrests, the two measures of the execution, commutation and removal rates as well as sentencing, custody and prison death rates. The lower-section of the table summarizes the data that capture state characteristics. These are legal drinking age in the state, the state unemployment rate, real per capita income, the infant mortality rate in the state, percent of population living in urbanized areas, percent black, the age distribution of state population and a dichotomous variable to indicate whether the governor is a republican. The bombing of the Federal Building in Oklahoma City in 1995 is controlled for with the dummy variable Oklahoma City-1995, although its omission from the models has no impact on

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11 A commuted sentence does not mean that the inmate is released from prison. Rather, the

the empirical results. The sources of these data are described in the Appendix. Table 1 also displays the standard deviations of the variables after removing state fixed-effects, time effects and state-specific time trends. The variation goes down significantly for some variables such as Urbanization, Percent Black and the age distribution variables, but substantial variation remains for most others.

V. Results

Table 2 presents a number of different specifications. Column I contains the specification where the homicide rate is explained by the probability of arrest (the number of murder arrests divided by the number of murders), the sentencing rate (the number of death sentences divided by the number of murder arrests made two years prior), the custody rate (the number of prisoners per violent crime), the risk of execution (the number of executions divided by the number of death sentences six years prior), and a number of state characteristics.

The model in column I as well as all other specifications estimated in the paper include state fixed-effects to control for state-specific characteristics that are not captured by the control variables, as well as time dummies and state-specific trends. Thus, they consider within-state changes and eliminate the impact of time-invariant omitted factors that are correlated with deterrence variables across states; while time dummies control for the unobserved time-varying determinants of homicide which

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sentence is typically converted to life in prison.

impact all states in the same fashion, and state-specific time trends capture the factors that impact the time-series behavior of homicide which can be different from state to state.

Deterrence variables are lagged once and the models are estimated with weighted-least squares, where the weights are state's share in the U.S. population. Robust standard errors are reported in parentheses under the coefficients. As is well-known, serial correlation in errors result in biased standard errors. Bertrand, Duflo and Mullainathan (2002) show that in aggregate panel data analysis one solution is to estimate standard errors with cluster adjustment to the level of aggregation. The third entry in each cell of Table 2 reports robust standard errors obtained from models estimated with weighted-least squares, as before, that also account for clustering of errors at the state level.

Columns II and III of Table 2 report the results of the models with commutation and removal rates, respectively. Column IV includes execution and commutation rates jointly, and column V displays the results of the model which contains execution and removal rates jointly. The execution, commutation and removal rates are all prorated measures. Using the alternative second measure did not alter the results. Similarly, measuring the custody rate as prisoners per population produced very similar results.[12]

In all specifications, the coefficient of the execution rate is negative and statistically significant, indicating that an increase in the risk of execution lowers the

homicide rate. Because the annual average time between a sentencing and removal from death is about five years, the removal rate is deflated by the number death sentences five years prior. As depicted in Table 2, the commutation rate and the removal rate from death row have positive and statistically significant impacts on the homicide rate. The custody rate (prisoners per violent crime) has a negative impact on the homicide rate. The same is true for the homicide arrest rate, although the coefficient is not statistically significant in all specifications. The prison death rate and the sentencing rates are not significantly different from zero.

To investigate the sensitivity of the estimated standard errors to an alternative way of controlling for the potential serial correlation in errors, we estimated the models by incorporating an AR(1) structure in the errors within each state. The results remained the same. We also deflated the number of death sentences by once-lagged murder arrest rate to arrive at the sentencing rate, which did not alter the results.

The magnitude of the impact of an execution is surprisingly similar to that reported by Ehrlich (1975). Using the average of the coefficients estimated, each additional execution (commutation) results in a reduction (increase) of murders by about 5. The impact of total removals is smaller: Each removal from death row other than execution and death yields about one additional homicide.[13] Columns VI and VII

12 These results are available upon request.

13 The impact of a 1-unit increase in executions, commutations and removals is calculated as $\beta(Pop)/Sent/1000$, where β is the estimated coefficient of the deterrence variable (execution rate, commutation rate or the removal rate), Pop is the mean of the population used in the estimation

of Table 2 display the results of the models employing the logarithms of the murder rate. They are consistent with the ones where the homicide rate is in levels.

In Table 3 we report the results of the models where the deterrence variables enter with two lags to allow richer dynamics. Put differently, the homicide rate in year *t* is impacted by the execution rate, commutation or removal rate, arrest rate, sentencing rate, custody rate and prison death rate in years *t-1* and *t-2*. As before, the models include state fixed effects, time dummies and state trends. The results are consistent with Table 2. With very few exceptions the individual coefficients of deterrence variables have expected signs: the coefficients of executions, homicide arrests, custody and prison deaths are negative, and those of commutations and other removals are positive. Table 3 also reports the sum of the lags for the deterrence variables along with a test for statistical significance of the sums. The sum of execution lags, arrest rate and custody lags are negative and significantly different from zero.

To investigate whether the presence of the death penalty has a direct impact on the homicide rate, we added a dichotomous variable to the models which takes the value of one if capital punishment is legal in the state and zero otherwise. The existence of the death penalty in a state is unlikely to be an exogenous event; rather it may be influenced by the murder rate. To avoid this simultaneity, we lagged value of the dummy variable. The result is presented in column I of Table 4. There is sufficient

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sample, *Sent* is the mean of the number of death sentences, which is the denominator of the deterrence variables. We divide by 1000 because the homicide rate is scaled by 1000.

variation of the dummy variable that measures the legality of the death penalty in a state as seven states legalized the death penalty between 1977 and 1997 (Kansas, New Hampshire, New Jersey, New Mexico, New York, Oregon and South Dakota), and Massachusetts and Rhode Island abolished it during the same time period. The variable (*Death Penalty Legal*) is negative and significantly different from zero indicating that the presence of death penalty has a negative impact of the murder rate. In column II we report the result where the lagged value of *Death Penalty Legal* is interacted with the lagged execution and commutation variables, and in column III it is interacted with lagged execution and removal variables. The coefficients of the execution variable is negative, those of the commutation and removal rates are positive, and they all are significant.[14] The coefficient of *Death Penalty Legal* suggests that the presence of death penalty lowers the number of murders by 64.

As an alternative specification, it may be reasonable to assume that the presence of capital punishment in the state is a function of past homicide rates in the state. More specifically, consider the following formulation for the existence of capital punishment.

(2) $L_t = \alpha MURDER_{t-1} + \alpha\lambda MURDER_{t-2} + \alpha\lambda^2 MURDER_{t-3} + \alpha\lambda^3 MURDER_{t-4} + \ldots,$

where L_t represents the death penalty indicator in the state in year *t,* MURDER stands for the homicide rate in the state, and λ is less than one in absolute value. Equation (2)

14 The coefficient of execution rate is not considerably different from those obtained in earlier specifications. When we estimated the models using the second measures of the execution, commutation and removal rates, the coefficient of the execution rate became somewhat smaller in absolute value.

portrays the existence of capital punishment in year *t* as a function of past homicide rates in the state, where homicide rates in more distant past have smaller impacts. Our main equation of interest, Equation (1), can be expressed more compactly as

(3) $MURDER_t = \beta\ DETER_{t-1} + \gamma L_{t-1}$

where state subscripts and other determinants of homicide are suppressed for ease of exposition. Substituting (3) into (2) gives

(4) $L_t = \alpha\beta\ DETER_{t-2} + \alpha\gamma L_{t-2} + \alpha\beta\lambda DETER_{t-3} + \alpha\gamma\lambda L_{t-3} + \alpha\beta\lambda^2 DETER_{t-4} + \alpha\gamma\lambda^2 L_{t-4} \ldots,$

and it is straightforward to show that Equation (4) can be re-written as

(5) $L_t = \alpha\beta\ DETER_{t-2} + \lambda L_{t-1} + \alpha\gamma L_{t-2}$

Equation (5) suggests that the presence of capital punishment, although endogenous, can be instrumented with twice-lagged deterrence variables and two lags of capital punishment law. The results of the instrumental variables estimation are presented in columns IV and V of Table 4 with commutation and removal rates, respectively. Again, the coefficient of the death penalty indicator (*Death Penalty Legal*) is negative and statistically significant. The coefficients in Table 4 suggest that an additional execution generates a reduction in homicide by a magnitude of 5, an additional commutation increases homicides by 4 to 5, and an additional removal brings about one additional murder. The coefficients of other deterrence variables are also consistent with those reported in previous tables. Estimating these models with the

second measures of execution, commutation and removal rates or using the prisoners per population as the measure of incapacitation did not change the conclusions.[15]

VI. Extensions

We estimated the models with the addition of quadratic state-specific time trends. This specification puts heavy demands on the data. Nevertheless, we obtained very similar results although the precision of the estimated coefficient of the execution rate was lower in models with the commutation variable, and the precision of the removal rate was lower in models with that measure.

Katz, Levitt and Shustorovich (2001) estimated separate models that included region-year and state-decade interactions. As explained in their paper, inclusion of region-year interactions allows the parameters of the model to be identified off of differences across states within a particular region and year. For this exercise we classified the states into four regions: Northeast, Midwest, South and West. Inclusion of state-decade interactions implies that we exploit the variation within a state around that state's mean value in a particular decade. Our data starts in 1977, but because we lose 6-7 years due to lagging the variables, we split the sample into two periods in

15 The coefficient of the execution rate became somewhat smaller in absolute value, such that an additional execution implied a reduction of four murders.

1992.[16] These results, which are not reported in the interest of space, were consistent with those obtained earlier.

To investigate how removals from death row, commutations, executions and other deterrence variables impact crimes other than homicide, we investigated their impact on robberies, burglaries, rapes and motor-vehicle thefts. To the extent that capital punishment is a murder-specific deterrent, they are not expected to have significant impact on these crimes. On the other hand, executions may impact crimes such robbery, burglary and rape if the offender is aware of the possibility that a offense may result in a homicide. Alternatively, an execution may have a negative impact on all crimes if it provides a signal to potential offenders regarding the attitude of the criminal justice system overall. Along the same lines, a commutation or a removal from death row may be taken as a signal for a more lenient criminal justice environment and therefore may promote criminal activity.

Table 5 presents the results for robbery, burglary, rape and motor-vehicle theft. For each model, crime-specific arrests are included. An increase in the custody rate, measured by prisoners per violent crime, lowers all four crimes reported in the table. Prison death rate is negatively related to burglaries. Increases in burglary arrests and rape arrests reduce these crimes. There is no evidence that non-capital crimes are influenced by the execution or commutations rates. The results did not change when

16 Splitting the sample in 1990 or 1991 did not significantly alter the results.

we used prisoners per population as the measure of custody, or when we used the removal rates.

VII. Conclusion and Discussion

The investigation of whether the death penalty deters homicide is important from an academic as well a public policy point of view. The effectiveness of capital punishment as a crime control device and its appropriateness in a modern democratic society have both been hotly debated in the United States. This paper uses a data set that consists of the entire history of 6,143 death sentences between 1977 and 1997 in the United States to investigate the impact of capital punishment on homicide. We merge this data set with state panels that include crime and deterrence measures as well as state characteristics. Our data set allows us not only to analyze the impact of executions, but also for the first time in the literature, the impact of commutations as well as total removals from death row on criminal activity. Because we can identify the exact month and year of each execution and removal, we match them with criminal activity in the relevant time frame. Controlling for a variety of state characteristics, we investigate the impact of the execution rate, commutation and removal rates, homicide arrest rate, the sentencing rate, the imprisonment rate and the prison death rate on the rate of homicide. The models are estimated in a number of different forms, controlling for state fixed effects, common time trends, and state-specific time trends. We find a significant relationship between the execution, removal and commutation rates and the

rate of homicide. Each additional execution decreases homicides by about 5, and each additional commutation increases homicides by the same amount, while one additional removal from death row generates one additional homicide. These results are very robust to model specifications and measurement of the variables. Executions, commutations and removals have no impact on robberies, burglaries, assaults or motor-vehicle thefts.

Although these results demonstrate the existence of the deterrent effect of capital punishment, it should be noted that there remains a number of significant issues surrounding the imposition of the death penalty. For example, although the Supreme Court of the United States remains unconvinced that there exists racial discrimination in the imposition of the death penalty, recent research points to the possibility of such discrimination (Baldus et al. 1998, Pokorak 1998, Kleck 1981). Along the same lines, there is evidence indicating that there is discrimination regarding who gets executed and who gets commuted once the death penalty is received (Argys and Mocan 2002). Given these concerns, a stand for or against capital punishment should be taken with caution.

Figure 1
The Homicide Rate vs Total Executions in the United States

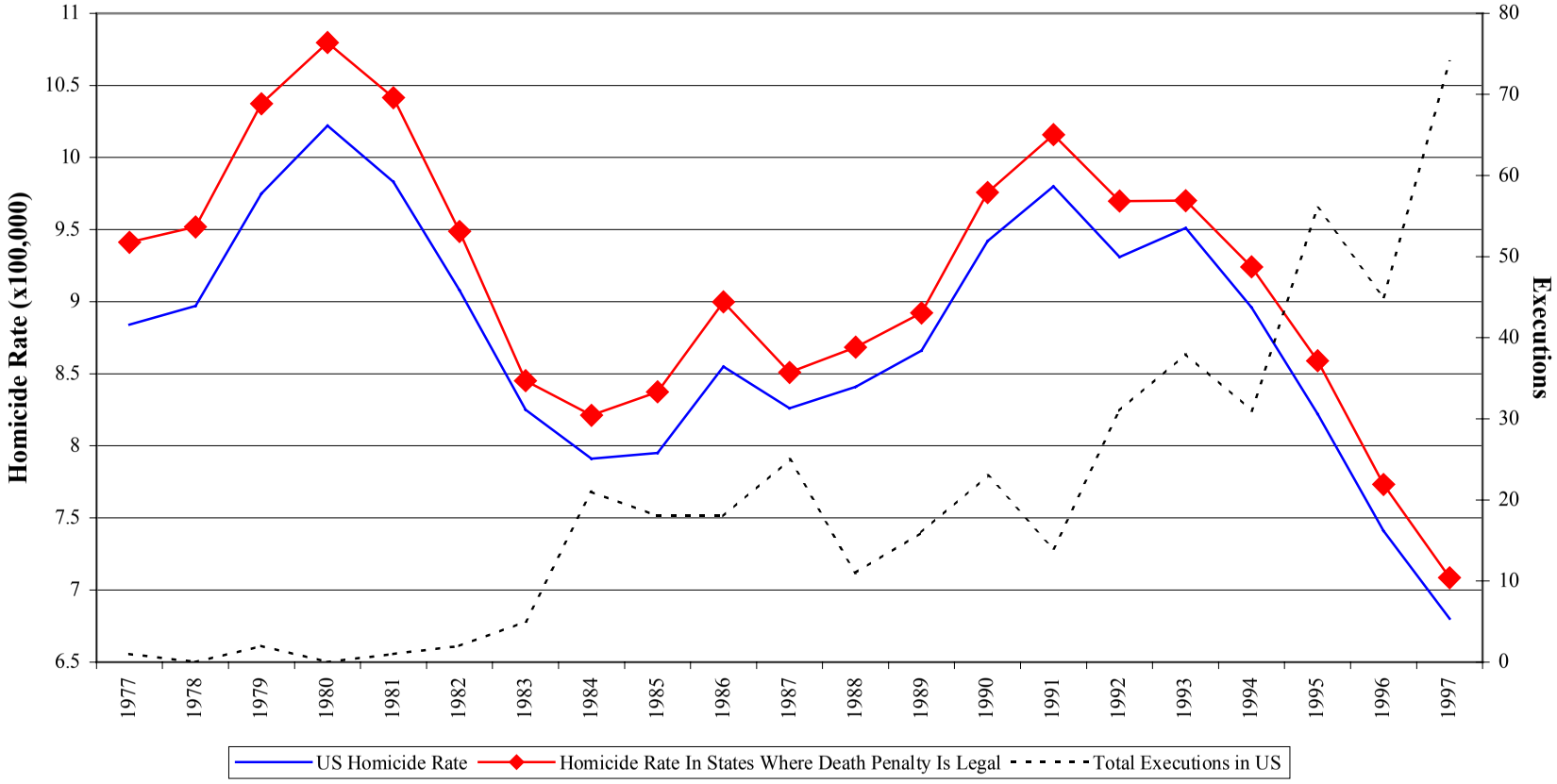

Table 1

Descriptive Statistics of the Data

		Mean (Std. Dev)	Standard Deviation
Variable	**Description**	**Raw Data**	**Removing State and Time Effects, and State Specific Time Trends**
Homicide Rate	The number of homicides divided by the population, multiplied by 1000.	0.070 (0.038)	(0.010)
Homicide Arrest Rate	The number of homicide arrests divided by the number of reported homicides.	0.876 (0.312)	(0.219)
Execution Rate	A prorated count of the number of executions in the previous and current year, divided by the number of persons sentenced to death six years before.	0.085 (0.276)	(0.192)
Execution Rate-2	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 sentenced to death six years before.	0.089 (0.31)	(0.23)
Commutation Rate	A prorated count of the number of commutations in the previous and current year, divided by the number of persons sentenced to death six years before.	0.019 (0.115)	(0.104)
Commutation Rate-2	The number of commutations in the first three quarters of the current year and the last quarter of the previous year, divided by the number of persons sentenced to death six years before.	0.019 (0.131)	(0.119)
Removal Rate	A prorated count of the number of removals from death row (other than executions, deaths of other causes, or reasons unknown) in the previous and current year, divided by the number of persons sentenced to death five years before.	0.332 (0.596)	(0.481)
Removal Rate-2	The number of removals from death row (other than executions, deaths of other causes, or reasons unknown) in the first three quarters of the current year and the last quarter of the previous year, divided by the number of persons sentenced to death five years before.	0.332 (0.673)	(0.569)
Sentencing Rate	The number of persons sentenced to death divided by the number of homicide arrests 2 years before.	0.017 (0.031)	(0.024)

(Table 1 Concluded)			
Prisoners Per Population	The number of persons in custody of state correctional authorities divided by the adult population, multiplied by 1000.	2.755 (1.539)	(0.274)
Prisoners Per Violent Crime	The number of persons in custody of state correctional authorities divided by the total number of violent crimes.	0.518 (0.288)	(0.086)
Prison Death Rate	The number of prison deaths other than executions divided by the number of state prisoners, multiplied by 1000.	2.457 (1.872)	(1.589)
Percent Black	The percent of the state population that is Black.	9.388 (9.464)	(1.193)
Republican Governor	Dummy Variable (=1) if the Governor is Republican in that Year.	0.409 (0.492)	(0.351)
Unemployment Rate	The state unemployment rate.	6.398 (2.084)	(1.033)
Per Capita Income	Real per capita income in 1982-1984 dollars, divided by 1000.	13.438 (2.322)	(0.354)
Infant Mortality Rate	The number of deaths under 1 year of age per 1000 live births.	10.076 (2.516)	(0.885)
Urbanization	The percent of the state population residing in urbanized areas.	67.781 (14.467)	(0.138)
Drinking Age 18	Dummy Variable (=1) if the legal drinking age for wines and spirits is 18 for at least half the calendar year in the state.	0.084 (0.277)	(0.151)
Drinking Age 19	Dummy Variable (=1) if the legal drinking age for wines and spirits is 19 for at least half the calendar year in the state.	0.110 (0.312)	(0.194)
Drinking Age 20	Dummy Variable (=1) if the legal drinking age for wines and spirits is 20 for at least half the calendar year in the state.	0.050 (0.219)	(0.175)
Percent 20-34	The percent of the state population that is age 20 to 34.	24.675 (2.406)	(0.459)
Percent 35-44	The percent of the state population that is age 35 to 44.	13.866 (2.184)	(0.233)
Percent 45-54	The percent of the state population that is age 45 to 54.	10.319 (1.199)	(0.142)
Percent 55+	The percent of the state population that is age 55 or older.	20.292 (2.977)	(0.297)
Oklahoma City 1995	Dummy variable (=1) for Oklahoma in year 1995.	0.001 (0.031)	(0.028)
		n = 1050[Ψ]	

Ψ We have 1047 observations for the Homicide Arrest Rate and 1049 observations for the Prison Death Rate. The number of observations for the execution rate and commutation rate variables is 750 because of the six-year lag of the denominator. Similarly, there are 800 observations for the removal rate variables because of the five-year lag of the denominator.

Table 2

The Determinants of the Homicide Rate

Variable	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
Execution Rate (-1)	-0.006** (0.0027) [0.0035]	—	—	-0.0063** (0.0028) [0.0034]	-0.0063** (0.003) [0.0029]	-0.0472* (0.026) [0.0257]	-0.0484* (0.0283) [0.027]
Commutation Rate (-1)	—	0.0069** (0.0028) [0.0032]	—	0.0073*** (0.0027) [0.003]	—	0.1076*** (0.0308) [0.0314]	—
Removal Rate (-1)	—	—	0.0017** (0.0007) [0.0007]	—	0.0018** (0.0008) [0.0007]	—	0.0198** (0.0081) [0.0082]
Homicide Arrest Rate (-1)	-0.0043* (0.0024) [0.0034]	-0.0046* (0.0025) [0.0034]	-0.0043 (0.0028) [0.0037]	-0.0045* (0.0025) [0.0034]	-0.0042 (0.0028) [0.0038]	-0.0433 (0.0295) [0.033]	-0.0349 (0.0321) [0.0368]
Sentencing Rate (-1)	0.0034 (0.0211) [0.0237]	0.00002 (0.0189) [0.0214]	0.0131 (0.0254) [0.0272]	-0.0002 (0.0196) [0.0221]	0.017 (0.0258) [0.0276]	-0.0856 (0.3332) [0.401]	0.3546 (0.3644) [0.3793]
Prisoners Per Violent Crime (-1)	-0.0354*** (0.0069) [0.009]	-0.0364*** (0.0069) [0.0096]	-0.0384*** (0.007) [0.0084]	-0.0357*** (0.0069) [0.0092]	-0.0383*** (0.007) [0.008]	-0.3465*** (0.0793) [0.0898]	-0.3819*** (0.0798) [0.0904]
Prison Death Rate (-1)	-0.0003 (0.0006) [0.0005]	-0.0003 (0.0006) [0.0005]	-0.0002 (0.0005) [0.0005]	-0.0003 (0.0006) [0.0005]	-0.0003 (0.0006) [0.0005]	-0.0001 (0.0066) [0.0058]	-0.0013 (0.0063) [0.0058]
Percent Black	-0.0001 (0.0003) [0.0005]	-0.0002 (0.0003) [0.0005]	-.000010 (0.0003) [0.0004]	-0.0001 (0.0003) [0.0005]	-0.00002 (0.0003) [0.0004]	-0.002 (0.0032) [0.0045]	-0.0011 (0.0033) [0.0043]
Republican Governor	-0.0019 (0.0013) [0.0022]	-0.0019 (0.0014) [0.0022]	-0.0011 (0.0013) [0.002]	-0.002 (0.0014) [0.0022]	-0.001 (0.0013) [0.002]	-0.0207 (0.0143) [0.0197]	-0.0084 (0.0139) [0.0185]
Unemployment Rate	-0.0008 (0.0007) [0.0012]	-0.0009 (0.0007) [0.0012]	-0.0011 (0.0007) [0.0012]	-0.0009 (0.0007) [0.0011]	-0.001 (0.0007) [0.0012]	-0.003 (0.0077) [0.0106]	-0.0064 (0.0075) [0.0115]
Per Capita Income	-0.0014 (0.0022) [0.0022]	-0.0014 (0.0022) [0.0022]	-0.0011 (0.0021) [0.0022]	-0.0014 (0.0022) [0.0022]	-0.0012 (0.0022) [0.0022]	-0.0212 (0.0266) [0.0257]	-0.0196 (0.0261) [0.0275]

Infant Mortality Rate	0.0022*** (0.0009) [0.0012]	0.0019** (0.0009) [0.0011]	0.0023*** (0.0009) [0.001]	0.0021** (0.0009) [0.0012]	0.0023*** (0.0009) [0.001]	0.0218** (0.0104) [0.0107]	0.0256** (0.0106) [0.0111]
Urbanization	-0.0406*** (0.0105) [0.0157]	-0.0398*** (0.0104) [0.0155]	-0.0399*** (0.0091) [0.0138]	-0.0398*** (0.0104) [0.0156]	-0.043*** (0.0094) [0.0139]	-0.3671*** (0.123) [0.1556]	-0.4364*** (0.1205) [0.1529]
Drinking Age 18	-0.0125* (0.0067) [0.0063]	-0.0125* (0.0067) [0.0068]	-0.0088 (0.0065) [0.0076]	-0.012* (0.0068) [0.0063]	-0.0091 (0.0067) [0.0073]	-0.1106 (0.0723) [0.0673]	-0.0784 (0.0702) [0.0612]
Drinking Age 19	-0.0099*** (0.0038) [0.0052]	-0.0096** (0.0038) [0.0053]	-0.0057* (0.0034) [0.0042]	-0.0099*** (0.0038) [0.0051]	-0.0058* (0.0034) [0.0041]	-0.0701* (0.0379) [0.0458]	-0.0397 (0.035) [0.0412]
Drinking Age 20	0.0003 (0.0024) [0.0021]	0.0004 (0.0024) [0.0022]	0.0016 (0.0022) [0.0023]	0.0006 (0.0024) [0.0021]	0.0019 (0.0022) [0.0022]	0.0049 (0.0276) [0.0254]	0.0136 (0.0262) [0.0257]
Percent 20-34	0.0061*** (0.0021) [0.0036]	0.0063*** (0.0021) [0.0035]	0.0063*** (0.0019) [0.003]	0.0062*** (0.0021) [0.0036]	0.0063*** (0.0019) [0.003]	0.0987*** (0.0252) [0.0405]	0.102*** (0.0237) [0.0375]
Percent 35-44	0.0019 (0.0036) [0.0056]	0.0022 (0.0035) [0.0055]	0.0003 (0.0035) [0.0053]	0.0024 (0.0036) [0.0055]	0.0005 (0.0036) [0.0054]	0.0195 (0.0415) [0.0676]	0.0099 (0.0437) [0.0727]
Percent 45-54	0.0118** (0.0049) [0.006]	0.0125*** (0.0048) [0.006]	0.0124*** (0.0048) [0.0062]	0.0125** (0.0049) [0.006]	0.0134*** (0.0048) [0.0061]	0.0265 (0.0703) [0.0712]	0.0252 (0.0687) [0.0802]
Percent 55+	-0.0146*** (0.004) [0.0046]	-0.0147*** (0.0039) [0.0047]	-0.0127*** (0.0038) [0.0038]	-0.0154*** (0.004) [0.0048]	-0.0134*** (0.0038) [0.0037]	-0.1262*** (0.0363) [0.0453]	-0.1082*** (0.0366) [0.04]
Oklahoma City 1995	0.0512*** (0.005) [0.0027]	0.0525*** (0.0047) [0.0026]	0.0519*** (0.0045) [0.0027]	0.0515*** (0.0049) [0.0027]	0.0513*** (0.0046) [0.0029]	0.5267*** (0.0573) [0.0272]	0.519*** (0.0522) [0.0282]
Number of Observations	680	693	695	679	691	679	691
R-Squared	0.955	0.956	0.956	0.956	0.956	0.965	0.965

Robust standard errors are in parentheses. Robust and clustered standard errors are in brackets. * indicates statistical significance between 10% and 5% ; ** indicates statistical significance between 5% to 1%; *** indicates statistical significance at the 1% level or better. All models include state-fixed effects, time dummies and state-specific trends. In columns (VI) and (VII), the dependent variable is in logarithm.

Table 3

Models with Multiple Lags

Variable	(I)	(II)
Execution Rate (-1)	-0.0063** (0.0028) [0.0033]	-0.0051* (0.0028) [0.0028]
Execution Rate (-2)	-0.0048 (0.0037) [0.0042]	-0.0021 (0.003) [0.0038]
Commutation Rate (-1)	0.0062* (0.0033) [0.0035]	—
Commutation Rate (-2)	0.0007 (0.0034) [0.0039]	—
Removal Rate (-1)	—	0.0008 (0.0007) [0.0008]
Removal Rate (-2)	—	0.0006 (0.0007) [0.0007]
Homicide Arrest Rate (-1)	-0.0053** (0.0024) [0.0033]	-0.0051* (0.0026) [0.0036]
Homicide Arrest Rate (-2)	-0.002 (0.0022) [0.0025]	-0.0016 (0.0023) [0.0026]
Sentencing Rate (-1)	0.0086 (0.0219) [0.0265]	0.0255 (0.0277) [0.0292]
Sentencing Rate (-2)	-0.0004 (0.0166) [0.0203]	-0.0105 (0.0174) [0.0202]
Prisoners Per Violent Crime (-1)	-0.0304*** (0.0083) [0.0098]	-0.0331*** (0.0085) [0.0095]
Prisoners Per Violent Crime (-2)	-0.0039 (0.0084) [0.0095]	-0.0043 (0.0082) [0.0098]
Prison Death Rate (-1)	-0.0008 (0.0007) [0.0006]	-0.0009 (0.0006) [0.0006]
Prison Death Rate (-2)	-0.0004 (0.0006) [0.0007]	-0.0008 (0.0006) [0.0007]

(Table 3 Concluded)		
Sum of Execution Equal to 0		
Coefficient	-0.0110**	-0.0072*
F-Statistic	4.79	2.82
P-value	0.029	0.94
Sum of Commutation Equal to 0		
Coefficient	0.0069	--
F-Statistic	2.26	--
P-value	0.1338	--
Sum of Removal Equal to 0		
Coefficient	--	0.0014
F-Statistic	--	1.66
P-value	--	0.198
Sum of Arrest Equal to 0		
Coefficient	-0.0073**	-0.0067**
F-Statistic	4.93	3.93
P-value	0.027	0.048
Sum of Sentences Equal to 0		
Coefficient	0.0083	0.0150
F-Statistic	0.07	0.17
P-value	0.790	0.678
Sum of Prisoners Per Violent Crime Equal to 0		
Coefficient	-0.0343***	-0.0374***
F-Statistic	18.75	23.35
P-value	0.000	0.000
Sum of Death Rate Equal to 0		
Coefficient	-0.0012	-0.0016*
F-Statistic	1.90	3.62
P-value	0.1684	0.058
Number of Observations	625	639
R-Squared	0.957	0.959

Robust standard errors are in parentheses. Robust and clustered standard errors are in brackets.

* indicates statistical significance between 10% and 5% ; ** indicates statistical significance between 5% to 1%; *** indicates statistical significance at the 1% level or better.

All models include state-fixed effects, time dummies and state-specific trends.

Table 4

The Impact of Legalized Death Penalty

Variable	(I)	(II)	(III)	(IV)	(V)
Death Penalty Legal (-1)	-0.0154*** (0.0055) [0.0061]	-0.0138* (0.0077) [0.0061]	-0.0119* (0.0071) [0.0056]	__	__
Death Penalty Legal (-1)* Execution Rate (-1)	__	-0.0067** (0.0028) [0.0036]	-0.0068** (0.003) [0.0029]	__	__
Death Penalty Legal (-1)* Commutation Rate (-1)	__	0.0068** (0.0028) [0.0029]	__	__	__
Death Penalty Legal (-1)* Removal Rate (-1)	__	__	0.002*** (0.0008) [0.0008]	__	__
Death Penalty Legal	__	__	__	-0.0312*** (0.0102) [0.0098]	-0.0210** (0.0093) [0.0107]
Death Penalty Legal * Execution Rate (-1)	__	__	__	-0.0070** (0.003) [0.0034]	-0.0062** (0.0029) [0.0027]
Death Penalty Legal * Commutation Rate (-1)	__	__	__	0.0046 (0.0035) [0.0037]	__
Death Penalty Legal * Removal Rate (-1)	__	__	__	__	0.0008 (0.0007) [0.0008]
Homicide Arrest Rate (-1)	-0.0008 (0.0027) [0.0033]	-0.0035 (0.0024) [0.0027]	-0.0032 (0.0027) [0.003]	-0.0036 (0.0023) [0.0025]	-0.0037 (0.0025) [0.0027]
Sentencing Rate (-1)	-0.0026 (0.0198) [0.0218]	0.0001 (0.0193) [0.0219]	0.0167 (0.0259) [0.0278]	0.0058 (0.0202) [0.0235]	0.0184 (0.0274) [0.0279]
Prisoners Per Violent Crime (-1)	-0.0402*** (0.0061) [0.0087]	-0.0367*** (0.0069) [0.0094]	-0.0392*** (0.007) [0.0082]	-0.0372*** (0.0069) [0.0105]	-0.0400*** (0.007) [0.0096]
Prison Death Rate (-1)	0.0001 (0.0003) [0.0003]	-0.0004 (0.0005) [0.0005]	-0.0003 (0.0005) [0.0005]	-0.0005 (0.0005) [0.0006]	-0.0006 (0.0005) [0.0006]
Percent Black	-0.0001 (0.0004) [0.0004]	-0.0001 (0.0003) [0.0005]	-0.000007 (0.0003) [0.0004]	-0.0001 (0.0003) [0.0005]	0.00005 (0.0003) [0.0005]
Republican Governor	-0.0014 (0.0011) [0.0016]	-0.0015 (0.0014) [0.0019]	-0.0006 (0.0014) [0.0017]	-0.00004 (0.0015) [0.0021]	-0.0001 (0.0014) [0.0017]

(Table 4 concluded)					
Unemployment Rate	-0.001*	-0.0009	-0.0011	-0.0005	-0.0009
	(0.0006)	(0.0007)	(0.0007)	(0.0009)	(0.0008)
	[0.0009]	[0.0012]	[0.0012]	[0.0014]	[0.0013]
Per Capita Income	0.0035*	-0.0014	-0.0012	-0.0008	-0.0021
	(0.002)	(0.0022)	(0.0021)	(0.0024)	(0.0022)
	[0.0027]	[0.0026]	[0.0024]	[0.003]	[0.0026]
Infant Mortality Rate	0.0022***	0.002**	0.0021**	0.0015*	0.0012
	(0.0007)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
	[0.0009]	[0.0011]	[0.001]	[0.0012]	[0.0011]
Urbanization	-0.0187**	-0.0361***	-0.0396***	-0.0291***	-0.0382***
	(0.0078)	(0.0092)	(0.0084)	(0.0095)	(0.0092)
	[0.012]	[0.0124]	[0.0111]	[0.013]	[0.0107]
Drinking Age 18	-0.0095**	-0.0118*	-0.009	-0.0151	-0.009
	(0.0047)	(0.0068)	(0.0066)	(0.0096)	(0.0071)
	[0.0066]	[0.0063]	[0.0074]	[0.0096]	[0.007]
Drinking Age 19	-0.0077**	-0.009**	-0.0052	-0.0077*	-0.0025
	(0.0033)	(0.0037)	(0.0034)	(0.004)	(0.0034)
	[0.0048]	[0.0048]	[0.004]	[0.0044]	[0.0046]
Drinking Age 20	0.0006	0.0019	0.0029	0.0009	0.0039
	(0.0023)	(0.0026)	(0.0023)	(0.0025)	(0.0024)
	[0.0026]	[0.0024]	[0.0025]	[0.0021]	[0.0028]
Percent 20-34	0.0012	0.005**	0.0052***	0.0055**	0.0048**
	(0.0014)	(0.0021)	(0.0019)	(0.0024)	(0.0022)
	[0.002]	[0.0032]	[0.0026]	[0.0036]	[0.0031]
Percent 35-44	-0.0024	0.0022	0.0006	0.0013	-0.0008
	(0.0025)	(0.0035)	(0.0035)	(0.004)	(0.0038)
	[0.0035]	[0.005]	[0.0049]	[0.0054]	[0.0048]
Percent 45-54	-0.0017	0.0146***	0.0152***	0.0157***	0.0158***
	(0.0033)	(0.005)	(0.005)	(0.0058)	(0.0055)
	[0.0045]	[0.006]	[0.0065]	[0.0071]	[0.0072]
Percent 55+	-0.0031	-0.0147***	-0.0131***	-0.0128***	-0.0126***
	(0.0029)	(0.004)	(0.0039)	(0.0044)	(0.004)
	[0.0037]	[0.0046]	[0.0037]	[0.0057]	[0.0042]
Oklahoma City 1995	0.0497***	0.0518***	0.0517***	0.050***	0.0512***
	(0.0048)	(0.005)	(0.0046)	(0.0045)	(0.0045)
	[0.0025]	[0.003]	[0.0033]	[0.0026]	[0.0024]
Number of Observations	877	679	690	628	642
R-Squared	0.950	0.957	0.957	0.961	0.960

Robust standard errors are in parentheses. Robust and clustered standard errors are in brackets.
* indicates statistical significance between 10% and 5% ; ** indicates statistical significance between 5% to 1%; *** indicates statistical significance at the 1% level or better.
All models include state-fixed effects, time dummies and state-specific trends.

Table 5

The Impact of Capital Punishment on Other Crimes

Variable	Robbery	Burglary	Rape	Motor Vehicle Theft
Execution Rate (-1)	-0.0203 (0.076) [0.0708]	0.0926 (0.2031) [0.1753]	-0.0028 (0.0086) [0.0136]	0.0442 (0.195) [0.2192]
Commutation Rate (-1)	0.0482 (0.1045) [0.1362]	-0.2535 (0.3144) [0.3207]	-0.011 (0.0193) [0.0231]	-0.4948 (0.3394) [0.3641]
Own Arrest Rate (-1)	0.0911 (0.3233) [0.5215]	-7.5594*** (1.9888) [2.7384]	-0.0745*** (0.0266) [0.0239]	0.2721 (1.0989) [1.4148]
Sentencing Rate (-1)	-0.3575 (0.4181) [0.4035]	-0.452 (1.536) [1.3391]	-0.0248 (0.0745) [0.0831]	1.2558 (1.604) [1.5769]
Prisoners Per Violent Crime (-1)	-0.5448*** (0.1817) [0.2704]	-3.1351*** (0.9166) [1.1079]	-0.0721*** (0.0253) [0.0319]	-2.2591*** (0.5761) [0.638]
Prison Death Rate (-1)	-0.0194 (0.0176) [0.0142]	-0.1061*** (0.0393) [0.0617]	-0.0018 (0.0014) [0.0018]	-0.0476 (0.0328) [0.0462]
Percent Black	-0.0073 (0.0085) [0.0129]	0.0412 (0.029) [0.0425]	0.0026** (0.0012) [0.0015]	-0.0439** (0.0218) [0.0302]
Republican Governor	0.0285 (0.041) [0.0782]	0.5803*** (0.1311) [0.2172]	0.0112*** (0.0041) [0.006]	-0.0864 (0.0929) [0.1121]
Unemployment Rate	0.0208 (0.0219) [0.0306]	0.3162*** (0.0584) [0.07]	-0.0019 (0.0024) [0.0029]	0.0118 (0.0519) [0.0642]
Per Capita Income	-0.0598 (0.0764) [0.1188]	-0.4508** (0.2113) [0.3953]	0.0161** (0.0079) [0.0119]	-0.2551* (0.1534) [0.3234]
Infant Mortality Rate	0.0674*** (0.0251) [0.0446]	0.0437 (0.0835) [0.1262]	0.0058* (0.0035) [0.0055]	0.0757 (0.0635) [0.0999]
Urbanization	-1.0832*** (0.3295) [0.6737]	-2.3392*** (0.8723) [1.5563]	-0.0529 (0.0404) [0.0734]	-1.5992* (0.905) [1.7168]
Drinking Age 18	-0.3305** (0.139) [0.1823]	-1.0393 (0.6865) [0.9818]	0.0337** (0.0168) [0.0273]	-0.0047 (0.3284) [0.5576]
Drinking Age 19	-0.422*** (0.1154) [0.14]	-1.6693*** (0.3338) [0.6456]	0.0295*** (0.0082) [0.0131]	-0.5874** (0.2587) [0.3338]

(Table 5 Concluded)				
Drinking Age 20	-0.0192 (0.0661) [0.0707]	-0.2955 (0.2428) [0.2979]	0.0194** (0.0077) [0.011]	-0.0264 (0.1766) [0.2147]
Percent 20-34	0.2384*** (0.0637) [0.1207]	0.4842*** (0.1686) [0.3065]	-0.0236*** (0.0066) [0.0099]	1.3742*** (0.1493) [0.261]
Percent 35-44	-0.2006* (0.1036) [0.1407]	-1.3889*** (0.3175) [0.3503]	0.0225* (0.0122) [0.0221]	-0.0834 (0.2821) [0.5456]
Percent 45-54	0.37*** (0.1411) [0.2469]	-0.2769 (0.4505) [0.7137]	0.0242 (0.0176) [0.0296]	-0.6439* (0.3528) [0.6606]
Percent 55+	-0.5583*** (0.1167) [0.1628]	0.5069* (0.2759) [0.3616]	-0.0039 (0.0098) [0.0176]	-1.657*** (0.2727) [0.5323]
Oklahoma City 1995	-0.0335 (0.0770) [0.0698]	0.2914 (0.24) [0.2024]	-0.0168* (0.0094) [0.0078]	-0.0285 (0.2094) [0.1431]
Number of Observations	679	679	679	679
R-Squared	0.972	0.972	0.958	0.960

Robust standard errors are in parentheses. Robust and clustered standard errors are in brackets.

* indicates statistical significance between 10% and 5% ; ** indicates statistical significance between 5% to 1%; *** indicates statistical significance at the 1% level or better.

All models include state-fixed effects, time dummies and state-specific trends.

Data Appendix

Crimes and Arrests

Crimes: The Bureau of Justice Statistics compiled annual state level data using the Federal Bureau of Investigation Uniform Crime Report (UCR) and publishes it as an electronic file.
Arrests: Data was obtained from the National Archive of Criminal Justice Data web site. The data is itself UCR data and was aggregated to the county level at the NACJD and then aggregated to the state level by the authors. Missing state level arrest values were filled in by directly contacting the local UCR state agencies. 1988 was a transitional year for Florida and arrest values are not available. Kansas was unable to produce data for 1995 and 1996 as well. Neither the values for Florida nor Kansas were imputed.

Capital Punishment Data

U.S. Dept. of Justice, Bureau of Justice Statistics. CAPITAL PUNISHMENT IN THE UNITED STATES, 1973-1998 [Computer file]. Compiled by the U.S. Dept. of Commerce, Bureau of the Census. ICPSR ed. Ann Arbor. MI: Inter-university Consortium for Political and Social Research [producer and distributor], 2000.

Prison Deaths and Prison Population

Prison Population: "Prisoners in Custody of State or Federal Correctional Authorities" [electronic file], BJS, National Prisoner Statistics Data Series (NPS-1), version 08/01/2000.
Prison Deaths: Sourcebook of Criminal Justice Statistics. For the year 1985, values were obtained from the BJS website which compiles the same data: "Deaths Among Sentenced Prisoners under State or Federal Jurisdiction" [electronic file], BJS, National Prisoner Statistics data series (NPS-1), version 6/19/2000. Alaska did not report prison deaths in 1994 and we did not impute it.

Other State Data

Total State Population and Age Representation: U.S. Census Bureau, Population Division, Population Distribution Branch [electronic file].
Ethnic Population Representation: Estimated using the March Current Population Survey data.
Income Per Capita: U.S. Department of Commerce, Economics and Statistics Administration, Bureau of Economic Analysis, Regional Economic Information System, State Annual Summary Tables (SA1-3, SA51-52), 1969-1999 [electronic file]. The data is given nominally and was converted to 1982-1984 dollars using the Consumer Price Index.
Unemployment Rate: Local Area Unemployment Statistics, Bureau of Labor Statistics [electronic file]. Not Seasonally Adjusted. 1977 data for all states and years 1978 and 1979 for California were completed using The Statistical Abstract of the United States.
Urbanization: "Urban and Rural Population: 1900 to 1990". U.S. Census Bureau [electronic files]. The files provided percent urbanization data for all states for 1970, 1980 and 1990. Values were linearly interpolated for the 1970s and 1980s. The same change in urbanization for the 1980's were used to calculate the urbanization numbers for the 1990s.
Infant Mortality Rate: Vital Statistics of the United States.
Governor Data: Gubernatorial Elections (1998).

References

Argys, Laura M. and H. Naci Mocan, 2002, "Who Shall Live and Who Shall Die? An Analysis of Prisoners on Death Row in the United States," Manuscript.

Baldus, D. et al., 1998, "Race Discrimination and the Death Penalty in the Post Furman Era: An Empirical and Legal Overview with Preliminary Findings from Philadelphia, Cornell Law Review, 83: 1638-1770.

Betrand, Marianne and Esther Duflo, 2002, "How Much Should We Trust Differences-and-Differences Estimates?" NBER Working Paper No. 8841.

Bowers, William J. and Glenn L. Pierce, 1975, "The Illusion of Deterrence in Isaac Ehrlich's Research on Capital Punishment," Yale Law Journal, 85: 187-208.

Cameron, Samuel, 1994, "A Review of the Econometric Evidence on the Effects of Capital Punishment," Journal of Socio-Economics, 23(1): 197-214.

Corman, Hope and H. Naci Mocan, 2000, "A Time-Series Analysis of Crime, Deterrence, and Drug Abuse in New York City," American Economic Review, 90(3): 584-604.

Corman, Hope and H. Naci Mocan, 2002, "Carrots, Sticks and Broken Windows," NBER Working Paper No. W9061.

Cover, James Perry and Paul D. Thistle, 1988, "Time Series, Homicide, and the Deterrent Effect of Capital Punishment," Southern Economic Journal, 54(3): 615-622.

Dezhbakhsh, Hashem, Paul H. Rubin and Joanna Shepherd, 2002, "Does Capital Punishment Have a Deterrent Effect? New Evidence from Post-moratorium Panel Data," Emory University, mimeo.

Ehrlich, Isaac, 1975, "The Deterrent Effect of Capital Punishment: A Question of Life and Death," American Economic Review, 65: 395-417.

Ehrlich, Isaac, 1977a, "Capital Punishment and Deterrence: Some Further Thoughts and Evidence," Journal of Political Economy, 85: 741-788.

Ehrlich, Isaac, 1977b, "The Deterrent Effect of Capital Punishment: Reply," American Economic Review, 67(3): 452-458.

Ehrlich, Isaac and George D. Brower, 1987, "On the Issue of Causality in the Economic Model of Crime and Law Enforcement: Some Theoretical Considerations and Experimental Evidence," American Economic Review, 77(2): 99-106.

Ehrlich, Isaac and Zhiqiang Liu, 1999, "Sensitivity Analyses of the Deterrence Hypothesis: Let's Keep the Econ in Econometrics, Journal of Law and Economics, 17: 455-488.

Forst, Brian, 1983, "Capital Punishment and Deterrence: Conflicting Evidence?," Journal of Criminal Law and Criminology, 74(3): 927-942.

Grogger, Jeffrey, 1991, "Certainty vs. Severity of Punishment," Economic Inquiry, 29(2): 297-309.

Hoenack, Stephen A. and William C. Weiler, 1980, "A Structural Model of Murder Behavior and the Criminal Justice System," American Economic Review, 70(3): 327-341.

Katz, Lawrence, Steven D. Levitt and Ellen Shustorovich, 2001, "Prison Conditions, Capital Punishment, and Deterrence," Manuscript.

Kleck, Gary, 1981, "Racial Discrimination in Criminal Sentencing: A Critical Evaluation of the Evidence with Additional Evidence on the Death Penalty," American Sociological Review, 46(1): 783-804.

Layson, Stephen K., 1983, "Another View of the Canadian Time-Series Evidence on Homicide and Deterrence," Canadian Journal of Economics, 16(1): 52-73.

Leamer, Edward, 1983, "Let's Take the Con out of Econometrics," American Economic Review, 73: 31-43.

Levitt, Steven D., 1997, "Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime," American Economic Review, 87(3): 270-290.

Levitt, Stephen D., 1998, "Juvenile Crime and Punishment," The Journal of Political Economy, 106(6): 1156-1185.

Lott, John R. Jr. and David B. Mustard, 1997, "Crime, Deterrence, and Right-to-Carry Concealed Handguns", The Journal of Legal Studies, 26(1): 1-68.

McFarland, Sam G., 1983, "Is Capital Punishment a Short-Term Deterrent to Homicide? A Study of the Effects of Four Recent American Executions," Journal of Criminal Law and Criminology, 74(3): 1014-1032.

McManus, Walter S., 1985, "Estimates of the Deterrent Effect of Capital Punishment: The Importance of the Researcher's Prior Beliefs," Journal of Political Economy, 93(2): 417-425.

Passell, Peter and John Taylor, 1977, "The Deterrent Effect of Capital Punishment: Another View," American Economic Review, 67: 445-451.

Pokorak, J., 1998, "Probing the Capital Prosecutor's Perspective: Race and Gender of the Discretionary Actors," Cornell Law Review, 83(6).

Raphael, Steven and Rudolf Winter-Ebmer, 2001," Identifying the Effect of Unemployment on Crime," The Journal of Law and Economics, XLIV: 259-83.

Ruhm, Christopher, 2000, "Are Recessions Good for Your Heath?" Quarterly Journal of Economics, 115(May): 617-650.

Ruhm, Christopher, 2001, "Economic Expansions Are Unhealthy: Evidence from Microdata," NBER Working Paper No. W8447.

Sorensen, Jon, Robert Wrinkle, Victoria Brewer, et. al., 1999, "Capital Punishment and Deterrence: Examining the Effect of Executions on Murder in Texas," Crime and Delinquency, 45(4): 481-493.