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The Deterrent Effect of Capital Punishment: A Cross-State Analysis of the 1960's

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The debate over capital punishment, which for centuries has been waged over essentially nonempirical matters, has focused more recently on the extent to which executions prevent (or encourage) homicides. Interest in this aspect of capital punishment was considerably heightened when, in the amicus curiae brief submitted in *Fowler v. North Carolina*,[1] the Solicitor General of the United States cited statistical evidence[2] reported by Professor Isaac Ehrlich supporting the hypothesis that capital punishment deters murder.[3]

Before vacating and remanding *Fowler*,[4] the Court received briefs and heard oral arguments in five other death penalty cases,[5] in which the deterrence question, as before, figured prominently.[6] Soon afterward, the Court ruled that "the punishment of death does not invariably violate the Constitution,"[7] and stated that for many murderers "the death penalty undoubtedly is a significant deterrent."[8]

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  1. 428 U.S. 904 (1976).
  2. Brief for the United States as Amicus Curiae at 35-38.
  3. Ehrlich, *The Deterrent Effect of Capital Punishment: A Question of Life or Death*, 65 Am. Econ. Rev. 397 (1975).
  4. 428 U.S. 904 (1976).
  5. Roberts v. Louisiana, 428 U.S. 325 (1976); Proffitt v. Florida, 428 U.S. 242 (1976); Woodson v. North Carolina, 428 U.S. 280 (1976); Jurek v. Texas, 428 U.S. 262 (1976); Gregg v. Georgia, 428 U.S. 153 (1976).
  6. Brief for the United States as Amicus Curiae at 34-45, 9a-16a, Gregg v. Georgia, 428 U.S. 153 (1976).
  7. Gregg v. Georgia, 428 U.S. 153, 169 (1976). *But see id.* at 231 (Marshall, J., dissenting); Commonwealth v. O'Neal, 339 N.E.2d 676, 682-85 (Mass. 1975).
  8. Gregg v. Georgia, 428 U.S. 153, 185-86 (1976). Although the Court did not support its belief in the deterrent value of capital punishment with empirical evidence, this evidence was not ignored:

The Supreme Court is by no means alone in its belief that capital punishment deters crime. Eighty-four percent of the respondents to a 1977 National Observer plebiscite supported restoration of the death penalty, and belief in the deterrent effect of capital punishment was the reason most often cited.[9] Public support for the death penalty has been similarly revealed by the Gallup Poll[10] and other opinion surveys.[11]

Belief in the deterrent value of the death penalty, however, is less common within the academic community. While support for Ehrlich's research exists,[12] replications of his analysis[13] have shown that his evidence of deterrence depends upon a restrictive assumption about the mathematical relationship between homi-

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"Although some of the studies suggest that the death penalty may not function as a significantly greater deterrent than lesser penalties, there is no convincing empirical evidence either supporting or refuting this view." *Id.* at 185 (footnote omitted). Professor Hans Zeisel has taken issue with this opinion, arguing that the evidence about the deterrent effect is, indeed, "quite sufficient" and that "the request for more proof is but the expression of an unwillingness to abandon an ancient prejudice." Zeisel, *The Deterrent Effect of the Death Penalty: Facts v. Faiths,* 1976 SUP. CT. REV. 317, 318.

9. Egan, *Plebiscite Results: Restore the Death Penalty,* National Observer, Jan. 29, 1977, at 1, col. 3.

10. During the decade ending in April, 1976, support for the death penalty among Gallup Poll respondents rose from 42 percent to 65 percent. *Id.*

11. *See* Vidmar & Ellsworth, *Public Opinion and the Death Penalty,* 26 STAN. L. REV. 1245, 1255 (1974) ("Belief in deterrent effectiveness is probably the most frequently assessed rationale for support of capital punishment.")

12. Although Tullock characterized Ehrlich's study of capital punishment as "sophisticated," the praise was qualified: "Unfortunately, the data available for this study were not what one would hope for, so not as much reliance can be put upon his results as one normally would give to work by such a sophisticated econometrician." Tullock, *Does Punishment Deter Crime?* 36 PUB. INTEREST 103, 108 (Summer 1974). Further support has been expressed in Posner, *The Economic Approach to Law,* Text of the Will E. Orgain Lecture, University of Texas Law School at 15-19, 31 (March 1975) (on file at MINNESOTA LAW REVIEW).

13. *See* Bowers & Pierce, *The Illusion of Deterrence in Isaac Ehrlich's Research on Capital Punishment,* 85 YALE L.J. 187 (1975); Klein, Forst, & Filatov, *The Deterrent Effect of Capital Punishment: An Assessment of the Estimates* (paper commissioned by the National Academy of Sciences, September 1976 draft, to appear in DETERRENCE AND INCAPACITATION: ESTIMATING THE EFFECTS OF CRIMINAL SANCTIONS ON CRIME RATES (A. Blumstein ed. 1977) (forthcoming) [hereinafter cited as DETERRENCE AND INCAPACITATION]; Passell & Taylor, *The Deterrent Effect of Capital Punishment: Another View,* Columbia University Discussion Paper 74-7509 (March 1975), *reprinted in* Reply Brief for Petitioner at App. E., Fowler v. North Carolina, 428 U.S. 325 (1976).

cides and executions,[14] the inclusion of a particular set of obser-
vations,[15] the use of a limited set of control variables,[16] and a
peculiar construction of the execution rate, the key variable.[17]

This Article first discusses briefly the strengths and weak-
nesses of time-series and cross-section analyses to test the hypoth-
esis that capital punishment deters homicides. A method that
avoids the more serious of these weaknesses is then described
and applied to state data for 1960 and 1970 to test the above hy-
pothesis. The results of this initial test do not support the hy-
pothesis. To ensure that these findings reflect reality rather
than simply the way in which the key variable was measured,
alternative measures of the execution rate are substituted. Sim-
ilar attempts are made to eliminate other possible biases that
have been identified in the literature. None of these modifica-
tions of the basic model is found to alter the initial finding in
any important way. It is concluded that the evidence of the
1960's supports the theory that capital punishment does not, on
balance, deter homicides.

I. TIME-SERIES AND CROSS-SECTION STUDIES

Professor Ehrlich's landmark statistical test of the hypothesis
that capital punishment deters homicide consisted of a regression
analysis of aggregate data for the United States for the period
1933 through 1969.[18] His basic approach is commonly referred

14. Bowers & Pierce, *supra* note 13, at 199-203; Klein, Forst, &
Filatov, *supra* note 13, at 31-32; Passell & Taylor, *supra* note 13, at 6-8;
note 33 *infra*.
15. Ehrlich reported that his deterrence result remained when
data from the 1930's were excluded, Ehrlich, *supra* note 3, at 410, but
others found that the result disappeared when data from the latter part
of the 1960's were excluded. Bowers & Pierce, *supra* note 13, at 197-204;
Klein, Forst, & Filatov, *supra* note 13, at 26-28; Passell & Taylor, *supra*
note 13, at 5, 21, 22.
16. Klein, Forst, & Filatov, *supra* note 13, at 14-17, 28-30. Control
variables are used in the analysis of nonexperimental data to reduce the
danger of erroneous inferences about relationships between variables.
To the extent that the murder conviction rate influences both the ex-
ecution rate and the murder rate, for example, its omission from an an-
alysis of the deterrent effect of executions would produce the appearance
of an association between executions and homicides even if, in fact, no
association existed. *See* notes 21-23 *infra* and accompanying text. In
the present analysis this problem is recognized and controlled for. *See*
text accompanying notes 38-41 *infra*.
17. *See* Klein, Forst, & Filatov, *supra* note 13, at 17-19.
18. Ehrlich, *supra* note 3, at 406, 409. Regression analysis is a
standard statistical method for determining the mathematical equation
that best describes the relationship between a dependent variable (in
this case, the homicide rate) and one or more predictor variables. Ehr-

to as "time-series analysis," since the units of observation con-
sist of a series of time intervals—in this case, individual years.

One of the crucial unresolved issues in Ehrlich's time-series
analysis centers around the sensitivity of his findings to the in-
clusion of data from the 1960's. Specifically, he found no deter-
rent effect when data for the period since 1964 were excluded
from the analysis.[19] This conclusion is not surprising, since
during the 1960's the murder rate rose precipitously, after dec-
ades of slow decline, while the use of capital punishment dimin-
ished until terminated in 1967;[20] but it does raise the question
of the extent to which the key statistical relationship found in
Ehrlich's time-series analysis reflects a true causal relationship.
It is possible that the appearance of deterrence that emerges in
Ehrlich's time-series study is primarily the product of variables
omitted from the analysis, an omission due largely to the un-
availability of data.[21] While all nonexperimental measure-
ments are subject to limitations, inferences about deterrence
drawn from the analysis of aggregate time-series data appear to
be especially prone to error because only a limited array of fac-
tors can be incorporated[22] or otherwise reflected[23] to safeguard
against spurious findings.

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lich's study was the first to estimate the deterrent effect of capital pun-
ishment by: (1) measuring factors other than the death penalty that
may have affected the homicide rate; (2) measuring the *extent* to which
the death penalty was used when it existed; and (3) attempting to
account explicitly for the reverse effect of homicides on the demand for
executions.

19. Ehrlich, *Deterrence: Evidence and Inference*, 85 YALE L.J. 209,
217 (1975). This phenomenon was first reported by Passell & Taylor.
Passell & Taylor, *supra* note 13, at 5, 21, 22.

20. *See* FEDERAL BUREAU OF PRISONS, DEPARTMENT OF JUSTICE, NA-
TIONAL PRISONER STATISTICS: CAPITAL PUNISHMENT, table 2, at 18-19
(No. SD-NPS-CP-3, November 1975).

21. It is, of course, also possible that omitted variables caused his
finding to understate the true effect of executions on homicides.

22. A key variable not available on an annual basis is the average
term of imprisonment for persons convicted of homicide and not exe-
cuted. The potential importance of this variable lies in its role as a
substitute sanction for capital punishment. In an earlier study not based
on time-series data, Ehrlich himself found that this variable was an
effective homicide deterrent. Ehrlich, *Participation in Illegitimate
Activities: A Theoretical and Empirical Investigation*, 81 J. POLIT. ECON.
521, 551 (1973). The aggregate number of homicide convictions, a central
variable in the analysis, is also not available annually. Aware of the
potential importance of this variable, Ehrlich constructed rough approx-
imations of its values from F.B.I. estimates of the annual number of
homicides, the annual probability of arrest, and the annual probability
of conviction given arrest. Ehrlich, *supra* note 3, at 407.

23. One way of reflecting regional factors is with the use of binary

Professor Ehrlich's second empirical test—based on a regression analysis of data for individual states, with separate results for 1940 and 1950—has been cited to further support the theory that capital punishment deters murder.[24] This "cross-section" technique has certain advantages over analysis based on aggregate time-series data: it allows the researcher to observe larger differences in the relevant factors,[25] to control for specific regional effects,[26] and to include potentially important factors about which information is not available on an annual basis.[27]

Several scholars have suggested that the existing estimates of the deterrent effect of capital punishment can be improved by analyzing data that reflect variation *both* temporally and geographically.[28] A method to accomplish this is set forth in the following section.

II. CROSS-SECTION ANALYSIS OF CHANGES

During the 1960's, after years of gradual decline, the homicide rate for the United States as a whole increased sharply (see Figure 1). Although the homicide rate in most states followed this general pattern, it rose much more sharply in some states

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regional variables in data that manifest geographical variation. *See* notes 26 & 41 *infra.*

24. Ehrlich referred to these results in his reply to critics, Ehrlich, *supra* note 19, at 213, 217, and reported them in Punishment and Deterrence: Some Further Thoughts and Additional Evidence, a paper delivered at the Joint Meeting of the Operations Research Society of America and the Institute of Management Science, Las Vegas (November 17, 1975) [hereinafter cited as Ehrlich, Punishment and Deterrence]. Since Ehrlich has described these findings as "preliminary and incomplete," *id.* at 1, they will not be discussed in detail here.

Professor Peter Passell has also performed a cross-state analysis of the deterrent effect of capital punishment, with separate results for 1950 and 1960. His findings differ sharply from Ehrlich's; he concludes that there is "no reasonable way of interpreting the cross-section data that would lend support to the deterrence hypothesis." Passell, *The Deterrent Effect of the Death Penalty: A Statistical Test,* 28 STAN. L. REV. 61, 80 (1975).

25. *See* note 69 *infra.*

26. Aggregation errors associated with the failure to account for these effects are discussed in Baldus & Cole, *A Comparison of the Work of Thorsten Sellin and Isaac Ehrlich on the Deterrent Effect of Capital Punishment,* 85 YALE L.J. 170, 175-77 (1975).

27. *See* note 22 *supra.*

28. Peck, *The Deterrent Effect of Capital Punishment: Ehrlich and his Critics,* 85 YALE L.J. 359, 367 (1976); Zeisel, *supra* note 8, at 317, 336; Bailey, Book Review, 67 J. CRIM. L. & CRIMINOLOGY 359, 360 (1976) (W. BOWERS, EXECUTIONS IN AMERICA).

than in others, and even declined in a few.[29]   This cross-state
variation, coupled with the differences from state to state in the
rate at which use of the death penalty declined from 1960 to 1970,

Figure 1.   The homicide rate in the United States, 1940-1970*
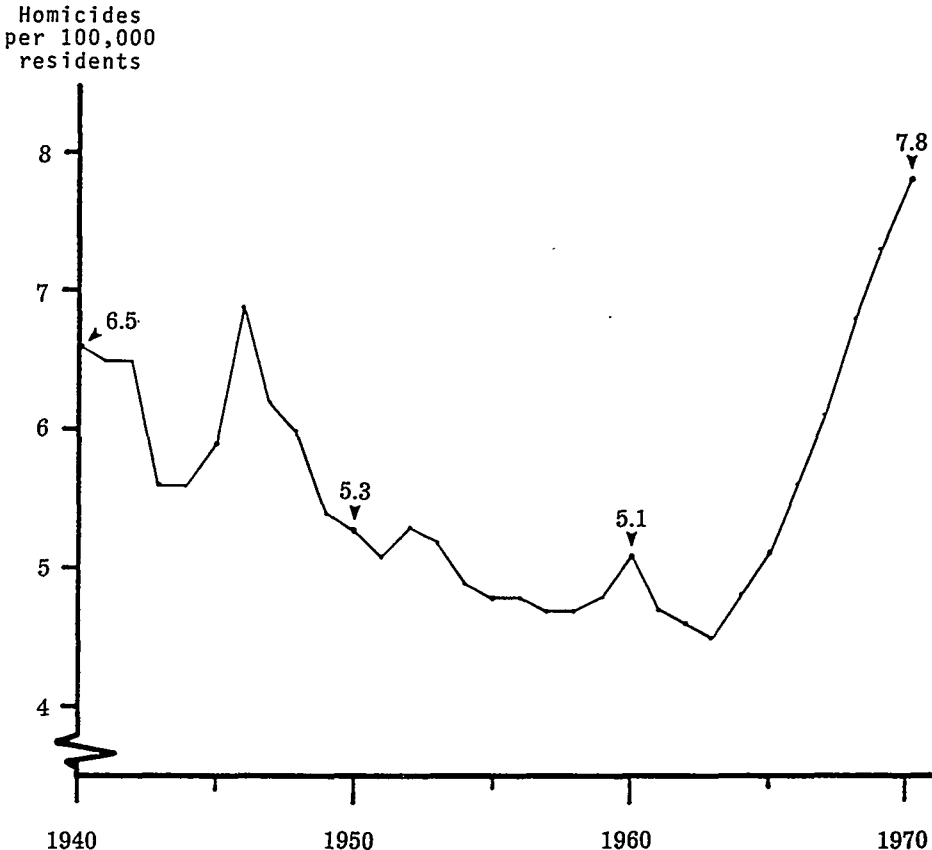
*   Sources: UNIFORM CRIME REPORTING SECTION, FEDERAL BUREAU
OF INVESTIGATION, UNITED STATES DEPARTMENT OF JUSTICE, INDEX OF CRIME,
UNITED STATES, 1933-1972 (Special tabulation presented to the author in
March 1975; copy on file with MINNESOTA LAW REVIEW).

BUREAU OF THE CENSUS, UNITED STATES DEPARTMENT OF COMMERCE,
THE STATISTICAL ABSTRACT OF THE UNITED STATES, table 2, at 5 (1970).

29.   From 1960 to 1970 the homicide rate increased in 43 states,
declined in five states (Alabama, Maine, Montana, Oklahoma, and Vir-
ginia), and was unchanged in two states (Nevada and North Dakota).   It
increased mostly sharply in Missouri (from 4.6 homicides per 100,000
residents in 1960 to 10.7 in 1970) and New York (from 2.9 in 1960 to 7.9
in 1970).   FEDERAL BUREAU OF INVESTIGATION, DEPARTMENT OF JUSTICE,
UNIFORM CRIME REPORTS, table 3, at 38-52 (1960), & table 4, at 72-78
(1970).

provides a unique opportunity to estimate the deterrent effect of capital punishment on the commission of homicides. The changes in these and other relevant variables that occurred between 1960 and 1970 in each state for which data are available can be measured and used to estimate the average effect of reductions in the execution rate on the rate at which homicides occur in the population. To the extent that capital punishment deters homicides, the homicide rate should have increased by the largest amounts from 1960 to 1970, *ceteris paribus*, in those states with the greatest reductions in the probability that a person convicted of murder would be executed.

Examining the data in this manner should overcome the potentially serious problems associated with aggregate time-series analysis.[30] Analyzing intertemporal changes in the relevant variables across states should also improve the estimates available from conventional cross-section analysis,[31] partly by reducing biases associated with omitted variables.[32] Moreover, the results of this approach appear less sensitive to alternative assumptions about the mathematical form of the model that describes the relationships among the relevant variables than do those of either the conventional time-series or cross-sectional approaches.[33] By

30. *See* notes 19-27 *supra* and accompanying text.

31. The cross-section analyses by Ehrlich and Passell are based on the levels of variables for individual census years. *See* note 24 *supra* and accompanying text. These single-year levels are used to estimate the elasticity of the homicide rate with respect to the probability of execution, given conviction for murder. The elasticity of one variable, y, with respect to another, x, is a number indicating the percentage increase (a negative number indicates a decrease) in y that results from a one percent increase in x. Ehrlich has estimated that the elasticity of the homicide rate with respect to the probability of execution, given conviction for murder, is around —0.06. Ehrlich, *supra* note 3, at 414. Since elasticity is a measure of the effect of a *change* in one variable on another variable, estimating elasticities by analyzing actual changes in variables in a cross-section of jurisdictions has considerably more appeal than estimating them from the levels of variables for any given year.

32. According to Klein, estimates based on cross-sectional data are prone to errors of spatial heterogeneity, although in certain instances, these errors can be eliminated by "differencing" two successive cross sections. Specific biases that can be eliminated under this technique include the bias produced by the failure to measure personality effects in samples of households and that produced by failure to measure entrepreneurial effects in samples of business firms. L. KLEIN, A TEXTBOOK OF ECONOMETRICS 350, 358 (2d ed. 1974). Commenting on a draft of this Article, Professor Klein suggested that interstate differences in social values may constitute a class of effects that can be accounted for by applying this method to cross-state data.

33. Whether the homicide rate is related to other factors in a linear

estimating the differential of the homicide rate rather than the parent relationship between the homicide rate and its determinants, one can be sure of describing a function that is additive in the differences of the explanatory variables.[34]

Applying this method of analysis to the 1960's is appealing for other reasons as well. More control variables are available for the most recent census years, and their measurement tends to be more accurate than it was in 1940 or 1950.[35] Moreover, there has been a great deal of controversy about the period from

or loglinear fashion is very much in controversy. Bowers & Pierce, *supra* note 13, at 199-206; Ehrlich, *supra* note 3, at 406; Ehrlich, *supra* note 19, at 217-19; Klein, Forst, & Filatov, *supra* note 13, at 31-32; Passell & Taylor, *supra* note 12, at 6e-7e; Peck, *supra* note 28, at 360-61. Estimates of the deterrent effect of capital punishment have been found to be quite sensitive to whether the relationship is assumed to be linear or loglinear. *See* note 14 *supra* and accompanying text.

The assumption of loglinearity and the use of logarithms in previous studies have created additional problems. During 1968, 1969, and 1970 there were no executions. Because it is impossible to take the logarithm of zero, Ehrlich assumed that one execution took place in each of these years so that he could use the loglinear model. Ehrlich, *supra* note 3, at 409 n.6. This procedure, however, builds biases into the analysis.

While the true relationship between the homicide rate and its determinants may be nearly linear or nearly loglinear, it is likely, in fact, to be precisely neither.

34. In regressing the change in the homicide rate on the changes in the relevant independent variables, partial differential coefficients rather than slope coefficients are obtained. Letting the homicide rate, Q/N, be determined by the rate at which convicted murderers are executed, E/C, and by other factors, X_1, X_2, . . . , the general relationship is written as

$$Q/N = f(E/C, X_1, X_2, . . .).$$

The differential of the homicide rate is of the form

$$d\frac{Q}{N} = \frac{\partial \frac{Q}{N}}{\partial \frac{E}{C}} d\frac{E}{C} + \frac{\partial \frac{Q}{N}}{\partial X_1} dX_1 + \frac{\partial \frac{Q}{N}}{\partial X_2} dX_2 + . . . ,$$

regardless of whether the parent function is linear, loglinear, or any other continuous expression. Since the partial differential coefficients will be constants only if the parent function is linear, the differential of the homicide rate will not generally be a linear function. It will, however, be *additive* in the differences of the explanatory variables. Hence, the regression coefficients produced in the estimate of the differential equation may be viewed as approximations of the averages of the respective partial differential coefficients over the range of observed values.

35. Ehrlich has also suggested that more recent data are likely to be better. Ehrlich, *The Deterrent Effect of Criminal Law Enforcement*, 1 J. LEGAL STUDIES 259, 272 (1972).

1960 to 1970 in the reviews of the available time-series evidence.[36] In short, analyzing changes during this decade cross-sectionally would appear to permit one to discover more directly whether the association between the cessation of capital punishment and the upsurge in the homicide rate during the 1960's was primarily causal or coincidental.

A. THE MODEL

The model that provides the initial structure for this analysis is

$$(1) \quad Q/N = f(E/C, \quad C/Q, \quad T, \quad Cr, \quad Age, \quad NW, \quad Male, \quad Urb, \quad Enr, \\ Pop, Div, Y, Pov, Emp, S).$$

This equation represents the notion that the homicide rate (Q/N) is potentially influenced by the rate at which persons convicted of murder are executed (E/C), the rate at which murders result in conviction (C/Q), the average prison term served by convicted murderers (T), the factors that determine the rate at which crimes other than homicide are committed (Cr), social and demographic characteristics [age (Age), race (NW), sex $(Male)$, urbanization (Urb), school enrollment rate (Enr), resident population (Pop), divorce rate (Div)], economic variables [median family income (Y), proportion of families in poverty (Pov), employment (Emp)], and a binary variable indicating whether the state is southern (S). The sources of data for these variables are given in the Appendix.[37]

Professor Ehrlich has provided theoretical justification for the inclusion of the criminal justice sanction variables and the economic variables.[38] The social and demographic variables have been added to minimize the degree of spuriousness in the estimates of central concern here, those reflecting the effects of the sanction variables on homicides.[39] The rate at which

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36. *See* notes 15 & 19 *supra* and accompanying text.
37. *See* pp. 765-67 *infra*.
38. Ehrlich, *Participation in Illegitimate Activities: An Economic Analysis*, in ESSAYS IN THE ECONOMICS OF CRIME AND PUNISHMENT 68, 70-92 (G. Becker & W. Landes eds. 1974); Ehrlich, *supra* note 3, at 398-406.
39. Any factor that influences both the execution rate and the homicide rate, if omitted from the analysis, will tend to distort the estimated effect of executions on homicides. Age, race, sex, schooling, population density and size, and family stability are all basic characteristics that would appear to be capable of producing such distortion. Ehrlich has incorporated the first five of these factors in his study of deterrence. Ehrlich, *supra* note 38, at 93.

crimes other than homicide are committed[40] and a binary Southern variable[41] are incorporated to capture the effects of additional exogenous factors that the other control variables do not specifically measure. Values of each of these variables for 1960 and 1970 are shown in Table 1.

Table 1. Aggregate United States values, mean state values and standard deviations for the variables used in the analysis, 1960 and 1970.

Variable:	U.S. total* 1960	U.S. total* 1970	State means[a] 1960	State means[a] 1970	Standard deviations[a] 1960	Standard deviations[a] 1970
Q/N[b]	5.1	7.8	4.7	6.6	3.2	3.7
E/C	.0157[c]	0	.0192	0	.0290	0
C/Q	.4132[d]	.3459[d]	.4304.	.3729	.1215	.1220
T	82.23[e]	67.54[e]	101.64	70.20	55.66	30.74
Cr[b]	1032.9	2738.5	942.7	2364.1	404.3	954.7
Age	.0482	.0634	.0493	.0636	.0043	.0060
NW	.1143	.1253	.1131	.1164	.1424	.1244
Male	.4926	.4867	.4957	.4893	.0094	.0082
Urb	.6986	.7348	.6189	.6619	.1494	.1444
Enr	.822	.869	.8453	.8873	.0641	.0456
Pop[f]	180.0	203.8	3.324	3.766	4.142	4.791
Div	.0022	.0035	.0031	.0042	.0049	.0029
Y[g]	5660	9586	5418	9172	1002	1467
Pov[g]	.184	.107	.1970	.1154	.0962	.0524
Emp	.4486	.4991	.4250	.4815	.0657	.0588
S	.3333	.3333	.2813	.2813	.4568	.4568

(a) Means and standard deviations are unweighted statistics for the 32 states for which no data were missing or undefined; (b) per 100,000 residents; (c) based on 48 states (Alaska and New Jersey did not report these statistics in 1960); (d) based on the 33 states that reported in both 1960 and 1970; (e) based on data from 34 states; (f) in millions; (g) based on income earned in the previous year.

* Aggregate U.S. values are used only in these two columns, in Figure 1, and in the concluding section of this paper.

Following the rationale described in the preceding section, the effects of interest are estimated by forming the equation of first differences:

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40. A rationale for the inclusion of the nonhomicide crime rate is given in Klein, Forst, & Filatov, *supra* note 13, at 17-19, and in text accompanying notes 64-65 *infra*.

41. It has become a standard practice in cross-state econometric analysis to incorporate a binary Southern variable to reflect other social and demographic characteristics. The use of such a variable in an analysis of homicides is further warranted by the fact that the homicide rates in the South are about twice that of the rest of the nation.

(2) $\Delta(Q/N) = a + b_1\Delta(E/C) + b_2\Delta(C/Q) + b_3\Delta T + c_1\Delta Cr + c_2\Delta Age + c_3\Delta NW + c_4\Delta Male + c_5\Delta Urb + c_6\Delta Enr + c_7\Delta Pop + c_8\Delta Div + c_9\Delta Y + c_{10}\Delta Pov + c_{11}\Delta Emp + c_{12}S,$

where Δ denotes the change in a variable calculated by subtracting the 1960 level from the 1970 level, "a" denotes a constant term, b_i denotes a partial differential coefficient for a sanction variable, and c_j denotes a partial differential coefficient for a control variable.

B. PARAMETER ESTIMATES

These coefficients can be estimated using ordinary least-squares regression analysis, with the full set of independent variables incorporated as regressors. These estimates are based on data from the 32 states[42] for which values of all the variables shown were reported both for 1960 and 1970:[43]

(3) (Q/N) = $-$ 5.911 $+$ $11.62\Delta(E/C)$ $-$ $5.714\Delta(C/Q)$
$(R^2=.692)$ (2.79)   (12.7)   (1.92)

$+$ $.001378\Delta T$ $-$ $38.68\Delta Pov$ $+$ $.001796\Delta Y$
     (.00773)   (15.8)   (.00096)

$+$ $.001430\Delta Cr$ $+$ $36.97\Delta NW$ $-$ $189.2\Delta Age$
     (.000692)   (17.8)   (139)

$-$ $.9595S$ $-$ $29.65\Delta Emp$ $-$ $9.021\Delta Enr$
     (.877)   (34.2)   (8.53)

$+$ $11.24\Delta Urb$ $+$ $92.58\Delta Div$ $+$ $.0000002382\Delta Pop$
     (15.5)   (158)   (.000000411)

$+$ $0\Delta Male$.

The numbers in parentheses are standard errors, and R^2 is the coefficient of determination, a measure of the proportion of the variance in the dependent variable that is explained by the independent variables used. Thus, 69 percent of the cross-state variance in the change in the homicide rate from 1960 to 1970 can be attributed to the set of variables in the right-hand side of equation (3).

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42. The 32 states on which these estimates are based are Arizona, California, Colorado, Connecticut, Delaware, Georgia, Hawaii, Idaho, Illinois, Kansas, Kentucky, Maine, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, Montana, Nevada, New Hampshire, New Mexico, New York, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Utah, Washington, West Virginia, and Wyoming. Conviction data were missing for 17 states in 1970, and the average term of incarceration was not available for an additional state (Vermont) in that year.

43. Similar results are obtained when the 1960 level of the homicide rate is included as a regressor to account for nonlinearity in Q/N.

The first result provides no support for the hypothesis that capital punishment deters homicide. The positive regression coefficient for the execution rate variable is, in fact, consistent with a counterdeterrent effect,[44] but the standard error of this estimate is too large for this finding to be taken seriously.[45] Equation (3) does provide evidence, on the other hand, of a deterrent effect of convictions on homicides. Those states with the largest reductions in the ratio of homicide convictions to homicide offenses tended to have the largest increases in the homicide rate, other factors held constant.

This regression equation, however, has too many shortcomings to allow it to stand alone as an adequate test of the deterrence hypothesis. Foremost among these is the imprecision in parameter estimation caused by the inclusion of 15 independent variables—ten of which are not significant (at the .10 level)—in an equation constructed from only 32 observations.[46] Eliminating these ten variables, except for the variable of primary interest, Δ (E/C), produces a result that fits the data better:

$$
\begin{aligned}
(4) \quad \Delta(Q/N) = \quad &- \quad \underset{(2.10)}{4.222} \quad + \quad \underset{(8.55)}{17.64\Delta(E/C)} \quad - \quad \underset{(1.68)}{5.970\Delta(C/Q)} \\
(R^2 = .577) \quad &- \quad \underset{(7.52)}{24.91\Delta Pov} \quad + \quad \underset{(.000507)}{.001515\Delta Cr} \quad + \quad \underset{(13.3)}{39.60\Delta NW} \\
&+ \quad \underset{(.000526)}{.0004679\Delta Y}.
\end{aligned}
$$

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44. Ehrlich explained the potential for a counterdeterrent effect as follows: "[O]ne may argue that the differential deterrent effect of capital punishment on the incentive to commit murder may be offset by the added incentive it may create for those who actually commit this crime to eliminate policemen and witnesses who can bring about their apprehension and subsequent conviction and execution." Ehrlich, *supra* note 3, at 398. Courts or juries may also be more reluctant "to convict defendants charged with murder when the risk of their subsequent execution is perceived to be undesirably high." *Id.* at 405. This latter possibility is discussed in text accompanying notes 57-59 *infra*. Von Weber has suggested as an alternative explanation that capital punishment may induce suicidally-inclined persons to commit murder. H. von Weber, *Selbstmord als Mordmotiv*, MONATSSCHRIFT FÜR KRIMINALBIOLOGIE UND STRAFRECHTSREFORM 161 (1937).

45. If executions had no effect on homicides, the probability is .37 that random factors alone would have caused the ratio of the regression coefficient for (E/C) to its standard error to be at least 0.91, the result in equation (3).

46. Estimates become increasingly precise (that is, subject to less random error) either as the number of observations increases or as the number of insignificant variables in the regression equation diminishes. The importance of precision in the estimation of the deterrent effect of capital punishment has been discussed by Ehrlich, *supra* note 19, at 220.

This result is basically similar to (3) for the variables of principal focus, except that elimination of nine weak independent variables increases the adjusted coefficient of determination, a standard measure of goodness-of-fit,[47] from .44 to .48, and increases the statistical significance of five of the six remaining variables.

Equation (4) provides evidence that the sharp increase in the homicide rate during the 1960's was the product of factors other than the abolition of the death penalty. Accounting for what appear to be the most important of these other factors— the murder conviction rate, economic variables, race, and the factors that caused non-capital offenses to escalate during the 1960's—it is apparent that those states in which the actual use of capital punishment ceased during the 1960's experienced no greater increase in the murder rate than did the states that did not use capital punishment in the first place. Under the theory that capital punishment deters murder, one would have predicted the opposite.

C. ROBUSTNESS TESTS

Before drawing inferences from data that are not produced by controlled experimentation, it is appropriate to test whether the estimates are "robust" to (that is, hold up under) departures from the assumptions on which the estimates are grounded.[48] Equation (4) is based on several assumptions: (1) the murder rate in any given year is influenced by the number of executions in that year; (2) none of the sanction variables is influenced by any of the other variables used in the regression analysis; (3) the variance in the homicide rate is no larger for highly populated states than for the less populated states; and (4) the rate at which non-capital crimes are committed is not affected by, nor does it affect, the other variables in the analysis. Each of these assumptions can be altered to test for robustness, which

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47. The formula for the adjusted coefficient of determination, $\overline{R^2}$, is

$$\overline{R^2} = R^2 - (1 - R^2)\left[\frac{K}{(N - K - 1)}\right]$$

where R^2 is the coefficient of determination, K is the number of independent variables, and N is the number of observations. A. GOLDBERGER, ECONOMETRIC THEORY 217 (1964).

48. The importance of robustness tests is well established in econometric analysis. H. THEIL, PRINCIPLES OF ECONOMETRICS 615-16 (1971).

will indicate the reliability of the estimates obtained in equation
(4).

1. *Alternative Constructions of the Execution Rate*

Since the execution rate is the independent variable of prin-
cipal focus in this analysis, it is surely appropriate to vary the
methods of measuring it.[49] The construction used in equations
(3) and (4) is based on the number of executions and convictions
in 1960 and 1970.   One alternative is to use executions in 1961
and 1971 instead of executions in 1960 and 1970, respectively, as
objective forecasts of the probability that a murder conviction
will lead to execution, since executions have been reported to lag
behind convictions by about a year.[50] The result corresponding
to equation (4) using this alternative measure, which is denoted
(E_{+1}/C), is

$$
\begin{array}{llllll}
(5) \ \ \Delta(Q/N) = & - & 5.391 & + & 2.977\Delta(E_{+1}/C) \ - & 5.637\Delta(C/Q) \\
(R^2=.506) & & (2.21) & & (11.5) & (1.83) \\
 & - & 27.32\Delta\text{Pov} & + & .001246\Delta\text{Cr} \ + & 42.01\Delta\text{NW} \\
 & & (8.03) & & (.000571) & (15.3) \\
 & + & .0007516\Delta Y \ . & & & \\
 & & (.000565) & & &
\end{array}
$$

This result is fundamentally no different from equation (4), sug-
gesting that lagging executions does not alter the observed effect
of executions on homicides.[51]

To reduce the sampling error associated with the small num-
ber of executions that occurred around 1960 and test another lag
structure, one can make the numerator of the execution rate the
average number of executions over the three-consecutive-year

---

49.   The potential importance of alternative constructions has been
stressed in previous analyses of the deterrent effect of capital punish-
ment.   Ehrlich, *supra* note 3, at 407-08; Passell, *supra* note 24, at 68, 75,
77.

50.   Ehrlich, *supra* note 3, at 407.   Using data from the Federal
Bureau of Prisons, I calculated that the median delay between sentence
and execution for persons executed during the period 1956 through 1959
was 14 months.   The distribution is skewed in the positive direction, in-
dicating a mean delay of somewhat more than 14 months.   FEDERAL
BUREAU OF PRISONS, DEPARTMENT OF JUSTICE, NATIONAL PRISONER STA-
TISTICS: EXECUTIONS 1 (No. 23, February 1960).

51.   The decline in R^2 from equation (4) to (5) might be regarded
as evidence that the homicide rate is less sensitive to variation in lagged
executions than to variation in current executions.   More fundamentally,
however, it appears systematically related to neither.

period centered about the year of the convictions in the denom-
inator.[52] This execution rate variable is denoted (E_m/C), and is
used in place of (E/C) in equation (4), giving

$$
\begin{aligned}
\text{(6)} \quad \Delta(Q/N) = \quad & - \quad 5.092 && + \quad 15.89\Delta(E_m/C) && - \quad 5.623\Delta(C/Q) \\
(R^2 = .525) \quad & \quad\quad (2.16) && \quad\quad (15.4) && \quad\quad (1.78) \\
& - \quad 26.83\Delta\text{Pov} && + \quad .001403\Delta\text{Cr} && + \quad 40.57\Delta\text{NW} \\
& \quad\quad (7.88) && \quad\quad (.000551) && \quad\quad (14.2) \\
& + \quad .0006700\Delta Y \;. \\
& \quad\quad (.000545)
\end{aligned}
$$

Again, this alternative does not produce a result that differs in
any important respects from equation (4).

Another execution rate variable can be formed by combining .
the independent variables (E/C) and (C/Q) into the single vari-
able (E/Q). Although this combination causes an important con-
trol variable, the murder conviction rate, to be lost, it allows all
50 states to be included in the analysis.[53] The result is

$$
\begin{aligned}
\text{(7)} \quad \Delta(Q/N) = \quad & - \quad 2.161 && + \quad 13.17\Delta(E/Q) && - \quad 13.38\Delta\text{Pov} \\
(R^2 = .321) \quad & \quad\quad (1.89) && \quad\quad (30.1) && \quad\quad (6.82) \\
& + \quad .001441\Delta\text{Cr} && + \quad 35.00\Delta\text{NW} && + \quad .0001917\Delta Y \;. \\
& \quad\quad (.000460) && \quad\quad (13.4) && \quad\quad (.000445)
\end{aligned}
$$

This result is remarkably similar to equation (4) except for the
substantial reduction in the proportion of variance in the homi-
cide rate explained by the independent variables, which is pro-
duced by the exclusion of the conviction variable and the use
of a larger number of observations. This reduction provides
further support for the hypothesis that convictions deter homi-
cides, consistent with findings by Ehrlich[54] and Passell[55] and
with the results of equations (3) through (6).

A final construction of the execution rate is designed to
eliminate whatever bias results from the reverse effect that
changes in the homicide rate may have on the execution rate.
All of the above regression equations assume that the causality
runs strictly from executions to homicides. These results will be
biased to the extent that the execution rate is a function of the

---

52. This idea comes from Passell, *supra* note 24, at 68, who used
instead a four-year average of executions.
53. *See* note 42 *supra* and accompanying text.
54. Ehrlich, *supra* note 3, at 410-11. Ehrlich's findings suggest that
arrests, convictions, and executions each independently deter the com-
mission of homicides, with arrests appearing to have the strongest effect
and executions the weakest.
55. Passell, *supra* note 24, at 69-71.

homicide rate, which would occur, for example, if the demand for capital punishment was stimulated by an increase in the homicide rate. This bias can be reduced by replacing the variable Δ(E/C) with the estimator $\Delta°$(E/C), formed separately by regressing Δ(E/C) on all the predetermined variables in Table 1.[56] This alternative produces the result

$$
\begin{aligned}
(8) \quad \Delta(Q/N) = \quad &- \quad \underset{(2.24)}{3.841} \quad + \quad \underset{(12.8)}{23.05\Delta°(E/C)} \quad - \quad \underset{(1.71)}{6.003\Delta(C/Q)} \\
&- \quad \underset{(7.82)}{23.69\Delta Pov} \quad + \quad \underset{(.000525)}{.001527\Delta Cr} \quad + \quad \underset{(13.7)}{38.39\Delta NW} \\
&+ \quad \underset{(.000551)}{.0004168\Delta Y} \quad ,
\end{aligned}
$$

which, again, is basically the same as the other equations. Thus, the major finding—that decreases in the execution rate are not associated with increases in the homicide rate—is robust with respect to alternative methods of constructing the execution rate variable.

2. *Alternative Structures of Simultaneity*

Although equation (1) assumes that the causation is unidirectional, some variables in the equation may be both determinants of murder and products of either the homicide rate itself or factors that influence the homicide rate. This phenomenon, known generally as "simultaneity," was assumed in equation (8). One variable other than the execution rate that may be determined simultaneously with the homicide rate is the rate at which homicide offenders are convicted; it may both affect the homicide rate, as is hypothesized in equation (1), and be produced by changes in the homicide rate. The latter would occur if, for example, the ability to convict homicide offenders was

---

    56. The predetermined variables are ΔAge, ΔNW, ΔMale, ΔUrb, ΔEnr, ΔPop, ΔDiv, ΔY, ΔPov, ΔEmp, and S. An alternate estimator, constructed from these variables together with ΔCr, produced a similar result. This general method, called the "two-stage, least-squares regression technique," is described in most standard econometrics textbooks. Because the coefficient of determination, described at equation (3), is difficult to interpret under the application of this technique, it is not reported for equations (8), (9), and (10). *See* P. DHRYMES, ECONOMETRICS: STATISTICAL FOUNDATIONS AND APPLICATIONS 240-63 (1970). Application of this technique to the analysis of crime deterrence, however, may create problems, since one cannot be confident that the control variables included in the equation of primary interest actually permit accurate identification of the crime function. Fisher & Nagin, *On the Feasibility of Identifying the Crime Function in a Simultaneous Model of Crime Rates and Sanction Levels*, in DETERRENCE AND INCAPACITATION, *supra* note 13.

hampered by an increase in the load of homicide cases. Failure to account for this reverse effect, or for the effect of changes in the execution rate on the conviction rate,[57] might bias all the regression coefficients estimated. To deal with this problem, the estimator $\Delta^\circ (C/Q)$ is constructed by regressing $\Delta (C/Q)$ on the predetermined variables.[58] This alternative measure of the conviction rate produces the equation

$$
\begin{aligned}
(9) \quad \Delta(Q/N) = \quad &- \quad 4.967 \quad &+& \quad 17.68\Delta(E/C) \quad &-& \quad 7.634\Delta^\circ(C/Q) \\
&\quad (3.62) \quad && \quad (10.4) \quad && \quad (6.63) \\
&- \quad 27.13\Delta Pov \quad &+& \quad .001390\Delta Cr \quad &+& \quad 42.38\Delta NW \\
&\quad (13.3) \quad && \quad (.000620) \quad && \quad (18.9) \\
&+ \quad .0006379\Delta Y \quad . \\
&\quad (.000767)
\end{aligned}
$$

Once again, the homicide rate appears unaffected by changes in the execution rate.[59]

Another type of simultaneity may exist with regard to the average term of incarceration served by persons convicted of homicide, T. This would result if, for example, sentences were lengthened in response to an increase in the homicide rate, in an attempt to discourage further homicides. The potential bias produced by this simultaneity can be reduced by forming the variable $\Delta^\circ T$, constructed by regressing ΔT on the predetermined variables.[60] The result produced under this construction is

$$
\begin{aligned}
(10) \quad \Delta(Q/N) = \quad &- \quad 4.566 \quad &+& \quad 17.08\Delta(E/C) \quad &-& \quad 6.019\Delta(C/Q) \\
&\quad (2.12) \quad && \quad (8.55) \quad && \quad (1.68) \\
&+ \quad .008252\Delta^\circ T \quad &-& \quad 26.68\Delta Pov \quad &+& \quad .001383\Delta Cr \\
&\quad (.00788) \quad && \quad (7.69) \quad && \quad (.000521) \\
&+ \quad 44.72\Delta NW \quad &+& \quad .0006326\Delta Y \quad . \\
&\quad (14.1) \quad && \quad (.000548)
\end{aligned}
$$

This result is basically similar to the others reported above.

The true system of simultaneity among variables is likely to be considerably more complicated than has been hypothesized. The results obtained by treating the execution rate, the conviction rate, and the average term of incarceration as endogenous variables, however, as was done in equations (8), (9), and (10), respectively, indicate that the biases due to failure to capture

---

57. *See* note 44 *supra.*
58. The predetermined variables under this formulation include those already cited, *supra* note 56, and $\Delta (E/C)$.
59. Alternative estimators of $\Delta (C/Q)$, one formed without $\Delta (E/C)$ and another formed with ΔCr, produce similar results.
60. *See* note 58 *supra.*

these simultaneous effects in equations (3) and (4) are not large.[61]

3. *Use of Weighted Regressions*

In cross-section analysis the variance of the dependent variable is often larger for more heavily populated places. This condition, known in a more general form as "heteroscedasticity," produces biased estimates of standard errors of the regression coefficients and biased tests of statistical significance. The presence of heteroscedasticity is commonly identified by visual inspection of a plot of the data, although more rigorous methods are available.[62] To eliminate this bias each observation is generally adjusted by weighting it by the square root of the population. Applying this weighting technique to the observations, under equation (4), the result is

$$
\begin{aligned}
(11) \quad \Delta(Q/N) = \quad &- \quad 4.927 \quad + \quad 18.59\Delta(E/C) \quad - \quad 6.349\Delta(C/Q) \\
(R^2 = .595) \quad & \quad (2.54) \qquad\qquad (10.6) \qquad\qquad\quad (1.89) \\
&- \quad 26.49\Delta\text{Pov} \quad + \quad .001243\Delta\text{Cr} \quad + \quad 50.32\Delta\text{NW} \\
& \quad (8.91) \qquad\qquad\; (.000476) \qquad\qquad (15.8) \\
&+ \quad .0007042\Delta Y \;. \\
& \quad (.000564)
\end{aligned}
$$

The similarity of this equation to equation (4) suggests that the general findings are robust with respect to conventional weighting.[63]

4. *Exclusion of the Other-Crimes Variable*

One of the control variables used in equations (1) through (11) is the rate at which crimes other than homicide are committed. It was included in an attempt to account for the factors that caused crime to increase generally during the 1960's, since the failure of previous analyses to capture these effects may have interfered substantially with their ability to isolate a pure deterrent effect of capital punishment.[64] Certain offenses incorporated in this control variable, however, are likely to differ from homicide only in that the victims did not die. Since it is possible

---

61. Similar results are obtained by endogenizing the rate at which crimes other than homicide are committed.

62. *See* Goldfeld & Quandt, *Some Tests for Homoscedasticity*, 60 J. AM. STAT. ASS'N 539 (1965).

63. All the unweighted regression results reported in this paper have also been obtained under the weighted technique, with similar results in each instance.

64. *See* note 40 *supra.*

that some nonhomicide offenses may themselves be deterred by capital punishment, having them in the right-hand side of the regression equation may have affected the estimates of the deterrent effect that were reported above.

It is possible to test the effect of this potential bias, whose direction is not obvious, a priori, by estimating a counterpart to equation (4) without other offenses as a control variable.[65] The result is

$$
\begin{array}{llll}
(12) \ \Delta(Q/N) = & - \ 5.371 & + \ 9.564\Delta(E/C) & - \ 6.040\Delta(C/Q) \\
(R^2 = .426) & (2.36) & (9.27) & (1.92) \\
& - \ 19.90\Delta Pov & + \ 42.72\Delta NW & + \ .001412\Delta Y \ . \\
& (8.37) & (15.1) & (.000480)
\end{array}
$$

As before, the deterrent effect of capital punishment is not apparent. While the omission of factors that caused crimes other than homicide to increase during the 1960's produces a result that differs somewhat from equation (4),[66] it does not, in this analysis, materially alter the finding.

III. CONCLUSION

The aim of this Article was to investigate empirically the deterrent effect of capital punishment. Building on studies by Ehrlich[67] and Passell,[68] the influence of the execution rate on the homicide rate was estimated by controlling for the effects of other variables and for the reverse effects of the homicide rate on the sanction variables. This analysis differs from previous ones, however, both because it focuses on a unique decade during which the homicide rate increased by over 50 percent and the use of capital punishment ceased and because it examines changes in homicides and executions over time *and* across states.[69]

---

65. When ΔCr is removed from equation (3) the only independent variables that are statistically significant (at .10) are $\Delta(C/Q)$, ΔPov, ΔNW, and ΔY. Hence, our selection of an efficient subset of independent variables, used in equations (4) through (11), is unaffected by the exclusion of ΔCr.

66. The inclusion of ΔCr in equation (4) reduces substantially the appearance of a strong effect of median family income on the homicide rate obtained in (12). Behind this reduction is a large correlation coefficient (.65) for the pair ΔCr and ΔY. The actual relationships between (Q/N), Cr, Y, and other factors are likely to be extraordinarily complex, and, although the topic is important, exploration of these relationships is beyond the scope of this discussion.

67. *See* Ehrlich, *supra* note 3; Ehrlich, Punishment and Deterrence, *supra* note 24.

68. *See* Passell, *supra* note 24.

69. This approach appears also to yield more efficient estimates of

The findings do not support the hypothesis that capital punishment deters homicides. The 53 percent increase in the homicide rate in the United States from 1960 to 1970 appears to be the product of factors other than the elimination of capital punishment. Foremost among these are a decline in the rate at which homicide offenses resulted in imprisonment (from 41.3 percent in 1960 to 34.6 percent in 1970 for the states that reported in both years) and increasing affluence during the 1960's.[70]

To obtain a sense of how well the estimates, based as they are on individual observations of 32 states, generalize to the United States as a whole, the coefficients of the basic equation, (4), can be combined with changes in the respective independent variables given in the first two columns of Table 1. This produces a predicted increase of 2.68 homicides per 100,000 residents. That the actual increase was 2.7, as shown in Table 1, provides some assurance that the estimates generalize to the aggregate of 18 states not analyzed in equation (4).

The apparent strength of the incarceration rate variable and the apparent weakness of the execution rate and term of im-

---

the relationship of primary interest, based on the coefficients of variation of the relevant variables. A variable's coefficient of variation is the ratio of its standard deviation to its mean value. In the extreme case in which a factor does not vary, it can have no relationship at all with another factor.

In fact, the coefficients of variation of both the homicide rate and the execution rate are substantially larger (0.923 and 1.51, respectively) in this study than the coefficients of variation for the homicide rate (0.157) and execution rate (0.946) based on annual aggregate United States data for the period 1933 to 1969. The coefficients of variation for the aggregate time-series data are calculated from the independent constructions of Q/N and PXQ_1, based on Ehrlich, The Deterrent Effect of Capital Punishment: A Question of Life and Death, Sources of Data at 2, 6 (May 1975) (unpublished paper on file at MINNESOTA LAW REVIEW).

70. One can only speculate as to why the homicide rate rose the most in those states with the greatest increases in wealth. Increased wealth may have provided more attractive targets to potential offenders, and produced heightened expectations and frustration. Since the nationwide increases in family income reported here are attributable to real growth and to inflation in roughly equal shares, see U.S. BUREAU OF CENSUS, STATISTICAL ABSTRACT OF THE UNITED STATES, table 1323, at 811 (1972) & Table 1, at p. 752 *supra*, the inflation component may have produced further frustration, thereby exerting additional upward pressure on the homicide rate. According to table 1323, the Consumer Price Index went from 88.7 to 116.3 between 1960 and 1970, an increase of 31.1 percent. During the same period the median family income rose from $5660 to $9586, see Table 1, at p. 752 *supra* (values for variable Y), an increase of 67.6 percent. Thus, the percentage increase in the median family income due to inflation was 46.0.

prisonment variables as deterrents to homicide lend some support to Cesare Beccaria's two-hundred-year-old suggestion that certainty of punishment deters more effectively than its severity.[71] There are, however, other explanations for these findings. The appearance of a strong deterrent effect of imprisonments on homicides may be the result of changes in factors omitted from this analysis.[72] And the apparent weakness of the deterrent effect of long imprisonments may be the product of the inaccuracy of our term-of-imprisonment variable,[73] since random errors in the measurement of this variable will bias downward estimates of the deterrent effect of the length of imprisonment.

It seems likely, nonetheless, that this finding of a deterrent effect of imprisonments of persons convicted of murder is more real than spurious. Errors in the measure of murder imprisonments are sure to exist, and these are likely to cause estimates of the deterrent effect of incarceration to understate the true effect.[74] Moreover, this particular finding is consistent with empirical results presented by Ehrlich and Passell.[75] And it supports von Hirsch's suggestion that if penalties for homicide were eliminated entirely it is difficult to imagine that the homicide rate would not increase.[76]

The finding that capital punishment, on the other hand, does not deter homicide is remarkably robust with respect to a wide range of alternative constructions of the execution rate, alternative assumptions about simultaneity among the crime and

---

71. C. BECCARIA, ON CRIMES AND PUNISHMENTS 58 (H. Paolucci trans. 1963).

72. Suppose, for example, that exogenous changes in omitted social factors in the 1960's produced a disproportionate increase in stranger-to-stranger homicides. This would cause an increase in the homicide rate to coincide with a decrease in the imprisonment rate, since it is harder to apprehend those who commit stranger-to-stranger homicides. The appearance of a deterrent effect would then be false.

73. Passell, *supra* note 24, at 67, has discussed potential sources of error in the measurement of this variable. A particularly important potential source of error comes from the fact that the measure of the average term of imprisonment is based on released homicide offenders, exclusive of homicide offenders who die in prison, some of whom had surely already served lengthy terms of incarceration.

74. On the other hand, errors in the measurement of the number of homicides, which appears both as the numerator of the homicide rate, (Q/N), and the denominator of the conviction rate, (C/Q), are likely to bias the estimates toward the appearance of a stronger deterrent effect of incarceration than may really exist. Klein, Forst, & Filatov, *supra* note 13, at 17-19.

75. *See* notes 54-55 *supra* and accompanying text.

76. A. VON HIRSCH, DOING JUSTICE 39 (1976).

sanction variables, whether or not the observations are weighted, and the inclusion of different subsets of available control variables.

Capital punishment may be a justly deserved and appropriate sanction in some instances. It is certainly an effective way to ensure that a person convicted of murder will not commit further crimes. The results of this analysis suggest, however, that it is erroneous to view capital punishment as a means of reducing the homicide rate.

APPENDIX

DATA SOURCES FOR THE VARIABLES USED IN THIS ANALYSIS

Q/N *Criminal Homicide Rate* = Number of murders and non-
      negligent manslaughters per 100,000 residents. FEDERAL
      BUREAU OF INVESTIGATION, DEPARTMENT OF JUSTICE, UNIFORM
      CRIME REPORTS, table 3, at 38-52 (1960) & table 4, at 72-81
      (1970).

E/C *Execution Rate* = Ratio of the number of executions to the
      number of homicide prisoners received from court. E/C
      denotes the ratio of executions to murder convictions that
      occur in the same year. E_{+1}/C denotes the ratio of execu-
      tions to convictions, with the executions occurring the
      year after convictions. E_m/C denotes the ratio of execu-
      tions to convictions, where E_m is the mean annual number
      of executions over the three-year period centered about
      the year of the convictions. The source of the number of
      executions is FEDERAL BUREAU OF PRISONS, DEPARTMENT OF
      JUSTICE, NATIONAL PRISONER STATISTICS: CAPITAL PUNISH-
      MENT, table 2, at 8-9 (No. 45, August 1969) for 1960 and
      1961 data, and table 2, at 18-19 (No. SD-NPS-CP-3, Novem-
      ber 1975) and table 3 (No. 20, February 1959) for the con-
      struction of 1959 data. The source of the number of
      homicide prisoners received from the court in 1960 is
      FEDERAL BUREAU OF PRISONS, DEPARTMENT OF JUSTICE,
      NATIONAL PRISONER STATISTICS: CHARACTERISTICS OF STATE
      PRISONERS, table A5, at 50-51 (1960); the source of the
      1970 data is FEDERAL BUREAU OF PRISONS, DEPARTMENT OF
      JUSTICE, NATIONAL PRISONER STATISTICS, STATE PRISONERS:
      ADMISSIONS AND RELEASES, table A2, at 6 (1970).

C/Q *Incarceration Rate* = Ratio of the number of homicide
      prisoners received from court to the number of murders
      and nonnegligent manslaughters. The source of the num-
      ber of homicide prisoners received from the court is given
      under E/C. The number of murders and nonnegligent
      manslaughters is calculated as the criminal homicide rate,
      described under Q/N, multiplied by the resident popula-
      tion. The source of the resident population is U.S. BUREAU
      OF THE CENSUS, DEPARTMENT OF COMMERCE, STATISTICAL
      ABSTRACT OF THE UNITED STATES, table 11, at 12 (1974)
      [hereinafter cited as CENSUS ABSTRACT].

T   *Term of Incarceration* = Mean time, in months, served by
      homicide prisoners released from prison (including pa-
      roles). Calculated from data given in FEDERAL BUREAU OF
      PRISONS, DEPARTMENT OF JUSTICE, NATIONAL PRISONER STA-
      TISTICS: PRISONERS RELEASED FROM STATE AND FEDERAL IN-
      STITUTIONS, tables 6-54, at 22-70 (1960) and FEDERAL BUREAU
      OF PRISONS, DEPARTMENT OF JUSTICE, NATIONAL PRISONER
      STATISTICS, STATE PRISONERS: ADMISSIONS AND RELEASES,
      table R4, at 47-81 (1970).

Cr   *Nonhomicide Crime Rate* = Number of offenses other than
      murder and nonnegligent manslaughter reported to police
      per 100,000 residents, calculated as the total crime index
      rate minus the criminal homicide rate described under
      Q/N. The sources of the total crime index rate data are
      the same tables that were cited under the description of
      Q/N.

Age   *Proportion of Residents of the Ages 21-24* = Ratio of the
      number of residents of the ages 21 through 24 to the total
      resident population. The source of the number of persons
      of the ages 21-24 for 1960 is CENSUS ABSTRACT, *supra*, table
      19, at 27 (1962); the source of the 1970 data is CENSUS AB-
      STRACT, *supra*, table 36, at 31 (1972). The Census Bureau
      gives the 1960 data for persons between the ages 20-24,
      which we multiply by 0.8. The source of the total resident
      population is given under C/Q.

NW   *Proportion of Nonwhites* = Ratio of the number of non-
      white residents to the total resident population. The
      source of the number of nonwhite residents is CENSUS AB-
      STRACT, *supra*, table 31, at 29 (1974). The source of the
      total resident population is given under C/Q.

Male *Proportion of Males* = Ratio of the number of male resi-
      dents to the total resident population. The source of the
      number of male residents is CENSUS ABSTRACT, *supra*, table
      17, at 25 (1962) & table 25, at 25 (1972). The source of the
      total resident population is given under C/Q.

Urb   *Proportion of Urban Residents* = Ratio of urban popula-
      tion to the total resident population. The source of the ur-
      ban population is CENSUS ABSTRACT, *supra*, table 18, at 19
      (1974). The source of the total resident population is given
      under C/Q.

Enr   *Enrollment Rate* = Ratio of the number of persons en-
      rolled in public elementary and secondary schools to the
      number of residents of the ages 5-17. CENSUS ABSTRACT,
      supra, table 196, at 122 (1974).

Pop   *Resident Population* = Number of residents, in millions,
      as of July 1. CENSUS ABSTRACT, *supra*, table 11, at 12 (1974).

Div   *Divorce Rate* = Ratio of the number of divorces to the
      number of residents. The source of the number of divorces
      is CENSUS ABSTRACT, *supra*, table 95, at 67 (1974). The
      source of the number of residents is given under C/Q.

Y   *Median Family Income* = Amount of income, in dollars,
      such that exactly half the resident families earn at least
      that much. CENSUS ABSTRACT, *supra*, table 627, at 387
      (1974).

Pov   *Proportion of Families in Poverty* = Ratio of the number
      of families below the low income level to the total number
      of resident families. CENSUS ABSTRACT, *supra*, table 634, at
      391 (1974).

Emp *Proportion of Adults Employed* $=$ Ratio of the number of
     residents employed in nonagricultural establishments to
     the number of residents at least 16 years of age. The
     source of the number of employed residents is CENSUS AB-
     STRACT, *supra*, table 363, at 226 (1972). The number of resi-
     dents at least 16 years of age is calculated from the CENSUS
     ABSTRACT, *supra*, table 19, at 27 (1962) & table 36, at 31
     (1972), as follows: For 1960 we use the resident population
     at least twenty years of age plus 0.8 times the number of
     residents between 15 and 19 years of age. For 1970 we use
     the resident population at least 18 years of age plus one-
     half the number of residents between 14 and 17 years of
     age.

S   *Binary Southern Variable* $=1$ if the state is Alabama,
     Arkansas, Delaware, Florida, Georgia, Kentucky, Louisi-
     ana, Maryland, Mississippi, North Carolina, Oklahoma,
     South Carolina, Tennessee, Texas, Virginia, or West Vir-
     ginia; otherwise $=$ 0.