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A Statistical Analysis of the Impact of Executions on Murders

Despite a lack of statistical evidence, deterrence is frequently sited as one of the primary justifications for capital punishment in the United States. A 1999 Harris Poll indicates that almost half of the American public believe that "executing people who commit murder deters others from committing murder."[1] Furthermore, Haney and Logan (1994) report that the Supreme Court, "has continued to make reference to deterrence as one of the two…purposes served by the death penalty." (p.89) This dichotomy between public belief and social science research implies a need for additional studies. This paper will begin with a review of the current literature and then present an analysis of the impact of executions on murders in each of the fifty states for the years 1960 through 1998.

LITERATURE REVIEW

In the 1950's and 1960's, several researchers did comparative studies on the effect of capital punishment. The best known is Sellin (1959) who compared the murder rates of contiguous states with and without the death penalty. Other researchers examined the murder rate in individual states before and after abolition or reinstatement of the death penalty. Almost all of these studies found that capital punishment had no significant impact on the murder rate.

In 1968, Becker proposed using an economic approach to the question of crime and punishment with the assumption that criminals are rational and will evaluate the costs and benefits of their criminal actions. Ehrlich (1975) followed with his famous multivariate regression study showing that executions do deter murder. He used a logarithmic model with nationally aggregated data for the period 1933 – 1969. His model included homicides/per capita as the dependent variable, three punishment variables (arrests/ murders, convictions/arrests, and executions/convictions) and several socioeconomic, demographic and law enforcement variables. Ehrlich concluded with the estimate that each execution would deter eight murders.

[1] Pastore, Ann L. and Kathleen Maguire, eds. (2000) *Sourcebook of Criminal Justice Statistics.* Table 2.65

Ehrlich's work produced a flurry of multiple regression analyses of capital punishment as well as additional comparative studies. Researchers used a variety of methods, including cross-sectional analyses for a particular year and time series analyses using either data for a single state or aggregated national data. Several also examined the murder rate before and after a highly publicized execution. Most used the murder rate as the dependent variable, although several also included rape and/or aggravated assault. The policy variables used varied considerably, including the ones used by Ehrlich, the execution rate, and the likelihood of death sentence. Control variables generally include the percent nonwhite (or percent black), the percent in a certain age group (e.g. % male 14-24, %16–34), poverty and unemployment measures, and a region dummy variable (south = 1). Some models also included per capita police expenditures, % metropolitan population, population growth as a proxy for migration, and/or the divorce rate. In more recent years, studies have focused on the impact of execution publicity. Almost all of the studies following Ehrlich found that executions have no impact on the murder rate, although a minority did find either a negative (deterrent) or positive (brutalization) effect.

Most of the studies chose to do either a cross-sectional or a time-series study. Peterson and Bailey (1988), after doing a cross–sectional analysis for each year from 1973–1984, combined the annual data sets and did a pooled cross–sectional and time–series analysis. The number of executions in that time period was low (32) and distributed among only 11 states, so the authors used the certainty of receiving a death sentence as a policy variable. Also used was the number of months per year that a state allowed the death penalty. The socioeconomic variables included were the Gini index, the divorce rate, the family poverty rate, the unemployment rate, the percent black population, the percent metropolitan population, the percent between ages 15–34, and a south dummy variable. The authors also built models with a lagged certainty variable and with the number of death sentences and murders in place of rates. The results showed a small positive relationship between the number of murders and the number of executions, but none of the other punishment variables were statistically significant. Peterson and Bailey used a linear regression and did not include a residual analysis in the report.

CURRENT ANALYSIS

For this project, I used multivariate regression and combined a cross–sectional analysis of the fifty states with a time-series analysis of the years 1960 through 1998. The results are consistent with a most of the literature in showing no significant impact from executions on murders.

DATA DESCRIPTION

Data was collected for 1950 observations. The mean, standard deviation, minimum value and maximum value for the major variables used are shown in Table 1. (Appendix) These variables are of several types: absolute numbers, rates per 100,000 people, percentages of the population, natural logs of numbers, and dummy variables. The changes in these variables from the previous to the current year were calculated for a separate data set and are not shown here.

Dependent Variable: Murder Rate

The number of murders (*mrnm*) in each of the 50 states from 1960 – 1998 was taken from the U.S. Department of Justice (DOJ) Crime & Justice Electronic Data Abstracts. The original data is from the Federal Bureau of Investigation's Uniform Crime Reports. Data from New York from 1960 – 1965 was unavailable, so those six observations are excluded from this analysis. State population by year (*pop*) was acquired from the same source and used to calculate the murder rate (*mrrt=mrnm* pop*/100,000). (*Pop* has one additional observation because the population of New York in 1960 was available from the 1960 census.) The log of the number of murders (*ln_mrnm* = log(1+*mrnm*)) was also calculated.

The maximum *mrnm* value, 4096 murders, was from California in 1993. The minimum, 1 murder, occurred in North Dakota three years and Vermont two years. The states with the highest average murder rate are Louisiana, Alabama and Texas, while North Dakota, Iowa and Vermont have the lowest average rate.

Policy Variable: Execution Rate

The number of executions per state per year (*exnm*) was derived from the U.S. Department of Justice Crime & Justice Electronic Data Abstracts for years 1992–1998 and from

Espy and Smykla[2] for the years1960–1991. *Exnm* was used to create variables for the execution rate (*exrt=exnm*pop*/100,000) as well as a dummy variable indicating an execution took place in the state that year (*exdm*). The natural log of *exnm* was calculated as well. (*log_exnm*=log(*exnm*))

The maximum value of *exnm* is 37 executions performed by Texas in 1997. The only other state to achieve double-digit executions is Virginia with 13 executions in 1998. Twenty-two states had no executions from 1960–1998. Nevada, Texas and Arkansas have the highest average execution rates.

Socioeconomic Variables

Data was collected on several variables that the Bureau of Justice Statistics (BJS) has identified as influencing the homicide rate. *Homicide Trends in the U.S.*[3] states that, "Young males, particularly young black males, are disproportionately involved in homicide compared to their share of the population," so one set of variables created was the percentage of young black males in the population. First, the numbers of black males in three age groups (15-19, 20-24, 25-29) per state per year were collected from several different sources. For 1990–1998 and 1981–1989, data was available from the Population Estimates Program of the U.S Census Bureau.[4] For 1980, 1970 and 1960, data was taken from the decennial censuses.[5] For the remaining years, 1961–1969 and 1971–1979, data was interpolated. Then, four variables for the rate of young black males in the population were created (*bm15_19*, *bm20_24*, *bm25_29*, *bm15_29*).

The BJS also discusses the role large cities play in the homicide rate. While the largest cities have higher rates than medium-large cities, small cities tend to have lower rates than rural areas. Two different sets of variables were used to try to capture this effect. The first set included

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[2] Espy, M. Watt and John Ortiz Smykla. EXECUTIONS IN THE UNITED STATES, 1608-1991: THE ESPY FILE [computer file]. 3rd ICPSR ed. Compiled by John Ortiz Smykla, University of Alabama. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [producer and distributor], 1994.

[3] Fox, J.A., BJS Visiting Fellow & Professor of Criminal Justice, Northeastern University, Zawitz, M. W., BJS Statistician. *Homicide trends in the United States*. Bureau of Justice Statistics, U.S. Department of Justice, 1999.

[4] Population Estimates Program, Population Division, U.S. Census Bureau. *(ST-99-19) Population Estimates for the U.S. and States by Age and Sex: July 1, 1990 – July 1, 1999* Population Estimates Program, Population Division, U.S. Census Bureau. *Estimates of the Population of States by Age, Sex, Race, and Hispanic Origin:1981 to 1989.*

[5] U.S. Census Bureau. *Census of Population, Volume 1: Characteristics of the Population, Chapter B: General Population Characteristics.*

the % of the state population living in a large (>50,000) center city (*cc*), the percent in rural areas (*rl*), the percent in the urban fringe of a center city (*uf*), and the percent in other urban areas (<50,000) (*ou*). This data was collected from the 1960, 1970, 1980 and 1990 censuses.[6] Data was interpolated for the years between the censuses and after 1990. Because the *cc* variable includes medium as well as large cities, another large city variable (*lgcty*) was created. This variable is the percent of a state's population living in one the nation's largest center cities. Included were the 27 largest cities in 1999, all with a center city population of over 500,000. City rankings from the Census Department and BJS were compared and then data collected and derived in the same manner as the other city size variables. A dummy variable (*lgctydm*) was used to indicate the presence of at least one of these largest cities in a state.

In an effort to adjust for changes over time, several economic measures were included in the analysis. The national poverty rate (*povrtnat*) from 1960 – 1998 and the regional poverty rate (*povrtreg*) from 1971 – 1998 are available on the U.S. Census Bureau's website. The Census Bureau estimated these rates using information from the annual Current Population Survey (CPS). The regions used by the Census Bureau are northeast, midwest, south and west. *Povrtreg* from 1960-1970 was estimated using the relationship between the national poverty rate and the various regional poverty rates in 1971. The U.S. Department of Commerce, Bureau of Economic Analysis (BEA) website provides GDP in chained 1996 dollars (*gdpnm*) as well as the percent change in GDP from the preceding period (*gdpchg*). The U.S. Department of Labor, Bureau of Labor Statistics (BLS) uses CPS data to determine the national unemployment rate (*unemnat*). The rate used here is from series ID# LFS21000000, unemployment of civilians aged 16 and over. Lastly, the Census Bureau uses the CPS to estimate national median income (*medinnat*). *Povrtreg* was multiplied by *pop* and then, along with *gdpnm* and *medin*, converted to a log variable.

The murder rate is influenced by additional factors (e.g. police expenditures, substance abuse, gang activity) that also affect the rate of other violent crimes. In an attempt to include these other factors in the model, two violent crime variables were created. The first, the number of violent crimes committed (*vcnm*) was calculated from the U.S. DOJ Crime & Justice

[6] U.S. Census Bureau. *Census of Population, Volume 1: Characteristics of the Population, Chapter B: General Population Characteristics.* 1960, 1970, 1980, 1990.

Electronic Data Abstracts and is the sum of forcible rapes, robberies and aggravated assaults. The violent crime rate (*vcrt=vcnm*pop*/100,000) was also calculated.

State and Year Variables

A dummy variable was created for each year (example: *y60*) and for each state (example: *al*). In an effort to reduce the total number of variables in the model, two sets of regional dummy variables were also created. The first set (*ne*, *mw*, *so*, *we*) was copied from Census Bureau divisions. Because this set did not seem to produce a good match, a second, larger set of regional variables was developed. For this set, any contiguous states with similar coefficients and t-statistics were aggregated, resulting in a total of 31 state/region dummy variables. In the same way, consecutive years with similar statistics were combined to form a total of 13 year/multi-year dummy variables. (Table 2, Appendix)

RESULTS

I began by building the best model possible using the control variables described above. Then a variety of execution variables were added to determine their impact on the dependent murder variable.

My first attempts to build a model used an ordinary least squares regression with murder rate as the dependent variable. Residual analysis showed a problem with heteroscedasticity due to the large differences in murder rate variability between low and high murder rate states. To correct for this heteroscedasticity, I used a weighted least squares regression (weight = *ln_mrnm*) and natural log variables where appropriate. Table 3 shows the model I consider to be the best as well as several alternate models. The log of violent crime is included in model 1 in an attempt to control for other variables that impact violent crime. Models 2 and 3 exclude violent crime. The included economic variables, regional poverty rate and the log of national GDP, proved to be

Table 3: Coeffiecients of selected variables (Standard errors in brackets)

Variable	Model 1	Model 2	Model 3
ln_vcnm	0.2823 ***		
	[0.0177]		
ln_pop	0.5425 ***	0.8584 ***	1.2542 ***
	[0.0266]	[0.0189]	[0.0244]
povrtreg	0.0298 ***	0.0354 ***	0.0386 ***
	[0.0021]	[0.0023]	[0.0024]
ln_gdpnm	0.3635 ***	0.8125 ***	0.3014 ***
	[0.0946]	[0.0961]	[0.0456]
bm15_29	13.5039 ***	17.7900 ***	26.4978 ***

	[0.7633]	[0.7605]	[1.5204]
lgcty	-0.2249 ***	-0.1435 ***	-1.9131 ***
	[0.0852]	[0.0906]	[0.3142]
state and year	yes	yes	yes
semi-grouped	yes	yes	no
Adjusted R2	0.9792	0.9765	0.9760

*** significant at the .001 level; ** significant at the .005 level;

statistically significant while the other economic variables did not. Only one young black male variable was used because of the high degree of correlation between the young black male variables. The variable used, bm15–29, is slightly more significant than bm15–19 and much more significant than bm20-24 and bm25-29. Lgcty proved to be statistically significant, while the other city/rural variables were not. The negative sign on lgcty is supported by some literature that indicates that while the absolute numbers of murders are higher in central cities, the rate of murder is lower than in less populated areas. In models 1 and 2, state and year dummy variables are grouped as described in the preceding data section. In model 3, the individual state and year dummy variables are used. In models 1 and 2, all but one of the state and four of the year dummy variables are significant at the .05 level and most are significant at the .001 level. In model 3, six of the year variables and three of the state variables are not significant.

When the two execution variables were added to these models, neither showed any statistical significance. (Table 4) In addition, the coefficients are very small for both variables, and ln_exnm switches sign between models 1 and 2. In summary, this examination of capital

Table 4: Coeffiecients of execution variables (Standard errors in brackets)

Execution Variable	Model 1	Model 2	Model 3
ln_exnm	-0.0061	0.0037	0.0061
	[0.0119]	[0.0126]	[0.0133]
exdm	-0.0033	-0.0025	-0.0001
	[0.0136]	[0.0144]	[0.015]

punishment shows no statistically significant impact of executions on murders.

FURTHER RESEARCH

This examination is a starting point from which a great deal of further research could be done. For instance, while the use of natural log variables and weighted least squares seems to be the appropriate way to handle extreme heteroscedasticity , further residual analysis and exploration may be called for.

In addition, some of the variables included could be further refined. There is an argument that executions could deter some types of homicide but not others, so separating out, for instance, stranger homicide from intimate homicide might lead to different results. Unfortunately, that data does not seem to be available on a state level for all the years considered in this analysis.

Several potentially relevant variables were not included in this project because of time and resource constraints. Examples include the level of spending on law enforcement, the black male labor force participation rate, the Gini coefficient, availability of handguns and publicity surrounding executions.

Another potentially important variable is some measure of the certainty of execution. To avoid having the same variable appear in both the numerator and denominator of other variables, I did not use executions/murders as a certainty measure. If homicide arrest or conviction data is available, however, perhaps executions/arrest and executions/conviction variables should be tested.

Appendix

Table 1: Variables

Variable	Description	# of obs.	Mean	St. Dev.	Minimum	Maximum
mrnm	# of murders	1945	354	512	1	4096
exnm	# of executions	1950	0.3549	1.5811	0	37
vcnm	# of violent crimes	1945	21,862	38,764	36	341,703
pop	population	1946	4,447,912	4,788,327	226,167	32,700,000
mrrt	murders/100,000	1945	6.5922	3.8408	0.1565	20.3492
exrt	executions/100,000	1946	0.0078	0.0307	0	0.4479
exdm	execution occurred	1950	0.1354	0.3422	0	1
vcrt	violent crimes/100,000	1945	357.50	246.23	9.23	1233.67
bm15_19	% black, 15-19, male	1950	0.0046	0.0050	0.000050	0.0225
bm20_24	% black, 20-24, male	1950	0.0039	0.0036	0.000050	0.0165
bm25_29	% black, 24-29, male	1950	0.0033	0.0031	0.000038	0.0129
bm15_29	% black, 15-29, male	1950	0.0117	0.0115	0.000153	0.0498
cc	% in center city	1950	0.2613	0.1078	0	0.6386
rl	% in rural areas	1950	0.3355	0.1462	0.0636	0.6908
uf	% in urban fringe	1950	0.2205	0.1675	0	0.7506
ou	% in other urban	1950	0.1827	0.0979	0.0052	0.6050
lgcty	% in cities over 500,000	1950	0.0631	0.1046	0	0.4637
lgctydm	large city in state	1950	0.3400	0.4738	0	1
povrtnat	national poverty rate	1950	14.28	2.82	11.1	22.2
povrtreg	regional poverty rate	1759	14.50	4.70	8.6	32.8
gdpnm	GDP in chained 1996 $	1950	4984	1716	2377	8516
gdpchg	% change in GDP	1950	7.62	2.57	3.2	13
unemnat	national unemploy. Rate	1950	6.05	1.45	3.5	9.7
medinnat	national median income	1950	40,740	4,852	29,077	47,769
ln_mrnm	log of (1+mrnm)	1945	4.9775	1.4766	0	8.318
ln_exnm	natural log of exnm	1950	0.1462	0.4214	0	3.638
ln_vcnm	natural log of vcnm	1945	8.8885	1.6314	3.584	12.742
ln_pop	natural log of pop	1946	14.8150	1.0307	12.329	17.302
ln_bmnm	natural log of bm15_29					
ln_lgcnm	natural log of lgcty					
ln_gdpnm	natural log of gdpnm	1950	8.4521	0.3577	7.774	9.050
ln_medin	natural log of medinnat	1950	10.6071	0.1293	10.278	10.774
[y60]…[y98]	[1960]…[1998]	1950/year	0.0256	0.1581	0	1
[al]…[wy]	[alabama]…[wyoming]	1950/year	0.020	0.140	0	1
ne	northeast	1950	0.1805	0.3847	0	1
mw	midwest	1950	0.240	0.4272	0	1
so	south	1950	0.3195	0.4664	0	1
we	west	1950	0.260	0.4387	0	1

Table 2a: Semi-aggregated year dummy variable set

Variable	Year(s)	Variable	Year(s)	Variable	Year(s)
y60	1960	y73_75	1973, 1974, 1975	y84_91	1984, 1985, 1986,
y61_65	1961, 1962, 1963,	y76_80	1976, 1977, 1979,		1987, 1988, 1989,
	1964, 1965		1980		1990, 1991
y66	1966	y81	1981	y92_95	1992, 1993, 1994,
y67	1967	y82	1982		1995
y68_72	1968, 1969, 1970,	y83	1983	y96_98	1996, 1997, 1998
	1971, 1972				

Table 2b: Semi-aggregated state dummy variable set

Variable	State(s)	Variable	State(s)	Variable	State(s)
ak	Alaska	ilmi	Illinois, Michigan	ga	Georgia
hi	Hawaii	wi	Wisconsin	fl	Florida
nhvtmeri	New Hampshire, Vermont,	nemn	Nebraska, Minnesota	kytnal	Kentucky, Tennessee,
	Maine, Rhode Island	sdia	South Dakota, Iowa		Alabama
ma	Massachusetts	nd	North Dakota	msarok	Mississippi, Arkansas,
ct	Connecticut	ksco	Kansas, Colorado		Oklahoma
ny	New York	wy	Wyoming	tx	Texas
de	Delaware	mtid	Montana, Idaho	mo	Missouri
mdnj	Maryland, New Jersey	ut	Utah	la	Louisiana
vanc	Virginia, North Carolina	wa	Washington	nmaznv	New Mexico, Arizona
wvsc	West Virginia, So. Carolina	or	Oregon		Nevada
ohinpa	Ohio, Indiana, Pennsylvania	ca	California		

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