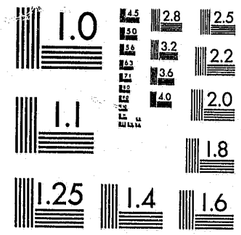

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RESEARCH ON ROBBERY:

AN ANALYSIS OF EXISTING LITERATURE AND AN ASSESSMENT OF FUTURE RESEARCH NEEDS

by Philip J. Cook
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This project was supported by Contract Number 1-0229-J-OJARS awarded by the National Institute of Justice, U.S. Department of Justice, under the Omnibus Crime Control and Safe Streets Act of 1968, as amended. Points of view or opinions stated in this document are those of the author and do not necessarily represent the official position or policies of the U.S. Department of Justice.

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ABSTRACT

Robbery is defined as theft or attempted theft by force or the threat of violence. Robbery is perhaps the most important component of the urban crime problem; James Q. Wilson calls it "the most costly of all common crimes," due to its high "psychic and communal costs." This report describes recent trends and patterns in robbery, presents a framework for analyzing the potential effects of a variety of policy interventions, and develops fairly detailed outlines of several robbery research projects that are technically feasible and important from the scientific and/or policy perspective.

A few of the principal findings are these:

*National Crime Survey (NCS) data and police data reported by the FBI both indicate that robbery rates peaked in 1975 and, after a brief decline, were climbing again by 1979.

*Police classified a roughly constant 10 percent of all criminal homicides as robbery murders between 1976 and 1979; it is possible, however, that the actual percentage increased during this period since the fraction of homicides that could not be classified by the police doubled during this period (to 17 percent).

*The robbery problem is highly concentrated in urban areas: one-third of all robberies occurred in the six largest cities in 1979.

*A recent survey of crime in the nation's junior and senior high schools estimated that there were one million robberies per year in these schools. This estimate exceeds the corresponding NCS estimate by a factor of 30.

*Direct economic losses to robbery victims (not including murders) are only about $.33 billion. This number very much underestimates the total social cost of robbery, however.

*The number of bank robberies has been growing with extraordinary rapidity during the last 25 years. The 48 percent increase between 1975 and 1979 represents its slowest rate of growth since 1957.

*A recent survey of prison inmates found that among those who reported committing robberies in the three years prior to their incarceration, the median annual commission rate was 4.8 and the 90th percentile rate was 86. Most active robbers commit a variety of other crimes as well.

Several robbery research projects are worth funding at this time.

*The huge disparity in in-school robbery estimates between the Safe Schools Study and the NCS should be investigated.

*The characteristics of robbers and robbery circumstances that are conducive to victim injury or death are poorly understood. Obtaining more information on this issue would be useful in setting prosecution and sentencing priorities.

*The most promising potential deterrent to commercial robbery is hidden cameras. Their effectiveness, and methods for promoting their wider dissemination, should be investigated.

*The reasons for the vast growth in bank robbery rates remain largely unexplored. The relatively high quality of the data for this crime is conducive to fruitful analysis.

An appendix analyzes several methodological issues pertaining to interrupted time series analysis, a technique that is being used with increasing frequency by criminologists evaluating the effect of interventions on robbery and related crimes.

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PREFACE

The original purpose of this report was to develop an agenda for federally financed research in robbery. This agenda (Chapters 10-14) is introduced by a description of patterns and trends in robbery (Part I) and an analysis of the robbery process from a policy intervention perspective (Part II). These first two parts are of interest in their own right and should serve as a useful summary to criminal justice researchers and practitioners.

The appendix, entitled "An Analysis of the Precision with which Time Series Intervention Analysis Estimates the Effects of Legal Interventions," considers the usefulness of a statistical technique that is currently being utilized very widely by researchers interested in measuring the effects of changes in criminal law or policy. The conclusions of this appendix are of course germane to the entire range of applications of this technique. It is included in this report because the evaluation of interventions which have an impact on robbery has been one of the major applications of the technique.

This report was prepared with the research assistance of Karen Kummer. Lois Mock of the National Institute of Justice provided a number of useful suggestions on revising the first draft.

PART I
PATTERNS AND RECENT TRENDS IN ROBBERY

CHAPTER 1. INTRODUCTION

Robbery is a particularly important and interesting type of crime. It is important because of the psychological and physical trauma suffered by the million victims each year, and because of the fear engendered by the threat of robbery; this threat causes changes in lifestyle that are destructive to social life and the sense of community in urban areas. Robbery is particularly interesting to criminologists because it is the only one of the seven traditional FBI Index crimes that is both a property crime and a violent crime.* It shares with other crimes of property the primary motivation (money), and the fact that in most cases the perpetrators do not know their victims. It shares with other types of violent crime a fairly high probability of victim injury or even death, the face-to-face encounter between perpetrator and victim, and the extreme overrepresentation of males and blacks among perpetrators (and, to a lesser extent, victims).

Most of what we can claim to "know" about robbery is descriptive information on trends and patterns. New sources of data that were developed during the 1970s and particularly the National Crime Surveys, have greatly enhanced our ability to create detailed descriptions of crime and the system's response to crime. Part I of this report uses these and other data as the basis for a fairly complete description of robbery trends and patterns. In those instances where there are two alternative basic sources of data on the same variable, I present both in a manner that facilitates comparison.

Developing an empirical basis for criminal justice system policy with respect to robbery requires more than descriptive information; unfortunately, there is no automatic connection between our ability to describe or diagnose a problem, and our ability to intervene effectively to mitigate the problem. Needless to say, our ability to provide reliable descriptive information on robbery is more advanced than our ability to assess the potential effectiveness of policy interventions. Part II of this report suggests a useful framework for understanding the robbery process from a policy perspective, and summarizes research that is germane to several specific policy options.

The gaps in knowledge revealed by the first two parts suggest a variety of useful research projects. Part III describes several of these projects, selected because they seem both feasible and important. It should be noted that there are a number of important research topics relevant to understanding robbery that are omitted from the list in Part III because their natural scope includes a variety of crime categories in addition to robbery: the preventive

*The crimes included in this Index are murder and non-negligent homicide, rape, robbery, aggravated assault, burglary, larceny, and auto theft. An eighth crime, arson, has recently been added to this Index.

effects of punishment, defensible space, and community watch programs are cases in point. Part III, then, is an answer to the following question: If resources are available for a research program concerned specifically with robbery, which topics should be given highest priority?

CHAPTER 2. DEFINITIONS AND RECENT TRENDS IN THE ROBBERY RATE

DEFINITIONS

Robbery is defined as theft or attempted theft, in a direct confrontation with the victim, by force or the threat of force or violence. The vernacular expressions for various types of robbery give some notion of the range of events included in this crime category: muggings, yokings, holdups, stickups, and so forth. A child "rolled" for his school lunch money and a bank teller confronted by a gang of shotgun-toting bandits are both robbery victims. While victims of burglary often say they have been "robbed," such incidents are not in fact classified as robbery unless the burglar actually encounters someone in the building and uses force or threatens them as a means to completing the theft. Purse snatching and pocketpicking incidents are not classified as robbery unless the victim resists and is overpowered.

Clearly robbery is a heterogeneous category of crime. Subsequent sections discuss several typologies of robbery and present statistical information on the detailed structure of the robbery problem. First, however, it is of interest to consider trends in the overall rate of robbery.

RECENT TRENDS IN THE ROBBERY RATE

The National Crime Survey (NCS, 1979)* estimated that there were about 1.1 million noncommercial robberies in the United States in 1979, or 6.3 per thousand residents aged 12 and over. The NCS estimated there were 279,000 commercial robberies in 1976, the last year the commerical survey was conducted (NCS, 1976); this number corresponds to a rate of 38.5 per 1000 commercial establishments.

The National Crime Survey has published estimates of national crime rates since 1973. Longer trends must be investigated by analyzing statistics on crimes known to the police, published in the FBI's Uniform Crime Reports (UCR). Data on criminal homicide from this source are quite accurate; for most other crimes, the UCR's data understate the true volume of incidents because a large

*In this report, references to specific sources are made in the text using this parenthetical form. In most cases the reference will consist of the author's last name followed by the date of publication; the complete reference is given in the bibliography. References to the annual reports of the Uniform Crime Reports (the FBI's Crime in the United States) and the National Crime Survey are referenced with the abbreviations "UCR" and "NCS" respectively, followed by the year to which their data refer; thus, "(NCS, 1979)" indicates the report of the National Crime Survey results for 1979.

fraction of these crimes is not reported to the police.* However, proportional intertemporal changes in these crime rates calculated from UCR data may be tolerably accurate.

Table 1 presents UCR robbery rates for 1960, 1965, 1970, 1975, and 1979.

Table 1

Rates of Robbery, Burglary, and Criminal Homicide, 1960-1979
(crimes known to the police)

	Rate per 100,000				
	1960	1965	1970	1975	1979
Robbery	59.9	71.2	171.4	218.2	212.1
Burglary	502.1	653.2	1071.2	1525.9	1499.1
Criminal Homicide	5.0	5.1	7.8	9.6	9.7
	Index (1970 = 100.0)				
Robbery	35	42	100	127	124
Burglary	47	61	100	142	140
Criminal Homicide	64	65	100	123	124

Source: UCR (1960, 1965, 1970, 1975, and 1979)

Burglary and criminal homicide rates are also presented, for comparison. The second part of this table presents the same statistics "normed" on 1970; that is, each entry shows the robbery, burglary, or homicide rate for a particular year and as a percentage of the rate of the corresponding crime in 1970.

The trends reflected in this table are familiar to every student of crime. The U.S. suffered massive increases in the rates of both property and violent crimes between 1965 and 1975. Between 1975 and 1979, crime rates were roughly constant. Robbery was the fastest growing Index crime in the late 1960s, increasing by 140 percent between 1965 and 1970. Burglary and homicide rates increased by approximately 60 percent during this period. Rates of growth slowed somewhat during the early 1970s; between 1970 and 1975, burglary rates increased 42 percent, while robbery and homicide rates each increased by roughly 25 percent.

Annual data on robbery is available from both the UCR and the National

*Respondents in the National Crime Survey claimed to have reported 50.5 percent of robberies in 1978, and 55.5 percent in 1979. However, the true reporting rate may be a good deal lower: comparison of the noncommercial robbery counts from the UCR and NCS indicates that the former is only about 30 percent of the latter. Of course, part of the disparity may be the result of the way robbery reports by citizens are handled by local police departments.

Crime Survey for 1973-1979. Table 2 presents these data. Despite the fact

Table 2

Annual Robbery Rates, 1973-1979

	Rate Per 100,000						
	1973	1974	1975	1976	1977	1978	1979
UCR	182.6	208.8	218.2	195.8	187.1	191.3	212.1
NCS	528.0	567.2	538.2	517.6	500.6	476.0	507.0
	Index (1975 = 100)						
UCR	84	96	100	90	86	88	97
NCS	98	105	100	96	93	88	94

Note: The Uniform Crime Reports (UCR) include commercial robberies in their total, whereas the National Crime Survey (NCS) does not. NCS also excludes victims aged less than 12 years old. However, the same denominators were used in calculating the 2 rates in each year.

Source: NCR data are taken from the National Crime Survey Report SD-NCS-N-18, NCJ-62993 "Summary Findings of 1978-79 Changes in Crime and of Trends since 1973," Sept. 1980. U.S. population figures used to calculate the NCS rates were taken from various issues of the UCR, to make them as comparable as possible with UCR rates.

that these two robbery counts are estimated from entirely different sources, and the fact that the NCS excludes commercial robberies, the two series exhibit similar patterns between 1975 and 1979;* both show a 12 percent decline between 1975 and 1978, and an increase in 1979. (It should be noted that the two series would not be in exact agreement even if both gave unbiased estimates of year-to-year changes in the robbery rate; the standard error of the NCS estimate is 5 percent, so there is a good deal of random "noise" included in the NCS robbery series.) There is a rather large discrepancy in the two series in the 1973-1975 interval, however.

SUMMARY

Reported robbery rates tripled between 1965 and 1975, and have remained roughly constant since then. UCR and NCS series are quite similar between 1975 and 1979, despite their differences in coverage and data collection technique.

*For an extensive discussion of the National Crime Survey and related victimization surveys, see Penick (1976) and Fienberg (1980). Eck and Riccio (1979) provide a useful discussion of the relationship between victim survey and reported crime rates.

CHAPTER 3. THE CONSEQUENCES OF ROBBERY

Robbery is a property crime, in the sense that most robbers are motivated by economic gain. Judged by the value of property taken in robberies, however, robbery is not a particularly serious crime; the loss in most robberies is less than $100. It is of course the violent nature of robbery that makes it such a serious crime in the eyes of the public and criminal law. The million plus robberies that occur each year result in psychological and physical trauma for hundreds of thousands of victims, and several thousand deaths. Perhaps even more important, the urban public's fear of robbery causes widespread anxiety and defensive behavior -- avoiding public places at night, carrying a weapon, moving to the suburbs -- that depreciate the quality of urban life. Race relations are perhaps also harmed by the urban public's fear of robbery -- youthful black males commit the majority of robberies, which may cause some people to be suspicious and fearful of all members of this group (Silberman, 1979).

This section presents a statistical description of some of the more readily measured consequences of robbery, with the two objectives of characterizing the aggregate impact of robbery, and the heterogeneity of events included within this category.

ROBBERY MURDER

Criminal homicide rates doubled between 1965 and 1974. A concomitant change occurred in the nature of homicide, with disproportionate increases in felony murders and other killings by strangers (Block and Zimring, 1973; Block, 1977; Zimring, 1977). Increases in robbery killings played an important role in these changes. In one particularly dramatic example, Zimring (1977, p. 318) found that in Detroit the number of police-classified robbery motive killings increased from 15 to 155 per year between 1962 and 1974. This type of killing is particularly frightening to the public, since it usually involves an unprovoked attack by a stranger. It is typically treated as murder by common law and as first degree murder by statute(Zimring, 1977, p. 331). Recent state capital punishment statutes instruct jurors and judges to treat the robbery context for a killing as an "aggravating circumstance" that helps justify the use of the capital sanction.

Developing an accurate measure of the robbery murder rate is difficult because a large percentage of robbery murders go unsolved. The police department reports to the FBI classify homicides by motive. As shown in Table 3, about 10 percent of criminal homicides have been assigned to the "robbery" category in recent years; other homicides that in fact occurred in a robbery context may have been classified in the "suspected felony" or "unknown motives" categories. Thus at least 2160 robbery murders occurred in 1979, and the true number may have been as much as twice that large.

Table 3

Robbery and Related Murders as a Percentage of All Criminal Homicides, 1976-1979

Police Classification	1976	1977	1978	1979
Robbery	10.3%	9.9%	10.2%	10.5%
Suspected Felony	7.0	5.9	5.6	5.3
Motives Unknown	8.5	14.2	13.8	17.7
Total Criminal Homicides*	16,605	18,033	18,714	20,591

*These numbers omit some homicides that apparently were not classified by the police agencies in their Supplemental Homicides Reports to the FBI.

Source: UCR, 1979, p. 12.

A conservative estimate of the likelihood that the victim will be killed in a robbery can be calculated on the assumption that all robbery murders were classified as such by the police. In 1979, there were about 4.6 police-classified robbery murders per 1000 robberies known to the police. Using the NCS estimate of the robberies in 1979 (augmented by the number of commercial robberies reported in the UCR) yields an estimated rate of about 1.5 per 1000. Thus, the probability that any one robbery victim will be killed is quite small.

Finally, it is important to note that 18 percent of all law enforcement officers killed in the line of duty between 1970-1979 were killed while attempting to stop a robbery or pursue a fleeing robber (UCR, 1979).

ROBBERY INJURY AND THEFT LOSSES

While robbery always includes force or threat of violence as one element, only about one-third of victims of noncommercial robbery were actually injured in 1978 (Table 4). Only about two percent of victims were injured seriously enough to require inpatient care in a hospital.

Table 4

Percent of Noncommercial Robbery Victimizations Which Injured the Victim, 1978

	Percent
Physical Injury	31.8
Hospital Care	9.4
Emergency Room Only	7.4
Inpatient Care	2.0

Source: NCS, 1978, various tables.

Cook (1976) used victimization survey data in 26 cities (collected in the early 1970s) to compute medical costs incurred by robbery victims. For all noncommercial robberies in these cities, 6.2 percent of victims incurred medical costs, which averaged $291. Only 0.5 percent incurred costs which exceeded $1,000.

Based on NCS estimates for 1978, 60 percent of noncommercial robberies were successful in the sense that something was stolen from the victim (Table 5). The value of the stolen items was less than $50 in 43 percent of successful robberies, and exceeded $250 in only 20 percent of such cases. Thus, in

Table 5

Theft Losses in Robbery

	Unsuccessful	Less than $50	$51-250	$251 or more	N.A.
Noncommercial, 1978	40%	26%	18%	12%	4%
Commercial, 1976	26%	11%	30%	26%	7%

Source: NCS, 1976 and 1978.

only about 12 percent of all noncommercial robberies (including unsuccessful ones) did the theft loss exceed $250. By way of comparison, about one-third of household burglaries resulted in a theft of items valued at more than $250 (NCS, 1978, p. 68).

Commercial robbery losses were naturally somewhat larger. The NCS for 1976 estimated that 74 percent of commercial robberies were successful. Of these, about 14 percent resulted in a theft of less than $50, and 36 percent in a theft of more than $250. All together, then, about one quarter of all commercial robbery attempts resulted in a theft of more than $250.

The statistics presented in this section indicate that less than 20 percent of all noncommercial robberies inflict serious economic losses and/or significant physical injury on victims.* We have no measure of the extent to which victims suffer serious psychological trauma, but a good many surely do. It is clear, in any event, that robberies differ widely in terms of the seriousness of their immediate consequences.

Table 6 presents an estimate of the total direct cost of nonlethal robbery to victims in 1978. This total of $333 million excludes any valuation of pain

*Cook (1976) found that noncommercial robberies resulting in large thefts were more likely than others to also result in victim injury, and vice versa. Therefore the fraction that resulted in one or the other (or both) is less than if they were independent events.

Table 6

Direct Economic Costs of Robbery to Victims
(Excluding Robbery Murder), 1978

	(millions)
Medical Expenses	$ 36.8
Property Loss, Noncommercial	115.8
Property Loss, Commercial	148.3
Days Lost from Work	32.5
Total	$333.4

Notes and Assumptions:

1. There were 1.317 million robbery victimizations in 1978, including 1.038 million noncommercial (NCS, 1978) and .279 million commercial (NCS, 1976). Of the latter, .207 million were successful.
2. Average medical expense per victimization was $19 circa 1973 (Cook, 1976), and was assumed to increase by the rate of inflation between 1973 and 1978. Thus this average was increased by a factor of 1.468.
3. The noncommercial average property loss was $76 circa 1973, (Cook, 1976) and was assumed to increase by the rate of inflation between 1973 and 1978.
4. The average property loss in successful commercial robberies was assumed to be four times the average property loss in successful noncommercial robbery. The latter was $122 circa 1973 (Cook, 1976). This figure was assumed to increase by the rate of inflation.
5. Days lost from work as a result of robbery was .72 million (estimated from NCS, 1978). Wages were assumed to be $45.52 per day, based on an assumption of an 8 hour day and an average wage of $5.69/hour (Economic Report of the President, 1981).

and psychological trauma, and makes no effort to assign an economic value to the lives of the robbery murder victims.* It also omits the cost of self-protection measures taken by individuals and businesses to protect against robbery, and the general anxiety felt by the urban public.

A more complete and theoretically valid method for estimating the social cost of robbery is to survey the population on the question of how much they would be willing to pay to eliminate robbery for one year. For example, if the 2.5 million retail trade concerns were willing to pay an average of $200, and each of the 80 million households an average of $50, then the total value would be 4.5 billion.

*The estimated value of property loss for 1978, $264 million, is higher than the UCR estimate for 1978 ($181 million). Given that fewer than half of all robberies are reported to the police and recorded by the UCR, one might expect a larger difference in these two estimates. However, the likelihood that a robbery will be reported increases with the amount of money stolen; for example, essentially all of the most lucrative robberies -- bank robberies -- are known to the police.

CRIMINAL JUSTICE SYSTEM COSTS

A complete accounting of the costs that robbery inflicts on society must include the cost to the criminal justice system of investigating robberies, processing defendants in the courts, and punishing convicts. A dramatic indication of the importance of robbery cases in the felony courts is the fact that 23 percent of all state prisoners (in 1974) were there on a conviction for robbery. (This statistic does not include robbery murderers.) Robbers constituted the largest category of prisoners in that year.

At the other end of the criminal justice system, robbery arrests constituted only 6.0 percent of all arrests for Index crimes (in 1979), and 6.8 percent of adult arrests for Index crimes (UCR, 1979).

There is no easy method for allocating the appropriate share of the total costs of the CJS to robbery cases, but the correct figure is on the order of several billion dollars. Supposing 75-100 thousand robbery convicts currently in prison, at an annual cost of at least $10,000 per prisoner, yields a total of about one billion dollars just for imprisonment. The total allocatable costs of police, courts, juvenile corrections, probation and parole, etc., no doubt exceed this figure by a wide margin.

CONCLUSIONS

The total cost of robbery to society is hard to measure, since the most important dimensions are difficult to quantify. Those costs that are readily measured from victim survey results -- property losses, medical costs, days lost from work -- do not add up to a very impressive total. The "willingness to pay" approach would yield a more valid estimate, and probably one that would be larger by one or two orders of magnitude. Robbery may well be a $7-10 billion problem, especially when criminal justice system costs are taken into account. James Q.Wilson (1978, p. 183) asserts that robbery is "the most costly of all common crimes," due to its "psychic and communal costs."

CHAPTER 4. WEAPON USE IN ROBBERY

While it is natural to evaluate the seriousness of a robbery by its consequences to the victim -- degree of injury and financial loss -- the major criminal law distinction is actually based on the robber's choice of technique. In particular, armed robbery is subject to more severe punishment than unarmed (strongarm) robbery, and a number of states have recently adopted a further distinction between gun robbery and other armed robbery (Jones and Ray, 1981). This chapter summarizes available data on the weapon distribution in robbery, and briefly considers the question of seriousness.

DISTRIBUTION BY WEAPON TYPE

The statistics in Table 7 suggest that about half of all robberies are unarmed, and only one-quarter involve firearms. There is a dramatic difference between commercial and noncommercial robbery in this respect, with half of the former involving firearms, and only one-sixth of the latter. The last column of this table reports the UCR tabulation of the weapons distribution in robbery. It would appear from the considerable differences between the UCR distribution and the survey based distribution that gun robberies are much more likely to be reported to the police than other types of robbery.

Table 7

Weapons Used by Robbery Offenders

	Noncommercial[a] NCS, 1978	Commercial NCS, 1976	Total[b] Victim Survey Est.	Total UCR(1978)
Unarmed	52%	35%	48%	38%
Firearm	16%	52%	24%	41%
Knife	21%	7%	18%	13%
Other	11%	6%	10%	9%

Source: NCS, 1976 and 1978.

Notes:

1. The weapon type was unknown in 5.9 percent of the armed cases. In constructing the table, it was assumed that these cases were distributed among weapon types in proportion to the distribution of other armed cases.
2. It was assumed that 21 percent of all robberies were against commercial targets; this assumption is based on the assumption of 279,000 commercial robberies (NCS, 1976) and 1,038,000 noncommercial (NCS, 1978). Combining statistics from these two years is reasonable, since the overall robbery rate did not change much during this period.

Table 8 displays the weapon breakdown for every year that is given in the UCR. It appears that the relative frequency of gun use in robbery increased between 1967 and 1975 (from 36 percent to 45 percent) and has declined slightly since then.

Table 8

Trends in Robbery Weapon Distribution

	1967[a]	1974	1975	1976	1977	1978	1979
Unarmed	42.2%	34.1	35.0	36.5	36.7	37.5	37.7
Firearm	36.3	44.7	44.8	42.7	41.6	40.8	39.7
Knife	13.8	13.1	12.4	13.0	13.2	12.7	13.2
Other	7.5	8.1	7.8	7.8	8.5	9.0	9.4

Source: UCR, 1967 and 1974-1979.

[a]The 1967 data are based on a special survey conducted by the Uniform Crime Reports. UCR (1967) summarized their results by noting that of armed robberies, 63% were committed with firearms, 24% with a knife, and 13% with another weapon. These results were combined with the armed/unarmed breakdown for 1967 to give the percentages displayed in this column.

SERIOUSNESS AND WEAPON TYPE

A recent survey of 900 assistant prosecutors found that they perceived gun robbery as substantially more serious than robbery with a blunt object or physical force (Roth, 1978). These judgments receive support from several empirical studies. First, the likelihood that a robbery will result in the victim's death is closely related to the lethality of the robber's weapon; using victimization survey data from eight cities on robbery, Cook (1980) estimated that the fatality rate in robberies ranged from 9.0/1000 for gun robberies, 1.7/1000 for other armed robberies, and .8/1000 for unarmed robberies. Furthermore, a cross section multivariate regression analysis of robbery murder in 50 cities (Cook, 1979) found that the fraction of robberies committed with a gun is a major determinant of the robbery murder rate. It is quite reasonable, then, to suppose that gunns are intrinsically more dangerous than other robbery weapons (Block, 1977; Zimring, 1977).

Gun robberies also tend to be more serious in the sense that they are more likely to be successful, and the "take" is larger on the average if successful. Unarmed robberies have the lowest chance of success, and the smallest "take" if successful (Cook, 1976, p. 182), when compared with robberies involving other weapons.

One set of results tends to confuse the relationship between weapon lethality and robbery seriousness; a number of studies (Conklin, 1972; Cook, 1976; Skogan, 1978; Cook, 1980) have found that the likelihood of victim injury is related inversely to the lethality of the weapon. It is unusual for the victim to be physically attacked in a gun robbery, while most unarmed robberies include such an attack. If there is an attack, however, the likelihood of seri-

ous injury or death increases with the lethality of the weapon.

SUMMARY

Gun robberies are more serious than others in the sense that they are more likely to result in the victim's death. The fraction of robberies committed with guns is only about one-quarter (according to NCS data) or as much as 40 percent (UCR data). It would appear that this fraction peaked in 1975 and declined steadily through 1979.

CHAPTER 5. GEOGRAPHIC DISTRIBUTION OF ROBBERIES

Robbery is the quintessential urban crime. Densely populated areas provide anonymity and a high concentration of potential targets for the robber. The statistical patterns with respect to city size reveal remarkable differences between the largest cities and the smallest.

CITY SIZE

UCR robbery rates increase rapidly with city size (Table 9, column 2). The largest cities have a collective robbery rate that is 36 times greater than in rural areas. The correlation between the UCR robbery rate and the logrithm of average city size across the 8 size categories (excluding "rural") is .96 .*

Table 9

Robbery Rates by Size of City

Size of City	Number of robberies (000) (UCR, 1979)	Estimated rate per thousand (UCR, 1979)	Estimated rate per thousand aged 12 & over (NCS, 1978)
1 million & over	147.1	8.32	17.2
500,000 - 1 million	72.4	5.83	11.0
250,000 - 500,000	58.8	5.08	5.1
100,000 - 250,000	44.3	2.82	
50,000 - 100,000	37.1	1.94	5.2
25,000 - 50,000	27.8	1.34	
10,000 - 25,000	18.6	.78	
< 10,000	10.0	.47	
Rural	6.3	.23	
Overall	458.7	2.23	5.9

The 58 cities with populations exceeding 250,000 in 1979 contained only 20 percent of the U.S. population, but reported 61 percent of all robberies. The six largest cities (with eight percent of the population) had 32 percent of the robberies, and New York City alone had 18 percent.

Robbery is more highly concentrated in large cities than any of the other

*The population statistic for each of the eight groups of cities was the mean population of the cities in that group.

Index crimes, by a wide margin. For example, the 58 largest cities reported only 47 percent of the criminal homicides and 31 percent of the burglaries.

Among the nation's largest cities, it appears that population size may be a less important correlate of robbery than population density. In a multivariate regression analysis of robbery rates in 50 large cities, Cook (1979) found that the principal explanatory variables were population density and the fraction of the city population that were youthful black males. The log of the population size and regional dummy variables were not statistically significant in this regression.*

Large cities differ from small cities not only with respect to overall robbery rates, but also location patterns. Fifty-five percent of robberies in the largest cities (250,000 or more) occur on the street; this fraction declines steadily with city size, and only 28.5 percent of robberies in the smallest cities are on the street (UCR, 1979, p. 18). On the other hand, the relative importance of commercial robberies is inversely related to city size, increasing from 21 percent for the largest cities, to 43 percent for the smallest cities.

SUBURBAN ROBBERY

Is robbery moving out to the suburbs? The statistics in Table 10 indicate that suburban cities have somewhat higher robbery rates than non-suburban cities of similar size, but that there has been essentially no change in these rates between 1975 and 1979. Thus it seems reasonable to conclude that there is a modest degree of "spillover" in robbery between central cities and suburbs, but that there has been no increase in this effect in recent years.

Table 10

Robbery Rates in Small Cities

Size of City	Robbery Rate in Suburban Cities (per thousand)	Robbery Rate in Other Cities (per thousand)
	1975	
25 - 50,000	1.34	1.22
10 - 25,000	.89	.66
< 10,000	.63	.34
	1979	
25 - 50,000	1.33	1.25
10 - 25,000	.82	.67
< 10,000	.57	.33

Source: UCR, 1975 and 1979.

*For further experiments in explaining city robbery rates, see Hoch (1974).

PATTERNS WITHIN CITIES

Intra-city differences in robbery and other crime rates tend to be quite large. the "ecology" of crime within large cities has been intensively investigated by criminologists since the 1920s (Baldwin, 1979).

The typical distribution of robberies within a large city can be explained by two reasonably well documented observations: (1) Most robbers reside in poverty areas, and typically operate close to home; (2) The most lucrative targets are in the commercial areas of the city, and robbers who do travel tend to seek out such targets.

Lynn Curtis' (1974) study of the geography of robbery and other violent crimes deserves particular attention due to its large data base and careful analysis. He studied five cities -- Boston, Philadelphia, Atlanta, Chicago, and San Francisco. He found that

> "High violence and poverty coincided spatially for the most part. Non-poverty areas with significant violence were usually on the fringes of high violence poverty areas or better-off neighborhoods that robbers entered to victimize residents (p. 148)."

Among the four types of violent crime, he found "Homicide and assault consistently showed the highest degree of localization and robbery the least among the five cities (p. 147)." Armed robbers tended to travel longer distances than unarmed robbers, with the central business district one important destination in Boston and Philadelphia.

A study of robbery in Oakland (Feeney and Weir, 1973) further illustrates the importance of opportunities in determining the geographic distribution of robberies. Robbery in Oakland was heavily concentrated on a few major streets; two thirds of all robberies were committed within a half block of a major traffic or business artery (p. 58). Commercial robberies were even more concentrated along such thoroughfares, but for the most part well away from the central business district. "The establishments which have the highest commercial robbery rates are those which tend to locate independently of other businesses" (p. 59.).

SUMMARY

The robbery problem is primarily an affliction of the nation's largest cities. Other types of crime are also concentrated in large cities, but not to the same degree as robbery. The majority of big city robberies occur on the street, whereas commercial robberies are more common (relatively speaking) in small cities. There appears to be some spillover between central cities and their suburbs with respect to robbery, but not much.

The distribution of robberies within cities is concentrated to some degree in poverty districts and the central business district.

CHAPTER 6. ROBBERY SITES

The site of a robbery serves as one useful dimension by which to classify robberies; the typical robbery on the street differs in a number of respects from robberies in schools, residences, or commercial buildings. The discussion below highlights some of the unique features of robberies in residences, schools, and banks and convenience stores.

RESIDENTIAL ROBBERY

Residential robberies include some of the most terrifying of all crime types -- an armed intruder breaking into a home and holding the residents at gun- or knifepoint. Such crimes may originate as burglaries which "convert" to robberies if the intruder finds the residence is occupied and decides to use threats or violence as a means of completing the theft (Repetto, 1974). Alternatively, they may involve a confrontation at the entrance, or a robbery committed by someone who has a right to be in the house (e.g., as an invited guest at a party). One piece of evidence suggest that this last circumstance dominates the residential robbery statistics -- 71 percent of all residential robberies are committed by acquaintances (NCS, 1978). This is the only category of robbery for which acquaintances figure importantly. Overall, only 23 percent of noncommercial robberies involved acquaintances in 1978.

Table 11

Patterns of Robbery

Noncommercial Robbery (NCS, 1978)		Commercial Robbery (UCR 1979*)	
Location	Percentage	Location	Percentage
Inside home	12.7%	Commercial House	53.3%
Near home	10.0	Gas Station	14.0
Nonresidential Building	11.5	Convenience Store	26.5
School	3.2	Bank	6.2
Street, park, school grounds	55.9	Total	100.0%
Elsewhere	6.8		
Total	100.0%		

*Calculated from data on p. 176, on the assumption that the "Miscellaneous" category is noncommercial.

ROBBERIES IN SCHOOLS

The NCS estimates that 3.2 percent of noncommercial robberies occur in schools. A related statistic from the NCS (1978) is that the robbery victimization rate for youth aged 12-19 is about one percent per year. A recent survey of school children and teachers suggests that these estimates may be much too low.

The Safe School Study interviewed a representative sample of junior and senior high school students in 1976. The most useful data on crime victimizations were for the month preceding the interview. For that one-month period, 1.0 percent of junior high students and 0.3 percent of senior high students reported being robbed on school property. Some of them were robbed more than once during this period. For a nine-month school year, then, these results for junior high students imply victimization rates of over 9.0 percent for junior high students, and 2.7 percent for senior high students; rates that are far in excess of the NCS estimate of about 1.0 percent per year for each of these age groups. The Violent Schools-Safe Schools report characterizes the robberies this way:

> "They are not stickups or muggings for the most part, but instances of petty extortion -- shakedowns -- which for some student victims become an almost routine part of the school day" (p. 60).

Not surprisingly, few of these robberies involve much property loss; in 76 percent of these incidents, the loss was less than one dollar (p. 60).

Perhaps even more disturbing than these high robbery rates for students is equally high rates for teachers. In a typical month, 0.6 percent of both junior and senior high teachers reported being robbed at least once on school property. The implied annual victimization rate of over five percent exceeds that for other adults by an order of magnitude.

Taken together, these results suggest that there are about one million school-related robberies per year -- as many, that is, as were estimated for the entire nation by the NCS. If the Violent Schools-Safe Schools survey results are valid, then school-related robberies constitute a large portion of the robbery "problem." While most of these robberies are not serious, it is disturbing that such an important institution, for which attendance is required by law, is in many cases doing such a poor job of protecting the more vulnerable students against intimidation and extortion.

ROBBERIES OF BANKS AND CONVENIENCE STORES

In 1957, there were 278 bank robberies in the U.S. In 1980, there were 6515. Between 1960 and 1970, the annual number of bank robberies increased by 18 percent per year compounded; between 1970 and 1980, the number increased at a compounded rate of 11 percent per year (see Table 12). These growth rates far outstrip the rates of growth for any other major category of robbery. Furthermore, the number of bank robberies has continued to increase rapidly even during the last five years, when the overall robbery rate has remained virtually unchanged; between 1975 and 1979, the number of bank robberies increased by 48 percent.

Table 12

Bank Robberies, Annual Totals, 1935-1980

	Robberies	Total Bank Crimes (incl. burglaries & larcenies)
1935	229	
1940	102	
1945	51	
1950	100	226
1955	306	526
1960	458	810
1965	1154	1749
1970	2331	3029
1975	4159	4883
1980	6515	7416

Source: FBI, private correspondance.
Note: In 1943, there were only 22 bank robberies recorded in the U.S. -- the lowest rate since national records were first compiled in 1934.

Fairly detailed records on bank robbery are collected by the FBI and have been compiled semiannually since 1973. Table 13 reports recent trends in the number of crimes (including the relatively few larcenies and burglaries), the success rate, average loot, and number of killings (not including perpetrators or law enforcement officers). Bank robbery tends to be less violent than other forms of robbery and involves much greater property losses on the average.

Table 13

Characteristics of Bank Crimes, 1974-1980

Year	Number of Bank Crimes	Number of Bank Robberies	Success Rate	Average Loot, Successful Crimes	Customers and Employees Killed
1974	4253	3517	85.8%	$11041	11
1975	4955	4180	87.3%	$7453	10
1976	4565	3816	87.7%	$6325	7
1977	4786	3988	86.2%	$6228	9
1978	5504	4739	88.0%	$6107	8
1979	7037	6148	88.6%	$7611	7
1980	7416	6515	89.0%	$7447	13

Source: FBI, semi-annual compilations entitled "Bank Crime Statistics, Federally Insured Financial Institutions" (mimeo).

The most common method of bank robbery is a threat with a visible firearm; slightly more than half involved visible firearms in 1980, of which over 90 percent were handguns. Most of the remaining robberies were perpetrated by use of a demand note passed to the teller. The vast majority of bank robberies were committed by individuals acting alone; there were a total of only 5081 known perpetrators involved in the 3957 bank crimes committed in the second

half of 1980. Thus the gang style bank robberies of the Bonnie and Clyde era are not at all typical of modern-day bank robbery.

Why have bank robbery rates increased so rapidly in recent years? Surely part of the answer lies in the increase in the number of small branch banks, which tend to be designed and located in such a way as to be highly vulnerable to robbers. But there are no complete, well-documented explanations available at present.

The other fast-growing category of robbery during recent years is robbery of convenience stores. Between 1970 and 1974, the annual number of such robberies more than doubled, and it has continued to increase (although at a much slower rate) since then. Currently convenience stores are the target for more than one quarter of all commercial robberies (NCR, 1979). As in the case of bank robbery, the reasons for the vast increase in convenience store robbery are obscure, although it probably does reflect in part an increase in the number of such stores.

SUMMARY

Three robbery sites were singled out for special comment. Residential robberies are unusual in that most of them involve perpetrators who are acquainted with their victims. School robberies are notable for their pettiness, and for their prevalence; if the Violent Schools-Safe Schools report is accurate, there are as many robberies in schools as in all other noncommercial sites combined. However, there is a gross discrepancy between this survey and the NCS findings on school robbery. Finally, bank robbery is notable for the large financial losses typical of this crime, and because of its unparalleled rate of growth over the last 25 years.

CHAPTER 7. CHARACTERISTICS OF ROBBERS AND THEIR VICTIMS

The National Crime Surveys and related victimization surveys have proven particularly valuable in quantifying demographic patterns in robbery and other violent crimes; the victim/respondent has actually seen the offender in most every crime of this sort, and is usually able to provide the interviewer with information on the number of offenders in the incident, and their race, sex, and approximate ages. Prior to the victimization survey program, estimates of the distributions of violent crime offenders and victims with respect to demographic characteristics were based on special studies of police report files (e.g., Curtis, 1974). Since police files only include reports of crimes known to police, which are unrepresentative of the universe of all crimes in some respects, this source of data is not entirely satisfactory. An alternative approach for estimating the age, sex, and race distributions of offenders has been to use demographic data on arestees; this source of information is even more suspect than police reports, since the process which generates arrests from crime reports seems likely to have substantial biases with respect to the demographic characteristics of offenders. Victimization surveys have provided a new and presumably more reliable basis for estimating the demographic distributions of both offenders and victims. These data have also served as the basis for checking the validity of estimates calculated from other data sources. Hindelang (1978), for example, reported the somewhat surprising result that arrest data and victim survey data yield similar estimates of the distribution of offenders by race. This finding is affirmed by the calculations presented below.

Subsequent sections present and discuss tabulations of robbery victim and offender characteristics. These tabulations are calculated from both NCS data and UCR arrest data.

NUMBER OF OFFENDERS AND VICTIMS PER INCIDENT

Most robberies involve two or more offenders (58 percent) and a single victim (92 percent). As shown in Table 14, 30 percent of robberies actually involve three or more offenders, and about one percent of these incidents involve large gangs of ten or more robbers.

Zimring (1980) reports that the propensity to commit robbery in groups is age-related to a substantial degree; adult robbers are much more likely to work alone than youthful robbers. This finding is confirmed by the NCS statistics reported in Table 15; 44 percent of single offenders were less than 21, but approximately 59 percent of offenders acting in groups were less than 21. (Generating the latter estimate from published NCS statistics requires several assumptions, as explained in the footnotes.)

Table 14

Distribution of Noncommercial Robbery Incidents by Numbers of Offenders and Victims

	Number of Offenders	Number of Victims
1	42.4%	92.4%
2	27.4%	5.8%
3	15.1%	1.3%
4	6.1%	
5	3.5%	
6-10	4.3%	
11-14	.6%	.5%
15-19	.3%	
20+	.3%	
Overall	100.0%	100.0%
Mean	2.4	1.2

Source: Number of Offenders calculated from Table 1 of Reiss (1980). Robbery was defined to include attempted and successful robberies and serious assaults with theft. Reiss' data are pooled NCS results from 7/1/72 to 12/31/75. Number of Victims taken from NCS (1978).

Table 15

Age Distribution of Robbery Offenders

		NCS (1978)		
Age Range	UCR Arrest Data, 1979	Single Offender*	Multiple Offenders*†	Overall‡
< 15	8.1%	4.5%		
< 18	31.5%	17.9%		
< 21	54.5%	44.0%	58.8%	55.9%
< 25	74.4%	-		

Notes:

* Incidents in which the age of the offender was not available in the NCS were assumed to have the same ofender age distribution as other incidents.

† Incidents involving multiple offenders of mixed ages (i.e., one or more aged 20 or less, and one or more aged 20 or more) were assumed to have an equal number in each category, and to have the same number of offenders on the average as incidents in which all offenders were in the same age category.

‡ 80.2% of all offenders were in the multiple offender category. This estimate is derived from two other estimates: (1) NCS estimated that 54.3% of all incidents involved multiple offenders; and (2) There are an average of about 3.4 offenders in a multiple offender incident (estimated from statistics in Table 14, above).

Table 16

Distribution of Robbery Offenders by Race

Race	NCS (1978) Single Offender*	Multiple Offenders*†	Overall‡
White	58.3%	39.1%	42.9%
Black	25.7%	65.5%	52.4%
Other	6.0%	3.5%	4.0%

Notes:
*Incidents in which the race of the offender was not available were assumed to have the same race distribution as other incidents.
†In the 7.0% of all incidents involving offenders of different races, it was assumed that half were white and half black.
‡See Footnote from Table 15.

Table 17

Comparison of Robbery Arrestees with Those Arrested for Property Crimes and Violent Crimes, 1979

	Robbery Arrests	Index Property Crime Arrests*	Index Violent Crime Arrests†
Age			
< 15	8.1	16.6	5.2
< 18	31.5	43.5	20.1
< 21	54.5	62.0	38.0
< 24	74.4	75.2	57.4
Race			
White	41.0	68.2	53.7
Black	56.9	29.4	44.1
Other	2.1	2.4	2.2
Race (Under age 18)			
White	35.0	71.2	48.7
Black	62.5	26.3	49.0
Other	2.5	2.5	2.3
Sex			
Male	92.6	78.2	89.8
Female	7.4	21.8	10.2

Source: UCR (1979)
*Auto theft, larceny, burglary
†Robbery, aggravated assault, rape, and criminal homicide.

Table 18

Robbery Victimization Rates and Distribution of Robberies by Victim Age, Race, and Sex, 1978

Victim Characteristics	Victimization Rate (per thousand)	Percentage of all Noncommercial Robberies
Age		
12-15	10.9	16.2%
16-19	9.8	15.5%
20-24	8.7	16.5%
25-34	5.9	19.1%
35-49	4.6	15.8%
50-64	3.3	10.2%
65+	3.0	6.6%
Race (aged 12 and over)		
White	5.2	77.2%
Black	11.4	21.6%
Other	4.8	1.2%
Sex (aged 12 and over)		
Male	8.3	67.3%
Female	3.7	32.7%

Source: NCS (1978).

AGE, RACE, AND SEX

Tables 15 through 18 report UCR arrest statistics on the demographic characteristics of robbery offenders and victims. The principal conclusions from these statistics are given below.

1. Victimization survey data and arrest data are in close agreement.

Victimization survey data reported in these tables exclude commercial robberies and robberies involving victims ages less than 12. The UCR arrest data are not subject to either of these exclusions. Furthermore, the major sources of error in the two types of statistics are entirely different: the victim survey estimates are subject to errors in perception and memory; the arrest statistics, while essentially free of those problems, are quite possibly an unrepresentative "sample" of all robbery offenders. Despite these differences, the two types of data give very similar estimates of the demographic distributions of offenders. For example, 55.9 percent of offenders were under age 21 according to the NCS, while 54.5 percent of all arrestees were less than 21 (Table 15).

2. Most robberies are committed by youthful males. Blacks commit more than half of all robberies.

About 75 percent of all offenders are less than 25 years old, and more than 90 percent are males. More than half of offenders are black. Blacks are most overrepresented among youthful offenders; 62 percent of youths less than 18 who are arrested for robbery are black (Table 16).

Since robbery is both a crime of violence and a property crime, it is in-

teresting to see whether the demographic characteristics of robbers tend to be more similar to property offenders or violent offenders. Judging from the arrest data in Table 17, property offenders tend to be younger, and violent offenders older, than robbers (though the former difference disappears by age 25). Blacks and males are more overrepresented in robbery than in either property or violent crimes, though more similar to violent crimes in this respect.

3. Distributions of demographic characteristics of robbery victims exhibit the same tendencies as robbery offenders, but in less extreme form.

Just as for offenders, victims are disproportionately youthful, black, and male (Table 18). None of these tendencies are nearly as pronounced for victims as for offenders.

INTERACTIONS BETWEEN VICTIMS AND OFFENDERS

When the demographic characteristics of robbers are compared with their victims, a strong "similarity pattern" emerges for each of the dimensions -- race, sex, and age (Cook, 1976). A useful statistic for illustrating this pattern is

$$R_{ij} = \frac{O_{ij}}{V_{ij}}$$

where O_{ij} is the percentage of robberies committed by offenders in demographic group i against victims in group j, and V_j is the percentage of the total population that are members of group j. For example, based on victimization surveys taken in 26 cities in the early 1970s, it was found that 52.3 percent of all robberies committed by blacks had white victims, whereas whites made up 70.4 percent of the total population; in this case

$$R_{BW} = \frac{52.3}{70.4} = 0.7 \quad .$$

Demonstration of the similarity pattern for group i requires that $R_{ii} > 1$. For those 26 cities, this statistic was calculated to be 1.3 for both black and white robbers, and 1.5 for both male and female robbers (Cook, 1976, pp. 177-178). There was also a pronounced similarity pattern with respect to age.

Blacks committed 70 percent of the noncommercial robberies in the 26 cities covered by special National Crime Panel victimization surveys in the early 1970s. Despite the fact that their victims were also blacks to a disproportionate degree (the similarity pattern), it was nevertheless true that a majority of their victims were whites. Whites were three times as likely to be robbed by nonwhites as by whites (Cook, 1976, p. 177). Thus interracial robbery is common -- much more so than for other crimes of violence.

The high rate of racial crossover robberies is related to the fact that robbers are usually strangers to their victims. For example, the 1978 NCS estimated that 77 percent of noncommercial robberies were by strangers. This percentage exceeds that for rape (72 percent) and assault (60 percent).

SUMMARY

Studies based on police files and arrest statistics suggested that youthful black males commit a vastly disproportionate fraction of all robberies; NCS data confirm this conclusion. Youthful black males also are disproportionately represented among victims, in part because there is a tendency for robbers to choose victims who are similar to themselves in terms of demographic characteristics. Despite this tendency, there is a good deal of racial crossover in robberies, mostly involving black robbers and white victims.

CHAPTER 8. ROBBERY CAREERS

From the point of view of robbery prevention, some of the most interesting descriptive information concerns robbery "career" patterns: age of onset and age of retirement, intensity, degree of specialization, modus operandi, and so forth. Answers to these questions would be helpful in quantifying the likely effects of deterrence or incapacitation-oriented programs

Victim surveys provide a wealth of information about the immediate circumstances and events associated with a representative sample of robbery incidents, but such surveys of course provide no information on offenders beyond what is visible to the victim at the time. Career information must be inferred from other sources, such as police and court records and interviews with prisoners and other identified offenders. These sources of information are based on samples of offenders that may be quite unrepresentative of the population of active offenders in some respects, and therefore must be interpreted with some care. In any event, a great deal of information on criminal careers is currently being collected, to good effect.

THE RAND STUDIES

A series of studies by the Rand Corporation (Greenwood, 1980) have gathered considerable information on robbers and other criminals through intensive interviews with prisoners concerning their careers in crime.* The alternative approach in this area has been to construct career information from police and/or court records.

The three Rand studies referred to in the discussion below are as follows:

a. Habitual Felons Survey (Petersilia, Greenwood, and Lavin, 1977):
A random sample of 49 incarcerated male felons who were serving time for armed robbery in a medium-security California prison in 1976 and had served at least one previous prison term. Information included official criminal histories and responses to a self-report questionnaire covering the inmates' entire criminal career.

b. Inmate Survey I (Peterson and Braiker, 1980):
A random sample of 624 male California prison inmates. Information included responses to an anonymous self-report questionnaire covering the three years prior to the current spell of incarceration.

*Conklin (1972) was the first to conduct an interview study of this sort. His work has been superceded by the far larger efforts of the Rand researchers.

c. Inmate Survey II (Greenwood, 1980):
A sample of 2400 prison and jail inmates in California, Michigan, and Texas, taken in 1979 and not yet completely analyzed.

Based on information collected from these surveys and other sources, the discussion below considers activity levels, crime specialization, motivation, sophistication, and involvement with drugs and alcohol.

ACTIVITY LEVELS

The distribution of robberies among active offenders fits the "J-curve" model that also describes the incidence of other deviant activities: in any one year, a few offenders have a very high rate of commission, whereas most active robbers only commit one or two. Figure 1, taken from Rand's Inmate Survey I, illustrates this point vividly. One characteristic of such a distribution is that the mean far exceeds the median: these values are 4.61 and 1.48 (armed robberies per year) respectively, for Inmate Survey I (Peterson and Braiker, 1980, p. 23).

Based on Inmate Survey I, it is possible, given several assumptions, to estimate robbery commission rates for all active street criminals (including burglars, con artists, drug dealers, and violent criminals); the Rand estimates were that 32 percent of all adult, male, active street criminals in California committed at least one armed robbery in a typical year, and those who committed at least one committed an average of about two (Peterson and Braiker, 1980, p. 28).

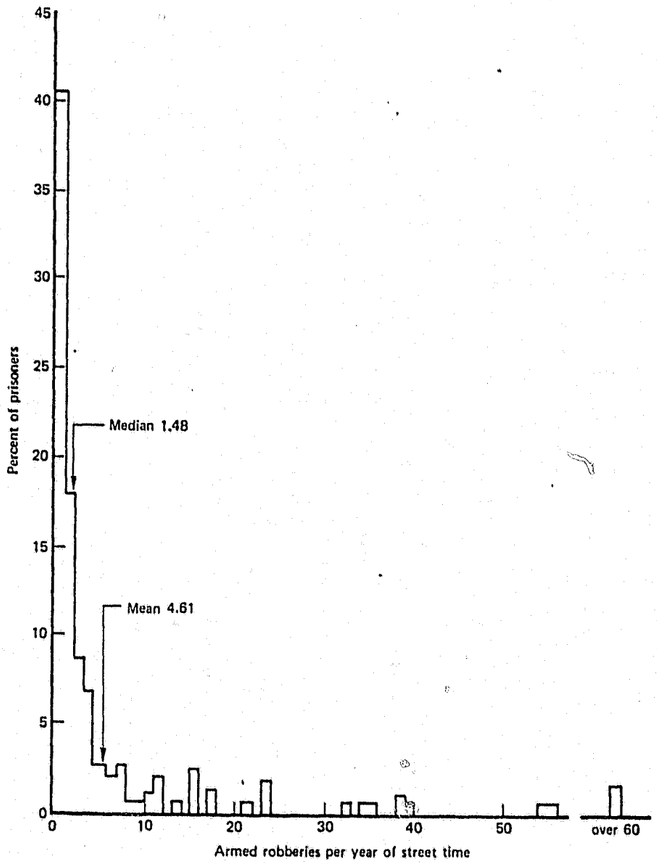
Preliminary results from Rand's Inmate Survey II suggest that the statistics above may understate the true activity levels by a very wide margin. Greenwood (1980) considers this second survey to be an improvement on Inmate Survey I; he reports (p. 26) that of surveyed inmates who committed armed robberies in the three years before their incarceration, the median annual commission rate was 4.8 armed robberies. The 90th percentile rate for this group is an extraordinary 86 robberies per year.

An alternative to the retrospective survey method for measuring activity levels is to use official criminal record data. For example, Cook and Nagin (1979) constructed a panel of violent offenders and burglars arrested in Washington, D.C. and processed in Superior Corut in 1973. We found that 10.1 percent of the 1904 adult robbery arrests in 1974 involved men from the 1302-member cohort arrested for robbery in 1973 (p. 18). Assuming that about 20 percent of adult robberies result in an arrest, these numbers imply a mean activity level of .74 robberies in the year following the cohort robbery arrest. Omitting the 16 percent who were incarcerated in 1974 yields an estimate of .88 robberies. This estimate is far below Rand's estimated mean robbery rate for robbers in the year before incarceration. One possible reason for the discrepancy is that a large fraction of men arrested for robbery "retire" in the subsequent year. Alternatively, it is possible that the robbery arrestees who were convicted and incarcerated in 1973 were much more active on the average than those who were not incarcerated.

The above results can be summarized as follows; about one-third of all active adult male street criminals commit at least one armed robbery in a year; of those who do commit at least one, and are incarcerated subsequently, the

Figure 1

Distribution of Armed Robbery Rate
(for sampled prisoners who commit this crime)



Source: Peterson and Braiker, 1980, p. 23

median person commits about 5 in that year; the distribution of activity levels among active robbers is very skewed, with the top ten percent committing a large fraction of all robberies; it is quite possible that the average robbery activity level is substantially less the year following an arrest than it was the year before.

It would be of considerable interest to have prevalence and incidence information on robbery commission for an entire population. One potential source of information is the data collected by Marvin Wolfgang and his colleagues on a Philadelphia cohort of males born in 1945. A ten percent sample of this cohort was selected and interviewed at age 26 (Collins, 1981). Ten percent of those interviewed admitted committing robbery before age 18, and five percent between ages 18 and 26.* The median numbers of robberies committed by those who reported at least one was three before age 18 and five between 18 and 26. Unfortunately, a fraction (42 percent) of the sample was not interviewed; those who were not located or refused to be interviewed were not representative of the cohort and in particular had lower SES characteristics and more contacts with the police. An obvious inference is that the prevalence estimates from this sample are biased and that the true prevalence percentages are higher for this Philadelphia cohort.

SPECIALIZATION

Rand Inmate Survey I, and numerous other longitudinal studies (Farrington, 1981), have found that most active offenders do not specialize in any one type of crime. Peterson and Braiker (1980, p. x) report that a typical group of 100 adult male California prison inmates convicted of robbery will have committed 490 armed robberies, 310 assaults, 720 burglaries, 70 auto thefts, 100 forgeries, and 3400 drug sales in the previous year of street time. Of the almost 200 respondents who reported committing a robbery in Inmate Survey I, only about 10 (five percent) were robbery "specialists" -- men who committed robbery frequently and to the exclusion of other types of crimes. (The other high rate robbers were also very active in other types of criminal activity.) While one-third of all respondents had committed a robbery, only 11 percent named robbery as their main crime (p. 84).

The basic picture, then, is one of considerable diversification. Nevertheless, men who commit robbery in one year are more likely than other street criminals to commit robbery in subsequent years, as shown in Table 19. Table 19 gives recidivism statistics for adult males arrested in 1973 in Washington, D.C. Robbery arrestees were more likely (both relatively and absolutely) to be rearrested for robbery than were burglary or assault arrestees.

Little is known about the degree to which active robbers specialize in particular types and techniques of robbery. It may be possible to extract this information from the Rand surveys.

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*These and subsequent statistics were supplied by James Collins in a personal communication.

Table 19

Rearrest Rates for Specified Crime Categories;
Adult Males, Washington, D.C., 1974-1976

Original Arrest, 1973	Murder, Assault, Rape	Burglary	Robbery
Assault	.248	.059	.092
Burglary	.187	.328	.216
Robbery	.184	.132	.443

Source: Cook and Nagin (1979), p. 19.

MOTIVATION

Robbery is similar to other property crimes with respect to its principal motive. Rand's Habitual Offenders Survey of 49 California Prisoners imprisoned for robbery (and having served a prior prison term) found that a majority of respondents' careers had progressed from auto theft and burglary to an increasing proportion of robbery and forgery. "The majority said they had switched to robbery because it required little preparation and few tools, was easy to do, seldom required hurting anyone, and offered unlimited potential targets" (Petersilia, Greenwood, and Lavin, 1977, p. vii).

Respondents in the Habitual Offenders Survey were queried concerning the main reasons for their crimes at different phases of their criminal careers. "Expressive" needs (thrills, peer influence) were the most important during the juvenile period, whereas financial need and desire for "high living" (drugs, alcohol, women) became much more important in later years (pp. 75-79). These characterizations are not specifically for robbery, but rather for all types of crime committed by members of the sample. Rand's Inmate Survey I also found that respondents' motives were characterized by the desire to enjoy high times or alleviate economic distress (Peterson and Braiker, 1980, p. 94).

One question that has received enormous attention in recent years has been the role of alcohol and drugs in crime. About 70 percent of respondents in the Habitual Offenders Survey were involved in alcohol or drugs at some point in their careers. Thirty percent of all respondents listed obtaining money for alcohol or drugs as their main motivation for crime since reaching adulthood (Petersilia, Greenwood, and Lavin, 1977, p. 76). Rand's Inmate Survey I found that street criminals who were regular users of hard drugs were no more likely than others to commit robbery; however, among those who do rob, the drug users had a robbery offense rate almost twice that of non-drug users (p. 150).

Interviews with over 10,000 inmates of state correctional institutions found that 39 percent of all those incarcerated for robbery reported that they had been drinking at the time of their offense (Roizen and Schneberk, 1978). This percentage is lower than for other crimes of violence.

SOPHISTICATION

The Habitual Offenders Survey collected extensive information on the

degree of planning exercised by respondents. The overall conclusion is this:

> "Approximately one-quarter (of respondents) did no planning or preparation whatsoever for burglaries and robberies...; about half did none or very little... For the typical offender, pre-crime planning involved only visiting the location before the crime, and less often, staking out the target (p. 60)."

One respondent (p. 61) made the interesting observation that, while he did not plan particular crimes, he devoted considerable time to thinking about different methods for committing crimes successfully and preparing himself in a general way for any opportunities that might arise.

This survey found that the amount of planning was greater during the respondents' adult career than their juvenile careers. It was also found that the tendency to use partners declined markedly with age (p. 66), apparently in part because of a concern that a partner might inform on them at some point.

CONCLUSIONS

The most interesting lesson from this review is that any attempt to create a typology of robbers must deal with the fact that most robberies are not committed by "robbers" (people who specialize in robbery), but rather by street criminals who commit a wide variety of crimes. Nevertheless, at any one time it appears that a small fraction of street criminals commit the majority of all robberies -- robbery commission rates differ enormously among active robbers, and the most active group are very active indeed (several robberies every week). Because of this disparity in commission rates, valid generalizations about <u>robbers</u> may not be valid generalizations about <u>robberies</u>, particularly if the most intensive group differs in important respects from others. For example, if drug-using robbers are much more active than others, then the fraction of robbers who use drugs will be much lower than the fraction of robberies committed by drug-using robbers. It is not clear at this point whether a random sample of robbers in prison tends to be more representative of robberies or robbers. For this reason, among others, results from inmate surveys should be interpreted with considerable caution.

The primary motivation for robbery is to obtain money, although juvenile robbers are also motivated by peer influence and the quest for "thrills." Drug and alcohol use are common among street criminals, and may influence criminal career patterns -- robbers who use drugs are twice as active as those who do not.

Robbery's advantages relative to other crimes are that it is quick, easy, and requires little planning or preparation.

PART II
ROBBERY INTERVENTION: A MODEL FOR CRIMINAL JUSTICE SYSTEM POLICY AND RESEARCH

CHAPTER 9. AN OVERVIEW OF THE ROBBERY PROCESS

The descriptive information presented in Part I is useful in establishing the dimensions of the robbery problem and providing some indication of where policymakers should focus their attention in addressing this problem. The important task for researchers is to move beyond description and begin a systematic search for cost-effective policy responses to robbery. A policy-oriented research agenda should be guided by three questions: (1) What is the nature of the problem? (2) Which interventions appear effective in reducing the social costs of robbery? and (3) Of those interventions that "work," which appear cost-effective?

The focus on policy interventions is dictated by several considerations. First and most important is the belief that the National Institute of Justice should be primarily concerned with evaluating and improving criminal justice system activities, rather than funding research that is of interest only (or primarily) to academics. Second, and perhaps more controversial, is my judgment that research oriented towards policy design and evaluation may actually yield a greater basic understanding of crime than less focused work oriented by sociological or psychological theory.

This chapter introduces the research agenda (Part III) with a theoretical sketch of the robbery process that focuses on identifying points of policy intervention.

DETERMINANTS OF ROBBERY RATES AND PATTERNS

Observed robbery patterns are the outcome of the interaction between a group of people that can be called (somewhat loosely) "street criminals" and the robbery opportunities provided them by the environment. Most of the street criminals commit a variety of crimes, at rates that differ widely among individuals and vary over time for any one individual. The mix of crimes committed by this group, as between robbery and other crime types, depends in part on how lucrative and safe robbery opportunities are relative to other opportunities for illicit income.

The street criminal exists in an environment of opportunities for economic gain -- opportunities to commit robberies, burglaries, larcenies, drug sales, "cons," and so forth, as well as legitimate economic opportunities. People who commit robberies usually have a variety of other sources (licit and illicit) of income. The incidence of robbery will depend on the number of active street criminals, their "tastes" for violent confrontations, the attractiveness of robbery opportunities relative to other opportunities for economic gain, and the availability of firearms. The relative incidence of robberies among different target types can be explained in similar fashion.

Number of Street Criminals

The fraction of the population actively engaged in "hustling" on the street depends on demographic, cultural, and economic factors -- the so-called "root causes" of crime -- as well as the effectiveness of the criminal justice system. Despite good intentions and high hopes of the Great Society era of the 1960s, it has proven exceedingly difficlut to transform the socioeconomic and cultural conditions that encourage urban youths to hustle for some part of their income and "kicks." The downward trend in the probabilities of conviction and punishment for crime during the massive crime wave of the 1960s and early 1970s may have contributed to the failure of these programs.

The role of the CJS in preventing robbery is complex and poorly understood. The main preventive effects of punishment are deterrence and incapacitation. An increase in the likelihood and/or severity of punishment for robbery will deter some street criminals from committing robbery, or at least cause robbers to rob less frequently. If this increase in CJS effectiveness is specific to robbery, this reduction is likely to be coupled with an increase in other forms of street crime (substitution). If the increase in CJS effectiveness is more comprehensive, then the result may be to encourage a number of street criminals to go into early retirement and discourage other youths from beginning criminal careers. This general deterrence process has been studied exensively by economists and others during the last decade (Blumstein, Cohen, and Nagin, 1978). The empirical results derived from aggregate data have been uninformative, but the predictions of deterrence theory have received some support from "natural experiments" (Cook, 1980).

Punishment in the form of incarceration physically prevents the convict from committing crimes against people outside of the prison. This incapacitation effect has also been studied extensively during the last decade (Cohen, 1978). The subject is more complicated than it may seem at first blush. Consider the following problems in estimating the magnitude of the incapacitation effect with respect to robbery: (1) Estimating the total incapacitation effect with respect to robbery requires some accounting of all inmates, not just those actually convicted of robbery -- remember that most robberies are not committed by robbery specialists; (2) Estimating the number of robberies prevented by locking up, say, one thousand street criminals for a year requires a method for estimating the number of robberies they would have committed if they had been given a suspended sentence (or had never been caught) -- a difficult task, given the volatility and vast interpersonal differences in robbery commission rates; (3) Most robberies, especially those committed by youths, are committed by groups of two or more. The problem that group crime poses to criminologists seeking to estimate the magnitude of the incapacitation effect is illustrated by this question: Will locking up a youth who would have committed six robberies, each with two accomplices, prevent all six robberies from occurring? Or none of them? Or perhaps two of them? (Reiss, 1980; Zimring, 1980); and (4) It is possible under some assumptions that some of the robbers who are incapacitated will be replaced by other criminals, though this eventuality seems less likely for robbery than for, say, prostitution (Cook, 1977; Ehrlich, 1981).

In sum, the number of active robbers at any time is influenced by the

criminal justice system, through the deterrent and incapacitative effects of punishment. There are a number of other determinants of the size of the street criminal population. These determinants are no doubt influenced by a variety of public programs outside the criminal justice system; however, the linkages between, say, anti-poverty programs and criminal activity are poorly understood.

Motivation and Personality

What factors influence street criminals' crime-related choices? The various types of crime included in the hustler's "portfolio" differ in a number of respects. Robbery is a quick, uncomplicated way of obtaining cash, that does not require making any arrangements with other people such as fences, drug buyers, etc. Its drawbacks are a relatively high probability of arrest, typically low "take" (in street robbery), and the possibility of being injured by the victim (in commercial robbery) (Petersilia, Greenwood, and Lavin, 1977, pp. 64-65). The necessity for physical confrontation and possibly attack of the victim may be a drawback for some, but not for others who have more of a taste for violence. Indeed, street robberies committed by large gangs of youths may be more of a violent "sport" than a way of making money (Cook, 1980a).

There are no interventions that have been domonstrated to be effective in reducing robbery by changing street criminals' tastes, skills, or special circumstances. The special "circumstance" that has received the most attention during the last decade is drug addiction, a concern that has elicited massive law enforcement efforts to reduce the availability of illicit drugs and bring addicts into rehabilitation programs (Gandossy et al., 1980). While it seems reasonable that addicts in search of a quick fix would find robbery a particularly attractive crime, Rand's Inmate Survey I found otherwise -- regular users of hard drugs were about as likely as other respondents to have been active in robbery.

Drunkenness may also play an important role in robbery. Drunks may be more likely to commit an impulsive robbery and also to serve as especially vulnerable victims. One intervention that has not been studied in this respect is the minimum age restriction on drinking.

Opportunities

A Robbery "opportunity" -- potential victim -- has a variety of characteristics of relevance to the street criminal, such as location, potential take, capability of defending against robbery, likelihood of intervention by bystanders, and the presence of alarms, cameras, and guards. From the criminal's viewpoint, these features determine the perceived attractiveness of the target, and particularly the following: (1) The amount of preparation required; (2) The likelihood of success given the weapons, skills, and accomplices available to the criminal; (3) The expected "take" if the robbery is successful; (4) The likelihood of injury at the hands of the victim; (5) The likelihood of arrest and conviction; and (6) The expected severity of punishment if convicted. These attributes are determined by the specific characteristics of the potential victim, interacting with the CJS and the characteristics of the robber. Table 20 illustrates this point for commercial robbery by listing some of the determinants of the probabilities of conviction and injury and of the expected take.

Table 20

Determinants of Commercial Robbery Outcomes

	Likelihood of Arrest and Conviction	Likelihood of Injury to Robber	Expected "Take"
Store Characteristics	1. Hidden camera 2. Alarm 3. Guard 4. Location (ease of escape)	1. Guard 2. Clerk's attitude, training, and weapons	1. Policy on holding cash 2. Access to vault
CJS Characteristics	1. Police response time 2. Priority assigned to such robberies by detectives and prosecutor 3. Court resources	1. Police policy on use of firearms	---
Robber Characteristics	1. Sophistication, planning 2. Prior criminal record* 3. Number of accomplices	1. Weapons and other means of intimidation 2. Skill	1. Amount of time spent in store 2. Planning

* If the robber is known to the police from previous arrests, the probability of his being identified through the "mug shot" files is increased. Prior record also increases the probability of conviction given arrest, since prosecutors are likely to devote greater resources to gaining convictions of career criminals.

The street criminal is faced with a variety of robbery and other criminal opportunities. The overall quality of the robbery opportunities will influence his choice of whether to commit robbery, and if so, how often. The relative quality of different types of robbery targets will influence the distribution of robberies among targets.

There are two types of interventions that can be discussed within this general framework. First, commercial robbery targets may be encouraged or required to adopt special measures to defend against robbery: reduce the cash on hand, hire guards, install alarms and hidden cameras, train clerks, and so forth. If only a few places take these actions, the likely effect is simply to reduce victimization rates there at the expense of increased robbery rates at other places that lack such precautions; if enough commercial targets adopt such measures, the effect may be to reduce the overall robbery rate. A second type of intervention would be government actions to increase surveillance (by police, neighbors, etc.) of likely robbery locations, improve street lighting, improve security in school restrooms and parking lots, organize neiborhood watch associations, design public housing projects to create "defensible space," and so forth.

Gun Availability

To complete a robbery successfully, the offender must find the means to intimidate or overpower the victim, and prevent intervention by bystanders. The inherent difficulty of this task depends on the nature of the victim and the circumstances. The most vulnerable victims are the elderly and the very young when they are by themselves. The least vulnerable targets are commercial places which have armed guards and other means of protection. The observed patterns in robbery clearly reflect the tendency of offenders to take victim vulnerability into account (Cook, 1976 and 1981; Skogan, 1980); commercial targets, especially those with several employees, are typically robbed by unarmed youths. The age, sex, and number of robbers, together with the lethality of their weapons, determine their capability; there is a strong tendency for the robber's capability to be inversely related to the vulnerability of his victim.

The principal intervention suggested by these observations is the regulation of gun commerce and use. Gun control measures, if they are effective in depriving some street criminals of guns, should reduce the commercial robbery rate by reducing the robbers' capability.

Gun control measures may also have some effect on the injury and death rate in robbery, as discussed below.

ROBBERY CONSEQUENCES

Robbery is such a serious crime in part because of the large number of robbery-related injuries and deaths. Some of these injuries and deaths are an inescapable byproduct of the robbery process, and most any intervention that reduced the overall robbery rate would probably also reduce the number of victim casualties. There is considerable evidence, on the other hand, that there exists a good deal of "excess violence" in robbery -- gratuitous violence that is not the consequence of victim resistance (Cook, 1980). For this reason, it is conceivable that interventions could be designed that would

reduce the amount of violence in robbery without reducing the overall robbery rate. The felony murder rule is an example of such an intervention. Other possibilities for reducing robbery murder include strengthening legal controls on gun commerce and use and adopting special sentencing provisions for robbers who use guns.

Interventions that are oriented towards reducing gun use will not reduce the injury rate in robbery, since gun robberies are much less likely to result in victim injury than other types of robbery. One possible intervention focused on robbery injury is to single out robbery defendants who are also chargeable with injuring their victim for high priority handling in the courts.

Robberies result in financial losses to victims as well as physical or psychological trauma. Potential victims can limit the financial loss by limiting the amount of cash they carry. This policy has of course been adopted by a number of commercial targets in large cities -- gas stations, buses, taxis, and so forth. But the public concern about robbery is motivated by the fear of injury more than by the concern with financial loss; that is precisely why robbery is so much more serious than purse snatching or shoplifting. Indeed, the most important effect of "cash limitation" policies by commercial places and public transport vehicles is to reduce the likelihood of injury to employees by reducing the robbery victimization rate.

SUMMARY

There are a number of interventions available to the criminal justice system that have the potential for reducing either the rate or the seriousness of robbery.

First is the traditional strategy of devoting greater effort, or perhaps better focused effort, to arresting, convicting, and incarcerating robbers. Given limited resources, the problem is to set appropriate priorities for the allocation of prosecution and prison capacity among robbery defendants. One aspect of this problem is to develop means for identifying that subgroup of robbery defendants who are most likely to pursue an active criminal career and/or inflict serious injuries on their future victims. Criminal careers research is directly relevant in this context. A second aspect of the priority setting problem is to determine which types of robbery inflict the greatest harm and hence should be most actively discouraged. One traditional distinction in this regard is between armed and unarmed robbery; many jurisdictions have recently created an additional distinction between robbery with a gun and robbery committed with another weapon. The wisdom of these distinctions can be investigated by studying the causal role of weapons in determining the outcome of the robbery.

A second type of intervention is to encourage robbery targets to protect themselves, and to cooperate with the CJS investigation and prosecution of robbery suspects. The possibilities here include everything from the formation of neighborhood watch associations to the installation of hidden cameras and methods for limiting the amount of readily available "loot." Reliable evaluation of such measures is difficult due to the resistance of public agencies to conducting experiments, but even post hoc evaluations of existing programs can generate some useful evidence.

A third type of intervention applies specifically to schools. If the robbery problem is anywhere near as severe in junior and senior high schools as indicated by the Violent Schools-Safe Schools report, then it warrants immediate attention. It is possible that a good deal can be accomplished to reduce in-school robberies through internal policies implemented by school officials. More problematic is the extent to which the CJS can and should be directly involved in maintaining order within the schools -- indeed, parents and school officials are often inclined to resist outside "interference" in what they consider to be internal concerns. In any event, the first major research project in this area should be to develop a reliable characterization of the nature and seriousness of the problem.

The fourth and final type of intervention is to modify policies directed at controlling youth's acess to drugs, alcohol, and guns. Despite years of research on the drug/crime nexus, it is still not clear whether a more active policy in controlling illicit drugs would reduce or increase the robbery rate. The causal role of alcohol use in robbery has not been evaluated. The relationship between gun availability and robbery patterns is better understood, but certainly not resolved.

There is clearly a long and varied menu of research projects that, if undertaken, could enhance our understanding of the robbery process and serve to better inform policymakers. Part III outlines several of these projects, chosen because of their importance, feasibility, and direct relation to robbery.

PART III
A ROBBERY RESEARCH AGENDA

CHAPTER 10. PROJECT 1. SCHOOL-RELATED ROBBERY: A RECONCILIATION OF NCS AND SAFE SCHOOL STUDY ESTIMATES

There is a glaring disparity between the NCS estimate of the number of robberies in schools and the estimate calculated from the student interviews and teacher questionnaires administered as part of the Violent Schools-Safe Schools Study (See Chapter 5). The NCS estimate is that about 32,000 robberies were committed in schools in 1978 -- 3.2 percent of all non-commercial robberies in that year. In contrast, the Violent Schools estimate for junior and senior high students is that about 112,000 students and 6000 teachers had something taken from them "by force, weapons, or threat in a typical month" (p.3). These estimates imply that there were more than 1.062 million robberies in schools during a n ne-month school year -- about the same number of noncommercial robberies in schools alone as the NCS estimated were committed in toto in the United States at about the same time. If the Safe Schools estimates are correct, then the overall robbery rate in the U.S. is twice as high as estimated by the NCS, and half of all robberies are committed in schools.

To my knowledge, there has been no effort to reconcile these two radically different estimates of the number of robberies in schools. (Indeed, two critics thought the Safe Schools estimates might be overly conservative (Emrich, 1978; Toby, 1980). Part of the difference may be due to the high incidence of series victimizations in schools, which are not tabulated in the NCS reports. However, the NCS estimate of the number of robberies occurring in series victimizations is only 49,000 (NCS, 1978, p. 98). It is also possible that NCS typically coded minor property crimes based on extortion or threats as something other than robbery -- but their official definitions indicate otherwise. We are left with a conundrum of major proportions.

An analysis of the difference in the two estimates of the number of school robberies would potentially be informative with respect to the following questions: (1) How much robbery is there in schools? (2) Is the Violent Schools Study reliable? (3) Should NCS publish a prevalence measure of victimization rates for each type of crime that includes series incidents? (4) Does the use of a one-month reference period in victimization surveys (as in the Violent Schools study) give more or less accurate victimization reports than the six-month period used by the NCS? (5) Is the NCS doing an adequate job in surveying teenagers? And so forth.

PROCEDURE

This study would probably not require any new data collection. The first task would be a careful scrutiny of the data collection methods employed by the Safe Schools Study and a comparison with NCS methods. This comparison should

yield judgments about likely biases in the two approaches. The second task would be a reanalysis of the robbery data collected in the student interviews. This work should yield some basis for answering the questions posed above. If no answer is found, then a Phase II project could be organized that would query a few hundred students twice, once using the Violent Schools methods and once using the NCS methods.

CHAPTER 11. PROJECT 2. TRENDS AND ETIOLOGY OF ROBBERY MURDER

The death of the victim is always a possible outcome of an armed robbery confrontation. The fact that several thousand robbery victims are killed each year is sufficient justification for viewing robbery as a serious crime. Despite the importance of robbery murder, surprisingly little is known about its incidence, recent trends, etiology, or legal consequences.

In 1979, the UCR classified 10.5 percent of all criminal homicides as robbery related. This fraction has remained virtually constant over the last few years (see Table 3). But between 1976 and 1979, the "motives unknown" category in UCR's criminal homicide typology doubled (from 8.5 percent to 17.7 percent), and it is reasonable to suppose that many of these murders were robbery related. Thus it is possible that robbery murder has increased substantially during the last few years, even though the official count has remained constant. The actual number of robbery murders in 1979 could have been anything from 2000 up to about 7000 (the sum of the "robbery," "suspected felony," and "motive unknown" categories).

Robbery related killings are included in the felony murder rule, which stipulates that a killing during the commission of certain felonies is murder even if there is no evidence of premeditation. Furthermore, states that specify aggravating and mitigating circumstances in their death penalty statutes typically include a felony circumstance as aggravating; thus, robbery murder is viewed by such statutes as especially serious, even within the class of all first degree murders. The actual disposition patterns of murder cases demonstrates that this statutory mandate is taken seriously by prosecutors and juries. For example, Zimring, Eigen, and O'Malley (1976) found that of the 21 defendants convicted of first degree murder in their Philadelphia sample, 17 had committed felony murders. Most of these were robbery murders. Recent studies of the administration of the death penalty have found that, at least in some states, the great majority of convicts sentenced to die are robbery murderers (Arkin, 1980; Bowers and Pierce, 1980).

The apparent preponderance of robbery murderers on death row has been little noted in the vast literature on the death penalty. This preponderance has important implications for the evaluation of the deterrent effect of capital punishment. If the death sentence is primarily reserved for robbery murder cases, then any deterrent effect would presumably be largely limited to the robbery murder rate. Yet research in this area has not distinguished between robbery murders and other types of criminal homicide.

One of the most important unanswered questions concerning robbery murder is its relationship to the vast bulk of robberies in which no one is killed. Three important possibilities can be delineated here:

1. Murder is a probabilistic event, with probability largely determined by the type of weapon used by the robber. Robbery murder and other robberies are similar with respect to the intent and violence proneness of the perpetrators. Murders are "accidental," or the result of a spontaneous response to the victim's decision to resist (Block, 1977; Zimring, 1977).

2. Robbery murders differ from other robberies with respect to the intent of the perpetrators; the murderers make an unprovoked decision to kill their victims, either so the victim will not be able to go to the police or out of some sadistic urge. Given this scenario, we would expect robbery murderers to differ from other robbers with respect to violence proneness and possibly other characteristics (size of offender group, age, use of alcohol and drugs, etc.).

3. Robbery murder is more murder than robbery. Robbery murderers have a prior relationship with the victim which has created a motive for murder -- the victim cheated the killer at cards or was a business rival in the illicit drug trade. The theft may be an after-thought to the murder.

These three possibilities are certainly not mutually exclusive, and all three types of robbery murder exist. The relevant question is whether one type of robbery dominates the others numerically, or is primarily responsible for observed trends and patterns in robbery murder. Cook (1979 and 1980) has analyzed both aggregate data and detailed data on specific robbery murders, in an attempt to answer this question. He found that intercity robbery murder differences are almost completely explained by corresponding differences in weapon-specific robbery rates, a result most compatible with the first description. On the other hand, the majority of robbery murders in his sample of individual cases appeared intentional (Cook, 1980). A related finding from Cook and Nagin (1979) is that robbery defendants accused of injuring their victims tended to be more violence prone than other robbery defendants.

More work in this area would be sueful. The three explanations have quite different implications for the potential effectiveness of alternative sentencing strategies and gun control policy. If the first characterization of robbery murder is largely correct, then the emphasis in reducing robbery murder should be on reducing gun robberies. If the third explanation is correct, then robbery murder should be viewed as an event that is etiologically distinct from the bulk of robberies; overall reduction in robbery rates will have little effect on the number of robbery murders.

PROCEDURE

Task 1: Document dispositional patterns in robbery murder cases and compare them with other criminal homicide cases, with particular focus on application of the death penalty. Current data on death row convicts are collected by the NAACP Legal Defense Fund and may be available for analysis. A review of the relevant literature would also be required. The purpose of this task is to investigate the following propositions: (a) In urban jurisdictions, most first degree murder convictions involve robbery murder cases; (b) In urban jurisdictions, all but a few of the death sentences are given to robbery murderers; (c) These findings (if correct) have important implications for racial patterns in sentencing (a high percentage of robbery murders, unlike other murders, are interracial), the claim that the death penalty is imposed

"capriciously," and the evaluation of the deterrent effect of capital punishment.

Task 2: Assess recent trends and the current level of the robbery murder rate. This task can be broken down into several parts:

(a) What accounts for the recent large increase in the "motive unknown" category in the UCR homicide reports? Have several large cities changed their coding policies in recent years or is the observed change more widespread? These questions could be investigated through interviews with UCR officials and analysis of supplemental homicide reports data, available from the UCR.

(b) What is the best estimate of the number of robbery related murders committed in, say, 1980? The prior issue here is with respect to the methods used to classify homicides by police departments in large cities. Interviews with city police officials, and some primary data analysis, may be required. This project should produce recommendations on how police departments and the UCR should classify homicides in which the evidence is not definitive. There should also be some indication of the reliability of intercity idfferences in reported robbery murder rates.

Task 3: Analyze intercity differences in robbery murder as a function of weapon specific robbery rates and other variables. The objective here is to determine the extent to which robbery murders can be explained as a probabilistic outcome of robbery, rather than as a distinct phenomenon. Models for this work include Zimring (1977) and Cook (1979).

Task 4: Assess the detailed circumstances of a sample of 100 robbery murders in a large city and compare them with a sample of 100 robberies causing serious injury and a larger sample of all robberies. The objective here is to ascertain differences among these three categories of murder with respect to offender characteristics, victim resistance, and victim characteristics (including prior criminal record, inebriation, and so forth). A large primary data collection effort is required, using police and court files. The objectives include an assessment of intent, prior relationship, violence proneness, and other factors that may influence the outcome of a robbery. The results would have important implications for the processing and sentencing of robbery defendants, especially with respect to appropriate discrimination on the basis of weapon use and degree of injury to the victim.

CHAPTER 12. PROJECT 3. PRIVATE ACTIONS TO FACILITATE ARRESTS IN COMMERCIAL ROBBERY: THE ECONOMICS AND EFFECTIVENESS OF HIDDEN CAMERAS

The criminal justice system's primary task in combatting the robbery problem is to seek methods for increasing the probabilities of arrest, conviction, and punishment for active robbers. There are a variety of techniques which can be adopted to these ends, including simply increasing the number of police assigned to a beat (Press, 1971; Chaiken et al., 1974); organizing special police unites for rabbery-targeted, apprehension-oriented patrol activities (Pate, Bowers, and Parks, 1976); and focusing prosecution resources on serious "career criminals." While these techniques can be somewhat effective in increasing robbery convictions, they also tend to be quite costly. For example, an evaluation of apprehension-oriented patrol activities by two experimental units of the Kansas City tactical squad found that one unit averaged one arrest for a target crime (robbery or burglary) for every 150 officer hours; the other unit averaged one arrest for every 250 hours (Pate, Bowers, and Parks, 1976, p. 69). During an extension period of this experimental study, the arrest efficiencies for both units declined considerably.

In seeking less costly methods of generating robbery arrests and convictions, it is useful to consider the circumstances under which robbery arrests typically occur. In an analysis of 66 robberies which led directly to one or more arrests in Durham, N.C., Cook and Fischer (1976, p. 20) found that the information supplied by victims and other witnesses was extremely important. In 33 percent of these cases, witnesses provided police with the name, address, or auto tag number of the suspect. Eighteen percent of the arrests were on-scene, and half of these on-scene arrests were made possible by a witness's report to the police of an ongoing robbery. Thirty percent of the arrests resulted from detective work, which usually included showing witnesses photographs of suspects. Thus, the fact that robbery always has at least one eye witness is the key element in most robbery arrests. The role of police is primarily oriented to making effective use of this eyewitness information to identify and locate suspects. The Kansas City experience helps confirm this generalization by demonstrating the ineffectiveness of an alternative method for generating robbery arrests; the special apprehension-oriented patrol units were not able to increase significantly the fraction of burglary and robbery arrests that occurred on-scene, despite the fact that much of their time was spent surveilling suspected robbers and prime robbery locations (p. 71).

Perhaps the most successful experimental intervention designed to increase the arrest and conviction rates for robbery is the installation of hidden cameras in convenience stores and other high risk robbery targets (Whitcomb, 1979). Eyewitness information is notoriously incomplete, imprecise, and unreliable. Pictures taken by hidden cameras while a robbery is in progress often provide a very useful supplement to information provided by the victim. Installation

of such cameras increases the arrest and conviction rate considerably, as demonstrated by a recent experiment in Seattle (Whitcomb, 1979).

In the Seattle experiment, 150 high risk sites were identified and divided randomly between a control group and experimental group. Hidden cameras were installed in the experimental sites. These cameras were triggered by the removal of a special bill from the cash drawer. The 150 commercial sites were robbed a total of 94 times during the ten-month experimental period. The effectiveness of the cameras is indicated by the fact that 56 percent of experimental site robbers were arrested, as compared with 22 percent of control site robbers (Whitcomb, 1979, p. 26). Essentially all of the arrests resulted in convictions. The cost of the Hidden Cameras Project itself was computed at about $1200 per experimental site conviction (p. 31); this figure would presumably have been lower if the capital costs of the cameras had been averaged over a longer period of time (and hence, more robberies).

Given the extraordinary success of the Seattle experiment, one might ask why all high robbery risk commercial locations do not install hidden cameras. If the Seattle results generalize to other cities, it would appear that the widespread adoption of these cameras would eventually lead to drastic reductions in the commercial robbery rate -- a conviction probability of around 50 percent would surely deter or incapacitate most everyone who would be inclined to rob a convenience store or gas station. But the economics of self-protection against robbery provides little incentive to owners to install hidden cameras. The owner of a convenience store that is robbed does not benefit directly if the robber is convicted (unless the loot is recovered); the benefit comes in the form of a slightly lower risk for all similarly situated victims. That is, the private investment in a hidden camera results in a collective rather than a private benefit. Owners of high risk commercial sites have a much greater incentive to invest in a highly visible means of self-protection (guards, dogs, visible alarms and cameras, etc.) or means of foiling attempted orbberies (firearms, silent alarms, bullet-proof enclosures for tellers, etc.). Such investments may be effective in discouraging the robbery victimization risk in sites where they are installed -- they do have a private benefit to the owner -- but they may actually increase the robbery risk to other, similarly situatied sites through the displacement effect. Because of the disparity between the private and collective benefits of a hidden camera, then, it seems likely that wide dissemination of these devices will require that they be required by law or else financed by a government agency. The latter possibility makes sense from the perspective that developing a hidden camera program is almost certainly more cost-effective in the fight against crime than allocating the same amount of money to hiring additional police or purchasing traditional police hardware. Indeed, L.E.A.A. has financed a number of hidden camera programs already, and in some cases these programs have been taken over by local government after federal funding expired (Whitcomb, 1979).

The great virtue of the Seattle hidden camera project was that it was conducted as a true experiment, with random division of sites between experimental and control groups. However, the experimental design did have certain flaws, and the cost accounting was sketchy. Given the apparent success of this project, it would be worthwhile to replicate the experiment in several other cities and to improve on it in certain respects. Hidden cameras, properly installed and operated, appear to have the potential to "solve" the

commercial robbery problem at relatively low cost. It is important that this opportunity be fully understood and exploited.

PROCEDURE

Task 1: Review the available literature on the cost-effectiveness of various public and private actions to increase the arrest and conviction rates for commercial robbery.

Task 2: Select two or three cities in which to replicate the Seattle experiment. Selection criteria should include the commercial robbery rate and the cooperativeness of the local police department.

Task 3: In each of these cities, use police records and other data to develop an equation that can be used to estimate the probability of robbery victimization. Predictor variables should include such factors as hours of operation, number of clerks, ease of escape, neighborhood crime rate, and amount of cash typically on hand, The immediate purpose of this exercise is to select target sites in the selected cities (i.e., sites with a high probability of victimization). Secondary objectives include developing an increased understanding of victim proneness and assessing the extent to which the determinants of victim-proneness are similar across cities.

Task 4: In cooperation with the local police departments, develop experimental programs similar to that conducted in Seattle. In one of the cities, the experiment should be modified after one year by having half of both the control and experimental sites post a sign stating "This store is protected by a hidden camera." This aspect of the experiment will yield valuable information on the extent to which robbers are informed about the presence of hidden cameras in stores that do not have the signs, as well as providing information on the magnitude of the displacement effect.

Preparatory to the implementation of the experiments, each site should be evaluated to determine what sorts of other protective devices have been adopted by the owners. This information will be useful in determining the interaction between hidden cameras and other means of protection.

The evaluation of the experiment should include the development and implementation of a careful cost-accounting framework. The ultimate objectives of the cost effectiveness component are (1) to determine the types of commercial locations in which it is worthwhile to install hidden cameras, and (2) to determine the relative cost effectiveness of cameras vs. other methods of increasing CJS effectiveness against commercial robbery.

Task 5: The cities chosen for the experimental deployment of hidden cameras should experience a decline in the overall commercial robbery rate, due to the enhanced deterrent and incapacitation effectiveness of the CJS. These effects should be estimated through use of quasi-experimental techniques, utilizing other cities as "controls." The displacement to noncommercial robbery within the experimental cities should also be estimated through quasi-experimental techniques.

CHAPTER 13. PROJECT 4. BANK ROBBERY

Bank robberies are currently being committed at a rate of about 7000 per year, a figure which reflects more than two decades of extraordinarily rapid growth. In response to what was viewed at the time as an unacceptable rate of bank robbery, Congress enacted the Bank protection Act of 1968, making the banking industry one of the very few that is governed by federal regulations with respect to crime security measures. Since implementation of this Act in January, 1969, the annual rate of bank robbery has grown 250 percent. Finding effective methods for reversing this trend should be a high priority for the banking industry and for the criminal justice system.

What accounts for the rapid and sustained growth in bank robbery rates? Part of the explanation lies in the increase in the total robbery rate during the 1960s and early 1970s. But Banks have been the target of more than their "share" of this overall growth in robbery, and bank robbery rates continued to increase after 1975 -- when the overall robbery rate was essentially constant. A second explanation lies in the extraordinarily rapid increase in branch banking and the corresponding movement in the industry to make banks more accessible in terms of density, location, and architecture. Banks that are accessible to customers are also accessible to robbers. The fact that the number of branch banking offices increased 50 percent between 1973 and 1980 surely helps explain why the number of bank robberies increased 160 percent during that period.

What can be done to reverse the trend in bank robbery rates? Probably the most effective measure would be to reverse the corresponding trend towards increasing numbers of highly accessible branch offices, although the economics of the industry apparently dictate otherwise. Alternatively, the rules promulgated under the Bank Protection Act could be amended to require greater anti-robbery effort by branch offices, particularly those located in high crime areas. Most bank offices already have a variety of security measures in place. For example, of the 3459 offices victimized by robbery, burglary, or larceny (86 percent robbery) in the first half of 1980, 98 percent had alarm systems and "bait money" and 87 percent had surveillance cameras. But in many cases these systems are not utilized during the robbery or other crime: for example, the surveillance camera failed to function in 27 percent of all cases where it was available and the bait money system failed in 38 percent of such cases. Improved training for tellers may thus be part of the answer here.

While greater security efforts would probably reduce bank robbery rates, it is not clear which measures (if any) are sufficiently effective to justify the cost. Hannan (1980) analyzed the effects of several security measures on bank office victimization probability for a sample of offices in Philadelphia; he found that the victimization probability is reduced substantially (one robbery per year, on the average) by the presence of an armed guard, but that sur-

veillance cameras have no discernible effect. Neither of these findings answer the cost effectiveness question. First, whether hiring a guard is worthwhile depends on two things, given Hannan's findings: (1) Is the social cost of a single robbery greater than the cost of hiring a guard for a year? and (2) Are the robberies prevented by guards displaced to other targets? Second, the apparent fact that the installation of a surveillance camera does not reduce the victimization probability of a particular bank office does not imply that the overall bank robbery rate is unaffected by surveillance cameras; such cameras facilitate arrest and conviction of bank robbers, which enhances the deterrent effect of criminal sanctions for bank robbery. If this indirect deterrent effect of surveillance cameras is sufficiently strong, then cameras are worthwhile despite the lack of direct effect.

It should be noted that the ultimate effectiveness of on-site prevention measures depends on the priority given bank robbery cases by the CJS. The probability of arrest and conviction depends on the immediacy and quality of evidence available on the site and the amount of resources devoted to the case by police, FBI agents, and courts. Whether bank office security measures are worthwhile may depend in part on the priority given bank robbery cases by the CJS.

The analysis of the effectiveness of efforts by banks and the CJS to prevent robbery is of great interest to criminologists as well as bank regulators and other policy people. The data currently available on bank robbery is more comprehensive and accurate than for any other serious crime. Data are available at the level of the individual robbery, as well as at various levels of aggregation. Furthermore, data are available to characterize banks that are not robbed, as well as those that are. Data of this sort lends itself to powerful tests of deterrence theory.*

PROPOSAL

Task 1: Develop a detailed guide to statistics on bank security, bank robbery, and court processing, including notes on data content and availability and references to studies that have employed the data in question.

Task 2: Analyze trends and cross section patterns in bank robbery, focusing in the following questions: (1) What is the trend in bank robbery victimization rates between 1960 and 1980? Annual victimization rates should be calculated for all financial institutions and for several subcategories, including branch offices of commercial banks, main offices of commercial banks, and branch and main offices of savings and loan institutions. These victimization rates should also be calculated for each of several years for each state and large city; and (2) To what extent can trends and cross section patterns in bank robbery be explained by target availability (particularly the density of branch offices) and the overall robbery rate?

Task 3: Write a narrative description of criminal justice system policies with respect to bank robbery, including information on the role of the FBI, the division of cases between federal and state trial courts, the evolution of sentencing practices, and so forth.

Task 4: Replicate Hannan's (1980) analysis of victimization probabilities using data from a number of jurisdictions. The objectives of this study are to determine the effects of bank office characteristics, security measures, and the local robbery rate on the probability of robbery victimization. Results should be combined with data on costs to determine the relationship between security-related expenditures and victimization probability (conditioned on the local robbery rate).

Task 5: Analyze the determinants of the probability that a bank robbery will result in the identification of suspects, arrests, and convictions, taking into account the modi operandi of the robbers, the characteristics of the bank, and the nature of the CJS response to the robbery. Perform a similar study of the determinants of the amount of loot. Combine these two sets of findings to develop a characterization of the quality of bank robbery opportunities from the potential offender's viewpoint. Also, the analysis can be used to estimate the cost of increasing the probability of a robbery resulting in the conviction and punishment of the robber. Combined with estimates of the deterrent and incapacitation effects of an increase in this probability, the analysis of the arrest and conviction will yield estimates of the cost of reducing the overall bank robbery rate.

Task 5: Estimate the marginal deterrent effect of changes in the probability and severity of punishment for bank robbery. Jurisdictions differ with respect to the CJS effectiveness against bank robbery, and the federal district judges differ with respect to their tendency to sentence bank robbers more or less severely. If data are available with which to estimate an index of CJS effectiveness and sentencing severity for a number of jurisdictions, then it may be possible to estimate the relevant deterrent effects (controlling for the local robbery rate, the availability of targets, and so forth).

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*The FBI has issued a semiannual compilation of bank crime statistics since 1973 and has a computerized micro data file giving details of the bank robberies committed since about 1971. Data elements on this file include the bank name, location, type of institution, security devices, amount of loot, solution, and characteristics of robbers. This file may be available to researchers. (My contact: Bruce Ciske, FBI, 202-324-4294). The American Bankers Association, and the four federal bank regulatory agencies also collect data on bank security and bank robbery. For a number of years following passage of the Bank Protection Act, banks were required to submit annual reports on security devices to the appropriate regulatory agency (Comptroller of the Curency, FDIC, Federal Reserve System, of Federal Home Loan Bank Board). While this requirement has been eliminated in recent years, the data through about 1977 may be available from the FDIC (contact for release policy at FDIC is Hoyle Robinson, 202-389-4425). Avery (1971) compiled and analyzed data from the early security and robbery reports for the FDIC.

Finally, data on processing bank robbery defendants in federal district courts is available from the annual publications of the federal court system (see Nagin, 1975).

And second, the loss in precision can be fairly small so long as the annual series contains at least one year in which the intervention is never in effect and another year in which the intervention is in effect for the entire year. Columns 1, 2, 4, and 5 correspond to this favorable situation while column 3 corresponds to the more unfavorable situation in which the intervention occurs in the middle of the last year in the sample. Note that in every column except column 3, the loss in precision is nearly always less than 50 percent, and when the autocorrelation is fairly mild ($\alpha = \pm .4$), the loss in precision is never more than 21 percent and sometimes as small as 2 or 3 percent.

PRACTICAL IMPLICATIONS

The calculations described above pertain to simplified hypothetical situations, and so any conclusions drawn from them are subject to the usual qualifications and caveats. Nevertheless, the calculations do suggest some guidelines for practical work. If monthly data are readily available and are fairly cheap to process, then they should be used so that the potential loss in precision from using more aggregated data is avoided. However, if the costs of collecting, editing, and processing data are roughly proportional to the number of observations, then using monthly data instead of annual data will increase cost by a factor of twelve without a proportionate increase in precision. Of course, one can imagine situations in which policymakers require immediate and precise information on the short-time effects of a legal intervention, so that the benefits from using data recorded at very fine time intervals exceed the costs. But one can just as well imagine situations in which a small increase in precision is not worth an 1100 percent increase in costs.

ANOTHER APPROACH

Box-Tiao intervention analysis focuses the entire research effort onto the assessment of the impact of a single intervention. As shown above, there is a limit as to how much can be learned by examining in great detail a single quasi-experiment. Berk, et. al (1979) describe a different strategy for legal impact assessment that involves the pooling of cross section / time series data. In this approach the investigator concentrates his or her efforts on building up a panel of data that contains time series data for several jurisdictions, each of which has experienced a similar intervention at some point within the sample period. The panel cannot always be compiled, but when it can the payoff in terms of precision can be much larger than the payoff is to analyzing intensively the effects of a single intervention.

For example, suppose the panel can be compiled, but because of data processing costs and data limitations only five years worth of annual data, instead of monthly data can be tabulated for each jurisdiction. For the absolute "worse case" in Table 2, the use of annual instead of monthly data would cause a loss in precision in estimation of 67 percent for any one jurisdiction. However, if the "noises" in the criterion variables are independent across jurisdictions, then the precision obtained from using panel data is the sum of the precisions across the jurisdictions. Thus,

for a career criminals prosecution program should be guided in part by predictions of future criminal activity.

The Rand surveys of prison inmates provide a new basis for predicting future criminality and hence for assigning prosecution priorities. In predicting future robbery behavior, it is important to take into account the likelihood that the defendant would injure or kill future victims and the related question of what type of weapon he would most likely use. Very little work has been done on the issue of predicting violence in robbery, but Cook and Nagin's (1979) analysis suggests that it is predictable to some extent. (This issue is also raised in proposed Project II.)

Since there is no good reason to study robbers separately in the career criminals context, I will not develop this proposal any further.

THE USE OF GUNS IN ROBBERY AND DEFENSE AGAINST ROBBERY

Robbery is often committed in response to an immediate opportunity, with little or no premeditation. If a robber is able to use a gun in an opportunistic crime, it is because he had it readily available at the time when the opportunity presented itself, i.e., he was carrying the gun on his person or in his car. Interventions which may be effective in reducing the use of guns in opportunistic robberies include (1) increasing police pro-activity in searching for guns when stopping traffic violators and suspects on the streets; (2) banning the sale of highly concealable handguns; and (3) creating severe penalties for carrying a gun illegally. Massachusetts implemented this last type of legislation in 1975, and there is evidence that it has been quite effective (Pierce and Bowers, 1981).

The potential effectiveness of anti-carrying interventions is limited by the extent to which opportunistic robbers are in the habit of going armed. It would hence be very useful to know how guns that are used in robbery happened to be available at the time of the robbery. Perhaps the only method of ascertaining this information is to interview convicted robbers about this aspect of their modus operandi.

Guns are also important for defense in commercial robberies. A large percentage of shopkeepers are armed in some cities and intend to use the gun against robbers should they appear. There is no data currently available on the following related issues: (1) The probability that an available gun will actually be deployed in self defense; (2) The effects of using a gun in self defense, including the likelihood of foiling the robber, apprehending the robbers, or causing the robber to attack and injure the victim; (3) The degree to which armed clerks are skilled in the use of guns. These questions could be answered through a special survey of commercial robbery victims. The information provided by such a survey would be useful in evaluating options for controlling handguns.

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APPENDIX

An Appraisal of the Precision with which Time Series Intervention Analysis Estimates the Effects of Legal Interventions

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I. INTRODUCTION

AN OVERVIEW OF THE TECHNIQUE

Box-Tiao (1965, 1975) intervention analysis has come to be regarded as a valuable research technique for detecting and measuring the impact of legal interventions. Deutsch and Alt (1977), for example, apply the technique to determine the impact of the Massachusetts gun-control law on several gun-related crime rates in the Boston area. McDowall, et al, (1980) describe numerous other applications of the technique, including measurement of the effects of changes in traffic laws and the effects of decriminalization of certain alcohol-related offenses. These applications have a very common structure. The investigator collects a time series of observations on a criterion variable that is believed to be influenced by the intervention. The data series covers both the pre-intervention and post-intervention time periods, though it is common to have many more observations for the pre-intervention time span than for the post-intervention time span. The basic idea is to compare statistically the post-intervention observations to the pre-intervention observations in such a way as to see if differences between the behavior of the series in the pre and post time spans are too large to have arisen solely by chance factors. In some applications, more than one criterion variable is used, but for the purpose of discussing the precision with which Box-Tiao methods estimate the effects of an intervention, it is assumed here that only one criterion variable is used. There is no loss of generality by supposing that only one variable is analyzed, since in practice investigators almost always apply the technique to each criterion variable separately.

In nearly every application of intervention analysis the investigator finds that the sequence of observations on the criterion variable is autocorrelated; i.e., the effects of the underlying factors that cause the series to change usually persist for several months or even years. The omission of these factors from the analysis is responsible for the autocorrelation in the criterion variable. The basic principle of the Box-Tiao approach is that the underlying determinants of the criterion variable do not have to be measured and included explicitly into the model; instead the sequence of observations on the criterion variable can be modeled as the realizations of a low order ARIMA model. Put another way, the autocorrelation generated by omitted variables can be accounted for by using simple mechanical models with only a few parameters to "match" or explain the observed pattern of autocorrelation in the series.

The idea of using simple ARIMA models rather than including proxies for the underlying determinants of the criterion variable often seems preposterous to researchers who are most familiar with cross sectional work. But the idea is not as farfetched as it seems, at least for the purpose of forecasting. For example, it is well known in the econometrics literature that the quarterly movements in the U.S. gross national product can be described well by a simple ARIMA model, despite the large number of factors that cause GNP to change from quarter to quarter. Indeed, in a very famous paper Nelson (1972) showed that simple one-variable ARIMA models can in many instances outperform the big econometric models with their hundreds of variables and equations. Thus, ARIMA models cannot be dismissed out of hand as being too simplistic or naive to be of practical use.

The structure of Box-Tiao intervention analysis can be most easily understood by noting that it is a special case of the multiple regression model with an autocorrelated error structure. The "abrupt-impact" or "shift-detection" model is the regression model with a single explanatory variable, a 0-1 dummy variable for the intervention. Likewise, the "dynamic" intervention analysis model (Box and Tiao, 1975) is the multiple regression model with separate dummy variables for each of the post-intervention time periods. The elaborate transformations of the data that are written out in great detail in the literature (e.g., Deutsch and Alt, 1977, p. 555), are simply the appropriate transformations to perform generalized least squares with an estimated variance-covariance matrix. (See Theil (1971) for a compact description of the transformations using matrix notation.) The equivalance of intervention analysis and regression has been mentioned before in the literature, but it deserves to be emphasized, because all of the standard results in regression theory apply with equal force to intervention analysis.

For example, suppose one the omitted variables is correlated with the dummy variable(s) that correspond to the post-intervention observations. The coefficients of the intervention variable(s) will then be biased and misleading. No amount of ARIMA modeling can ever eliminate this bias. Consider the extreme case in which, unbeknownst to the investigator, an overly enthusiastic data tabulator "shades" or cheats slightly on the numbers in order to exaggerate (or attenuate) the apparent impact of the intervention. The ARIMA model can never successfully take this hidden factor into account. In fact, the usual diagnostic statistic that is commonly reported, namely the "Q" statistic, will not indicate that anything is amiss in this case. The Q statistic only tests for whether the autocorrelation in the residuals has been eliminated, and this can still be accomplished with ARIMA methods even when the regression model is seriously misspecified.

HOW MUCH CAN BE LEARNED FROM ONE QUASI-EXPERIMENT?

In some applications, however, it is reasonable to assume that the correlation between the omitted variables and the intervention dummy is small, at least in the short term. In this case Box-Tiao intervention analysis can be expected to give an unbiased estimate of the true effects of the intervention, in the sense that on average the technique will neither under nor overestimate the actual effects of the intervention. But the procedure still analyzes only a single "quasi-experiment," so it is interesting to investigate how much can in fact be learned from a single occurence of an intervention. That is, it is interesting to characterize the precision with which the technique can be expected to estimate the impact of the intervention.

Section II of this appendix investigates in some detail the magnitude of the estimation error entailed in using Box-Tiao intervention analysis. The calculations are elementary and many of the results can be found in one form or another in basic statistics books, but the conclusions are important. First, the precision with which the procedure estimates the impact of an intervention depends not only on the number of pre-intervention observations and the number of post-intervention observations, but also on the amount of "noise" inherent in the data series. Furthermore, the ability of the technique to detect the effects of an intervention depends upon the magnitude of those effects relative to the amount of noise in the series. Thus, one should view with some suspicion general claims (e.g., Deutsch and Alt, 1976) about the ability of the technique to detect very small effects with only one or two post-intervention observations, unless such claims are accompanied by documentation of the extent to which relatively noise-free data are encountered in the social sciences. Finally, when the data are noisy one should include additional explanatory variables in the model, because they can help reduce the amount of noise in the series, and thereby make the effects of the intervention easier to detect. ARIMA models can still be used to take account of the autocorrelation that is not removed by the additional explanatory variables.

THE GAINS FROM USING MONTHLY DATA

Studies that employ Box-Tiao intervention analysis typically use data recorded for very small time intervals, oftentimes monthly data. The use of monthly data can produce an abundance of degrees of freedom, at least for the pre-intervention time span. But if monthly data are much better than quarterly or annual data, why not just continue dividing up the time span into weeks or even days? Intuition suggests, however, that as the frequency with which the data are recorded is increased the precision with which the effects of the intervention are estimated does not increase in direct proportion.

The final section of this appendix provides some information on the extent to which precision is increased when an investigator uses monthly instead of annual data. The calculations pertain to stylized hypothetical research situations, so the conclusions have to be qualified accordingly. Nevertheless, the results of Section III demonstrates that in many instances the gains in precision cannot be expected to be anywhere near as large as the

twelve-fold increase in the number of degrees of freedom. In fact, in some cases that are not too unrealistic, the gain in precision is as small as three or five percent. The reason for the relatively small gains in precision is that no matter how finely the time span of the data is divided into, the research project is still investigating only the effects of a single intervention or quasi-experiment. Thus there are limits as to how much can be learned from a single quasi-experiment, no matter how intensively it is investigated. One might expect, then, that there is a much bigger payoff to pooling the data together for several quasi-experiments, even if some information has to be sacrificed by using annual instead of monthly data. This conjecture is verified and discussed further at the end of Section III.

II. THE STATISTICAL POWER OF THE TECHNIQUE

A frequently posed question in the literature (e.g., Hay and McCleary, 1979, Deutsch, 1979) is whether Box-Tiao intervention analysis can be expected to detect a small shift in the mean of a series with relatively few (1-12) post-intervention observations. The question pertains to the power of the statistical tests used with the technique, and there is no clear-cut answer. It is possible to present examples in which the technique can detect a small shift with virtual certainty and other examples in which the technique stands virtually no chance of detecting any shift, small or large.

To develop the examples, consider the basic "abrupt impact" or "shift detection" model, in which the investigator assumes the intervention has an immediate and permanent effect on the criterion variable y_t. The statistical model generating the data is assumed to be

$$(1) \quad y_t = \ell + \delta x_t + u_t$$

where ℓ is the pre-intervention mean of the series, x_t is a 0-1 dummy variable with $x_t = 1$ for post-intervention observations, the parameter δ measures the extent to which the intervention shifts the mean of the series, and u_t is the "noise" in the series. Suppose that the noise is known to be serially uncorrelated -- much can be learned about the "precision" of the technique by considering this special case. When there is no autocorrelation in the noise, then the best linear unbiased estimate of the shift in mean is simply the difference between the post- and pre-intervention means of the series: $\hat{\delta} = \bar{y}$ (post) $- \bar{y}$ (pre). The variance of this estimator can be found in many elementary statistics books

$$(2) \quad \sigma^2_{\hat{\delta}} = \sigma_u^2 \left(\frac{1}{n_1} + \frac{1}{n_2}\right)$$

where σ_u^2 is the variance of the noise term and n_1 and n_2 are the number of pre- and post-intervention observations, respectively. The variance $\sigma^2_{\hat{\delta}}$ of the estimator is inversely related to the precision or degree of accuracy of the estimator, in the sense that a small variance implies that the error in estimating the shift in mean is small, on average, and vice versa for a large variance.

Some interesting conclusions about the effects of varying the number of pre and post-intervention observations can be drawn directly from equation (2). First, diminishing returns set in for adding pre-intervention observations. No matter how large n_1 is, the variance of the estimator cannot be reduced below σ_u^2/n_2. Likewise, there is a lower limit to which the variance can be reduced by accumulating more post-intervention observations. For a fixed total number of observations, the variance is minimized when the number of pre and post observations are equal. The best place to have the intervention, then, is right in the middle of the sample.

The issue of whether or not intervention analysis is capable of detecting a small shift in the mean of the series pertains to the power of the statistical test that the investigator uses. A test's power is the probability that it will reject the null hypothesis (no shift in mean in this case) when in fact the alternative hypothesis is true (a shift has occurred). To compute the power of the test used to detect a shift in the mean of the series, suppose the noise is normally distributed and for simplicity assume that the investigator knows the variance σ_u^2 of the noise. Relaxing the assumption of a known variance only complicates the calculations without changing any of the conclusions. The test for a shift in mean will then be based on the Z statistic $\hat{\delta}/\sigma_{\hat{\delta}}$, where $\hat{\delta}$ is the estimated shift in mean and $\sigma_{\hat{\delta}}$ is the standard deviation of the estimate. Assume, again for simplicity only, that the test is a one-tailed test for a positive shift. The probability that the test will detect a positive shift of size δ is the probability that the null hypothesis of no shift will be rejected, i.e., the probability that the computed Z statistic will exceed the appropriate upper critical point z_c of the standard normal distribution. (The critical point z_c is chosen to make the probability of a Type I error equal to some pre-set value, e.g. .05 or .01) Elementary statistical calculations show that this probability is

$$P\,[\text{detect shift } \delta] = F\left(\frac{\delta}{\sigma_{\hat{\delta}}} - z_c\right)$$

where F is the standard normal cumulative distribution function. Viewed as a function of the shift δ, this expression is the power function of the test. By using the expression (2) for the variance of the estimator, the power function can be written as

$$(3) \quad F\left(\frac{\delta/\sigma_u}{\frac{1}{n_1} + \frac{1}{n_2}} - z_c\right)$$

The power of the test, then, increases with additional observations at either end of the sample, so that more data is always better than less.

Note, however, that the power of the test also depends on the size of the shift δ relative to the amount of noise in the data, which is measured by σ_u. If the data are very noisy, i.e., if σ_u is very large, then there is

very little chance of finding the shift. For any fixed size δ of the shift, the limit of the power function as σ_u grows indefinitely large is $F(-z_c)$, which is simply the significance level of the test. Thus, with very noisy data a test conducted at the five percent significance level has not much more than a five percent chance of detecting the shift. On the other hand, as σ_u tends to zero, the power function approaches unity. Thus, with non-noisy data, the same test will detect the shift with virtual certainty.

No general statement can be made, then about how many post-intervention observations are required in order to detect a shift in mean, nor can any statement be made about how large a shift can be detected with relatively few, say 1-12, post-intervention observations. The power function of the test is specific to the data series employed. This remark is based on the simplest situation in which the noise is not autocorrelated, but it applies with equal force to the case in which the noise autocorrelated. For, the variance of the estimate of the shift in the mean is proportional to the variance of the innovation in the noise variable.* This latter variance is a "free" parameter, i.e., specific to the data series, and it plays the same role in power function calculations that σ_u^2 plays in the calculations presented above.

In a widely cited study, Deutsch and Alt (1976, p. 784) reach different conclusions. Specifically, they conclude that Box-Tiao-intervention analysis "...is capable of detecting even small shifts [2 percent] with a high degree of accuracy." The basis of this claim is a simulation study in which intervention analysis is applied to artificially generated data series into which small mean-shifts were inserted near the end of each series. For various patterns of autocorrelation in the noise, the procedure appears to perform reasonably well, other things equal. However, the study does not report the results of experimenting with the most important parameter of all, namely the variance of the serially uncorrelated random variables that are used as inputs to the ARIMA model. (These random variables are the innovations in the noise.) By choosing this variance small enough, one can virtually guarantee that intervention analysis will perform well; on the other hand, by choosing this variance large enough, one can produce a simulation study that makes the procedure appear to be incapable of detecting much of anything.

III. TEMPORAL AGGREGATION AND INTERVENTION ANALYSIS

As noted in the introduction, Box-Tiao intervention analysis is usually applied to data that are very finely disaggregated by time periods, oftentimes by months. The use of monthly instead of annual data increases the number of observations by a factor of twelve. This section addresses the question of how much precision is gained by using monthly data. The strategy is to compute the precision with which the effects of an intervention would be esti-

* The innovation in a stochastic process is the part of the process that cannot be forecasted from its own past.

mated using monthly data and annual data under a variety of assumptions about autocorrelation and the number of pre- and post-intervention observations. As is documented below, having access to monthly data cannot be expected to increase the precision by anything like a factor of twelve.

THE FRAMEWORK

The "base" case for the analysis is as follows. There are 60 monthly observations that are generated according to the "abrupt impact" model

$$(4) \quad y_t = \ell + \delta x_t + u_t \qquad t = 1, 2, \ldots, 60$$

where, as before, the parameter ℓ is the level of the series before the intervention, x_t is a 0-1 dummy variable with $x_t = 1$ when the intervention is in effect, the parameter δ is the shift in the mean of the series attributable to the intervention, and u_t is the mean-zero noise in the y_t series. The noise in the monthly series is assumed to be a first-order moving average process (an ARIMA (0, 0, 1) process) which can be written as

$$(5) \quad u_t = v_t + \alpha v_{t-1}$$

where the v_t's are serially uncorrelated random variables, and α is the moving average parameter. When the moving average parameter is positive, the noise series is positively autocorrelated and evolves smoothly through time. When the moving average parameter is negative, the noise series is negatively autocorrelated and tends to have a jagged appearance.

In the base case with 60 monthly observations the intervention is assumed to take place in January of the fifth year. Thus there are 48 pre-intervention observations and 12 post-intervention observations. Four variations on this case are considered. In the first of the four cases, the "position" of the intervention within the 60 observations is moved to the center, and in the second case it is moved to July of the fifth year. In the latter two cases, twelve observations are added at the beginning of the sample and at the end of the sample, respectively.

THE PRECISION OBTAINED FROM MONTHLY DATA

Table 1 reports measures of the precision with which an investigator would estimate the shift in mean, δ, when he or she applies Box-Tiao intervention analysis to the monthly data.* The measure of precision is $1/\sigma^2_{\hat{\delta}}$, where $\sigma^2_{\hat{\delta}}$ is the variance of the estimate of δ. Thus, a small variance implies a large value for the precision and vice versa. The calculations are based on the assumption that the investigator knows the moving average parameter α in (5). This is, of course, unlikely to be true in practice where α would have to be estimated along with the other parameters of the model. Nevertheless, the results based on the assumption that α is known can provide

* The variance of the estimated shift in mean was obtained by computing the appropriate element of the variance-covariance matrix for regression coefficients estimated by generalized least squares.

Tables for Appendix

Table 1

Precision of the estimated shift in mean using monthly data*

n_1 :	48	30	54	60	48
n_2 :	12	30	6	12	24
α					
.80	.38	.56	.25	.40	.59
.40	.55	.83	.33	.57	.88
.00	1.00	1.56	.56	1.05	1.66
-.40	2.51	4.09	1.27	2.62	4.38
-.80	13.03	27.90	4.09	13.67	30.08

Table 2

Ratio of the precision obtained with annual data to the precision obtained with monthly data

n_1 :	48	30	54	60	48
n_2 :	12	30	6	12	24
α					
.80	.82	.72	.33	.84	.89
.40	.97	.80	.41	.97	.98
.00	1.00	.82	.44	1.00	1.00
-.40	.93	.79	.46	.93	.96
-.80	.48	.43	.38	.50	.52

* Precision is defined to be one over the variance of the estimator. The variables n_1 and n_2 are the number of pre- and post-intervention observations, respectively. The parameter α is the moving average parameter; the autocorrelation is positive when α is positive.

some clues about precision without conducting expensive monte carlo experiments.

The calculations were scaled in a way to make the precision equal to unity in the base case ($n_1 = 48$, $n_2 = 12$) when there is no autocorrelation in the noise ($\alpha = 0$). Thus, a 95% confidence interval for the estimate of the shift in mean would, in this special sub-case, be of the form $\delta \pm 1.96$, so that any estimate $\hat{\delta}$ exceeding 1.96 in absolute value would lead to rejection of the null hypothesis of no shift in mean. It should be emphasized, however, that because of the freedom to choose the scaling, the "levels" of the entries within Table 1 are not informative-- only relative comparisons between two entries in the table are meaningful.

Before analyzing the effects of using annual instead of monthly data, some interesting conclusions can be drawn directly from Table 1, which pertains only to the monthly data. Notice that the estimate of the shift in mean is much more precise when the noise in the series is negatively autocorrelated ($\alpha < 0$) than when the noise is positively autocorrelated. In fact it is better to have negative autocorrelation than no autocorrelation at all. The explanation is as follows. The estimate of the shift in mean δ simply the difference between weighted averages of the post-intervention and pre-intervention observations. (The weighting is due to the autocorrelation; if $\alpha = 0$, the estimate is simply the difference between the arithmetic averages of the pre and post-observations.) When there is negative autocorrelation, adjacent terms that are used in forming the averages are negatively correlated, and so the errors in estimation tend to cancel each other out. This offsetting of errors leads to relatively more precise estimates of the pre and post means and thus to relatively more precise estimates of the difference between them. On the other hand, when there is positive auto-correlation, the errors of estimation tend to move together which results in a loss in precision.

Deutsch and Alt (1975, p. 784) claim to have evidence that negative auto-correlation leads to a loss in precision, unlike a gain in precision as Table 1 would suggest. In fact, they argue that the choppiness or roughness in the series can cause additional post-intervention observations to obscure the effects of the intervention, so that it is best to have only a few post-intervention observations.* In other words, the investigator can increase precision by throwing out some post-intervention observations. A comparison of the fourth and fifth columns to the first column in Table 1, however, indicates that no matter what the pattern of autocorrelation is, more observations always increase precision regardless of whether the additional observations are for the pre or post periods. Furthermore, examination of Deutsch and Alt's expression (equation (13), p. 781) for the variance of the estimated shift in mean shows that the variance of the estimate is always a decreasing function of the number of post-intervention

* In the Deutsch and Alt study the first difference of the criterion variable instead of the level of criterion variable is assumed to follow a first order moving average scheme.

observations. Thus, there is reason to doubt the interpretation of the calculations they report (Table 3, p. 784) at least insofar as the calculations pertain to negative autocorrelation and the effects of adding more post-intervention observations.

THE PRECISION OBTAINED WITH ANNUAL DATA

Given that the true statistical model operating in monthly time is (4), the model relevant for the annual data is*

$$(6) \quad Y_s = \ell + \delta X_s + U_s$$

where s runs over years, Y_s is the annual average of the monthly y series, the parameters ℓ and δ have the same meaning as before, X_s is the annual average of the 0-1 intervention variable (it will just be the fraction of the year the intervention is in effect), and U_s is the annual average of the noise term. As can easily be checked, the noise term U_s still follows a first order moving average process, though with a much smaller autocorrelation parameter (i.e., the autocorrelation in the annual data is much weaker than in the monthly data).

Table 2 contains information about how much precision is in fact lost when annual instead of monthly data are used to estimate the shift in mean. Each entry in the table is ratio of the precision obtained with monthly data to the precision obtained with annual data.† (Recall that the precision of an estimator is defined as one over its variance.) The various entries in the table correspond to different assumptions about the degree of autocorrelation in the monthly data and the number of pre- and post-intervention observations available to the project. Two conclusions emerge from study of Table 2.

First, the precision obtained from using annual data is not nearly as small as one-twelfth the precision obtained from using monthly data: in no case is the ratio of the precisions as small as .08. Indeed, whenever the intervention is in January and the data are not autocorrelated, there is no loss in precision at all. The reason is that in this instance the estimators of the shift in mean are identical. Each estimator is simply the difference between the arithmetic averages of the pre and post-intervention observations. An investigator using annual data, of course, employs a different value for the "degrees of freedom" in the t table when doing a statistical test, but the estimate of the shift in mean in this instance is no less precise than the estimate that would be obtained from the monthly data.

* Even if the appropriate model for monthly data is the "dynamic impact" model with differential effects for post-intervention time periods, estimating the model (6) for annual data will give a reliable indication of the total effects of the intervention. Geweke (1978).

† As can easily be checked, the aggregation from monthly to annual data amounts to multiplying each data vector by an "aggregation" matrix. The variance of the estimated shift in mean was obtained by computing the variance-covariance matrix of the regression coefficients estimated by generalized least squares applied to the aggregated data.

And second, the loss in precision can be fairly small so long as the annual series contains at least one year in which the intervention is never in effect and another year in which the intervention is in effect for the entire year. Columns 1, 2, 4, and 5 correspond to this favorable situation while column 3 corresponds to the more unfavorable situation in which the intervention occurs in the middle of the last year in the sample. Note that in every column except column 3, the loss in precision is nearly always less than 50 percent, and when the autocorrelation is fairly mild ($\alpha = \pm .4$), the loss in precision is never more than 21 percent and sometimes as small as 2 or 3 percent.

PRACTICAL IMPLICATIONS

The calculations described above pertain to simplified hypothetical situations, and so any conclusions drawn from them are subject to the usual qualifications and caveats. Nevertheless, the calculations do suggest some guidelines for practical work. If monthly data are readily available and are fairly cheap to process, then they should be used so that the potential loss in precision from using more aggregated data is avoided. However, if the costs of collecting, editing, and processing data are roughly proportional to the number of observations, then using monthly data instead of annual data will increase cost by a factor of twelve without a proportionate increase in precision. Of course, one can imagine situations in which policymakers require immediate and precise information on the short-time effects of a legal intervention, so that the benefits from using data recorded at very fine time intervals exceed the costs. But one can just as well imagine situations in which a small increase in precision is not worth an 1100 percent increase in costs.

ANOTHER APPROACH

Box-Tiao intervention analysis focuses the entire research effort onto the assessment of the impact of a single intervention. As shown above, there is a limit as to how much can be learned by examining in great detail a single quasi-experiment. Berk, et. al (1979) describe a different strategy for legal impact assessment that involves the pooling of cross section / time series data. In this approach the investigator concentrates his or her efforts on building up a panel of data that contains time series data for several jurisdictions, each of which has experienced a similar intervention at some point within the sample period. The panel cannot always be compiled, but when it can the payoff in terms of precision can be much larger than the payoff is to analyzing intensively the effects of a single intervention.

For example, suppose the panel can be compiled, but because of data processing costs and data limitations only five years worth of annual data, instead of monthly data can be tabulated for each jurisdiction. For the absolute "worse case" in Table 2, the use of annual instead of monthly data would cause a loss in precision in estimation of 67 percent for any one jurisdiction. However, if the "noises" in the criterion variables are independent across jurisdictions, then the precision obtained from using panel data is the sum of the precisions across the jurisdictions. Thus,

with five years worth of annual data for twelve jurisdictions there are as many data points as there are with five years worth of monthly data for a single jurisdiction, but the precision obtained form using panel data will be at least eight times as large as would be obtained from applying intervention analysis to monthly data for a single jurisdiction.

This calculation, of course, is based on a hypothetical research situation and so it can only be considered a crude indicator of the gains from using panel data. By putting the interventions right at the end of the monthly series, or by making the autocorrelation in the monthly data more complex, it would be possible in fact to make the use of annual panel data appear less attractive. Furthermore, to the extent that the noises in the criterion variables are correlated across jurisdictions, the increased precision from using panel data will be smaller. (Pfeifer and Deutsch, 1979, discuss some methods for ARIMA modeling with crosscorrelated time series.) Despite the factors that tend to reduce the gains from pooling data across jurisdictions, one can still expect the gains to be relatively large. Having a "battery" of quasi-experiments instead of only one quasi-experiment is probably the nearest the social scientist can ever get to having independent replicated experiments.

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