The Effect of Gun Availability on Robbery and Robbery Murder: A Cross-Section Study of 50 Cities

(By Philip J. Cook, Assistant Professor of Policy Sciences & Economics, Duke University)

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A. INTRODUCTION

Firearms are used in a large fraction of the violent crimes of robbery, assault, and murder. The widespread availability of firearms, particularly handguns, has frequently received part of the blame for the extraordinarily high rates of violent crimes in the United States, and the violent crime wave of the 1965-75 decade may have been fueled in part by the growth in the availability of handguns in urban areas. Advocates of stringent gun control have long argued that the adoption

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of a program which made it more costly or time consuming or legally risky for criminals to obtain guns would have the effect of reducing the amount and seriousness of violent crimes.[1]

This paper analyzes the relationship between gun availability and the crime of robbery, which is defined as theft or attempted theft through violence or the threat of violence. The importance of guns in robbery is indicated by the fact that forty-five percent of robberies reported to the police are perpetrated with a gun (almost always a handgun), and that gun robberies are much more likely to result in the death of the victim than robberies committed with other weapons. The major findings of this study, based on an extensive analysis of intercity differences in the rates of robbery and robbery murder, are: (1) that an increase in the density of guns in a city has no effect on the overall robbery rate but is associated with an increase in the fraction of robberies which involve a gun; (2) the per capita rates of gun and nongun robbery murder are nearly proportionate across cities to the rates of gun and nongun robbery, respectively; (3) these two findings, together with the fact that gun robberies are almost three times as likely to result in the death of the victim as nongun robberies, imply that the per capita rate of robbery murder increases with the density of guns in a city—a result which also emerges from a direct analysis of the data. These findings are certainly relevant to the ongoing debate over the wisdom of adopting more stringent gun control measures, but do not yield predictions about the efficacy of adopting any particular gun control strategy. However, my results do suggest the prediction that, *if* a way could be found to reduce the density of handguns in a city, then this reduction would ameliorate the seriousness of the robbery problem.

The theoretical and empirical approach used in developing these results may be of interest as a contribution to the largely neglected study of how the availability of "inputs" into the crime production process influences the level and structure of crime rates. In robbery, the important inputs other than labor are weapons and "targets," and the terms on which these inputs are available appears to have a major influence on robbery patterns. Weapon availability is measured here by a new city gun density index, which should have applications in a number of other contexts.

This paper is organized as follows:

B. Description of Robbery and Robbery Data
C. Theoretical Issues in Gun Availability and Robbery
D. Construction of the Gun Density Index
E. Determinants of Intercity Differences in Robbery Rate
F. Robbery Murders
G. Conclusions

1. Definition:

The Uniform Crime Reporting Handbook defines robbery as "the taking or attempting to take anything of value from the care, custody, or control of a person or persons by force or threat of force or violence and/or by putting the victim in fear (p.14)."

This definition includes a wide variety of incidents, ranging from the strong arm theft of a student's lunch money to bank holdups and truck hijackings. The distinction between robbery and "larceny from the person" rests on whether the victim resists—a pursesnatching becomes a robbery if the woman attempts to hold onto her purse and a struggle ensues. A burglary ("unlawful entry of a structure to commit a felony or a theft") is classified as a robbery if a resident of the building confronts the burglar and the burglar attempts to intimidate the resident. A large fraction of residential robberies are interrupted burglaries.[2]

A robbery incident which results in the death of the victim or which includes a rape is counted by the FBI as a murder or rape, not as a robbery.

[1] See Newton and Zimring (1969).
[2] Repetto (1972).

2. Robbery Data:[3]

	Percent with attack	Percent resulting in victim hospitalization
Robbery weapon:		
Gun	23	26
Knife or other	40	22
Unarmed	73	9

The most comprehensive source of data on robbery rates and patterns are the reports to the FBI made by cities participating in the Uniform Crime Reporting system. In recent years, a series of criminal victimization surveys has been conducted by the Census Bureau to supplement the Uniform Crime Reporting system. A nationwide survey has been conducted every six months since 1973, and special surveys have been conducted in 26 large cities.[4] It remains an open question whether the crime surveys yield a more accurate representation of intertemporal and cross-section crime patterns than the Uniform Crime Reports,[5] but the question is moot for the analysis presented here: the twenty-six cities which have been surveyed do not constitute a large enough sample on which to base a comprehensive analysis of intercity robbery patterns. While I do use descriptive statistics from victimization survey data on occasion, most of the empirical work is based on 1975 UCR robbery data for the 50 largest cities.

There are serious doubts concerning the accuracy of the UCR data, as anyone who has even a nodding acquaintance with the criminology literature must know.[6] The robbery count published by the UCR for each city is the number reported to the FBI by the city police department. This number is suspect primarily because a large fraction of robberies (especially the less serious incidents) are never reported to the police. Furthermore, the police departments may not classify incidents accurately (note the subtleties of classification described above), and in some cases may fail to report all known incidents to the FBI for political or other reasons. These problems of underreporting detract from the confidence which should be placed on any cross-section analysis of UCR statistics; if there are systematic intercity differences in the degree to which robbery rates are underreported, then the data will yield a biased impression of the importance of various city characteristics in influencing the true robbery rate.

3. Robbery Trends and Patterns:

Robbery is predominantly a crime of the large cities: 65 percent of all robberies occur in cities with population exceeding 250,000 (which contain less than one quarter of the U.S. population), and 18 percent of all U.S. robberies are committed in New York City alone.

A majority (56 percent) of big city robberies reported to the FBI in 1975 occurred on the street, 14 percent in residences, and the remaining 30 percent involved commercial targets. An analysis of the victimization survey data for 26 cities conducted by Cook (1976) found that the typical street robbery was committed by two or more Negro male youths: 84 percent of these robberies involved nonwhite offenders, 53 percent involved youths aged less than 21, 63 percent involved two or more offenders (though the victim was almost always alone at the time of the robbery). The typical victim was male (64 percent), white (62 percent), and aged 25 or more (62 percent).

4. Seriousness:

The number of robberies reported to the FBI has more than tripled since 1965, and victimization rates in some of the most robbery-prone cities (Detroit, Boston, Newark) are as high as 4 percent per year. The seriousness of the robbery

[3] Some of these data are published in *Crime in the United States*.
[4] See U.S. Dept. of Justice, 1975, 1976a, 1976b.
[5] See Skogan, 1974 and 1975, Fienberg (1977).
[6] Skogan (1975).

problem is not the result of the direct economic loss to victims—72 percent of the street robberies reported in the victimization surveys resulted in the theft of less than $50.[7] Much more important is the high rate of injury and death which results from robbery incidents, and the mental anguish of even those robbery victims who are not injured. Furthermore, the widespread fear of "crime in the streets," endemic in most of the large cities, distorts the life style of the city and has social costs far beyond the direct losses to actual robbery victims. That this fear is well founded is suggested by the fact that one out of every seven murders in the 50 largest cities was the result of a robbery incident.

The likelihood that a robbery will result in the injury or death of the victim is substantially influenced by the type of weapon used by the robber. The best data on the likelihood of injury is taken from the victimization surveys of the 26 cities. For street robberies reported in these surveys, gun robberies had the lowest injury rate (2.8 percent) while the highest injury rate occurred in robberies in which the robber used a club. Table 1 gives the complete breakdown on injury rates by weapon type. Directly comparable data for robbery murders is not available. However, calculations based on the 1975 UCR data for the 50 largest cities reveal a clear pattern which reverses the impression that guns are "safer" than other weapons in robbery. The fraction of gun robberies which result in the death of the victim is 5 times as high as the corresponding fraction for robberies with other weapons (including unarmed): consequently, while less than half of robberies involved a gun, fully two-thirds of all robbery murders involved a gun. Table 2 summarizes these results.

TABLE 1.—INJURY RATES IN STREET ROBBERIES BY WEAPON TYPE

	Percent of victims incurring medical costs	Percent of victims incurring medical costs exceeding $1,000
Weapon:		0.3
Gun	2.8	.4
Knife	6.6	.7
Other weapon	12.9	.2
Unarmed	5.2	.5
All incidents	6.2	

Source: Table 10–8 of P. J. Cook "A Strategic Choice Analysis of Robbery" in W. Skogan (ed.) Sample Surveys of the Victims of Crime, Ballinger, 1976.

TABLE 2

	Robbery murders/ 1,000 robberies with stated weapon tyle	Robbery murders/ 100,000 population
Gun robberies	7.66	2.29
Nongun robberies	2.71	1.07
All robberies	4.84	3.36

Source: Unpublished UCR data on homicides and robberies in the 50 largest cities.

Tables 1 and 2 give very different impressions of the relative dangerousness of guns in robberies. Could it be true that gun robbers are less likely to injure a victim but much more likely to kill him than other robbers? The difference is almost certainly *not* the result of differences in the data sources: indeed, since gun robberies are more likely to be reported to the police than nongun robberies,[8] the true disparity between gun and nongun robbery murder rates/1000 robberies is *larger* than that reported in Table 2. I believe the correct explanation is the following: nongun robberies are much more likely than gun robberies to be initiated by an assault on the victim (as connoted by the terms "mugging" and "yoking").[9]

[7] Cook (1976).

[8] Zimring (1977).

[9] This claim is verified by results reported in Cook and Nagin (1978), Table IV. 2. For robberies involving adult male offenders reported in the National Crime Panel household victimization surveys, the following results were obtained: It should be noted that "gun" robberies are those in which at least one of the offenders had a gun (most robberies are committed by two or more offenders). An attack in a gun robbery may therefore involve another weapon. If the attack does involve a gun, it may be in the form of clubbing or pistol-whipping, rather than shooting. Injury results in the second column should be interpreted accordingly.

Such an attack is not needed in a gun robbery in most cases because the display of the gun is sufficient in itself to intimidate the victim. In the relatively few cases where the gun robber actually shoots the gun, however, it is much more likely to inflict deadly harm on the victim than an attack with some other sort of weapon. Some evidence for this explanation is found in Table 1, which indicates that the *serious* injury rate (medical costs exceeding $1000) in gun robberies is relatively high when compared with the overall injury rate. The weapon-linked *murder* pattern is a continuation of this "trend."

C. THEORETICAL ISSUES

The term "gun availability" appears frequently in the Congressional hearings and scholarly literature dealing with gun control. Reducing gun availability, and particularly reducing the availability of handguns to potential criminals, is the proximate objective of the range of gun control policies which Bruce-Briggs (1976) has labelled the "interdiction" strategy: policies which include licensing and registration, mandatory waiting periods between purchase and transfer, bans on mail order sales, and even total bans on private possession.

Ideally, interdiction policies could be designed and implemented so as to discriminate between legitimate and criminal uses, preserving the public's access to the former while eliminating the latter. In practice, deiscrimination policies take the form of prohibiting certain categories of individuals from acquiring or possessing firearms. The current federal law, the Gun Control Act of 1968 (GCA), adopts this discrimination strategy; the GCA makes gun possession by a felon or ex-mental patient illegal, and furthermore makes it illegal for gun dealers to sell guns to anyone "they have reason to believe" is a felon, ex-mental patient, or minor (age less than 21 in the case of handguns).[10] In an effort to make the discrimination strategy more effective, and to facilitate the enforcement of state and local gun control ordinances, GCA bans mail order gun sales and required that handguns be purchased in the buyer's state of residence. Dealers are required to be licensed by the federal government (Bureau of Alcohol, Tobacco, and Firearms) and to keep records of all sales; people who only sell a few guns per year are not required to be licensed and are not governed by the same restrictions as dealers.

A number of states and cities have adopted ordinances which strengthen the federal law in various ways. Table 3 summarizes the laws which apply in the 30 largest cities. With a few exceptions, state and local ordinances have adopted the discrimination strategy. For example, states and cities which require handgun buyers to be licensed have typically issued such licenses to most all applicants after a brief effort to check criminal records, with no intent of inhibiting gun sales. States which have adopted a waiting period between purchase and transfer are in effect attempting to discriminate against buyers who might be in the middle of an argument and need a cooling off period.

Discrimination policies are not intended to reduce the stock or the flow of new handguns into a jurisdiction. There are large differences in gun density among cities, with Southern and Mountain Region cities tending to be relatively high and cities in the Northeast and Far West relatively low (see Table 5 below). These differences surely reflect differences in demand rather than differences in supply or legal restrictions for the most part.

The alternatives to a discrimination strategy are any of a number of policies designed to reduce the density of handguns, which I will term "disarmament" policies. Examples of disarmament policies include restrictive licensing (Boston, New York City), a ban on cheap handguns or other means of raising the minimum price at which guns can be acquired (e.g., gun registration fees), a ban on the acquisition of handguns (recently adopted in Washington, D.C.), or a total ban on private possession. Such policies receive support from people who believe that effective gun control cannot be achieved through discrimination policies.

The two main arguments are: (1) Discrimination policies are ineffective because it is impossible to prevent felons and minors from obtaining guns when guns are readily available to everyone else—the market is too "leaky," and (2) Many gun crimes (as well as gun accidents and gun suicides) are committed by adults who are neither ex-felons nor ex-mental patients, and hence can obtain a gun legally under GCA provisions. Recent scholarly studies which have attempted to assess the effectiveness of current state and local ordinances tend to support the claim that these ordinances have been ineffective at reducing crime.[11] It is

[10] For a comprehensive discussion of the legal antecedents, politics, and effects of the GCA, see Zimring (1975).
[11] Magaddino (1976) and Murray (1975).

not clear whether these ordinances are ineffective as a result of a fundamental deficiency in their design, or rather simply because they have not been enforced adequately.[12]

Only a few evaluations of disarmament policies have been published. Since the first serious recent effort to disarm the public in a U.S. jurisdiction has just begun in Washington, D.C.,[13] published evaluations have been based on international comparisons or on analysis of the impact of adoption of a stringent gun control statute in a foreign nation. Naive international comparisons have virtually no value. For example, several authors have ascribed Japan's extraordinarily low murder rate to their stringent gun control statutes.[14] This explanation is completely inadequate, given that Japan's total murder rate is much lower than the U.S. *nongun* murder rate. In any event, cross national comparisons always suffer from the difficulty of controlling for cultural and other differences, and should be interpreted with great caution.[15]

Table 3.—State and Local Handgun Regulations, 1975

A. State permit to buy [1]—
- Boston
- Buffalo
- Chicago
- Detroit
- Newark
- New York
- Baltimore [2]
- St. Louis [3]

B. Some State or local requirements—
1. Local permit required:
   - Philadelphia
   - Cleveland
   - Milwaukee
   - District of Columbia
2. Local waiting time, possibility of investigation:
   - New Orleans
   - Minneapolis
   - Miami
3. State waiting period required:
   - Portland (5 days)
   - Oakland (5 days)
   - San Francisco (5 days)
   - San Diego (5 days)
   - Los Angeles (5 days)
   - Pittsburgh (2 days)

C. No regulation:
- Atlanta
- Dallas
- Denver
- Houston

Of much greater interest is the possibility of evaluating the changes in violent crime rates resulting from the adoption of a stringent disarmament statute,[16]

[12] Zimring (1975) and Bruce-Briggs (1976).

[13] The ordinance in the District of Columbia, which went into effect in 1976, bans the acquisition or transfer of handguns by District residents. The Sullivan Law in New York State has imposed a restrictive licensing system throughout most of the 20th century.

[14] Etzioni (1973) makes the comparison with Japan and other nations which have strict gun control laws.

[15] See Bruce-Briggs (1976) humorous critique of international comparisons. Newton and Zimring discuss difficulties with international comparisons, pp. 124–125.

[1] Ordinances mandating that gun buyers obtain a permit from state or local authorities have been in effect in Massachusetts, New York, Illinois, Michigan, New Jersey, Maryland, Missouri, and North Carolina since 1968 or before.

[2] Maryland law requires that an application for handgun purchase be sent to the state police 7 days before the actual transaction, with at least the possibility that the State Police will investigate the purchaser and disallow the purchase.

[3] Missouri law requires that handgun purchasers have a permit from the county sheriff, but does not specify the categories of people who are ineligible to receive a permit (beyond the requirements that the applicant be of age and of "good" moral character).

[16] Of particular interest are evaluations of the recent crackdown on gun ownership and use in Jamaica. See Gendreau and Surridge (1976) and Diener and Crandall (undated).

although even with a valid study of this type it is difficult to extract lessons relevant to U.S. policy. In spite of the lack of experience with disarmament policies within the U.S., analysis of available U.S. data can yield some insight into the potential effect of adopting such a policy at the national or local level. Since the main proximate objective for disarmament policies is to reduce gun density, one method of predicting the effects of adopting such a policy is to compare violent crime rates in jurisdictions which currently have high gun density with violent crime rates in low gun density jurisdictions. Such an analysis, based on 1975 data for 50 large cities, is presented in subsequent sections of this paper for the crime of robbery. But first, it is necessary to discuss three preliminary questions: (1) How does gun density *per se* affect the availability of guns for robbery? (2) What effects should we expect a reduction in gun availability to have on robbery rates and patterns? and (3) Is it valid to make inferences concerning the potential effects of a disarmament strategy from analysis of recent cross-section data on cities?

1. Gun density and gun possession by potential robbers

The extent to which robbers are armed with guns in a particular city is the result of a number of factors which can be usefully classified in the usual demand and supply framework.

(*a*) *Supply.*—In a frictionless market, the notion of gun "availability" to an individual purchaser is equivalent to the money price of a gun (or vector of prices if there are a variety of types of guns for sale). The market for guns is far from frictionless, however. Transactions costs may be a particularly important consideration in analyzing supply conditions for the kinds of people who constitute the great majority of active robbers. The most visible and readily accessible gun sellers are presumably the federally licensed dealers, who advertise and are easily located by purchasers. However, licensed dealers are prohibited by federal law from selling handguns to minors or people with felony records, and furthermore are required to register every sale on a form which is subject to inspection by the police. While these requirements are no doubt widely violated in practice, they may be sufficient to deter a substantial fraction of potential robbers from buying from licensed dealers—especially in cities and states which require buyers to have a purchase permit.

The alternative sources of supply are the informal "hand-to-hand" market, and fences of stolen merchandise.[17] (A black market for guns imported from less restrictive areas may be important in the few cities, such as New York, which have stringent regulations on gun purchase.[18]) These sources of supply are presumably characterized by significant transactions costs, due to the difficulty of buyers and sellers finding each other and negotiating a deal in such markets. Potential buyers in these markets will ordinarily have to search, or simply postpone purchase for some length of time, before encountering an acceptable offer of sale. The result is that the typical robber will own a gun—if ever—during a smaller fraction of his active career than would be true if there were no transactions costs.

The crucial assertion for the present context is that transactions costs are directly related to the density of gun ownership in a city. The supply of guns by fences and in the hand-to-hand market will be relatively "thin" and erratic in cities with low gun ownership rates; the typical buyer will have to search (or wait) longer before finding an acceptable deal in Boston than in Dallas. Relatively high transactions costs in low density cities would be expected to reduce the gun ownership rate among robbers and other criminals.

Robbers can acquire guns by borrowing, renting, or stealing them as well as by purchase, but the effect of city gun density on the ease of negotiating these other types of transactions should be much the same as for purchasers. For example, a gun originally purchased by an adult member of the household may be "borrowed" by a teenage son. (More than one-quarter of all robberies are

[17] Newton and Zimring, Chapter 3, report on the basis of a 1968 Harris poll that over half (54 percent) of handguns are acquired used. Over half of used firearms are acquired from friends or other private parties.

[18] The Bureau of Alcohol, Tobacco, and Firearms traced over 2,500 handguns "received, recovered, or seized" by the New York Police Department during a six-month period. Only 4 percent of these guns were first sold at retail in New York State. In cities with less stringent gun regulations, the percent of traced guns originating in state was much higher; e.g., 80% in Atlanta. See Project Identification, ATF P 3310.1 (5/76).

committed by youths aged less than 18 years.) Obviously this possibility is more likely to be available to any one teenager in a high density city than a low density one.

It is impossible to assess directly the importance of these mechanisms by which gun density influences gun availability to robbers. It is no doubt true that anyone who is determined to obtain a gun will be able to do so, given enough money and effort—the "professional" robbery will not be deterred by the relatively low gun availability I have ascribed to low density cities. But the difference in availability between a low density city such as Boston and a high density city such as Dallas may be enough to deter a substantial fraction of potential robbers from obtaining guns.

In addition to the effects of gun density, supply conditions are potentially influenced by state and local ordinances governing gun transactions. States which require buyers to obtain a police-issued permit before acquiring a gun may thereby drive more buyers into the informal markets (supplied by unlicensed sellers) in which the purchase permit requirement is readily evaded in practice. The effect of this increase in demand in such markets will be to raise the average money price, thereby reducing the availability of guns to robbers. In the long run, a licensing requirement may also reduce availability to robbers by reducing the overall density of guns in an area.

(b) *Demand*.—The value of a gun to an active robber is the sum of two components. First, the robber may value the gun as a "tool of the trade"—an investment which will have some payoff in the form of increasing the profitability of robberies. If the robber views the acquisition of a gun as purely a business proposition, then he will buy if he encounters an offer to sell at a price less than the discounted present value of the prospective increase in net robbery earnings.[19] Robbers will of course differ in their perceptions of how much a gun is worth as an investment, depending on how active they plan to be, their time horizon, and other factors.

The second component of the value of a gun to a robber is derived from a gun's other uses. After all, most handgun owners in urban areas are not robbers; they acquire guns for their value in self defense, hunting, target shooting, or simply as collector's items.[20] There is no reason to believe that robbers do not share these values to some extent, although once again we would expect robbers to be somewhat heterogeneous with respect to the value placed on the possession of a gun for these purposes.

Whether a robber actually acquires a gun depends on the total value he attaches to gun ownership compared with the money price and transaction costs of acquiring a gun. I have argued above that the overall gun density in a city will influence the cost of acquisition—is there also reason to believe that gun density will influence robbers' demand for guns? In a sense, the answer is yes. Cities differ very widely with respect to gun density, for reasons which appear to have more to do with tradition and culture than with the residents' objective circumstances. How else can we explain why 50 percent of urban households in Texas and the Mountain states report owning guns, compared with only 10 percent of households in New England and the Midatlantic states? To the extent that robbers tend to share their urban neighbors' taste for gun ownership, then it will be true that robbers in high gun density cities will have a greater demand for guns than robbers in low density cities. The argument is not so much that gun density has a direct causal effect on robbers' demand, but rather that the same cultural factors which influence overall gun density are also likely to influence the robbers' demand.

There are several conclusions which follow from the discussion above. First, gun density in a city influences the "availability" (costs of acquisition) to actual or potential robbers. Second, robbers living in cities with a high density of gun ownership are likely to have a greater demand for guns than robbers in low density cities. Intercity differences in gun density do not directly *cause* these postulated differences in demand; both are the result of a shared culture or tradition which places widely differing value on gun ownership among different regions of the country. Third, these demand and supply considerations both suggest that a relatively high proportion of robbers in high density cities will possess guns.

What effect will these hypothesized differences in gun ownership rates among robbers have on the amount and composition of robbery rates in a city?

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[19] This calculation may be quite complex in principle, since the acquisition of a gun may suggest changes in frequency of robbery, target selection, and number of accomplices; these changes will in turn cause a change in expected income coupled with changes in the threat of legal punishment and injury at the hands of a victim.

[20] Newton and Zimring, Chapter 10.

2. The effect of gun possession on robbery

The defining task of robbery is to overcome the victim's natural resistance to parting with his valuables through intimidation or force. Several techniques of physical intimidation are commonly used in robbery, including actual attack (as in "muggings" and "yokings"), and the threatening display of a weapon such as a gun, knife, or club. The probability of success depends on quickly forestalling or overcoming resistance on the part of the victim. If we think of robbery as a production process with robbers, victims, and weapons as inputs, the marginal product of a gun in robbery can be defined as the increase in the probability of successful intimidation (compared with the most effective alternative weapon) due to the use of the gun. This marginal product will depend on the circumstances, but will presumably be positive in most cases. A plausible assertion is that the marginal product of a gun is directly related to the ability of the victim to defend himself—his strength, access to weapons and alarms, etc. The marginal product tends to be especially high in a commercial or bank robbery, and close to zero when the victim is an elderly woman on the street. The *value* of a gun's marginal product (VMP) is equal to the marginal product multiplied by the amount of money and other valuables which can be stolen from the victim if the robbery is successful. Since better defended targets tend to have greater than average "loot," the gun's VMP increases a fortiori with the ability of the victim to defend himself.

The relative attractiveness of different robbery targets thus changes when a (potential) robber acquires a gun for some reason; well defended, high payoff targets become much more attractive, while weak targets become only slightly more attractive at best. Consider the possible effects of acquiring a gun: (1) Choice of targets unaffected, robbery technique changes to include a gun (weapon substitution); (2) Change target choice as well as technique (target substitution); and, if he was not previously active; (3) Entry into the robbery business. Given the postulated change in the relative attractiveness of targets, we would expect target substitution, if it occurs, to involve substitution of better defended targets for weaker ones. Entry, if it occurs, would be likely to occur against well defended targets.

This analysis of the individual robber's response to the acquisition of a gun is a useful basis for generating predictions about the effect of the adoption of a successful disarmament policy in a city. Policy-relevant concerns include the effect on the overall robbery rate, the effect on the relative frequency with which guns are used in robbery, and the effect on the relative frequency with which different target types are robbed.

(a) *Robbery Rates.*—The effect of a change in gun availability on robbery rates is not clear. For example, an increase in gun availability may result in some potential robbers "entering" the business. But the average rate at which active robbers commit this crime may well *decrease* as a result of the increase in gun availability. The targets available to gun robbers tend to be more lucrative than those selected by nongun robbers,[22] and the likelihood that the robbery will be successful is also higher with a gun. The average "take" of a gun robbery is about two and one-half times as high as the average "take" of nongun street robberies. A robber who acquires a gun may substitute a few lucrative targets for many less lucrative targets, thereby maintaining his income while reducing his risk of arrest and punishment. It is possible that the average rate of robbery commission per active robber will fall enough to compensate for the postulated increase in the number of active robbers; if so, then an increase in gun availability will not cause an increase in the overall robbery rate.

This discussion can be formalized as follows. Suppose the individual robber maximizes the expected value of his utility for a period given by

$$(1)\quad pU[Y(p,G)]+(1-p)V[Y(p,G)],$$

where

- $1-p=$ probability of being arrested and punished (assumed to occur at the end of the period)
- $G=$ indicator for the possession of a gun
- $Y=$ income from robbery, assumed to be a differentiable function of the risk level $(1-p)$ chosen by the robber.
- $U=$ utility of robbery income if the robber is not arrested and punished
- $V=$ utility of robbery income if the robber is arrested and punished

[22] See Cook (1976) for statistics on the take and success rates in robbery.

It is assumed that

(2) $U(Y)>V(Y)$
(3) $U',V'>0>U'',V''$
(4) $Y_p<0$

These assumptions imply the following condition for a utility-maximum choice of p (and hence Y):

$$(5)\quad Y_p=\frac{V-U}{pU'+(1-p)V'}$$

It is crucial in interpreting this result to define the income locus $Y=Y(p, G)$ with some care. It is assumed that at the beginning of the period the robber perceives a variety of robbery opportunities, which differ according to the expected "take" and the probability of apprehension and punishment. Any given income level can be achieved in a variety of ways; for example, the robber might expect to take $200 either by robbing four people on the street or one liquor store. For each income level Y, the Y–p locus reflects the minimum-p combination of robberies will achieve at least that level of total income.

The solution for p will in general be different when the robber owns a gun ($G=1$) than when he does not ($G=0$). The diagram illustrates this shift, in the likely case in which acquisition of a gun increases the robber's illicit income.

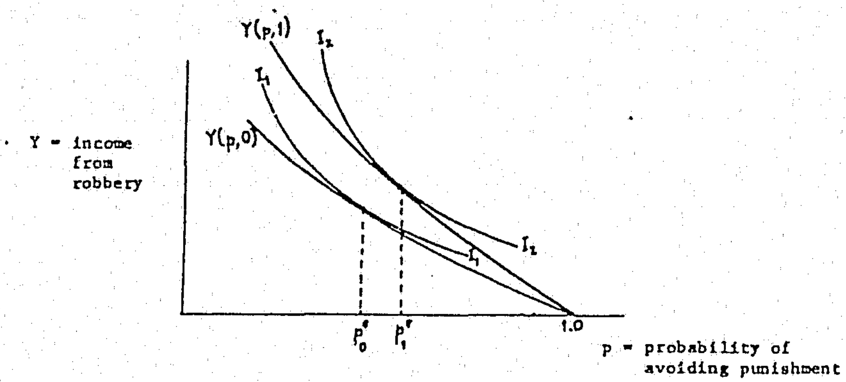

Figure 1

But this result does *not* imply that the *number* of robberies committed during the period increases as a result of the acquisition of a gun; the relationship between robbery income and the number of robberies is not clear, but it is plausible that the "gun" solution involves fewer, more lucrative robberies than the nongun solution. The basic problem here is that a simple unweighted count of the number of robberies is not the theoretically appropriate index of robbery activity. However, appropriate adjustments to this count cannot be made from available data.

Another reason why an increase in gun availability (in the sense of gun density) may have a negative effect on the overall robbery rate is that potential robbery victims are more likely to be armed in cities where gun ownership is widespread. The probability that a robber will be killed or injured by his victim is small but not insignificant, particularly in the case of commercial robbery. Such justifiable homicides almost always are committed with a gun, so that potential victims in high gun density cities should pose a greater threat to robbers than in low density cities.

Table 4 presents statistics on the likelihood that a robber will be killed by his victim or by an employee of a commercial enterprise. The probability is very low in the low gun density regions (the Northeast and Pacific Coast cities), but much higher in the South and Midwestern cities where gun ownership is much more common. To put these death rates in perspective, they can be compared with the overall annual death rate for 20 year old Negro males of 340 per 100,000. In Atlanta, for example, a robber in this demographic group would double the likelihood of his death by committing seven robberies in a year. The likelihood of a robber being wounded by his victim is presumably some multiple of the likelihood that he will be killed. It should be noted that these data would have been much more informative if it had been possible to separate commercial and noncommercial justifiable homicides. It may be, for example, that justifiable homicide rates are a function of the fraction of robbery targets which hire armed guards rather than a function of overall gun density in a city. Nevertheless, the statistics are adequate for demonstrating that the fear of some victim's ability to defend themselves should be considered when analyzing deterrents to robbery.

3. Making inferences from analysis of cross-section data

The empirical analysis which follows measures the intercity relationship between gun density and the rate and composition of robbery. There is also a preliminary attempt to measure the effect of a requirement that gun purchasers must possess a license issued by the state authorities.

TABLE 4.—CIVILIAN JUSTIFIABLE HOMICIDES WITH ROBBERS AS VICTIMS

	Number of civilian justifiable homicides in robbery, 1973 and 1974	Estimated death rate of robbers per 100,000 robberies
A. Northeast:		
1. New York	38	4.5
2. Boston, Buffalo, Newark, Pittsburgh (combined)	6	4.3
B. Pacific:		
3. Los Angeles, Oakland, Portland, San Diego, San Francisco (combined)	11	3.1
C. Mid-Atlantic:		
4. Baltimore	9	8.1
5. Washington	11	27.2
D. Midwest—High-gun density cities:		
6. Cincinnati	2	4.4
7. Cleveland	14	20.7
8. Detroit	50	25.6
9. St. Louis	10	23.1
E. South—High-gun density cities:		
10. Atlanta	16	48.2
11. Houston	13	17.9
12. New Orleans	4	10.2

Notes: The count of justifiable homicides of robbers was tabulated by hand from the supplementary homicide reports submitted to the FBI by the city police departments. Most (though by no means all) reported justifiable homicides include some information on the circumstances, allowing the robbery justifiable homicides by civilians (including security guards to be identified and distinguished from justifiable homicides in other contexts). It was not possible in many instances to distinguish between commercial and noncommercial robbery incidents.

The second column is the quotient of (1) the 2-year total of justifiable homicides, and (2) twice the number of robberies reported in the most recent victimization survey conducted in the city. (Surveys were conducted in 1974 or 1975.) The denominator is doubled to reflect the fact that the average robbery incident involves about 2 robbers.

These results can only be interpreted in the context of a causal framework such as that presented above. The central argument is that the fraction of active robbers who possess guns is closely related to the overall density of gun ownership in a city. To the extent that high gun density cities tend to have relatively undesirable patterns or levels of robbery, we can conclude that a program which was successful in reducing gun ownership among robbers would tend to improve this aspect of the crime program, other things being equal. One possible method of reducing gun ownership among robbers is to impose regulations, such as restrictive licensing, which have the effect of reducing overall gun density in a city. This strategy should be effective against robbery because it should reduce gun availability to robbers. The only caveat to this conclusion is that an overall reduction in gun ownership may undermine whatever deterrent effect that widespread gun ownership has on robbers (but this concern is unlikely to be important if shopkeepers are still permitted to own guns or hire guards). If high gun density cities do not differ with respect to robbery rates and patterns from low density cities, we can conclude that gun ownership by robbers is not of much concern to public policy.

Subsequent sections discuss the measurement of gun density, the issues involved in specifying appropriate robbery equations, and the results from estimating these equations using cross-section data on cities.

D. MEASURING GUN DENSITY

By "gun density" I mean either the fraction of households in a city who own guns or the number of guns per household. Ideally for my purposes, the measure would be limited to handguns and other concealable firearms (e.g., sawed-off shotguns), since almost all robberies are committed with such guns. In fact, 96% of firearm robberies reported to the FBI were committed with handguns in 1967.[22] A further desirable refinement would be to exclude guns which for one reason or another are not operational.[23]

Since data on gun sales by city are not available, and the many nationwide sample surveys of gun ownership have samples which are too thin to permit estimates for individual cities, it is necessary to measure gun density indirectly. Any measure which is highly correlated with gun density would be acceptable for my purpose here, since such a proxy would have essentially the same cardinal properties as a direct measure of density.[24]

Three possible proxies for gun density are the fraction of suicides committed with a gun, the fraction of homicides committed with a gun and the number of fatal gun accidents per capita. Data on suicide and gun accidents for each of the 50 largest cities were calculated from unpublished Vital Statistics data. Homicide statistics were calculated from unpublished FBI data. All of these statistics are given in Appendix A. Each of these measures is briefly discussed below.

1. The fraction of suicides committed with a gun

Assuming that most suicide attempts are made with weapons which are readily available to the victim, we would expect that the fraction of suicide attempts made with a gun in a city would reflect gun density in that city. The measure actually used here—the fraction of *successful* suicides committed with a gun—will presumably be larger than the fraction of attempts with a gun to the extent that guns tend to be more deadly than other suicide weapons.[25] However, this "instrumentality effect" of guns will not change the *ordering* which this statistic gives to the cities.

2. The fraction of murders committed with a gun[26]

Most murders are the direct result of arguments and fights. This lack of premeditation suggests, as in the case of suicide, that the weapon which is selected will be one readily at hand (and not acquired specifically for the purpose of committing the murder). The homicide statistics presented in Appendix A exclude murders which were associated with an act of arson, robbery, or rape.

Since three-quarters of gun murders are committed with handguns, it would appear that this measure is more closely associated with handgun density than with the density of guns per se.

3. Fatal accident rate

The fatal firearms accident rate should reflect the density of guns which are actively in use in hunting, target shooting, etc., rather than the overall density of guns. Hence it is not directly related to gun density as the preceding two measures. Indeed, the firearms fatal accident rate for the Nation has fallen steadily over the last 25 years, in spite of the evident increase in gun ownership rates—this decrease may be the result of a decline in the amount of hunting in the U.S. during this period.

Besides this challenge to the validity of the fatal gun accident rate as an indicator of gun density, there is a practical problem in using it for this purpose: in many cities the annual number of gun accidents is so low that relatively small inconsistencies in classification could result in a substantial change in the city's ranking. In any event, it is of some interest that the gun fatal accident rate is positively correlated across cities with each of the first two measures.

The gun density index which I have adopted for use in this study is the average of the percent of suicides with gun and the percent of homicides with gun. Besides the a priori arguments briefly presented above, there are two pieces of evidence which suggest very strongly that this measure is a valid indicator of gun density.

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[22] *Crime in the United States*, 1967.

[23] See Zimring (1976) for an interesting categorization of guns according to their accessibility for immediate use.

[24] See Zimring (1968) for a discussion of the use of hunting licenses as a gun density measure.

[25] Newton and Zimring, Chapter 6, find that firearm suicide attempts are as likely to be successful as hanging, and much more likely to be successful than other common means.

[26] Brill (p. xv) constructs a "Firearm Choice Availability Measure" which consists of the percent of murders, robberies, and aggravated assaults committed with a gun.

First, in spite of the fact that murder and suicide differ radically in terms of motivation, circumstances, and demographic patterns, the percent of suicides with gun is highly correlated with the percent of homicides with gun across cities ($\rho = .82$.). Apparently both of these measures are heavily influenced by the same underlying city characteristic.

A second test of the validity of the city gun density index was made by comparing it with the results of the gun ownership question on the NORC General Social Surveys conducted in 1973, 1974, and 1976 (no gun ownership question was included in the 1975 Survey). By combining the three survey samples, I obtained a sample dense enough to estimate regional gun ownership patterns with a reasonable degree of accuracy. Table 5 gives the fraction of urban (population greater than 250,000) households which reported owning a firearm in each of eight regions. The fraction of households which reported owning a pistol is also given in this table. Both of these statistics can be compared with the population-weighted average of the city gun index for each of these regions. Figure 1 plots the NORC data against the gun density index across the eight regions, together with the corresponding regression line. Both pistol ownership and overall firearm ownership rates are linearly related to the gun density index across regions, with correlation coefficients of .83 and .94 respectively. Furthermore, the predicted values of gun and pistol ownership rates calculated from the regressions are within the 95 percent confidence interval of the survey point estimates in every case.

Taken together, these results demonstrate the validity of the gun density index. The comparison with the NORAC survey results suggest that this index has interval scale properties, and the regression results provide a method for estimating the actual gun or pistol ownership rate for any one city from the gun density index number for that city.

TABLE 5.—RELATIONSHIP BETWEEN GUN DENSITY INDEX AND ESTIMATED PERCENT OF HOUSEHOLDS OWNING GUNS

Region	Gun density index	Percent urban households owning pistol	Predicted percent owning pistol	Residual	Percent urban households owning firearms	Predicted percent owning firearms	Residual	N
New England and Mid-Atlantic	37.0	5.0	4.5	0.5	10.0	11.1	−1.2	281
Pacific	46.5	11.6	10.7	.9	25.9	21.4	4.5	112
East North Central	57.4	14.6	17.4	−2.8	28.8	32.5	−3.7	205
South Atlantic	59.2	24.0	18.6	5.4	40.0	34.4	5.6	75
West North Central	60.5	11.2	19.4	−8.3	27.8	35.7	−7.9	54
West South Central	68.6	22.2	24.5	−2.3	41.7	44.2	−2.5	108
Mountain	69.0	33.8	24.8	9.0	48.5	44.6	3.9	68
East South Central	74.6	25.8	28.3	−2.5	51.7	50.5	1.2	58

Notes: The regions include the following cities from the 50 cities sample: 1. Boston, Buffalo, Newark, New York, Philadelphia, Pittsburgh, Rochester; 2. San Francisco, San Diego, Long Beach, San Jose, Los Angeles, Seattle, Portland: 3. Milwaukee, Chicago, Toledo, Indianapolis, Cincinnati, Detroit, Cleveland, Columbus; 4. Washington, Baltimore, Miami, Norfolk, Charlotte, Atlanta, Jacksonville, Tampa; 5. Saint Paul, Minneapolis, Omaha, Kansas City, St. Louis: 6. Oklahoma City, Austin, Tulsa, El Paso, Houston, San Antonio, New Orleans, Fort Worth, Dallas, Baton Rouge; 7. Denver, Tucson, Phoenix; 8. Louisville, Memphis, Birmingham, Nashville.

The gun density index is the population weighted average for each region of the city gun density indexes in that region. The procedures used for constructing the city gun density indexes are explained in appendix A.

The "percent owning pistol" and "percent owning firearm" are calculated from the National Opinion Research Center's General Social Survey files for 1973, 1974, and 1976. The results for the three years were combined in order to yield more reliable estimates. "N" is the total number of respondents in these 3 years living in cities with population exceeding 250,000 in the relevant region. These surveys use a clustered sampling technique; the reliability of the estimates is about the same as the reliability which would be obtained by a pure random sample with ⅔ respondents.

"Predicted percent owning pistol" is calculated from a regression of the NORC estimates on the regional gun density indexes across the eight regions. The estimated equation is

$$HG_r = -19.0 + .63I_r \qquad R^2 = .68$$
$$(10.6)(.18)$$

where the standard error of the coefficient estimates are given in parenthesis. The "residual" is the difference in the actual percent owning a pistol and the percent predicted from the equation.

"Predicted percent owning firearm" is calculated similarly from this regression:

$$G_r = -27.5 + 1.05 I_r \qquad R^2 = .88$$
$$(9.3) \quad (.15)$$

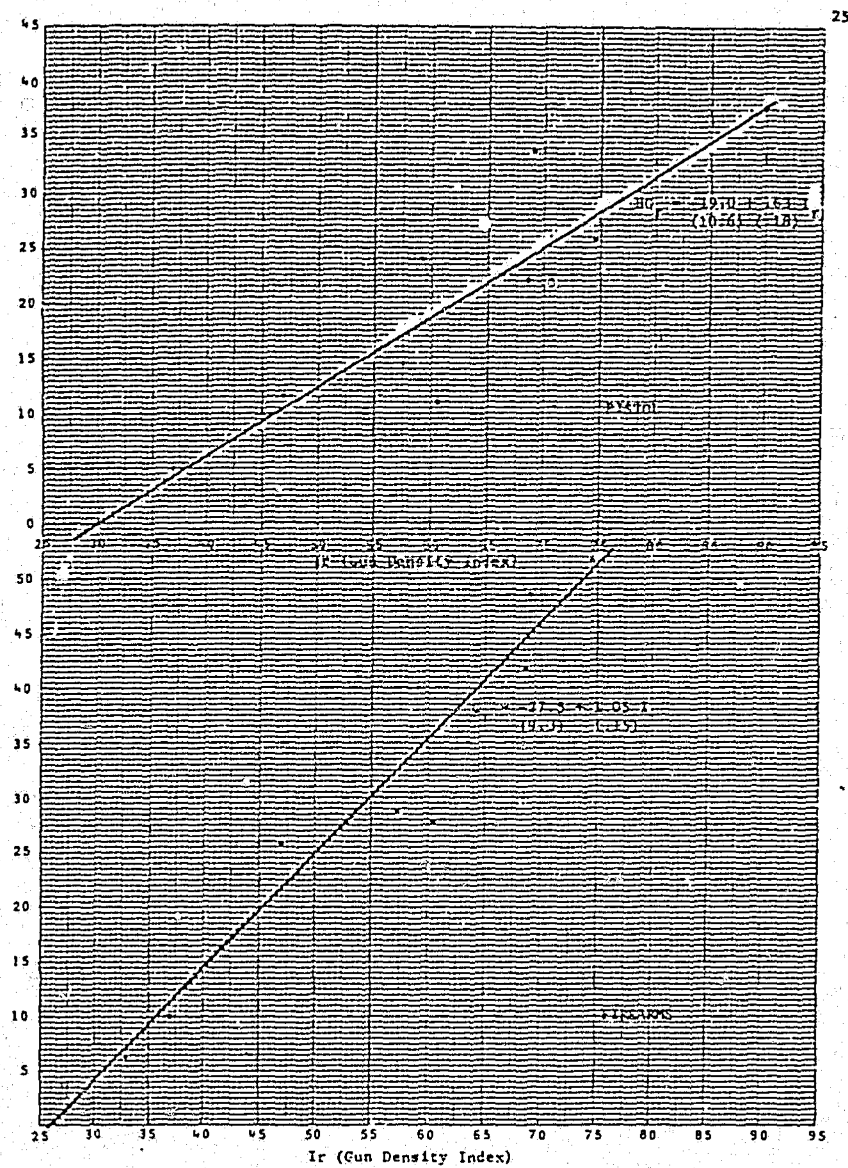

FIGURE 2

E. DETERMINANTS OF THE INTERCITY DIFFERENCES IN ROBBERY RATE

Official (UCR) robbery rates differ tremendously among large cities; for 1975, the most robbery-prone city (Detroit) suffered from a reported robbery rate which was *nine times* as high as the lowest city (San Jose) with the range running from 1.6/1000 to 14.9/1000.

The criminology literature abounds with suggestions of city characteristics which should be considered in explaining intercity crime differences, and no single equation purporting to explain these differences could take more than a few of these explanatory variables into account. Since my objective is primarily to measure the effect of gun density on robbery rates, rather than to provide a complete explanation of intercity differences in robbery, there is no necessity to try all possibilities. It is well known that an unbiased estimate of the effect of an explanatory variable X can be generated by a multivariate regression analysis which includes only those explanatory variables which are correlated with X. In practice, the omission of explanatory variables from the regression equation will not seriously bias the coefficient estimate for X so long as these omitted variables are only weakly correlated with X or have only a weak causal effect on the dependent variable for the sample which is being used. Unfortunately, in a field such as criminology where theory gives so little direction to empirical work, it is difficult to know a priority which variables are important in the sense discussed above.

The procedure I have adopted for selecting a specification for the robbery equation is to map out several categories of explanatory variables which a prior consideration or previous research suggest are important. One of more variables which seem to capture the essential aspects of each category were then included in the equation, though in some cases they were dropped before being included in the final specification for reasons I explain below.

Each of these categories are briefly discussed below. Appendix B defines the variables actually used in the robbery equations and lists the data on which this equation was estimated.

1. The dependent variables

For the regressions reported in Tables 6 and 8, the dependent variables are the total number of robberies of a particular type (gun, nongun, or total) which occurred in the central city in 1975, divided by the city's population. Each of these rates is distributed approximately log normally across cities. All regressions are run twice, once using a linear form and once using the log of the robbery rate as a dependent variable. In Table 7, the dependent variable is the log of the ratio of gun and nongun robbery rates.

Since my focus is on conditions which influence the supply of robberies, the robbery rates are to be viewed as robbery commission rates rather than victimization rates. They are misleading as such to the extent that some robberies in each city are committed by people who are not residents of the city, and some residents of the city commit robberies outside the city limits. The few useful replies received in response to a questionnaire mailed to police chiefs in the sample of 50 central cities suggest that there is some difference among cities with respect to the fraction of robberies committed by non-residents: police estimates of the fraction of robbery arrestees who were non-residents ranged from 1 percent to 20 percent. One possible proxy for the net flow of robbers into a city is the fraction of the metropolitan area's population which resides in the city.[27] Presumably the main city in a metropolitan area acts as a "magnet" for criminals, since in most cases it will be the center of commercial activity and night life in the area. The relative size of the inflow to the central city should be closely related to the relative size of the nearby population.

2. Errors in measurement

It has been thoroughly documented that crime rates reported by the police understate the true crime rates in a city for every crime except murder. Of greater concern is that some cities underreport robberies to a greater degree than others. Intercity reporting differences are only of concern for our purposes if the fraction of robberies which are reported in official statistics happens to be correlated with the gun density index. There is no apparent method of controlling for reporting differences in the context of the robbery equation. However, it is possible to test the hypothesis that the degree of underreporting is uncorrelated with gun availability by using an alternative measure of the robbery rate.

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[27] This measure was suggested by Wilson and Boland (1976), p. 230.

Victimization surveys were conducted in 26 of the 50 cities during either 1974 or 1975. Reported robbery rates generated by these surveys are subject to various errors and are not strictly comparable to the published UCR data (the most important differences being the fact that nonresidents who are robbed in the central city are not counted in the victimization surveys[28]). In any event, the victimization survey results have been viewed by some scholars (though not all) as a more consistent representation of robbery rates that the UCR data.[29] If true, then the ratio of the UCR robbery rate to the victimization survey robbery rate should measure the degree of underreporting in a city. The correlation between this ratio and the gun availability index for cities for which data are available is small and statistically insignificant (−.13). The victimization survey measure of robbery rates is also used as a dependent variable in one of the regressions reported in Table 6. The primary problem with using this measue is the small sample size.

3. Demographic characteristics

Almost all robberies are committed by youthful males, and about 70 percent of urban robberies are committed by blacks.[30] These demographic patterns do not "explain" robbery in any sociological sense, but it is perhaps acceptable to include measures of the demographic characteristics of the cities' populations as proxies for whatever underlying factors *do* explain these patterns. The variable used in the regression specification here is the percent of the city's population in 1970 which was black males aged 10–20. (By 1975 this group would be aged 15–25, the peak ages for participation in robbery.)

4. Socioeconomic characteristics of the population

Robbers, like other violent criminals, are disproportionately drawn from poor neighborhoods. In part the relationship between poverty and violent crime may be the result of one aspect of the deterrence phenomenon; people with poor legitimate opportunities have less to lose from being arrested and punished. The variable actually used in the robbery regression is a measure of the fraction of the city population who are relatively poor; specifically, the percentage of the city's families with income less than one-half the median family income for the Standard Metropolitan Statistical Area.[31]

5. Robbery inputs

Two inputs to the "production process" which characterizes robbery are weapons and targets.

The gun density index developed in Section D is included in the robbery equation primarily as a measure of gun availability to robbers. One possible objection to including this variable as a determinant of the robbery rate is that the legitimate demand for guns (especially *handguns*) is in part motivated by a desire for self-protection against *criminals*.[32] It could therefore be argued that gun density and crime rates are *simultaneously* determined, with gun density influencing crime rates and vice versa. This problem, if present, would leave the proper interpretation of an estimated coefficient on gun density in a crime equation in doubt. However, this simultaneity argument is only a problem in the present context if guns are purchased for defense against *robbery*. This may be the case for store owners, but it is unlikely that the typical gun buyer who seeks protection for his home is concerned about robbery (most of which occurs on the street) so much as *burglary*—criminal intrusions into the home. If the threat of being robbed has little effect on the overall demand for guns, the simultaneity problem is not serious. It is certainly true that robbery is not the primary determinant of intercity differences in gun density, since the two are *negatively* correlated across cities ($\gamma = -.38$).[33]

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[28] Fn. 5, supra.

[29] Wilson and Boland (1976) use a modification of the published results for victimization survey data for the 26 cities.

[30] Cook (1976).

[31] Ehrlich (1973) uses a similar measure in specifying a robbery regression on state data. His poverty measure is the percent of households in the state with income less than ½ the median in the state.

[32] Clotfelter (1977) finds that the demand for guns is influenced by the overall Index violent crime rate.

[33] See Figure 3.

Ideally we would want to include a measure of the availability of attractive robbery targets in the robbery equation. The measure actually used—the number of stores per capita in the city—is not entirely satisfactory, but can be justified. The extent to which store owners defend themselves against robbery (e.g., by minimizing the amount of cash kept on hand, hiring guards, etc.) depends in part on the probability that the store will be robbed. The robbery victimization rate *per store* will be lower in cities with a high density of stores, other things (including the robbery rate *per* capita) being equal. Thus the arguable effect of an increase in store density is to dilute the robbery rate, thus reducing the incentive to self protect and thereby increasing the attractiveness of stores as robbery targets.[34]

6. Criminal justice system effectiveness

The criminal justice system influences crime rates through a variety of mechanisms, the most important of which are associated with the threat and delivery of punishment. In particular, the deterrence mechanism has been widely studied in the context of explaining interjurisdictional differences in crime rates. A number of studies have reported that differences in the threat of punishment across jurisdictions (states, cities, counties, and even precincts have been used as units of observation of these studies) are negatively correlated with crime rates, and this negative correlation has been interpreted as a result of the deterrence process.[35] However, there are serious methodological problems with these studies. Furthermore, at least two carefully done empirical studies (both using cross-section data on states) have found no evidence that the deterrence effect explains a significant portion of interjurisdiction differences in crime rates.[36] There are at least three possible explanations for the null result reported in these studies: (1) The deterrence effect is very weak; (2) States do not differ very much in the relative effectiveness of their CJS's; or (most likely) (3) The measures of CJS effectiveness used in these and other studies are very inadequate proxies for the underlying dimension of interest.

Because of the serious doubts I have concerning the usual measures of CJF effectiveness,[37] I have used somewhat different variables in the robbery regressions which follow. The only such variable which appears in the final specification[38] is the ratio of FBI Index crimes to the average number of police officers who are actually on patrol at any one time in a city—an indicator of the workload of one sector of the CJS.[39] Presumably the police resources available for the solution of any robbery, and hence police effectiveness, will decline as the overall crime workload increases. Because this CJS effectiveness measure was not available for all cities in the sample, all regressions were run both with and without this variable.

7. Population density

James Q. Wilson and Barbara Boland (1976) gives several possible justifications for including city population density in a regression analysis of robbery including the "opportunity" theory that potential victims are more readily available in dense cities and the "subculture" theory that "dense cities should make it easier for like minded individuals to find and associate with each other under conditions of weak social control and so, by their interaction, intensify any proclivities they may have for criminal activity (p. 224)." Hoch's (1974) experiments with explaining inter-SMSA differences in crime rates found that the log of SMSA population performs better than population density as an explanatory variable, but such was not the case in the present context (see Table 6).

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[34] Cook (1977) presents this argument in greater detail.

[35] See Nagin (1977a) for a review of these studies. A recent example is the paper by Mathieson and Passell (1976).

[36] Forst (1976) and Nagin (1977b).

[37] See Cook (1977b).

[38] I experimented briefly with a variable indicating those states which give the juvenile court jurisdiction over defendants up to a relatively high age (18), but without notable success.

[39] Chaiken (1977) describes the intercity relationship between crime rates and the number of uniformed officers. The variable I use is based on the same data as is used in Wilson and Boland (1977). They report that there is a surprising amount of difference among cities with respect to the fraction of uniformed officers who are actually on patrol at any one time.

TABLE 6.—REGRESSION RESULTS FOR OVERALL CITY ROBBERY RATES, 1975

Independent variables	Log UCR robbery rate per 1,000 (1)	(2)	(3)	(4)	(5)	UCR robbery rate per 1,000 (6)	(7)	Log of victim survey robbery rate per 1,000 (8)	Means for 46 cities [1] (9)
	*Dependent variables								
1. Constant	−0.407 (1.332)	[2] 0.870 (.472)	[2] 0.837 (.450)	[2] 0.847 (.486)	0.784 (.471)	1.53 (2.92)	1.39 (2.84)	[2] −4.73 (.42)	--------
2. Gun density index	.140 (.706)	.341 (.667)	.230 (.637)	.508 (.682)	.411 (.661)	2.60 (4.09)	.95 (3.98)	.882 (.650)	0.579
3. Gun regulation dummy	[3] .256 (.142)	[3] .252 (.135)	[2] .254 (.126)	--------	--------	--------	--------	--------	.196
4. Youthful black males (percent)	[4] .128 (.052)	[3] .114 (.041)	[3] .122 (.044)	[4] .108 (.042)	[4] .116 (.046)	[2] .467 (.255)	[4] .637 (.278)	.0197 (.0328)	2.55
5. Population per square mile (1,000's)	[2] .0358 (.0210)	[4] .0453 (.0170)	[3] .0448 (.0157)	[3] .0577 (.0161)	[3] .0575 (.0151)	[3] .338 (.097)	[3] .315 (.091)	[3] .0480 (.0150)	7.00
6. Fraction of SMSA in city	[4] −.861 (.389)	[3] −.972 (.315)	[3] −.971 (.300)	[3] −1.035 (.323)	[3] −1.027 (.313)	[4] −4.48 (1.94)	[4] −3.87 (1.89)	--------	.466
7. Crimes per cop (1,000's)	--------	--------	[4] .855 (.360)	--------	[4] .913 (.376)	--------	[3] 6.82 (2.27)	--------	.291
8. Retail stores per 100 population	.635 (.451)	.418 (.398)	.178 (.373)	.215 (.395)	−.034 (.375)	−1.74 (2.37)	−3.09 (2.26)	--------	.807
9. Fraction in relative poverty	.546 (1.753)	−.101 (1.583)	−.095 (1.573)	.345 (1.615)	.400 (1.629)	12.0 (9.7)	10.0 (9.8)	--------	.219
10. Northeast region dummy	−.185 (.174)	--------	--------	--------	--------	--------	--------	--------	.130
11. Southeast region dummy	−.118 (.143)	--------	--------	--------	--------	--------	--------	--------	.370
12. Western region dummy	.021 (.135)	--------	--------	--------	--------	--------	--------	--------	.217
13. Log population	.0840 (.0951)	--------	--------	--------	--------	--------	--------	--------	13.3
R^2	.825	.804	.858	.786	.839	.774	.830	.458	--------
N	46	46	39	46	39	46	39	25	--------

[1] The mean for independent variable 7 (crimes per cop in 1,000's) is calculated for the 39 cities for which these data were available.
[2] Significant at 10 percent level.
[3] Significant at 1 percent level.
[4] Significant at 5 percent level.

8. *Regional variables*

I experimented with the common practice in cross-section studies of including regional indicators in the regression specification. In spite of the multitude of possible justifications for including these variables, coefficient estimates on regional variables were in all cases statistically insignificant and had little effect on estimates of the coefficients of other variables in the equation. For this reason regression results for specifications which include regional indicators are not reported here, except for one example included in Table 6.

9. *State regulation*

A dummy variable indicating relatively strong state regulation of gun purchasers is included in some of the regressions. In particular, the indicator takes the value one for cities located in states which require purchasers to obtain a permit, and zero otherwise. The cities so indicated are Boston, Buffalo, New York City, Chicago, Detroit, Newark, Baltimore, St. Louis, Kansas City, and Charlotte.

REGRESSION RESULTS FOR THE TOTAL ROBBERY RATE

Table 6 presents results for six alternative regression specifications for explaining intercity differences in the overall UCR robbery rate in 1975. A seventh regression is also included, which utilizes as a dependent variable the National Crime Panel's survey-based measure of the robbery rate for each of 26 cities. The first six regressions differ with respect to functional form and which set of independent variables are included. Results for other regression specifications based on this same collection of variables (not reported here) are qualitatively similar.

The most important concern in the present context is the relationship between gun density and robbery rates. In every regression the estimated coefficient is positive, but statistically insignificant. The conclusion that there is no demonstrable systematic relationship between these two variables could be anticipated from a glance at Figure 3; the scatter plot of robbery rates vs. the gun density index is diffuse and essentially patternless. Since the theoretical discussion in Section C suggested that there is no strong a priori reason to expect either a positive or negative relationship between robbery rates and gun density, these results are not particularly troublesome.

The result which *is* surprising is that cities located in states which have the most stringent regulation on gun purchase have significantly *higher* robbery rates than other cities, *ceteris paribus.*

The next section reports that this positive association obtains for both gun and nongun robbery (see Table 8). Since it is hard to believe that gun regulations cause increases in the robbery rate, one is forced to conclude that there are variables omitted from the regression specifications which influence robbery rates and which are systematically related to the presence of relatively stringent gun regulations

33-D

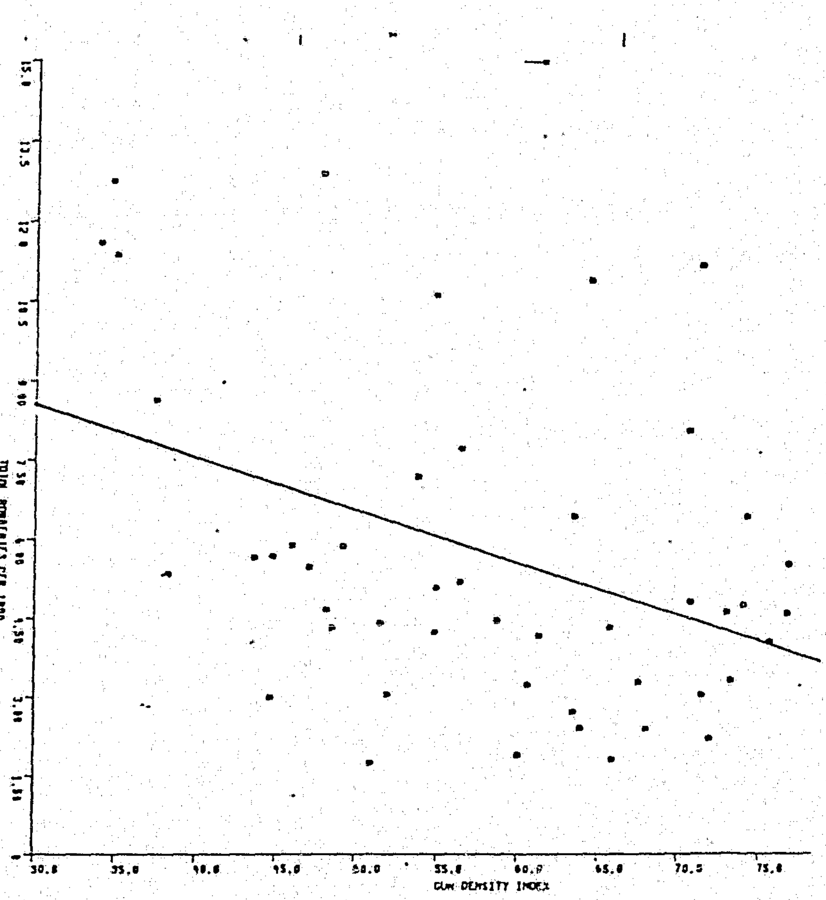

FIGURE 3

TABLE 7.—REGRESSION RESULTS FOR CITY ROBBERY RATES, 1975: THE GUN-NONGUN MIX

Independent variables	Dependent variable—log (gun robberies divided by nongun robberies) (1)	(2)
1. Constant	−0.583	[1] −0.876
	(.456)	(.364)
2. Gun density index	[2] 2.48	[2] 2.63
	(.64)	(.52)
3. Gun regulation dummy	−.145	−.102
	(.130)	(.102)
4. Youthful black males (percent)	[1] .104	[2] .107
	(.040)	(.036)
5. Population/square mile (thousands)	.00715	.00660
	(.01639)	(.01270)
6. Fraction of SMSA in city	−.263	−.235
	(.305)	(.242)
7. Crimes/cop (thousands)		[1] .627
		(.291)
8. Retail stores/100 population	−.508	[1] −.674
	(.385)	(.302)
9. Fraction in relative proverty	−3.30	[1] −2.91
	(1.53)	(1.27)
R^2	.701	.815
N	46	39

[1] Significant at 5-percent level.
[2] Significant at 1 percent level.

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TABLE 8.—REGRESSION RESULTS FOR CITY ROBBERY RATES, 1975: SEPARATE ANALYSES FOR GUN AND NONGUN RATES

Independent variables	Dependent variables: Log gun robbery per 1,000 (1)	(2)	(3)	Gun robbery per 1,000 (4)	(5)	Log nongun robbery per 1,000 (6)	(7)	(8)	Nongun robbery per 1,000 (9)	(10)
1. Constant	−0.101	−0.308	−0.268	0.425	−0.052	0.469	0.546	0.608	1.10	1.45
	(.542)	(.465)	(.455)	(1.789)	(1.468)	(.526)	(.538)	(.512)	(1.64)	(1.78)
2. Gun density index	[1] 1.74	[1] 1.74	[1] 1.60	[1] 5.77	[1] 4.94	−.638	−.816	−1.030	−3.17	−3.98
	(.76)	(.65)	(.64)	(2.51)	(2.06)	(.738)	(.755)	(.724)	(2.30)	(2.50)
3. Gun regulation dummy			.197					[1] .299		
			(.127)					(.143)		
4. Youthful black males (percent)	[1] .160	[2] .172	[2] .176	[1] .365	[1] .524	.0517	.0625	0693	.102	.111
	(.047)	(.046)	(.045)	(.156)	(.144)	(.0458)	(.0527)	(0.502)	(.143)	(.174)
5. Population per square mile (1,000's)	[2] .0559	[2] .0563	[2] .0465	[1] .155	[2] .139	[2] .0559	[2] .0548	[1] .0399	[2] .183000	[2] .175
	(.0179)	(.0149)	(.0159)	(.059)	(.047)	(.0174)	(.0172)	(.054)	(.054)	(.057)
6. Fraction of SMSA in city	[2] −1.16	[2] −1.13	[2] −1.09	[1] −3.01	[1] −2.45	[1] −.937	[1] −.922	−1.47	−1.42	−1.42
	(.36)	(.31)	(.30)	(1.19)	(.98)	(.349)	(.358)	(.341)	(1.09)	(1.18)
7. Crimes per cop (1,000's)		[2] 1.21	[2] 1.17		[2] 5.46		.608	.539		1.36
		(.37)	(.36)		(1.17)		(.429)	(.409)		(1.42)
8. Retail stores per 100 population	−.048	−.383	−.219	−2.12	[1] −3.12	.344	.206	.455	.379	.025
	(.441)	(.370)	(.378)	(1.46)	(1.17)	(.428)	(.429)	(.424)	(1.337)	(1.417)
9. Fraction in relative poverty	−1.45	−1.28	−1.66	−.07	−2.21	2.11	1.83	1.25	[3] 12.1	[3] 12.2
	(1.80)	(1.61)	(1.59)	(5.94)	(5.08)	(1.75)	(1.86)	(1.79)	(5.5)	(6.1)
R^2	.738	.838	.850	.665	.814	.794	.823	.846	.810	.826
N	46	39	39	46	39	46	39	39	46	39

[1] Significant at 5 percent level.
[2] Significant at 1 percent level.
[3] Significant at 10 percent level.

Other coefficient estimates are for the most part in agreement with prior expectations, with the exception of "retail stores/capita" and the relative poverty measure—these two variables have weak and erratic estimated effects on the overall robbery rate.

REGRESSION RESULTS FOR GUN AND NONGUN ROBBERY RATES

Even if gun density is not systematically related to the overall level of robbery in a city, the availability of guns to robbers is still of concern to policymakers if gun density influences robbers' choice of weapons or targets. Figure 4 presents the scatter diagram relating gun density to the fraction of robberies committed with a gun. This diagram illustrates a clear positive association between the two variables. The regression results in Table 7 demonstrate that this association persists when factors which are thought to influence the overall level of robbery are controlled for. Experiments with alternative functional forms, not reported here, yield similar results.

The estimated coefficient on the state gun regulation dummy variable requires some interpretation. Such regulations may affect weapon use in robbery indirectly by causing some reduction of overall gun density in a city. This indirect effect cannot be measured in the present context. The coefficient estimate on the dummy variable serves as a measure of the direct effect of these regulations, holding overall gun density constant. The negative coefficient estimate reported here is compatible with the existence of this direct effect, but the coefficient is not statistically significant.

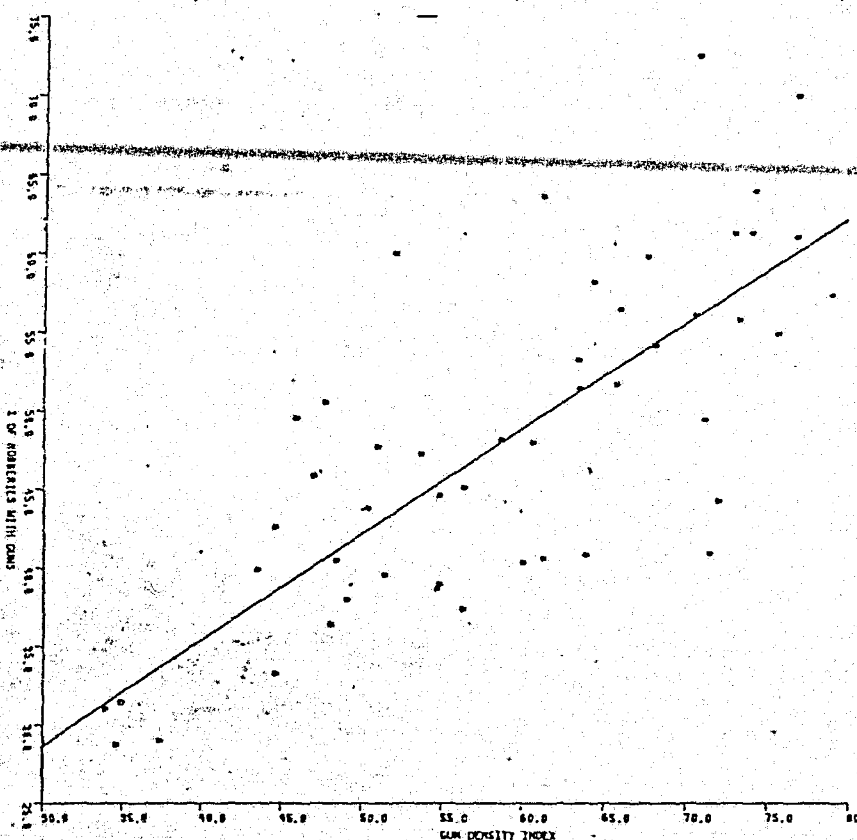

FIGURE 4

Table 8 presents regression results for a number of specifications utilizing gun or nongun robbery rates as the dependant variables. While there are no surprises here,[40] it is useful to make several more observations concerning the measured effect of gun density. First, the gun density coefficients in corresponding pairs of gun and nongun robbery regressions are measured with almost equal precision in every case. The estimated coefficients are significant in the gun robbery regressions and not in the nongun regressions because the estimated coefficients are larger (in absolute value) in the former.

Second, the elasticities associated with the gun density coefficient estimates for both the linear and log-dependant forms of the gun robbery regressions are all close to 1.0. This result can be transformed through a simple calculation to derive an estimate of the elasticity of gun robbery with respect to the percent of households owning a pistol—the answer in all cases is close to .5.[41] *In other words, a 10 percent reduction in the number of pistols in a city is associated with about a 5 percent reduction in the gun robbery rate.*

An analysis of the influence of gun availability on the distribution of robbery targets (commercial vs. noncommercial) did not yield any clear cut results. The theoretical expectation that increasing gun availability should cause a relative increase in commercial robbery rates is not supported by the available data.

The elasticity of gun robbery (GR) with respect to the fraction of households which own a pistol (HG) is given by the formula

$$E_{GR,HG}=\frac{\overline{HG}}{\overline{GR}}\cdot\frac{dGR}{dHG}=\frac{\overline{HG}}{\overline{GR}}\cdot\frac{dGR}{dI}\cdot\frac{dI}{dHG}$$

Now $\overline{GR}=2.6$

$\overline{HG}=-19.0+.63\,\overline{I}$ (from table 5, notes)

where $\overline{I}=57.8$, therefore $\overline{HG}=17.4$

From equation 1 of table 8, $\frac{dGR}{dI}=.049$ and, as noted above, the relationship between HG and I has slope .63. Therefore,

$$E_{GR,HR}=\frac{17.4}{2.6}\cdot\frac{.049}{.63}=.52$$

Using the log form (Equation 1) the elasticity expression becomes

$$E_{GR,HG}=\frac{.017(17.4)}{.63}=.47$$

Conclusions from the findings presented in Tables 6, 7 and 8 can be briefly summarized. Both gun density and robbery rates differ widely among the cities in the sample, but there is little if any relationship between the two variables. The zero order correlation is slightly negative and the partial correlations in a variety of multivariate specifications are all slightly positive. An increase in gun density is associated with some substitution of guns for other weapons in robbery. High gun density cities tend to have relatively high gun robbery rates and relatively low nongun robbery rates, whether or not other factors are controlled for in the analysis. The possible importance of this result is evaluated in the next section.

F. ROBBERY MURDERS

The evidence presented above suggests that the overall density of gun ownership in a city has little influence on the city's robbery rate, but a strong effect on the fraction of robberies which involve a gun. The propensity of robbers to use guns rather than other weapons is of concern to the extent that the type of weapon influences the outcome of the robbery. The weapon-related differences in outcome, documented above, include differences in the fractions of robberies which result in injury, and death of the victim. This section focuses on the issue of robbery murder. Is it true that the increase in gun robberies associated with an increase in gun density causes a concomitant increase in the robbery murder rate?

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[40] The sum of the coefficient estimates for each independent variable in the linear forms of the gun and nongun regressions is necessarily equal to the corresponding coefficient estimates for the linear form of the total robbery equation with the same specification (in Table 6).

[41] The elasticity calculations are made using the means of the relevant variables; the gun density index has a mean of 57.8 over the 40 cities in this sample, and the gun robbery rate has a mean of 2.60/1000 population.

The relationship between the typical robbery and the relatively few events which are classified by UCR at "robbery murders" is not well understood.[42] Weapon use in robbery, and indeed the overall robbery rate, will only influence the robbery murder rate if robbery murders are closely related to the typical robbery in which the victim is not killed. The following hypothetical examples illustrate some of the possible relationships between robberies and robbery murders:

Example 1: A robber holds up a liquor store with a gun, demanding cash. When the clerk reaches under the counter as if to set off an alarm or pick up a gun, the robber panics and shoots and kills the clerk.

Example 2: A man enters a liquor store, shoots and kills the clerk without speaking, and then empties the cash register.[43]

Example 3: One man shoots and kills another following a drunken argument. As an afterthought, the killer takes the victim's wallet.

All three of these cases would most likely be officially classified as robbery murders. The examples differ dramatically in terms of the relationship between the two elements of the crime: the theft, and the murder. If the robbery murder statistics are dominated by cases similar to example 3, then it is appropriate to view robbery murder as more murder than robbery; in this case, we would expect variations in robbery rates to have little relationship to variations in the robbery murder rate. At the other extreme, as in example 1, is the possibility of murder as an accidental outcome of the instrumental violence (or threat thereof) which is an element of every robbery. The rate of such "accidental" robbery murders may be influenced by the composition of robberies with respect to weapon use, circumstances, etc.; holding such factors constant, we would expect the robbery murder rate to vary proportionately with the overall robbery rate.

The crucial distinction between examples 1 and 3 is in terms of whether the primary motive of the assailant is to injure the victim or to steal from him. The criminal's behavior in example 2 can be viewed as the result of a combination of the two motives; the violent act may be an end in itself, as well as a means for completing the theft successfully. There is indirect evidence that a large proportion of robberies which result in the victim's serious injury do involve greater than "necessary" levels of violence, suggesting that violence in such cases is not simply a means of obtaining compliance from the robbery victim.[44] To the extent that the level of violence used in robbery is partially determined by the robber's personality, rather than by instrumental considerations alone, the relationship between the typical robbery and those robberies which result in the victim's death becomes rather complex. The robbery death rate will be influenced by the robbery rate, but also by the distribution of "violence proneness" among robbers.

Regression results reported in Table 9 suggest that there is a tight link between the rates of robbery and robbery murder across the 50 cities in the current sample. The correlation between the gun robbery murder rate and the gun robbery rate is .90, and the correlation for the nongun case is .76. These results are supported by Zimring's time series analysis of Detroit data.[45] They are strong evidence for rejecting the scenario suggested by example 3 as typical of robbery murders.

Equation 4 includes the murder rate (net of felony murder) which can be viewed as a further test of the possibility that robbery murder is "more murder than robbery" in the sense discussed above. The coefficient estimate is positive but not significant at the 10 percent level, and the two robbery rate variables continue to be significant and important explanations of robbery murder.

The natural inference from these results is that robbery murders are the probabilistic result of robberies. The coefficient estimates in equation 1 and 2 suggest that an additional 1000 gun robberies result in 6.6–8.8 additional robbery murders, whereas an additional 1000 nongun murders result in 1.6–2.6 additional robbery murders. Since the constant terms are not significantly different from zero, the results are compatible with the simple model suggested by example 1: every robbery involving a given type of weapon has the same probability of resulting

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[42] Whether a murder involved a robbery or not must be inferred from the circumstances. If there are no eyewitnesses available. While robbery murders in commercial locations may be easily classified correctly in most cases, the problems are presumably much greater for street robberies.

[43] This example is modeled on a real incident in Houston described by Lundsgaarde, p. 138.

[44] Cook and Nagin report a number of relevant findings from the National Crime Panel victimizations surveys in 26 cities. For example, only 25 percent of the victims who were seriously injured in gun robberies attempted any sort of physical resistance (fleeing or hitting the robber). The corresponding fraction is 33 percent for unarmed robberies.

[45] Zimring (1977) finds that for Detroit the ratio of robbery murder to robberies by type of weapon is virtually constant from year to year during the 1960's. This finding reinforces my proportionality finding for cross-section data. However, Zimring finds that there was tremendous jump in this ratio during 1971 and 1972 for each type of weapons. This change has not been explained as yet.

in the victim's death. This probability is about three times as high for gun robberies as for nongun robberies. An alternative view of the results—one which is more compatible with the evidence discussed above—is that the dangerousness of a robbery depends on the violence proneness of the robber, the robbery circumstances, and perhaps other factors, but that the distribution of these factors is independent of the robbery rates across cities.

An alternative approach to estimating weapons effects in robbery is to regress the fraction of robberies which result in death on the fraction of robberies which involve guns. If the number of murders is in fact, strictly proportional to the number of robberies of each weapon type, then the constant in this regression term can be interpreted as the likelihood of death in a nongun murder, and the coefficient as the difference between the likelihood of death in gun and nongun robberies.[46] The results of this equation indicate that the fraction of robberies involving guns explains a small but significant percentage of the intercity variance in the robbery murder/robbery ratio. The point estimate for the likelihood of death in a gun robbery is 7.2/1000, which is close to the estimate generated by equation 1.

$$\frac{\text{Robbery murders}}{\text{1000 robberies}} = \underset{(1.16)}{1.52} + \underset{(2.38)}{5.68}\ \frac{\text{Gun robberies}}{\text{Robberies}}\quad R^2 = .113$$

We can infer the effect on the robbery murder rate of a reduction in city gun density by combining the results from Tables 8 and 9. For example, using gun density coefficient estimates from linear equations 5 and 10 in Table 8, and the coefficient estimates from equation 3 of Table 9, a straightforward calculation[47] yields the following result: *a 10 percent reduction in the number of pistols in a city is associated with about a 4.2 percent reduction in the number of robbery murders.*

An alternative approach to estimating the effect of gun availability on the robbery murder rate is to calculate the "reduced form" regressions, presented in Table 10. The results of these regressions are very similar to the gun robbery regression results in Table 8; this similarity is not surprising given the high correlation between the gun robbery rate and the robbery murder rate, and the fact that the two variables by coincidence have the same mean. Based on the regression results in Table 10, equation 3, a 10 percent reduction in the number of pistols is associated with a reduction in the robbery murder rate by about 5 percent.

TABLE 9.—ROBBERY MURDER RATE AS A FUNCTION OF THE ROBBERY RATE REGRESSION RESULTS

Dependent variable	Constant	Gun robbery rate per 1,000	Nongun robbery rate per 1,000	Assault murder rate per 1,000	R^2	R
1. Gun robbery murder rate per 100,000 [1]	−0.239 (.174)	[2] 0.773 (.056)			0.81	47
2. Nongun robbery murder rate per 100,000 [1]	.081 (.098)		[2] 0.211 (.027)		.58	47
3. Total robbery murder rate per 100,000 [1]	−.284 (.232)	[2] .907 (.089)	[3] .136 (.072)		.82	47
4. Total robbery murder rate per 100,000 [1]	[3] −.463 (.255)	[2] .741 (.138)	[3] .138 (.071)	0.359 (.230)	.83	47

[1] 1974-75 average.
[2] Significant at 1-percent level.
[3] Significant at 10-percent level.

Note: Standard errors in parentheses.

[46] Suppose

$$M = aG + bN = aG + b(R - G)$$

where M-number of robbery murders
G, N-number of gun (no gun) robberies
R-number of robberies

Dividing through by R and rearranging terms yields

$$\frac{M}{R} = (a-b)\frac{G}{R} + b$$

[47] The calculation of the elasticity here is similar to the procedure explained in fn. 42 supra.

TABLE 10.—ROBBERY MURDER RATE PER 1,000 RESIDENTS[1]—REGRESSION RESULTS

Independent variables	Log robbery murder rate		Robbery murder rate	
	(1)	(2)	(3)	(4)
1. Constant	[3] −1.696 (.849)	−1.485 (.898)	−0.728 (1.879)	−0.942 (1.951)
2. Gun density index	[2] 2.08 (1.20)	1.70 (1.28)	[3] 5.92 (2.66)	[2] 4.90 (2.78)
3. Youthful black males (percent)	[4] .229 (.076)	[4] .292 (.093)	[4] .462 (.169)	[4] .689 (.202)
4. Population/square mile (thousands)	[3] .0736 (.0282)	[3] .0731 (.0288)	[4] .208 (.062)	[4] .195 (.063)
5. Fraction of SMSA in city	−9.03 (.581)	−.954 (.619)	[2] −2.49 (1.29)	−1.90 (1.35)
6. Crimes/cop (thousands)		.843 (.722)		[3] 3.94 (1.57)
7. Retail stores per 100 population	.690 (.708)	.716 (.734)	−1.76 (1.57)	−1.82 (1.59)
8. Fraction in relative poverty	−.510 (2.796)	−2.38 (3.09)	−1.05 (6.19)	−5.79 (6.71)
R^2	.689	.730	.718	.767
N	45	38	45	38

[1] 1974–75 average.
[2] Significant at 10 percent level.
[3] Significant at 5 percent level.
[4] Significant at 1 percent level.

Note: Standard errors in parentheses.

G. CONCLUSIONS

The conclusions reached from the theoretical and empirical analysis in this paper are of course tentative, and subject to a variety of possible sources of error. Some findings appear in my judgment to be more robust and more strongly supported by the data than others, and hence deserving of greater confidence. These "strong" findings are summarized first, followed by a summary of the weaker findings and a discussion of the proper interpretation of the findings relating to the effects of gun density.

Strong findings

1. The proxy measure of the density of gun ownership in the 50 largest cities, discussed in section C, has a strong claim to validity for cross-section studies. It is the first serious effort to develop such a measure, and should be valuable in a variety of research contexts.

2. The fraction of robberies which involve guns is closely (positively) related to the overall density of gun ownership in a city.

3. Murders which are classified as robbery murders by UCR occur at a rate that is closely linked to the robbery rate. Therefore, it would appear that robbery murder is an outcome (in a probabilistic sense) of encounters which were motivated in some important sense by theft; that is, robbery murders are similar in that respect to robberies. About three times as many gun robberies result in the victim's death as is true for nongun robberies. Gun robbery murders are roughly proportional to gun robberies across cities, and nongun robbery murders are roughly proportional to nongun robberies. There is a strong case, then, for the claim that an increase in the proportion of robberies with guns will increase the ratio of robbery murders to robberies. There is some evidence that a relative increase in the use of guns in robbery may *reduce* the victim injury rate, but this possibility could not be thoroughly analyzed.

Other findings

4. The density of gun ownership among city residents is not an important determinant of the city's robbery rate. This finding is subject to doubt primarily because it is possible that an important relationship does exist but is being obscured in the present sample by the effect of some unknown factors which have been excluded from the regression specifications. This possibility is of less concern in evaluating finding 2, to the extent that the unknown factors tend to have the same proportional effect on gun and nongun robbery. (The intercity correlation between gun and nongun robbery rates is .60, suggesting that the etiology of gun and nongun robbery is similar.)

5. An increase in the density of gun ownership is associated with an increase in the gun robbery rate, and a corresponding increase in the rate of robbery murder.

6. Differences in gun density have little measureable effect on robbers' choice of targets as between commercial and noncommercial alternatives. A number of other dimensions of target choice are of interest, but were not investigated here due to data limitations.

7. State regulations requiring purchase permits have little if any direct effect on the robbers' choice of weapon. These regulations may have an indirect effect by reducing overall gun density, but this possibility was not explored here. One of several problems in evaluating this conclusion is that there was no attempt to take the quality of the state's implementation mechanisms into account in measuring the effect of a purchase permit requirement.

Interpretation

The extent of gun ownership in a city is reasonably viewed as an important determinant of whether actual and potential robbers will acquire guns. First, guns are arguably more readily available in the "grey" and black markets in cities where gun ownership is widespread. Second, there is no reason to believe that criminals acquire guns only for specifically criminal purposes—if robbers are similar to other residents of their city with respect to their valuation of a gun's uses in noncriminal activities, then robbers' demand for guns will be relatively high in high density cities. The cost of a gun net of this value in noncriminal uses will hence be lower in high density cities. While it is not possible to sort out these supply and demand effects, they both point towards the conclusion that a relatively high fraction of robbers will be armed in high density cities. A policy which was successful in increasing the net cost of acquiring a gun for use in robbery will then reduce the fraction of robberies committed with a gun. Given the empirical results reported here, this reduction in gun use would have little effect on the overall robbery rate, but would reduce the robbery murder rate.

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APPENDIX A

CONSTRUCTION OF THE CITY GUN DENSITY INDEX

The city gun density index for city i is defined as

$$100 \cdot \frac{1}{2}\left(\frac{GS_i}{S_i}+\frac{GM_i}{M_i}\right)$$

where

S_i = the number of suicides committed during 1973 and 1974 in city i

GS_i = the number of suicides committed with a firearm in 1973 and 1974 in city i

M_i = the number of murders committed during 1973–1975 in city i, excluding murders committed in the context of arson, rape or robbery

GM_i = the number of murders (as above) committed with a firearm.

Table A–1 gives the data from which the index is calculated. This table also includes the gun accident fatality rate for 1973 and 1974 combined (i.e., the percent of the city's population killed in a gun accident during 1973 or 1974).

The source for the suicide and gun accident data is the Vital Statistics death files for 1973 and 1974, compiled by the National Center for Health Statistics. A detailed description of computation procedures is available from the author.

The source for the murder data is a special homicide data file constructed by the FBI. This file includes a brief description of each of the homicides reported to the FBI by police departments in the 50 largest cities for a number of years.

The intercity correlations between the gun accident fatality rate, the percent suicides with gun, and the percent homicides with gun are as follows:

Gun accident fatality rate:

- Percent suicides with gun .... .16
- Percent homicides with gun .... .04

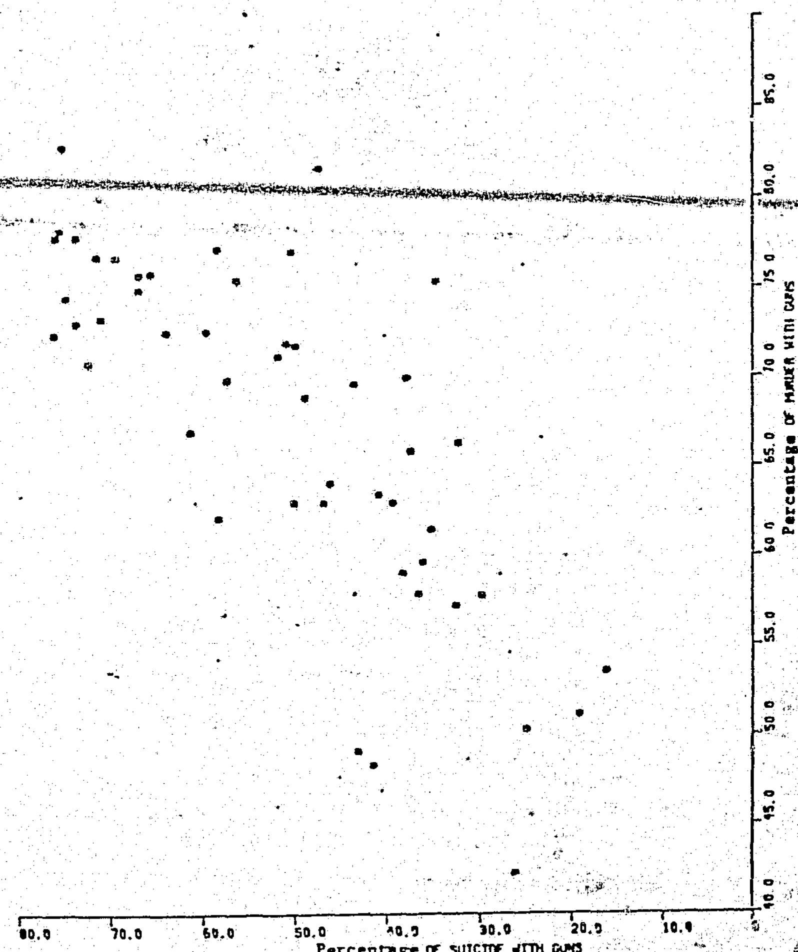
Percent suicide with gun .... .82

TABLE A-1.—COMPONENTS OF THE GUN DENSITY INDEX

	Gun index	Number of suicides, 1973–74 average	Number of gun suicides	Percent of suicide with gun	Number of murders, 1973–74 average	Number of gun murders	Percent of murder with gun
Newark	33.7	14	55	25.4	115	48	41.9
Boston	34.3	19	123	15.4	103	55	53.2
New York	34.6	184	998	18.4	1,385	704	50.8
San Francisco	37.1	103	425	24.2	110	55	50.0
Philadelphia	43.3	143	493	29.0	351	202	57.5
San Diego	44.3	118	290	40.6	51	25	48.1
Buffalo	44.4	22	69	31.8	48	27	56.9
Long Beach	45.5	72	170	42.3	42	20	48.8
Los Angeles	46.7	392	1,092	35.8	424	244	57.6
Washington	47.3	58	164	35.3	213	127	59.4
Minneapolis	47.8	41	119	34.4	34	21	61.2
Seattle	48.1	78	208	37.5	48	28	58.7
Pittsburgh	48.8	42	133	31.5	50	33	66.0
San Jose	50.6	67	174	38.5	28	17	62.7
Toledo	51.1	195	527	36.6	40	26	65.5
Milwaukee	51.6	88	191	40.0	53	34	63.1
Chicago	53.3	78	195	37.0	683	476	69.6
Baltimore	54.3	68	150	46.0	230	144	62.7
St. Paul	54.4	18	53	33.9	16	12	75.0
Portland	54.5	48	131	45.3	30	19	63.7
Denver	56.0	59	119	49.3	75	47	62.7
Miami	56.0	71	166	42.7	68	47	69.3
Indianapolis	58.3	88	183	48.0	70	48	68.6
Austin	59.7	42	73	57.5	25	16	61.8
Omaha	60.3	30	61	49.1	30	22	71.4
Detroit	60.8	181	361	50.1	517	370	71.6
Cincinnati	60.9	72	141	51.0	58	41	70.9
Kansas City	63.0	78	138	56.5	84	59	69.6
Oklahoma City	63.1	106	215	49.5	44	34	76.7

TABLE A-1.—COMPONENTS OF THE GUN DENSITY INDEX—Continued

	Gun index	Number of suicides, 1973–74 average	Number of gun suicides	Percent of suicide with gun	Number of murders, 1973–74 average	Number of gun murders	Percent of murder with gun
El Paso	63.5	55	91	60.4	19	13	66.7
Cleveland	63.9	107	230	46.5	252	205	81.3
Columbus	65.3	75	135	55.5	56	42	75.1
Tulsa	65.5	70	119	58.8	28	20	72.3
Charlotte	67.2	42	73	57.5	58	44	76.9
San Antonio	67.7	108	171	63.1	127	92	72.3
Atlanta	70.2	96	148	64.8	210	158	75.5
Houston	70.4	282	426	66.1	280	209	74.6
St. Louis	70.8	84	127	66.1	190	143	75.4
Phoenix	71.1	167	233	71.6	71	50	70.6
Tucson	71.6	92	131	70.2	21	15	73.0
Louisville	72.5	68	99	68.6	69	53	76.4
Jacksonville	72.8	124	170	72.9	91	66	72.8
Memphis	73.6	104	147	70.7	116	89	76.5
New Orleans	73.8	83	110	75.4	169	122	72.2
Fort Worth	74.2	83	112	74.1	75	56	74.2
Dallas	75.3	179	245	73.0	199	155	77.6
Nashville	76.4	95	127	74.8	85	66	78.0
Birmingham	76.5	58	77	75.3	67	52	77.6
Baton Rouge	78.6	41	55	74.5	23	19	82.6



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