Estimation of Individual Crime Rates From Arrest Records

by

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1.0 INTRODUCTION

This paper addresses a matter of fundamental concern for understanding and controlling crime, namely patterns of individual criminality. Despite an enormous volume of research into the causes and prevention of crime, we still know amazingly little about the progress of individual criminal careers. In particular, we do not know the number of crimes an individual commits each year - the individual crime rate - and how that rate changes as a person ages and/or accumulates a criminal record. Such knowledge about individual criminal careers is absolutely basic to our understanding of individual criminality, particularly our understanding of how various social factors may operate on the individual either to encourage or inhibit criminal activity.

Basic knowledge about individual criminality also has immediate practical import in terms of developing effective crime control policies. For example, incapacitation - or physically preventing the crimes of an offender (e.g., through incarceration) - has recently emerged as a popular crime control strategy. The benefits derived from incapacitation in terms of the number of crimes prevented, however, vary greatly with the magnitude of individual crime rates.* The higher an individual's crime rate, the more crimes that can be averted through his incapacitation.

The variation in individual crime rates during a criminal career has important implications for developing an incapacitation policy. For example, one incapacitative strategy calls for more certain and longer imprisonment for offenders with

*See, for example, Shinnar and Shinnar (1975) and Cohen (1978) for a development of the relationship between individual crime rates and incapacitative effects.

prior criminal records. If individual crime rates decrease as a criminal career progresses, then there are comparatively smaller crime-reduction benefits associated with incapacitating criminals when they are already well into their criminal careers and are committing fewer crimes. Clearly, evaluating the crime control effectiveness of various incapacitation strategies requires information about the patterns of individual criminality during a career.

The fact that we still lack this very basic knowledge about such a fundamental variable is testimony to the enormous difficulties in measuring individual crime rates. These difficulties arise because the crimes an individual commits are not directly observable. Two approaches are available for estimating individual crime rates, one using self-reports obtained from offenders and the other involving the analysis of recorded arrest histories. Each approach has its limitations, but we can hope that by using both approaches on independent data sets we can converge to the best estimates of individual crime rates.

The self-reports are subject to inevitable response biases arising from simple memory recall problems as well as from deliberate efforts to mislead.* The self-report approach is currently being used in a comprehensive study of habitual offenders by the Rand Corporation.** The analysis of presumably more reliable arrest histories, on the other hand, must invoke various assumptions about the arrest process in order to infer conclusions about the unobserved crimes from data on the observed arrests.***

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*Reiss (1973) provides a comprehensive review of the problems associated with self-report techniques.

**The intermediate results of this project are reported in Petersilia et al (1977) and Braiker, et al (1978).

***One of these assumptions is that false arrests are relatively rare, so that arrests are indeed directly linked to crimes committed. Another is that the probability of arrest for a crime is the same for all offenders. This is a strong prior assumption that ignores the possibility of a core of highly professional criminals who commit crimes at a high rate but who have low probabilities of arrest for a crime.

In this paper, we analyze arrest histories in order to uncover patterns in individual arrest rates during a criminal career. The implication of these results for inferences about individual crime rates are explored using various assumptions about the relationship between crime rates and the apprehension process. The estimates of individual crime rates derived here from arrest histories are then compared to estimates generated from the analysis of self-reports.

2.0 PRIOR RESEARCH ON CRIMINAL CAREERS

Prior research on criminal careers is largely limited to case studies and biographical or auto-biographical sketches which are useful for their uniqueness rather than as characterizations of the typical offender.* The major exceptions are the Gluecks' longitudinal studies of criminal careers in the 1920's (Glueck & Glueck, 1937; Glueck & Glueck, 1940) and the Wolfgang, et al (1972) study of delinquency in a birth cohort. Another major source of data on adult careers is the FBI Careers in Crime File. Some analysis of this data is published in the staff report of the President's Commission on the Causes and Prevention of Violence (Mulvihill, et al, 1969).

Even these studies, however, address only limited aspects of a criminal career, principally the patterns of crime-type switching between arrests. There is also some attention to variations in criminal activity with age, but the analysis is typically restricted to the percentage distribution of total arrests over the different age categories and the arrest rate per total population at different ages. These statistics indicate a high incidence of arrests for teenagers. As indicated in Figure 1, for example, while population arrest rates have changed in absolute magnitude over time (almost doubling between 1965 and 1976), the same pattern has persisted for the relative magnitudes of the different age groups, with 15-17 year-olds having the highest arrest rates per population of any age group.

*Some of the classics among these studies are Booth (1929), Shaw (1930 and 1931), Sutherland (1937) and Martin (1952).

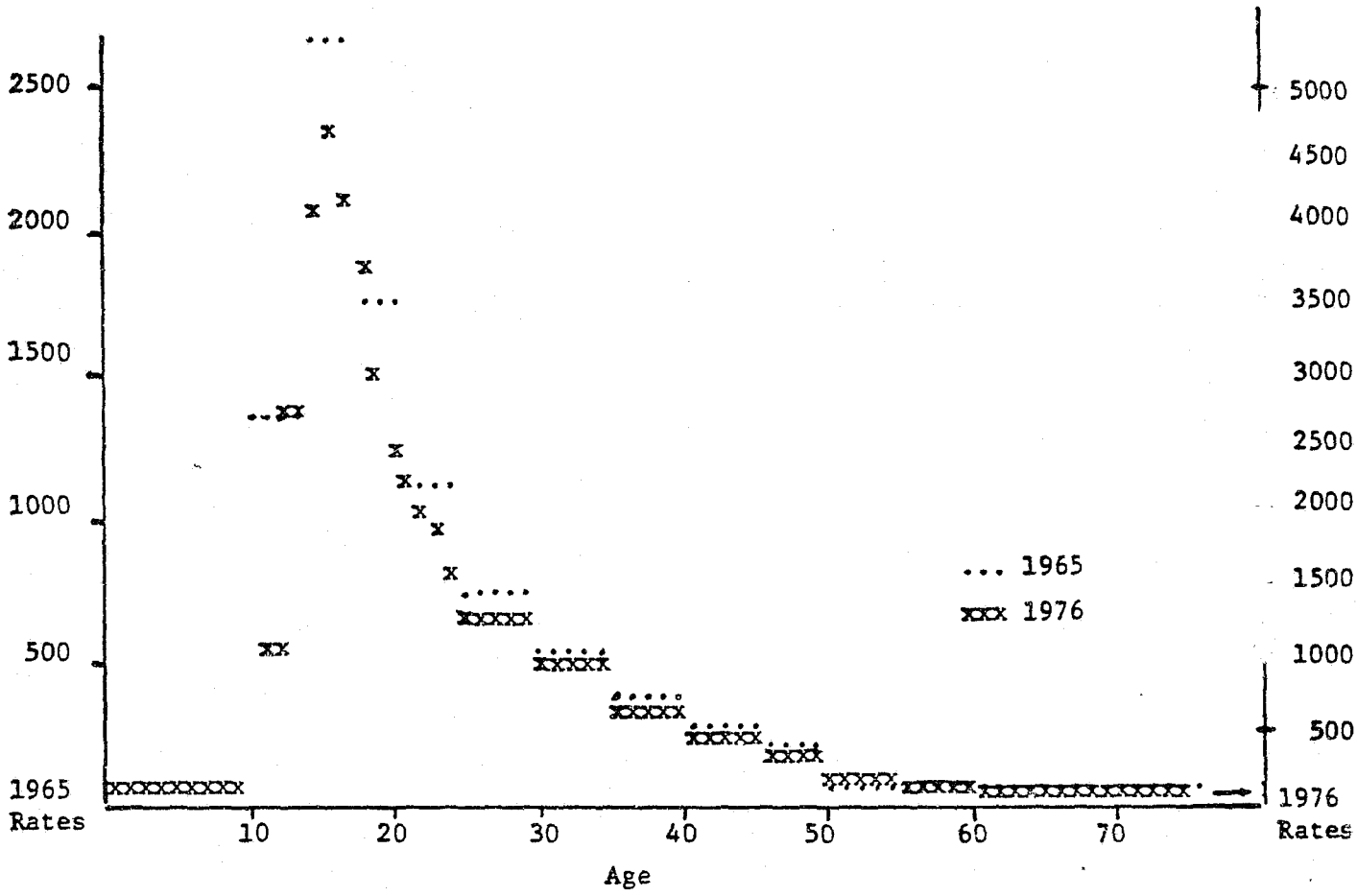

Figure 1

Arrests for Index Crimes/100,000 Population by Age*

*The 1965 arrest rates are taken from Table 1 of The Challenge of Crime in a Free Society (p. 56). For 1976 the number of reported arrests by age come from Table 32, Uniform Crime Reports: 1976. Population estimates by age for 1976 are available in Bulletin 643 of the Current Population Reports.

Not all police agencies report arrests to the FBI; in 1976, arrests were ported for an estimated population of 175,499,000, or 82.6% of the estimated total population of 212,420,000 in 1976. To estimate arrest rates per population, we take the ratio of reported arrests to 82.6% of the total population in each age group. This amounts to assuming that the age distribution of the population in the jurisdicitons reporting to the FBI is essentially the same as the age distribution of the total population in 1976.

The Gluecks (1937 and 1940) also found a steady decrease in the proportion of criminals who were still active offenders during successive follow-up periods. This was taken as evidence of an increasing drop-out from criminal activities with the passage of time.

These results have served as the basis for the hypothesis that individual criminality declines with age, perhaps because of the aging process and its associated increased maturity and/or declining vigor. The Gluecks' "age of onset" theory represents a further refinement of this hypothesis, where the time until criminal activity ceases is determined as some interval after the start of a career rather than an explicit function of chronological age.

The available findings of an aging effect, however, are based on measures of the incidence of arrests in the total population. They may result from changes either in the individual arrest rates of offenders with age, or in the number of persons actively engaging in crime at any age. To the extent that the arrest patterns that have been observed (e.g., Figure 1) are due to variations in the size of the criminal population at each age, these patterns do not necessarily reflect variations with age in the rate of criminal activity of active criminals.

The size of the active criminal population at any age will be affected by variations in the age of onset of criminal activities and in the age of drop-out from criminal activities. Data are available on the age of onset of crime by age. In a study of recidivism Belkin, et al (1973) combined data on juveniles from the Philadelphia cohort (Wolfgang, et al, 1972) with estimates for adults (Christiansen, 1967) to yield the probability of first arrest by age. As indicated by the solid line in Figure 2, the probability of beginning a criminal career varies with age, first increasing rapidly to a peak in the middle teens and then falling off, especially after age eighteen. Applying these probabilities to population estimates for

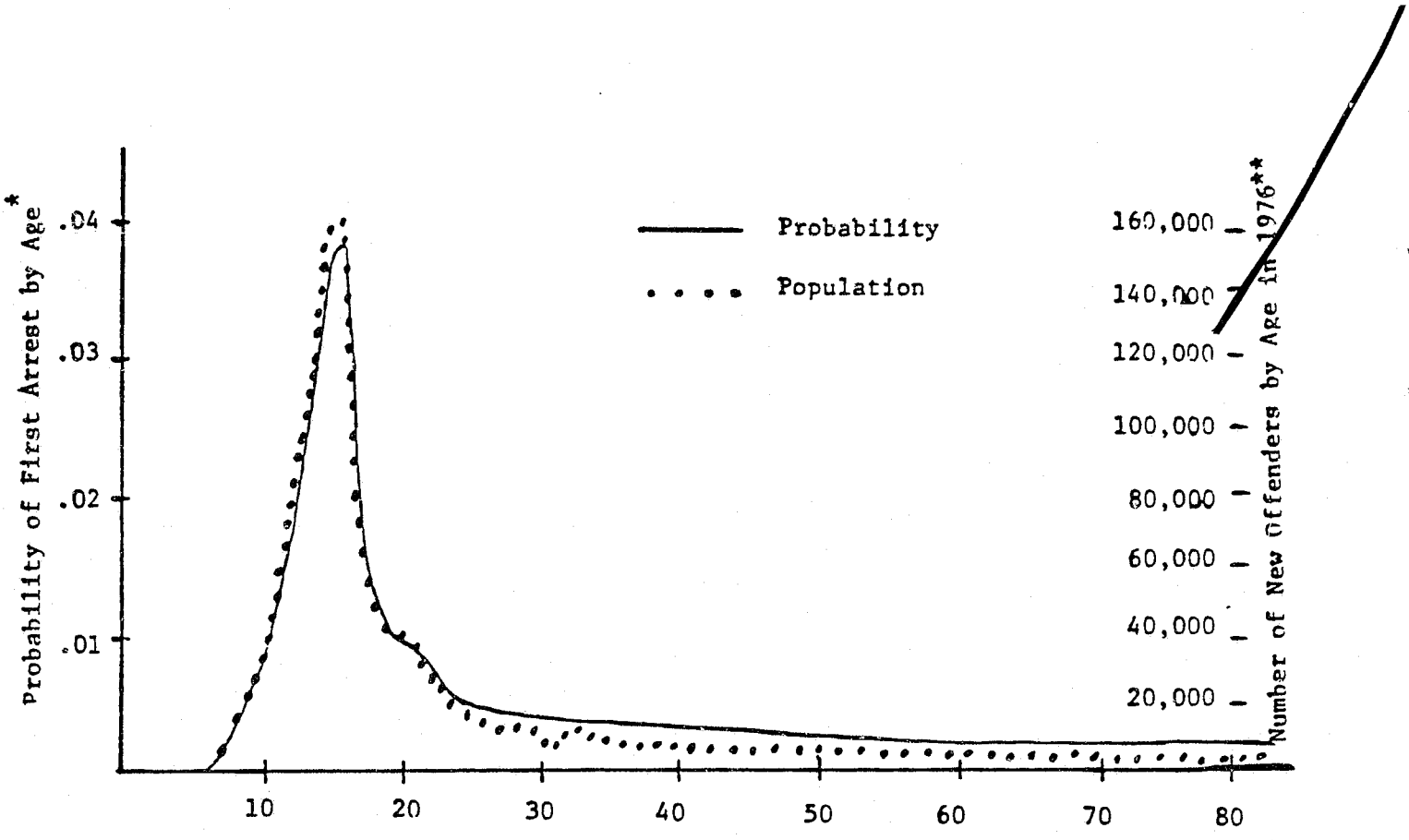

Figure 2

Incidence of First Arrests by Age

*Source: Belkin, et al (1973), Figure 4.

**Estimated by applying the probability of first arrest by age to the population estimates for each age in 1976. (U.S. Bureau of Census, Current Population Reports, Series P-25 No. 643.)

1976* we can estimate the number of people beginning criminal careers at each age in 1976. As indicated by the dotted line in Figure 2, there are many more people beginning criminal careers during the middle teens than at any other age.

Additional evidence is available suggesting that many of those people beginning criminal careers drop out of criminal activities very quickly.** Combining this phenomenon of early drop-out with the distribution for the age of onset in Figure 2 suggests that there will be a bulge in the criminal population around those ages with the greatest input (the middle teens). These also happen to be the ages with the highest arrest rates per capita (Figure 1).

These considerations thus suggest that the variation in age-specific arrest rates observed in Figure 1 reflects a variation in the size of the criminal population for different ages more than a variation in individual arrest rates with age. In other words, an individual offender in the 15-17 age group may not be subject to any more arrests in a year than an offender in any other age group. There may simply be a higher proportion of offenders among 15-17 year-olds than among other age groups. To isolate variations in individual arrest rates during a criminal career, we must explicitly control for the size of the active criminal population generating the arrests at any time.

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*Bureau of Census, Current Population Reports, Series P-25, No. 643.

**Wolfgang, et al (1972, p. 160) report substantial drop-out after only one arrest for juveniles (46.4%). In a separate analysis of the length of adult criminal careers, Greene (1977, Chap. 2) reports a good fit for exponentially distributed career lengths with a mean of 11.87 years. With such a distribution, more than one-third of the offenders would end their criminal careers within five years.

The intensity of individual criminal activity has also been of central concern in estimating the crime-control effects of incapacitation. The literature on incapacitation contains some attempts to estimate empirically the magnitude of individual crime rates.* These researchers, however, only attempt to develop overall average rates for the criminal population as a whole. There is no effort to develop separate estimates for different periods during a criminal career.

In addition to considering the beginning and end of a criminal career, these researchers emphasize the importance of eliminating time served in prison or jail when estimating individual crime or arrest rates. Since an otherwise active offender is incapacitated during those time intervals, they should not be included when estimating individual crime rates. The actual intensity of individual criminal activity is the crime rate while free. Failure to exclude any time served will thus lead to underestimates of the individual crime rates. The magnitude of this bias, of course, will depend on the extent of time served; the less time that is actually served, the smaller the bias in the estimate of individual crime rates.

In this paper, we want to isolate variations in the intensity of individual criminal activity during a criminal career from variations in the size of the offending population. The appropriate unit of analysis for the study is a sample of offenders who are currently involved in criminal activity.

3.0 DATA

The data to be used here are from the FBI computerized criminal history file and include the adult criminal records (through early 1975) of all those individuals arrested for homicide, rape, robbery, aggravated assault, burglary,

*See, for example, Clarke (1974), Greenberg (1975) and Greene (1977). Several of these estimates are critically discussed and compared in Cohen (1978).

Table 1

Comparison of Washington, D.C. Arrestees
With Arrests in General for 1973

	1973 Washington, D.C. Arrestees	1973 UCR Arrests for Cities	
		Total	Persons ≥ 18
RACE:			
White	8.1%	69.0%	
Non-White	91.8%	31.0%	
SEX:			
Male	89.7%	84.4%	
Female	10.3%	15.6%	
AGE:			
<18	0.1%	26.5%	———
18-20	18.6%	13.9%	18.9%
21-24	24.4%	14.1%	19.2%
25-29	19.9%	10.5%	14.3%
30-34	12.3%	7.5%	10.2%
35-39	8.4%	6.1%	8.3%
40-44	5.0%	5.8%	7.9%
45-49	4.6%	5.3%	7.2%
≥50	6.7%	10.0%	13.6%

*Federal Bureau of Investigation (1974) Uniform Crime Reports: 1973 (Washington, D.C.: U.S. Government Printing Office), Table 32.

or auto theft in Washington, D.C. during 1973.* The data include the adult arrest histories of those 5,338 offenders, and include records for 32,868 arrests.** Despite the large size and richness of the dataset, there are some features of the data that limit the generality of the results to the U.S. as a whole.

The characteristics of the Washington, D.C. arrestees were compared with those of persons included in the reported arrests in the Uniform Crime Reports for 1973. (See Table 1.) The two populations are not directly comparable because persons with more than one arrest are counted more than once in the U.C.R. arrest data. This multiple counting alone, however, would not account for the observed differences. The Washington, D.C. arrestees are clearly not representative of arrestees in U.S. cities in general. Non-whites are heavily over-represented as they are in the general D.C. population***. Juveniles are also under-represented because no FBI records are maintained on them. The arrestees are, however, closer in age to all adult arrestees in 1973, although 21-29 year-olds are over-represented among Washington,D.C. arrestees.+

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*Clarence Kelly, the former Director of the Federal Bureau of Investigation, and James Q. Wilson of Harvard University were instrumental in making these data available.

**An additional 26 offenders were dropped from the data because their records contained serious inconsistencies (e.g., arrest dates occurring before birth dates).

***In the 1970 census, the population of Washington, D.C. was 71% non-white compared to 12.3% non-white for the total urban population of the United States.

+The ages 21-29 are also slightly over-represented in the general Washington, D.C. population. In the 1970 census, 24.1% of the adult D.C. population (> 18 years old) was 21-29 years old, while 20.6% of the adult population in all urbanized areas of the U.S. was in this age category.

Using the 1970 population figures, the ratio of the proportion of adult arrestees to the proportion of the adult population 21-29 years old is 1.84 in Washington, D.C. compared to 1.63 in all urbanized areas of the U.S. Thus, the age distribution of the population combined with the higher arrest rate per capita of 21-29 year olds accounts for most of the excess in arrests for 21-29 year olds in Washington, D.C.

It should also be noted that the arrestees to be used here are not drawn randomly from the population of offenders, and indeed there is no reasonable way of generating such a random sample. We can only identify those offenders who come to the attention of the criminal justice system (CJS) through the arrest process. As a result, as long as criminals differ in their crime-committing acitvity and in their vulnerability to arrest, the arrestees in any year cannot be representative of all offenders in general. In particular, offenders who are more criminally active and/or more vulnerable to arrest are more likely to be arrested at least once in a year, and thus they will be over-represented among the arrestees in a year.

The arrestees, however, are representative of those offenders who are detected by the CJS. From the perspective of direct crime control through, say, incapacitation or rehabilitation, we are indeed interested primarily in the criminal behavior of those offenders who <u>are</u> available for sanctioning, since it is <u>their</u> crimes that can be reduced directly.

When computing individual arrest rates from the arrest histories, only those periods when an offender is criminally active should be considered. This requires consideration of the start and end of a criminal career and concern for any time spent in confinement during that career. If the incidence of

false arrests is relatively rare* and the time delays between committing a crime and a subsequent arrest are small,** virtually everyone in our dataset can be presumed to have been criminally active when arrested in 1973. There are, however, certain biases in the 1973 data introduced by the selection criteria in that year. Any individual arrest rates based on 1973 data would be inflated because everyone in the population studied had to have at least one arrest in that year in order to appear in the data. Furthermore, arrests for serious crime types are similarly over-represented in that year because selection was based on an arrest for a serious crime type in 1973. To avoid these biases, the analyses will use only arrest data prior to 1973.

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*The issue of false arrests is an important concern when inferring crimes from arrests. It is well established that a majority of arrests fail to end in conviction even for serious crime types. This gulf raises questions about the validity of assuming that virtually everyone arrested has indeed committed a crime.

Taking arrests or convictions as indicators of crimes involves two different types of errors. Using false arrests as indicators of crimes committed involves errors of commission, or classifying non-events as events, while restricting consideration only to cases resulting in a conviction is more likely to involve errors of omission, or failing to identify a proper event. In dealing with specific individuals, of course, the presumption of innocence makes the error of commission unacceptable. In dealing with aggregate statistics, however, there must be a relative weighing of these two types of error.

To do this, we need some assessment of the factors contributing to the failure to convict after arrest. Recent examinations of the reasons for non-conviction suggest that non-conviction is by no means synonymous with innocence.

In the first place, Forst, et al (1977) and the Vera Institute of Justice (1977) report that the vast majority of non-convictions are the result of diversions out of adult criminal courts (to Juvenile Court or to pre-trial diversionary programs) and dismissals, rather than acquittals. Furthermore, the reasons for dismissal frequently have little to do with the innocence of the defendant. On the contrary, cases are dismissed because of non-cooperation by witnesses (which is often due to a prior relationship between the victim and the defendant), due process problems, and the comparative insignificance of the case relative to other cases waiting in the queue.

In view of the predominantly procedural reasons why arrests fail to reach conviction, the errors of commission associated with truly false arrests are believed to be far less serious than the errors of omission that would occur if the more stringent standard of conviction were required.

**Data for police operations reported in Greenwood, et al (1975) indicate that one-third of all arrests are made at the scene of the crime (p. 77). Of the remaining cases turned over to investigators, 72% are either cleared by arrest or the investigation is suspended within one day (p. 63).

Pinpointing the start of criminal careers is more difficult. Unfortunately, no juvenile arrests are recorded in the data, so we will restrict our analysis to adult criminal careers. Since arrests are a relatively rare event (even for identified offenders) the time between arrests can be several years, and the time of the first adult arrest is likely to be an unreliable indicator of the true start of adult careers. Instead, we consider all adult criminal careers to commence at age 18, an assumption that implies that the large majority of adult arrestees were also criminally active as juveniles. There is an empirical basis for this assumption. First, the data in Figure 2 indicate that the probability of a first arrest after age 18 is quite low. A follow-up beyond age 18 of the Philadelphia birth cohort (Wolfgang [1977]) offers further support for this assumption: of the adults (over age 18) in the cohort with arrest records between ages 18 and 22, a full 75% also had juvenile arrest records. Thus, the analysis begins with the very reasonable approximation that all offenders in our data are criminally active from age 18 through 1973. There will admittedly be some errors associated with the assumption that all adult offenders are active at age 18. To avoid these errors, the analysis will later be restricted to only those offenders who actually experience a first arrest at ages 18, 19 or 20, thus assuring that the adult careers have indeed started by age 21.

To get a measure of individual criminal intensity during a criminal career, the relevant time at risk should comprise only the time free in the community and exclude all time served in confinement. The criminal history file does contain some data on post-arrest dispositions including trial outcomes and custody information, but there is no information beyond the recorded arrest for 59% of the arrests. The absence of information could mean that there were

no further actions by the CJS on a case or that the appropriate information is missing due to incomplete record keeping. A comparison with Washington, D.C. court dispositions for 1974 (Table 2), however, indicates that the frequency of post-arrest dispositions in the arrest histories are reasonably complete.

Unfortunately, the data on the actual time served by offenders is much less complete. To compute the exact time served on a sentence we need both the reception and release dates in institutions for custody dispositions. Both dates are available in fewer than 10% of the known sentences to confinement. The remaining sentences to confinement have fairly complete data on sentence lengths and on reception dates into institutions, but are missing the release date.

Table 2
Comparison of Post-Arrest Dispositions
from Washington, D.C. Court Data (1974)
with Arrest Histories

Disposition	Washington, D.C. Arrest Histories	1974 Washington, D.C. Court Data*
Proportion of Arrests Resulting in A Conviction	.27	.30
Proportion of Arrests With Sentence to Confinement	.15	.10

* Forst, et al (1977).

One approach to estimating time served for those commitments without a release date is to begin the time served interval at the reception date and to set time served equal to some portion of the minimum sentence. For those records with the actual time served known (i.e., both reception and release dates are known) the ratio of time actually served to the minimum sentence is 1.2. When this ratio was used to estimate time served for those commitments with reception dates known but with release dates unknown, however, a consistency check revealed that a significant portion of the records (more than 34%) had arrests occurring during the assumed time-served interval. Thus, the estimates of time served derived by this technique are questionable.

The importance of obtaining accurate estimates of time served depends strongly on the magnitude of the time-served correction to the time at risk. If the time served by the individuals in our data set is small, ignoring time served should not significantly alter the arrest-rate estimates. In fact, the average minimum sentence for those sentenced to incarceration was 13.2 months. Multiplying this average sentence length by the probability of confinement after arrest, the expected minimum sentence per arrest is just 1.93 months. The large number of arrests found before expiration of the minimum in our consistency check indicates that many people do not serve even the minimum sentence, so the actual expected time served per arrest will be considerably less than two months, or less than 16% of the potential time free in a year. Such minimal times served are not likely to significantly effect the arrest-rate estimates.

4.0 METHOD

Several factors are considered as potentially influencing individual arrest rates during a criminal career. The first is age. It is well known that most criminals eventually do stop committing crimes; however, we do not know whether this drop-out occurs suddenly or after a gradual decline in criminal activity. Another factor is the length of a criminal record. While not empirically substantiated, tradition and some statutes have taken the presence of a criminal record as an indicator of a higher than average criminal intensity, thereby justifying harsher sentences. Individuals specializing in different crime types might also have characterisically different arrest rates; for example, robbers may be far more criminally active than larcenists.

The last factor considered is the possible trends over time in arrest rates. These trends might reflect general increases or decreases in criminality

over time that are independent of age, or they might arise from a cohort effect where different cohorts (groups of offenders all beginning their criminal careers at the same time) have characteristically different arrest rates. Such a cohort effect might, for example, reflect the effect of being socialized at different times.

To explore the impact of each of these factors, individual arrest rates - μ - are estimated by:

- age of the offender,
- number of prior arrests in a record,
- crime type "specialties," and
- year of observation.

Individual arrest rates give the average number of arrests in a year for an individual.* Rather than aggregate arrest rates which ignore crime type, we are interested in crime-type-specific arrest rates. One alternative is simply to count everyone's arrests for a given crime type. The resulting rates, however, would simply reflect the relative incidence of arrests for the different crime types in the population. Instead we want to characterize a person by the crime types he "normally" commits. In this way we can compare the burglary rate of burglars with the robbery rate of robbers.

Uniquely characterizing an offender by crime type is a difficult matter. Analyses of crime-type switching during a career indicate considerable variation in crime types across a career.** This makes it difficult to characterize an

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*The individual arrest rate is here assumed to be stochastic in nature. In this event an individual with arrest rate μ does not have exactly μ arrests each year. Instead, the actual number of arrests may vary from year to year, with the mean rate μ characterizing the parameter of the probability distribution for the number of arrests in a year.

**Wolfgang, et al (1972), Blumstein and Greene (1976).

individual uniquely as a "robber" as opposed to a "burglar" because the same individual is likely to engage in both offenses at different times.

To resolve this ambiguity, two approaches were used for estimating crime-specific arrest rates.

(1) previous arrest (μ_p): during any year of observation a person was characterized by the crime type of his last arrest before the current observation year, and

(2) any arrest (μ_a): the person was characterized by each crime type in his record prior to the current observation year.

In the first measure (μ_p) a person is considered a "robber" if his last arrest was for robbery and in the second, (μ_a) he is a "robber" if he has ever been arrested for robbery before.*

To estimate individual arrest rates in a year, the arrest histories from age 18 through 1972 were broken down into man-years of observations. Each such observation was characterized by the calendar year, the offender's age in that year, the number of prior arrests at the start of that year and by the crime type(s) of prior arrests. The individual arrest rate in a year for any particular combination of attributes (a,k,c,t) is then calculated as the number

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*These two approaches are intended to represent the extremes of restrictiveness in associating crime types with individuals. For μ_p, the most limited formulation, an offender is characterized by only one crime type at a time and this characterization may change at the next arrest. In the μ_a case, an offender may be characterized by several different crime types at the same time depending on the variety of his prior record. Also, once characterized by a crime type, that characterization stays with the offender through the remainder of his career.

These two characterizations represent different types of errors. In the μ_p case, we may be missing some of the crime types that actually do characterize an offender at some point in time, while in the μ_a case, we may continue to attribute crime types to an offender after they no longer characterize his behavior.

of arrests for crime type c occurring during the man-years of type (a,k,c,t) divided by that number of man-years. This procedure yields a four-dimensional array of individual arrest rates characterized by age, prior record, crime type and year.

Table 3 presents a sample of the resulting estimates. For example, the average individual robbery arrest rate for "robbers" younger than 21 in 1971 who have two prior arrests is .313 robbery arrests that year. This is the number of individuals ever previously arrested for robbery who are no more than 20 years old in 1971 and with two prior arrests at the start of that year, divided into the number of robbery arrests by these individuals in 1971.

It will be noted that the number of observations in the individual cells is often small (<10). The marginal cells, however, are of reasonable

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*The average or expected value of the individual arrest rates, $\bar{\mu}$, is given by $\sum_{i=1}^{N} \mu_i/N = \sum_{i=1}^{N} (a_i/m_i)/N$, where a_i is the number of arrests for individual i (i=1,2,...,N and m_i is the number of man-years he is observed. The quantity (a_i/m_i) is then the arrest rate estimated for individual i.

The procedure for estimating average individual arrest rates used in this paper is $\hat{\mu} = \sum_{i=1}^{N} a_i / \sum_{i=1}^{N} m_i$. While $\bar{\mu} \neq \hat{\mu}$ in general, they are equal in the special case where all individuals are observed for the same number of man-years i.e., $m_i = m$ for all i. Then $\sum_{i=1}^{N} m_i = N.m$ and $\hat{\mu} = \sum_{i=1}^{N} a_i/N.m = \sum_{i=1}^{N} (a_i/m)/N = \bar{\mu}$. Thus, when the observation period generating a μ estimate is identical for each individual, the procedure used in this paper will yield unbiased estimates of the average individual arrest rate, $\bar{\mu}$.

When the number of man-years of observation generating an estimate varies over individuals, the $\hat{\mu}$ estimate is a biased estimate of $\bar{\mu}$; in particular, the longer histories (those contributing more man-years) are weighted too heavily in $\hat{\mu}$. This variable number of man-years is likely to occur in examining the effects of prior arrests and when several years are aggregated. If some persons begin their careers in 1926 while others don't start until 1936, the former will contribute fifteen man-years to the category 1925-40 and the latter will contribute only five. Similarly, some individuals have one prior arrest for several years, while others have one prior for only one year.

The magnitude of the resulting bias in $\hat{\mu}$, however, is likely to be small when the amount of variation in man-years is small relative to the total number of individuals observed. Furthermore, the $\hat{\mu}$ estimate is appropriate if the individual arrest rates are assumed to be homogeneous, that is, all individuals in a category have the same underlying individual arrest rate ($\mu_i = \mu$ for all i).

Table 3

Sample of Individual Arrest Rates (μ_a) Estimated for Robbery
(Individuals Characterized by Crime Types of Any Prior Arrests)

Number of Prior Arrests = 2:

Year	Age						Total
	≤20	21-25	26-30	31-35	36-40	≥ 41	
1925-40	0(1)*	0(9)	0(6)	0(2)	-(0)	-(0)	0(18)
1941-50	0(7)	.077(26)	.053(19)	0(18)	0(10)	-(0)	.037(80)
1951-60	0(7)	.014(71)	0(57)	0(45)	0(2)	0(13)	.005(195)
1961-65	.105(19)	.132(76)	.024(42)	.027(37)	0(16)	0(10)	.070(200)
1966	.429(7)	0(17)	0(10)	0(6)	0(4)	0(2)	.065(46)
1967	.182(11)	.190(21)	.091(11)	.200(5)	0(5)	0(2)	.145(55)
1968	.250(8)	.045(22)	.077(13)	.250(4)	0(2)	0(4)	.094(53)
1969	.600(10)	.120(25)	.154(13)	0(4)	0(2)	0(4)	.190(58)
1970	.429(14)	.226(31)	.143(14)	0(5)	0(3)	0(3)	.214(70)
1971	.313(32)	.293(41)	.182(11)	.333(9)	0(3)	0(4)	.270(100)
1972	.323(31)	.163(49)	.154(13)	0(7)	0(2)	0(4)	.189(106)
Total	.279(147)	.124(388)	.057(209)	.042(142)	0(49)	0(46)	.109 arrests/year (981)

*The number of individual man-years generating each estimate appears in parentheses.

size and the interior cells display patterns of variation consistent with those found in the margins.

In the preliminary analyses, no adjustments for time served were made when estimating individual arrest rates. To avoid any distortions in the results that might be introduced by the missing data on time served, the arrest rate patterns are first analyzed ignoring time served, and the impact of time served is then considered.

5.0 RESULTS

5.1 The Observed Variations in Individual Arrest Rates

Analysis of variance was performed on the individual arrest-rate estimates (Table 4)* These revealed that arrest rates vary with age, crime type, number of prior arrests and time, with crime type interacting with age and with prior arrests. The marginal means reported in Table 5 indicate that arrest rates increase with the number of prior arrests, decrease with age and have been increasing over time. The particular form of arrest-rate characterization used makes very little difference in any of these results.

To explore any variations in these effects for the different crime types, simple regressions were used to analyze crime-specific individual arrest rates in terms of age, year and number of prior arrests. Because of the readily apparent non-linearities in the arrest rate estimates over the values of the independent

*In estimating the arrest rates by age, time, number of prior arrests and crime type, there were sometimes no observations for a given cell in the four-dimensional array. In order to accomodate this problem of missing observations in the analysis of variance, some categories were collapsed together (particularly the early calendar years and the older ages) to increase the number of observatjons in a category. Those few individual arrest rate cells still without observations were assigned a value that was interpolated from the other arrest rate estimates in the same year and age categories, a procedure consistent with standard missing-observation techniques.

Table 4

Results From Analysis of Variance Performed on the Individual Arrest Rates: The Significance of the Different Variables

Variable	μ_p Individual Arrest Rates When People are Characterized by Crime Type of Last Arrest			μ_a Individual Arrest Rates When People are Characterized by Crime Type of Any Previous Arrest		
	% of Variance Explained	F-Value	(d.f.)	% of Variance Explained	F-Value	(d.f.)
Age (A)	5.7	28.53**	(3)	10.9	54.2**	(3)
Crime Type (C)	8.3	17.79**	(7)	9.8	20.9**	(7)
No. of Prior Arrests (K)	3.2	16.22**	(3)	1.1	5.555**	(3)
Year (T)	1.6	3.048**	(8)	1.7	3.165**	(8)
CxA	4.4	3.157**	(21)	2.8	1.986*	(21)
CxK	4.4	3.141**	(21)	3.4	2.414**	(21)
CxT	3.4	.907	(56)	3.8	1.018	(56)
AxK	.8	1.348	(9)	.6	.956	(9)
AxT	1.9	1.208	(24)	1.6	.970	(24)
KxT	2.4	1.479	(24)	1.5	.952	(24)
CxAxK	5.1	1.216	(63)	4.5	1.062	(63)
CxAxT	10.8	.969	(168)	9.8	.873	(168)
CxKxT	9.5	.854	(168)	9.3	.829	(168)
AxKxT	5.1	1.069	(72)	5.2	1.076	(72)
Residual	33.5		(504)	33.8		(504)
Total	100.0		(1151)	100.0		(1151)

*Significant .01 level.

**Significant .005 level or better.

TABLE 5

MARGINAL MEANS FOR ESTIMATED INDIVIDUAL ARREST RATES PER YEAR*

Variable	μ_p Individual Arrest Rate When People are Characterized By Crime Type of Last Arrest	μ_a Individual Arrest Rate When People are Characterized By Crime Type of Any Previous Arrest
CRIME TYPE:		
Robbery	.13	.12
Aggravated Assault	.10	.10
Burglary	.14	.11
Larceny	.19	.14
Auto Theft	.12	.09
Weapons	.06	.05
Drugs	.22	.19
All Others	.25	.23
AGE:		
$\leq$ 20	.22	.21
21-25	.17	.14
26-30	.12	.10
$\geq$ 31	.09	.06
# PRIOR ARRESTS		
1	.11	.11
2	.13	.12
3	.16	.12
$\geq$ 4	.21	.16
CALENDAR YEAR:		
1951-60	.12	.09
1961-65	.14	.12
1966	.13	.11
1967	.12	.11
1968	.17	.13
1969	.20	.16
1970	.18	.15
1971	.16	.14
1972	.16	.15
OVERALL MEAN	.15	.13

*The mean individual arrest rates reported here are simply the marginal means obtained by averaging all the separate μ estimates within a variable category. The reported means are the arrest rates for any single crime type characterizing an offender and not for all the arrests experienced by an offender. Thus, the reported rates, $\tilde{\mu}$, by crime type, age, prior arrests and calendar year, as well as the overall rate are interpreted as follows: offenders characterized by an arbitrary crime type category are arrested for that crime type an average of μ times per year.

variables, piecewise regression was used.* Some variations in effect by crime type are apparent in Table 6. The decrease in arrest rates with age tends to persist over the two pieces and is found for all crime types except auto theft. There are significant increases with time for all crime types. The effect of prior arrests is particularly strong up to three prior arrests for most crime types, but it is not important for robbery, auto theft and drugs.

At first glance these results seem very reasonable. Without adjusting for time served, the observed trends in arrest rates for different crime types are consistent with prior expectations about criminal careers. People are subject to fewer arrests as they get older, but arrest rates increase as they accumulate a criminal record.** Controlling for age, there is also an increase in arrest rates over time which is consistent with the often cited presumption of greater social disorganization in recent years.

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*The regressions are only intended to identify the direction and relative significance of the separate effects of age, prior record and year. A simple piecewise linear model was used to test for any trends with

$$\mu_i = a_1 + a_2 A1_i + a_3 A2_i + a_4 T1_i + a_5 T2_i + a_6 K1_i + a_7 K2_i + \epsilon_i$$

where the subscript i indicates the crime type.

When a single arrest-rate estimate applies to a range of values of an independent variable (e.g., 21-25 years old), the variable is assigned the value of the midpoint of the range for the purposes of the regressions. Thus, the exact numerical values of the coefficients are not always meaningful. The sign of the coefficient and its "t-statistic", however, do indicate the direction and strength of any effect that may exist.

Separate regressions including two-way interaction terms were also run. The interactions among the variables were generally quite small so these results are not reported here.

**The finding that individual arrest rates decrease with age and increase with the number of prior arrests is consistent with the results of the analysis of self-reported crimes (Braiker, et al, 1978) which also finds that individual crime rates decrease with age and increase with the accumulation of a prior record.

Table 6

Results of Weighted Piecewise[a] Regressions[*] on Individual Arrest Rates (μ_a)[**] Within Crime Types: Significant Variables[***]

Crime Type	Age			Year		Prior Arrests	
	Break Point	A1	A2	T1 [≤1962]	T2 [>1962]	K1 [≤3]	K2 [>3]
Robbery	[32.5]	− (5.871)	− (5.523)	+ (7.821)	+ (6.855)		
Aggravated Assault	[None]	− (3.000)		+ (3.378)		+ (2.339)	+ (3.278)
Burglary	[27.5]	− (6.227)	− (7.357)	+ (6.999)		+ (3.022)	+ (2.839)
Larceny	[27.5]	− (5.727)	− (6.765)	+ (5.373)	+ (2.110)	+ (5.232)	+ (2.304)
Auto Theft	[27.5]			+ (3.494)			− (2.271)
Weapons	[37.5]	− (2.237)			+ (4.313)	+ (2.909)	
Drugs	[None]	− (3.965)		+ (5.760)			
All Others	[27.5]		− (8.281)		+ (5.652)	+ (9.094)	

[a] The breakpoints of the piecewise variables are noted in brackets.

[*] Because of the wide variation in the number of man-years used to compute each μ estimate, the variables are weighted by multiplying by the square root of the number of observations generating each estimate of the individual arrest rate.

[**] The results for μ_p are similar.

[***] Only the signs of those coefficients that are more than twice their standard error are reported here. The ratio of the absolute value of the coefficient to its standard error is reported in parentheses. To the extent that the limiting distribution of the individual arrest rates is normal (by appeal to the Central Limit Theorem), this ratio is approximately a t-statistic. Values of t greater than 2 are significant at the .05 level in a two-tailed test, while values greater than 3 are significant at the .002 level.

5.2 Alternative Explanations for the Observed Variations

There is a distinct possibility that the above results are an artifact induced by the estimation procedure. Because the longitudinal arrest histories vary in length and in the number of arrests, each individual arrest rate estimate is based on a different subset of persons. For example, the arrest rate estimate for 20-year-olds in 1960 with one prior arrest is based on a totally different set of individuals than the estimate for 20-year-olds in 1970 with one prior arrest. The arrest rate estimates are thus based on a cross-section of arrestees with different attributes, rather than a longitudinal comparison of the same arrestees.

Furthermore, because selection was based on having an arrest in 1973, the age distribution in our data varies systematically over time. Looking at the distribution over age for different years (Figure 3), there is a greater representation of younger persons in the early years and an increasing representation of older persons in more recent years. Offenders who were older in, say, 1950 are not likely to be still criminally active in 1973; so they are under-represented in earlier years. This means that there are some systematic changes in the mix of cohorts that give rise to the individual arrest rate estimates. Thus, the differences in arrest rates observed over age, prior record and year may reflect differences in the arrest rates of the different cohorts giving rise to the estimates, rather than differences during an individual's career.

To see how this artifact might arise, suppose there is a cohort effect where each cohort is characterized by a "common" arrest rate that does not change during an individual's career, but which may vary between cohorts. This common arrest rate for a cohort might be homogeneous with all cohort members having the same rate. More generally, individual arrest rates might be heterogeneously distributed in such a way that the individual arrest rates within a cohort are all drawn from the same distribution and the "common" arrest rate for the cohort is the mean of this distribution.

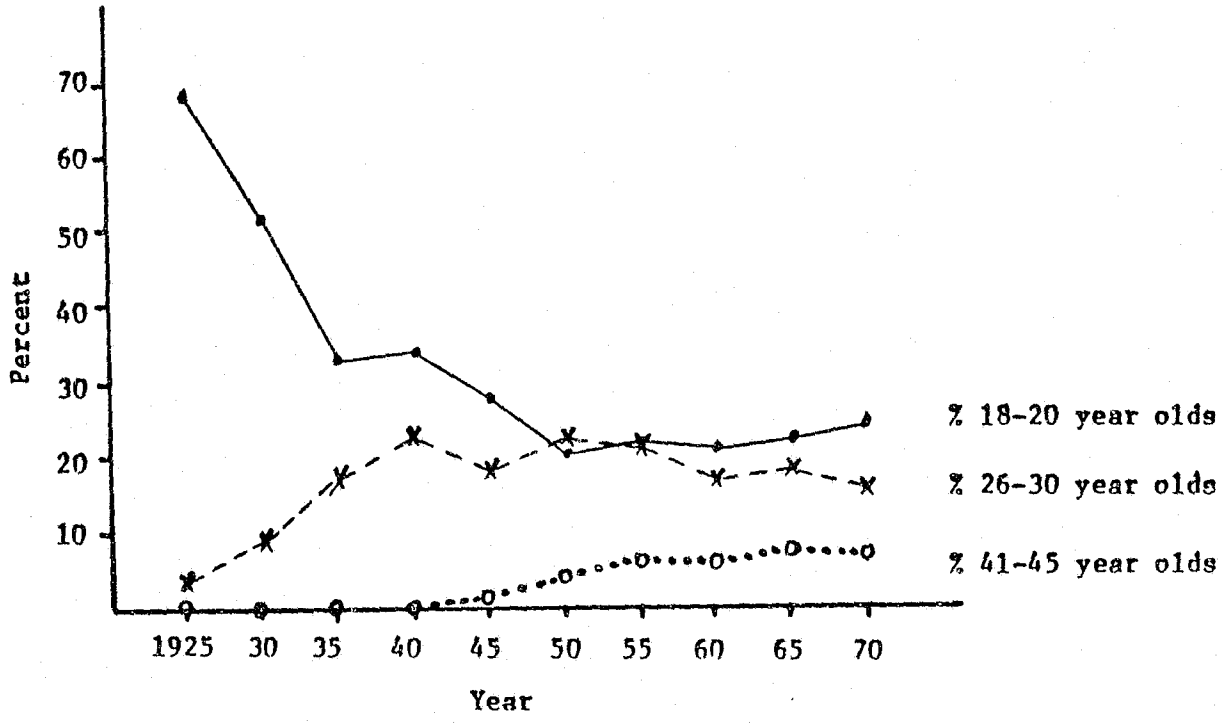

Figure 3

Distribution of Arrestees by Age in Different Years

The cohort arrest rates might vary among different cohorts for two different reasons. First, arrest rates may in fact vary over cohorts with changes in the prevailing level of criminality. As different cohorts are subjected to varying social and economic circumstances as well as different socialization patterns, they adopt distinct patterns of criminal activity. If the tendency toward criminality increases over time, for example, then cohorts entering criminal careers in later years will have higher arrest rates than those who entered earlier.

Alternatively, any variation among cohort arrest rates could be due to the peculiarities of our data. In particular, there is a definite bias toward longer criminal careers as one looks back further in our data. For example, the data for the 1965 cohort (people beginning their criminal careers in 1965) do not contain any individuals with careers shorter than 9 years; everyone is active at least from 1965 through 1973. The data for the 1971 cohort, on the other hand, contain people with careers as short as three years (active from 1971 through 1973 and possibly beyond). If there were a negative relationship between individual arrest rates and the length of criminal careers (i.e., people with long careers tend to have lower arrest rates), then we would observe lower arrest rates for earlier cohorts.

Whether because of real changes in criminality or because of a selection bias, the arrest rates of later cohorts in our data may be higher than those of earlier cohorts. In this event, assuming everyone begins his adult criminal career at age 18, 18-year-olds entering careers in 1940 would display lower arrest rates than 18-year-olds entering in 1970, and this alone could produce the opposite aging and time effects observed.

Consider first the apparent decrease with age. Controlling for time and prior arrests, the regression results indicate that within each crime type arrest rates decline with age, generally dropping off rather sharply at younger ages and tending to level off to a slower rate of decline at older ages. For any year t, however, the older individuals come from earlier cohorts. Under the cohort conditions just described they would have lower arrest rates than the younger persons in the same year who come from later cohorts. By comparing a cross-section of persons from different cohorts, then, there would appear to be an aging effect even though every individual's arrest rate might indeed remain constant over age.*

This same procedure of mixing cohorts could also produce the apparent increase in arrest rates over time.** Controlling for age, the individuals contributing to the arrest rate in later years come from later cohorts with higher arrest rates; a twenty year old in 1972 comes from a later cohort than someone who was twenty years old in 1960. Thus, what appears to be evidence of

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*The finding of an aging effect for self-reported crime rates in Braiker, et al (1978) may be subject to this same "cohort" or "history" effect. The crime rate for any age a is based on the number of crimes committed by those respondents age a during the three year period immediately prior to the current commitment to prison. Thus, the crime rates by age are based on the responses of different subsets of respondents. Furthermore, since 75% of the inmate respondents had served three years or less, this response period was restricted to the relatively brief interval from 1 to 6 years immediately prior to the survey date. As a result, the crime rates for the older ages during this interval come from members of earlier cohorts, while the crime rates at younger ages during this same interval are from more recent cohorts.

**Improved record keeping resulting in more complete arrest records in more recent years might also be contributing to the observed increase in arrest rates with time.

individual arrest rates systematically changing during an individual's career may in fact be an artifact of computing the arrest rates using systematically different samples of individuals, each characterized by a different individual arrest rate that remains constant throughout a career.

The relationship between prior arrests and individual arrest rates could be reflecting similar selection artifacts. Controlling for age and time, arrest rates increase with increases in the number of prior arrests. This could suggest that arrests have a cumulative criminogenic effect. However, the same people are not used when computing the individual arrest rate for each prior-arrest category; thus, the variations with prior arrest could reflect a selection effect whereby those individuals displaying longer prior records are simply those with higher individual arrest rates.

Consider, for example, individuals who are 25 in 1970. Some of these individuals have one prior arrest, others two, and so forth. Assuming they all began their adult criminal careers at about the same age, say 18, they all had about eight years to accumulate arrest records. Those with more prior arrests by age 25 are likely to be the individuals with higher individual arrest rates, μ, while those with fewer prior arrests have lower individual arrest rates.* In this event, the variation in individual arrest rates observed over prior arrests would reflect variations in the arrest rates across different individuals, rather than variations in arrest rate resulting from the accumulation of arrests that occurs during an individual's criminal career.**

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*Since arrest rates are stochastic, this is not tautological. There is some admittedly small probability that individuals with low arrest rates will have a large number of arrests while individuals with high arrest rates will have only a small number of arrests.

**The increase in self-reported crime rates with prior record reported in Braiker, et al (1978) may be due to this same selection artifact of comparing different subsets of individuals. At any age those with a more serious prior record may simply be a subset of offenders with higher individual crime rates.

Clearly, a longitudinal analysis of cohorts is a necessary approach to resolving some of the ambiguities in interpreting the results. In such an analysis, the individual arrest rates of the same sample of individuals can be observed over their careers, and any variations with time, age, and/or prior arrests cannot be attributed to different combinations of individual arrest rates.

5.3 A Cohort Analysis of Individual Arrest Rates

The Washington, D. C. arrest data provide some opportunity for examining cohorts, albeit with considerably reduced sample sizes. The following criteria were used to define a cohort: an individual reached age 18 in some year t, and his first recorded arrest was at age 18, 19, or 20. These constraints were intended to assure that all the members of a cohort did indeed start their adult criminal careers at about age 18 in the same year.

Four cohorts were chosen, one for each of the years from 1963 to 1966. These years were selected because they were recent enough to provide reasonable numbers of cases and yet distant enough to provide several years of observations. By choosing cohorts from the mid-sixties, we also hoped to minimize the variability in record-keeping over the observation period. Each cohort was observed from age 21, when all members had accumulated at least one prior arrest, through the end of 1972. This procedure guarantees that the same individuals are observed over age and time.*

The cohort samples are described further in Table 7. Because of the relatively small sample sizes (<50) no attempt was made to simultaneously control for the rate at which individuals accumulated arrests. As a result, the same individuals are not observed over the different prior-arrest categories, and any prior record effect observed within a cohort could still reflect variations in arrest rates across individuals rather than during an individual career.

*The results, however, are based on the experiences of offenders who have at least two arrests (one in 1973 and one when they were 18, 19, or 20), and may not apply to those offenders who are arrested only once during their careers.

Table 7

Description of Cohorts

Cohort Number	1	2	3	4
Year Reached Age 18	1963	1964	1965	1966
Observation Period	1966-72	1967-72	1968-72	1969-72
Number of Years Observed	7	6	5	4
Number Observed by Crime Type:				
Robbery	40	38	47	56
Aggravated Assault	39	32	52	49
Burglary	38	31	46	38
Larceny	36	33	39	59
Auto Theft	25	18	29	28
Weapons	19	15	23	23
Drugs	21	19	39	31
All Others	66	56	90	91

The resulting cohorts are representative of all the arrestees with respect to post-arrest dispositions (Table 8). Over all crime types and all cohorts, 27.6% of the arrests resulted in conviction and 16.5% of the arrests ended in a sentence to confinement. These rates are quite consistent with the rates for all Washington, D.C., arrestees reported in Table 2.

Also, as with all the arrestees, the actual time served is recorded in only a small percentage (5%) of the cohort confinements. Most of the remaining sentences to confinement have a reception date into an institution, but no release date. When time served was estimated by setting the release date as a fixed proportion of the minimum sentence for all arrestees, many arrests were found to have occurred during the estimated time-served interval. A more careful examination of the recorded sentences revealed two sentence types: 1) flat sentences, consisting of a single sentence value; and 2) indeterminate sentences specifying a sentence range in the form of a minimum and maximum.

Inquiries with corrections authorities in Washington, D. C. indicated that the earliest possible release on parole is typically after serving the minimum for an indeterminate sentence or one-third of a flat sentence.* When this procedure** for determining the release date was used to estimate time served, the number of estimated time-served periods within which an arrest occurred before the assumed release was reduced to only 6%. In those few cases of such an inconsistency, the release date was assumed to be the arrest date.

This procedure enabled time served to be estimated for an additional 69% of the cohort confinements, so that 74% of all confinements had either an actual or estimated time served.*** The resulting estimates of time served are summarized

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*Indeed, those few cohort members with actual time served recorded served 98.6% of the minimum for indeterminate sentences and 59.5% of flat sentences.

**This procedure for estimating time served was originally used by Greene (1977).

***Both the sentence length and a reception date were required to estimate time served; without the start date no consistency check for arrests during the time-served interval could be performed.

Table 8

Conviction and Time Served After Arrest
by Cohort Members - All Cohorts Combined

Crime Type	% of Arrests Resulting in a Conviction	% of Arrests With Sentence to Confinement	% of Arrests With Estimates of Time Served	Average Months Served on a Sentence per Commitment*	Expected Months Served on a Sentence per Arrest**
Robbery	12.9	7.0	4.4	16.0	1.1
Aggravated Assault	22.3	14.6	11.0	3.8	.6
Burglary	29.9	20.1	14.5	9.1	1.8
Larceny	37.2	23.8	18.8	3.5	.8
Auto Theft	24.3	14.5	11.2	4.5	.7
Weapons	21.2	14.2	9.7	1.5	.2
Drugs	26.9	14.2	9.1	4.4	.6
All Others	32.2	17.7	13.1	3.0	.6
All Crime Types	27.6	16.5	12.1	4.8	.8

*This average time served is based on those commitments with some estimate of time served.

**This expected time served is given by the product of the percentage of arrests with a sentence to confinement times the average time served per commitment. It assumes that those commitments with no time served estimates are like those with time served estimates.

for all cohorts in the last two columns of Table 8. The average time served per commitment is longest for robbery (16 months) and burglary (9.1 months). Because of the relatively low chance of confinement after arrest, however, the expected time served per arrest is quite small, less than one month except for robbery and burglary.

The individuals in the cohorts were characterized by every crime type that ever appeared in their arrest record. So, for example, an individual was considered a "robber" if he was ever arrested for robbery. Whenever available, the actual or estimated time served was excluded from the observation periods, and the individual arrest rate while free for crime type i at age a and after k prior arrests is calculated from:

$$\frac{\text{number of arrests}_{i,a,k}}{(\text{total time} - \text{time served})_{i,a,k}}$$

Using the cohort data, the marginal means of the individual arrest rates while free no longer display a clear decrease with age or increase with prior arrests (Table 9). In fact, there is now some tendency for individual arrest rates to increase with age. The overall means for each cohort also increase, with later cohorts having higher arrest rates. In the analysis of variance performed on these individual arrest rates within cohorts there is no effect of age or prior arrests, and crime type is the only variable that is significant in determining individual arrest rates.

The individual crime-type-specific arrest rates within cohorts were regressed against age, number of prior arrests, and cohort to identify any trends due to these variables. The regression results reported in Table 10 are consistent with the analysis of variance results. For the most part there are relatively few significant coefficients indicating that arrest rates are generally <u>trendless</u> over age and prior arrests. The principal exception, which incidentally contradicts the previous findings in the full sample of arrestees, is that arrest rate <u>increases</u> with age for burglary, drugs and the category "all other" offenses. There is also a definite cohort effect, with

Table 9

Individual Arrest Rates While Free
Within Cohorts: Marginal Means*

Variable	Mean Individual Arrest Rate (Arrests per Year)**				
	Cohort				All Cohorts (1969-72)
	1 (1966-72)	2 (1967-72)	3 (1963-72)	4 (1969-72)	
Age: 21	.19	.21	.25	.32	.25
22	.19	.20	.28	.30	.25
23	.16	.19	.31	.31	.25
24	.19	.27	.32	.35	.29
25	.26	.23	.33	--	--
26	.25	.26	--	--	--
27	.29	--	--	--	--
Prior Arrests:					
1	.18	.19	.24	.31	.23
2	.23	.21	.31	.31	.26
3	.14	.24	.28	.35	.24
≥ 4	.24	.24	.32	.32	.28
Crime Type:					
Robbery	.19	.21	.24	.27	.23
Aggravated Assault	.20	.15	.19	.20	.19
Burglary	.22	.11	.36	.29	.26
Larceny	.19	.26	.31	.31	.27
Auto Theft	.10	.12	.16	.15	.14
Weapons	.16	.13	.29	.26	.22
Drugs	.29	.25	.34	.36	.32
All Others	.30	.38	.38	.49	.40
GRAND MEAN	.22	.23	.30	.32	.27

*The arrest rate while free is computed by excluding any time served from the observation period.

**The means reported in this table represent the individual arrest rate for any single crime type, and not the total of all arrests experienced by the offender.

Table 10

Results of Weighted Regressions on Individual Arrest Rates While Free Within Cohorts:* Significant Variables**

Crime Type	Cohort 1 [n=28][a] Variable	Sign	Cohort 2 [n=24][a] Variable	Sign	Cohort 3 [n=20][a] Variable	Sign	Cohort 4 [n=161][a] Variable	Sign	All Cohorts [n=881][a] Variable	Sign
Robbery					Prior Arrests	+ (2.233)			Cohort	+ (2.072)
Aggravated Assault			Age	+ (2.449)						
Burglary							Age	+ (2.728)	Age Cohort	+ (2.034) + (2.850)
Larceny									Prior Arrests Cohort	+ (2.892) + (3.019)
Auto Theft										
Weapons							Age	+ (2.588)		
Drugs	Age	+ (2.177)							Age	+ (2.441)
All Others	Age	+ (3.572)	Age	+ (2.340)	Prior Arrests	+ (2.149)	Prior Arrests	+ (2.919)	Prior Arrests Cohort	+ (2.842) + (4.250)

*A simple linear model was used to test for trends in any of the independent variables, with

$$\mu_i = b_0 + b_1 \text{AGE}_i + b_2 \text{PRIOR ARRESTS}_i + b_3 \text{COHORT}_i + \eta_i$$

where the subscript i indicates the crime types. The variables were weighted by the square root of the number of man-years generating each arrest rate estimate.

**Only the signs of those coefficients that are more than twice their standard error are reported here. The absolute value of the ratio of the coefficient to its standard error is in parentheses. To the extent that the limiting distribution of the individual arrest rates is normal (by appeal to the Central Limit Theorem), this ratio is approximately a t-statistic.

[a]The number of distinct μ estimates available for each regression is in brackets.

higher arrest rates associated with later cohorts for robbery, burglary, larceny and "all others."*

By examining arrest rate patterns within cohorts we have tried to distinguish between a "career change" model in which an individual's arrest rate changes during his criminal career and a "cohort" model where individual arrest rates may vary among cohorts, but do not change during an individual's career. Because of the limited number of years the cohorts are observed, the cohort results do not support a definitive choice between these two models. The results, nevertheless, strongly suggest that the previously observed effects of a decline in arrest rates with age and an increase with the number of prior arrests could well be artifacts. Indeed, it appears that there is a definite cohort effect with individuals starting their careers in more recent years displaying higher arrest rates. This cohort effect may be due to a real increase in criminality in more recent years or to the bias in our data of selecting individuals with longer careers for the early years. Once established, these individual arrest rates are relatively stable over age and prior record, although the arrest rates do exhibit some tendency to increase with age for a few selected crime types.

6.0 IMPLICATIONS FOR INDIVIDUAL CRIME RATES

The estimates of individual arrest rates for different crime types presented at the bottom of Table 9 are especially worthy of note because they are extremely low. On average, individuals were arrested only once every five years for any single crime type. These very low arrest rates were obtained despite the fact that we are looking at a sample of more serious offenders - 85% have more than one arrest and arrests for the FBI index offenses** are relatively more frequent among their arrests than among U.S. arrestees in general, even before the selection year, 1973.

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*Excluding time served made no difference to these results; the arrest rate patterns found within the cohorts are the same whether or not time served is excluded.

**The index offenses include homicide, rape, aggravated assault, robbery,

These estimates of individual arrest rates can be used in combination with various assumptions about the arrest process to estimate individual crime rates. These crime rate estimates will be derived preserving the crime type and cohort differences found to be important in the previous section. Since no data are available to estimate the probability of arrest by age, however, the age effect found for some crime types will have to be ignored here.

If the individual crime rate (λ) is independent of the probability of arrest for a crime (q), an individual's arrest rate (μ) is just the product of λ and q ($\mu=\lambda q$). To go from the arrests of an offender to his crimes, then, we need some estimate of the probability of arrest for a crime. If all offenders are equally vulnerable to arrest for their crimes and false arrests are relatively rare, one measure of this probability is given by the ratio of the number of arrests to the number of reported offenses. Table 11 reports these ratios for various offense types for Washington, D.C., in 1971.*

The number of crimes in this ratio includes only reported offenses, while an individual's crime rate includes both reported and unreported crimes. The ratio of arrests to reported crimes can be adjusted for the non-reporting of crimes using data on the reporting rates for various crime types available from the National Crime Panel Surveys of Criminal Victimization. Table 12 presents the reporting rates by crime type for criminal victimizations during 1973 in Washington, D.C. (U.S. Department of Justice, 1975). Dividing the reported crimes in Table 11 by the reporting rate yields new estimates of the probability of arrest for a crime whether reported or unreported. These estimates are presented in Table 13.

The number of arrests used in Table 13 includes multiple arrests of several offenders for a single offense. The arrests, then, are not directly

*Data for 1971 were used because this is the last year before 1973 in which the number of reported offenses for weapons and drug offenses are separately reported.

Table 11

Ratio of Arrests to Reported Crimes
in Washington, D.C. During 1971*

Crime Type	Reported Offenses	Arrests	Arrests/ Reported Crime
Robbery	11,589	2,650	.23
Aggravated Assault	4,070	2,253	.55
Burglary	19,932	2,383	.12
Larceny	29,572	3,514	.12
Auto Theft	9,939	1,102	.11
Weapons	2,078	1,846	.89**
Drugs	4,836	3,068	.63**
All Others	20,879	12,650	.61**

*Source: 1971 Annual Report, Metropolitan Police Department, Washington, D.C.

**The ratios of arrests to reported crimes are unrealistically high as estimates of arrest probability for the less serious offenses of weapons, drug violations and "all others." This is because commission of these offenses typically goes unreported unless they are discovered by the police, and when discovered by the police they usually result in an arrest.

Table 12

Reporting Rates by Crime Type*
for Washington, D.C. in 1973

Crime Type	Proportion of Crimes Reported to the Police**
Robbery	.69
Aggravated Assault	.52
Burglary	.64
Larceny	.35
Auto Theft	.76
All Offenses***	.50

*Derived from Tables 1 and 6 for Washington, D.C. in Criminal Victimization Surveys in 13 American Cities (U.S. Department of Justice, 1975).

**The rates for each crime type from the personal, household and commercial sectors in the victimization survey are weighted by the estimated number of each type of event to yield the average reporting rates by crime type presented here.

***The category "all offenses" only includes those offenses investigated in the criminal victimization surveys, namely rape, robbery, assault, burglary, larceny and auto theft.

Table 13

Estimates for the Probability of Arrest for a Crime -- Reported and Unreported

Crime Type	Total Offenses*	Arrests	Probability of Arrest for a Crime
Robbery	16,796	2,650	.16
Aggravated Assault	7,827	2,253	.29
Burglary	31,144	2,383	.08
Larceny	84,491	3,514	.04
Auto Theft	13,078	1,102	.08
Weapons**	16,624	1,846	.11
Drugs**	38,688	3,068	.08
All Others**	167,032	12,650	.08

*The estimates of total offenses are derived by dividing the number of reported offenses by the reporting rate for each crime type.

**No empirical estimates of the reporting rates are available for the primarily victimless crime types of weapons, drugs, and all others. Furthermore, since the reporting rates for these victimless crimes are likely to be much lower than those of crimes with victims, even the average reporting rate for all offenses in the victimization survey (.50) will overestimate the reporting rate for the victimless crimes.

For the purposes of this estimate of the probability of arrest for a crime, we arbitrarily assume that the reporting rate for weapons, drugs and "all other" offenses is just one-quarter the rate for crimes with victims, or .125.

related to unique crime incidents, but rather they indicate the number of offender-arrests that occur. The ratio of arrests to total offenses therefore overestimates the probability that an individual offender is arrested for a crime. This rate can be adjusted to account for the fact that crimes are often committed by multiple offenders. Multiplying total offenses (which represent unique crime incidents) by the average number of offenders per crime yields an estimate of the number of offender-crimes committed.* The ratio of offender-arrests already available from police statistics to offender-crimes is then a more accurate measure of the probability that an offender is arrested for a crime.

The statistics derived from police reports typically do not include data on the number of offenders involved in an offense. The number of offenders per crime, however, can be estimated from the victimization surveys. An analysis of reports of multiple offending in these surveys by Reiss (1976) indicates that the availability of data on multiple offending varies considerably by crime type (see Table 14). The best data are available for those crimes involving direct offender-victim contact, like robbery, rape and assault. Data on the number of offenders are more limited for most other crime types, particularly the property crimes, which involve no victim confrontation. The average number of offenders per crime estimated from the available data are reported in Table 14.**

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*This bias in the estimate of the probability of arrest for a crime was pointed out in Shinnar and Shinnar (1975) and Shinnar (1978). Correcting the estimate by the number of multiple offenders per crime was first used in Blumstein and Greene (1978).

**The ratio of offenders per crime is derived from those incidents in the victimization surveys in which the number of offenders is known. Therefore, the adjustment of offenses rests on the important assumption that the number of offenders per crime is not substantially different for those offenses in which the number of offenders is not known. The adjustment used here will overestimate the number of offender-crimes if the number of offenders are more likely to be known in multiple offender crime incidents.

Table 15 presents the final estimates of the probability that an offender is arrested for a crime after adjusting for non-reporting and multiple offenders per crime.* There is considerably less variation across crime types in the probability of arrest for a crime than in the ratio of arrests to reported crimes in Table 11. With the exceptions of aggravated assault and larceny, about 5% of crimes result in an arrest, regardless of crime type.

The estimates of the probability of arrest for a crime can be used with the individual arrest rates by crime type in Table 9 to estimate individual crime rates. Applying the estimates of the probability of arrest in Table 15 to all offenders** the individual crime rate is calculated as the individual arrest rate divided by the

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*Table 14 reports the number of offenders per crime for all crime incidents. It is apparent from the victimization data that juveniles are more likely to be multiple offenders. Assuming juvenile offending groups are not smaller than adult groups, juveniles will then have a higher ratio of offenders per incident (r) than adults.

This difference in r for adults and juveniles could affect the final estimates of the probability of arrest for a crime generated for adults. However, most of the crime incidents in the victimization surveys in which the offenders were known involve adult offenders so the ratio r for all incidents in Table 14 is likely to be only slightly larger than the comparable ratio for adults alone.

We can estimate r for adults and juveniles separately using the data reported in Reiss (1976). Assuming the average size of multiple offender groups is the same for adults and juveniles, the juvenile ratio for all crime types is estimated as 2.5, while the corresponding adult ratio is 1.7. Using the slightly lower r values for adults alone will generate slightly higher estimates of the probability of arrest for a crime than reported in Table 15 and slightly lower estimates of individual crime rates than reported in Tables 16 and 19. The differences, however, are small. Furthermore, generating estimates for adults alone requires additional assumptions that: (i) the size of multiple offender groups is the same for adults and juveniles; (ii) the reporting rate is the same for all incidents regardless of whether the incident involves adults or juveniles; and (iii) the victim correctly distinguishes adult and juvenile offenders. Because of the potential errors involved in the estimates for adults alone and the minimal changes in the results, only the estimates using the ratio of offenders per incident for <u>all</u> incidents are reported and used here.

**This amounts to assuming that the probability of arrest for a crime is invariant over offenders and contant throughout a criminal career.

Table 14

Estimates of the Number of Offenders per Crime from Crime Estimates Reported in the National Crime Survey Between July 1, 1972 and December 31, 1975*

Crime Type	Proportion of Incidents Reporting Numbers of Offenders	Number of Offenders	Number of Crime Incidents	Offenders Per Incident
Robbery	97.2%	5452	2386	2.3
Aggravated Assault	95.4%	5684	2173	2.6
Burglary	6.2%	1922	1240	1.6
Larceny	4.4%	4908	3082	1.6
Auto Theft	5.7%	352	200	1.8
All Crime Types**	19.8%	44,263	22,303	2.0

*Derived from Tables 1 and 3, Reiss (1976).

**Includes rape, purse snatch, minor assault and other vehicle thefts in addition to the crime types itemized in this table.

Table 15

Final Estimate of the Probability of Arrest for a Crime Corrected for Multiple Offenders per Crime

Crime Type	Total Offender-Crimes	Number of Offender-Arrests	Probability of Arrest for a Crime
Robbery	38,631	2,650	.069
Aggravated Assault	20,350	2,253	.111
Burglary	49,830	2,383	.049
Larceny	135,186	3,514	.026
Auto Theft	23,540	1,102	.047
Weapons	33,248	1,846	.056*
Drugs	77,376	3,068	.040*
All Others	334,064	12,650	.038*

*The adjusted probability of arrest for a crime is only roughly approximated for the less serious offenses of weapons, drug violations and "all others" by using the number of offenders per crime for "all crime types" in the victimization survey (2.0).

probability of arrest for a crime. The resulting individual crime rate estimates, both before and after excluding time served, are reported in Table 16.

Among the crime types with empirical estimates of the probability of arrest for a crime (those above the line in Table 16), the individual crime rates are highest for larceny (10.88 offenses per year) and burglary (5.73 offenses per year); the rate is lowest for aggravated assault at less than two offenses per year. The tendency for individual crime rates to increase in later cohorts is evident for all crime types except aggravated assault and burglary.

Comparing the individual crime rate while free (excluding time served) with an individual's effective crime rate (no adjustment for time served) gives an estimate of the percent reduction in the individuals' crimes due to current

Table 16

Estimates of Individual Crime Rates

Crime Type	Estimates of Individual Crime Rates With and Without Time Served*									
	All Cohorts		Cohort 1 (1963)		Cohort 2 (1964)		Cohort 3 (1965)		Cohort 4 (1966)	
	Individual Crime Rate	% Reduction	Individual Crime Rate	% Reduction	Individual Crime Rate	% Reduction	Individual Crime Rate	% Reduction	Individual Crime Rate	% Reduction
Robbery	3.28 *3.41*	3.8%	2.64 *2.74*	3.6%	3.06 *3.10*	1.3%	3.33 *3.54*	5.9%	3.81 *3.96*	3.8%
Aggravated Assault	1.68 *1.72*	2.3%	1.78 *1.83*	2.7%	1.34 *1.39*	3.6%	1.72 *1.77*	2.9%	1.78 *1.82*	2.2%
Burglary	5.42 *5.73*	5.4%	4.60 *4.84*	5.0%	2.40 *2.42*	0.8%	7.53 *8.11*	7.2%	6.13 *6.42*	4.5%
Larceny	10.44 *10.88*	4.0%	7.32 *7.64*	4.2%	9.88 *10.28*	3.9%	11.68 *12.24*	4.6%	11.88 *12.28*	3.3%
Auto Theft	2.85 *2.98*	4.4%	2.24 *2.28*	1.8%	2.61 *2.67*	2.2%	3.30 *3.52*	6.3%	3.11 *3.24*	4.0%
Weapons**	3.87 *4.02*	3.7%	2.73 *2.87*	4.9%	2.42 *2.45*	1.2%	5.05 *5.25*	3.8%	4.55 *4.71*	3.4%
Drugs**	7.68 *8.00*	4.0%	6.80 *7.23*	5.9%	6.15 *6.30*	2.4%	8.08 *8.53*	5.3%	8.68 *8.90*	2.5%
All Others**	10.03 *10.42*	3.7%	7.63 *7.95*	4.0%	9.55 *9.89*	3.4%	9.66 *10.03*	3.7%	12.45 *12.92*	3.6%

*Effective Crime Rate (in Roman type) - crimes/year/offender not adjusted for any time served.
Crime Rate While Free (in Italic type) - crimes/year/offender excluding any time served.

**The crime rate estimates for weapons, drugs and "all others" are only approximate, since no empirical estimates were available for the number of multiple offenders/crime or the reporting rate for a crime when deriving the probability of arrest for these crime types.

imprisonment policies (i.e., the incapacitative effect).* The percentage reduction in crimes is reported in Table 16. The incapacitative effect is quite small, being highest for burglary at about a 5 percent reduction from potential burglaries for all cohorts. This low incapacitative effect is primarily due to the very small amounts of time served by the offenders.** The more time that is served, the large the number of crimes prevented during periods of incarceration.

So far, the analysis of individual crime rates has been restricted to the incidence of single crime types. For example, Table 16 indicates that individuals characterized as robbers+ commit 3.40 robberies per year while free, while individuals characterized as burglars commit 5.73 burglaries per year while free. These individuals often commit other crime types as well, and the arrest histories can be used to estimate the individual arrest rates for all offense types for the different types of offenders.++ Table 17 reports these individual arrest-rate estimates after adjusting for time served. Except for drug offenders, there is very little variation in total arrests for the different types of offenders; regardless of the crime types in an offender's record, offenders are arrested a total of about once per year. Drug offenders are arrested slightly more often than other offenders, with 1.35 arrests per year.

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*This estimate refers only to the reduction in crimes committed while free in the community. It is not discounted for any additional crimes committed while incarcerated. Furthermore, the estimate ignores the effect of the possible variations in crime rates over age that were suggested by the arrest rate patterns for some crime types. This incapacitative effect is also somewhat higher than the incapacitative estimated using the values of λ, q and JS in Tables 16, 15, and 8, respectively, in the expression $\lambda qJS/(1+\lambda qJS)$ from Shinnar and Shinnar (1975) because the estimates in Table 16 include the effect of any time served and not just time served for the crime type of interest.

**The actual time served by the offenders is no doubt somewhat longer than is estimated here. First, no time served was estimated for about 26% of all the confinements (those without a start date for their sentence). These additional confinements, however, add less than .05 to the probability of confinement after arrest.

Furthermore, when estimated, time served was set equal to the minimum or to 1/3 of a flat sentence, thus understating the time served by those few individuals who serve more than the minimum. The current estimate of time served per confinement, however, is so small (4.8 mos. over all crime types) that even doubling it will not significantly alter the current estimates of individual arrest rates or crime rates.

+In the cohorts individuals are characterized by all the crime types that appear in their arrest histories. Thus, a person is considered a robber if he is ever arrested for robbery. Likewise anyone who is ever arrested for burglary is considered a burglar.

++That is, we can count the number of arrests for robberies and drug violations for

Table 17

Individual Arrest Rates for Each Crime Type
by Type of Offender-All Cohorts Combined

Arrests of*:	Individual Arrest Rates While Free** for Crime Type:								
	Robbery	Aggravated Assault	Burglary	Larceny	Auto Theft	Weapons	Drugs	All Others	Total
Robbers	.23***	.11	.10	.12	.03	.05	.10	.33	1.07
Aggravated Assaulters	.14	.19	.08	.11	.03	.04	.10	.37	1.04
Burglars	.12	.08	.26	.17	.04	.04	.09	.30	1.10
Larcenists	.11	.09	.15	.27	.03	.04	.09	.36	1.15
Auto Thieves	.11	.10	.09	.08	.14	.06	.10	.30	.97
Weapons Offenders	.10	.09	.08	.11	.04	.22	.11	.30	1.04
Drug Offenders	.13	.08	.13	.20	.04	.05	.32	.41	1.35
All Others Offenders	.11	.09	.11	.12	.03	.05	.10	.40	1.01

*Individuals are characterized by the crime types of any arrests in their arrest histories.

**Arrests/year/offender after excluding any time served.

***The diagonal elements in boxes are the individual arrest rates previously reported in Table 9 for each type of offender.

Aside from arrests for the residual category of "all offenders," offenders have the most arrests for the crime type characterizing the offender (the rates along the diagonal in Table 17)*. The relative magnitudes of the arrest rates for the other crime types, however, indicate substantial switching among crime types for the offenders. This movement between crime types is confirmed in the transition matrix of crime-type switches between consecutive arrests for all cohort members (Table 18). For most crime types, individuals change crime type between arrests at least two-thirds of the time.

The individual arrest rates in Table 17 can be adjusted using the estimates of the probability of arrest for a crime in Table 15 to generate estimates of individual crime rates. These are presented in Table 19. Aside from the category "all others," larceny is the most frequently committed offense for all types of offenders.**

Looking at all five index offenses (excluding homicide and rape), individual offenders commit a total of between 9 and 17 of these offenses a year. Offenders characterized as aggravated assaulters, auto thieves, weapons and "all others" offenders commit the fewest "index" offenses a year (around 10), while larcenists and burglars have the highest individual crime rates for "index" offenses (from 15 to 17 offenses a year). These estimates are derived from the cohort analysis and therefore refer most precisely to the individual crime rates of offenders in their twenties who were criminally active in Washington, D.C. in the late Sixties and who were arrested at least twice and were still active in 1973,

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*This is due to the fact that an offender characterized by a crime type must have at least one arrest for that crime type, while he need not have any arrests for other crime types.

**This phenomenon among crime rates differs from the pattern observed for arrest rates in Table 17 where the offense characterizing an offender was the most frequent. The difference is due to the comparatively lower arrest probability for larceny (Table 15), which results in higher estimated crime rates for larceny.

Table 18

Transition Matrix of Crime-Type Switches
Between Consecutive Arrests-All Cohorts Combined

Arrest i+1 / Arrest i	Probability That Next Arrest is For Crime Type: Robbery	Aggravated Assault	Burglary	Larceny	Auto Theft	Weapons	Drugs	All Others	(Number of Arrests)
Robbery	.301*	.132	.098	.098	.037	.027	.047	.260	(296)
Aggravated Assault	.131	.211	.080	.084	.038	.034	.072	.350	(237)
Burglary	.090	.082	.333	.149	.039	.043	.082	.180	(255)
Larceny	.080	.083	.100	.286	.037	.027	.076	.312	(301)
Auto Theft	.112	.119	.052	.104	.261	.045	.037	.269	(134)
Weapons	.154	.077	.077	.055	.022	.209	.099	.308	(91)
Drugs	.149	.065	.065	.091	.019	.052	.312	.247	(154)
All Others	.095	.081	.085	.112	.040	.048	.071	.468	(705)

*The diagonal elements in boxes indicate the probability of repeating the same offense on the next arrest. These transition probabilities indicate the degree of specialization in any crime-type from one arrest to another.

Table 19

Estimates of Individual Crime Rates for Each Crime Type
by Type of Offender - All Cohorts Combined

Crimes of*:	Individual Crime Rates While Free** for Crime Type: Robbery	Aggravated Assault	Burglary	Larceny	Auto Theft	Weapons+	Drugs+	All Others+	Index++ (Excluding Homicide and Rape)	Total
Robbers	3.41***	.97	2.13	4.92	.61	.93	2.45	8.55	12.04	23.97
Aggravated Assaulters	1.97	1.72	1.76	4.40	.54	.78	2.38	9.61	10.39	23.16
Burglars	1.74	.74	5.73	6.76	.78	.75	2.23	7.92	15.75	26.65
Larcenists	1.64	.78	3.42	10.88	.65	.73	2.35	9.47	17.37	29.92
Auto Thieves	1.57	.93	2.00	3.00	2.98	1.07	2.50	7.82	10.48	21.87
Weapons Offenders	1.49	.79	1.73	4.52	.85	4.02	2.63	7.79	9.38	23.82
Drug Offenders	1.84	.75	2.84	8.00	.78	.89	8.00	10.74	14.21	33.84
All Other Offenders	1.52	.83	2.44	4.92	.72	.91	2.50	10.42	10.43	24.26

*Individuals are characterized by any crime type that appears in their arrest histories.

**Crimes/year/offender after excluding any time served.

***The diagonal elements are the individual crime rates previously reported in Table 16 for each type of offender.

+No reliable estimates of the number of multiple offenders per crime or of reporting rates were available to derive estimates of the probability of arrest for a crime for weapons, drugs, and all other offenses. The estimated crime rates for these crime types, therefore, are not as reliable as the estimates for the other crime types.

++The index offenses include homicide, rape, aggravated assault, robbery, burglary, larceny and auto theft.

The rates in Table 19 also indicate some tendency for offenders to commit related crimes, especially for the property offenses. In addition to high burglary rates (5.73 offenses/year free), burglars also have comparatively high larceny rates (6.76 offenses/year free). Similarly, larcenists have high rates for burglary and larceny (3.42 and 10.88 offenses/year free, respectively). Drug offenders also commit large numbers of property crimes, particularly burglaries and larcenies (2.84 and 8.00 offenses/year free, respectively).

6.1 A Comparison of the Individual Crime Rates Estimated From Arrest Histories With Estimates Derived From Self-Reports of Criminal Activity

The estimates of individual crime rates presented here are based on the arrest histories of active offenders. Individual arrest rates are combined with estimates of the probability of arrest for a crime to estimate individual crime rates for various offense types. These estimates invoked a variety of assumptions about the arrest and crime reporting processes. In particular, the rate of multiple offenders per crime and the reporting rate are assumed to be independent of each other and invariant over time. The resulting probability of arrest for a crime is assumed constant over all offenders and invariant over time. These are strong prior assumptions and their violation could lead to various biases in the estimates of individual crime rates.

An alternative method for estimating individual crime rates is to use self-reports of crime from a population of known offenders. The reliability of these estimates will depend on the accuracy of the self-reported crimes. This self-reports approach has recently been used by the Rand Corporation for a sample of prison inmates in California institutions (Braiker, 1978). Individual crime rates are estimated as the number of offenses reported by

the offenders divided by the total time at risk (the time an offender was on the streets and therefore free to commit crimes). When computing crime-type specific rates only those offenders ever committing the crime type are considered.

These self report estimates, however, refer to the population of offenders whose most recent convicted offense and prior record are serious enough for them to be in prison. As a result the estimates may be biased toward higher individual crime rates than for the total population of serious offenders (those in and out of prison). Chaiken (1978) uses models of the crime committing and imprisonment processes to estimate the probability that an "active serious offender"* will be in prison at some time t. Using these probabilities, the individual crime rates estimated for prison inmates can be adjusted to obtain estimates of individual crime rates for all "active serious offenders."

The resulting estimates of individual crime rates from self-reports are presented in Table 20 for selected crime types,** along with the comparable estimates from arrest histories generated here. The two totally independent estimates of individual crime rates are strikingly similar. The differences

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*The population of "active serious offenders" refers to the "people who commit about the same types of crimes and at about the same frequency as the people who go to prison." (Chaiken, 1978, p. 3).

**Only those crime types with both self-report and arrest history estimates are presented in the table.

Table 20

Comparison of Alternative Estimates of Individual Crime Rates by Crime Type Derived from Rand Self-Reports and Washington, D.C. Arrest Histories

Crime Type*	Individual Crime Rates While Free**	
	Rand Self-Reports	Arrest Histories***
Robbery	1.97	3.41
Aggravated Assault	2.38	1.72
Burglary	7.23	5.73
Auto Theft	3.48	2.98

*There are some differences in the crime type categories used in the two estimates. The Rand Study reports the rate of armed robberies while arrest history estimate is based on all robberies. Also, the arrest history estimate is based on all aggravated assaults, while assaults in the Rand Study include reported incidents of "beatings," "cut-shot," "threatened" and "tried to kill."

**Number of crimes/year/offender after excluding any time served.

***As reported in Chaiken (1978), Table 6.

between the crime rate estimates can be satisfactorily accounted for by differences between the two populations of offenders and differences in the crime categories themselves.

First, the self-report estimates are restricted to a population of serious offenders, namely offenders who have similar crime committing behavior to those offenders who end up in prison. The arrest histories, on the other hand, are for arrestees in a year and may include many casual offenders with lower individual crime rates. Therefore, one would expect the self-report estimates to be somewhat higher than the arrest history estimates, as they are for all crime types in Table 20 except robbery.

The difference between the crime rate estimates for robbery, on the other hand, can be accounted for by differences between the crime type categories used. The self-report estimates refer only to the incidence of armed robberies, while the arrest history estimates include all types of robberies. Applying the proportion of armed robberies among all robberies, 65.8%, reported in the Uniform Crime Reports in 1973, to the estimate for robbery from arrest histories yields an estimated individual armed robbery rate of 2.24. This is closer to the rate estimated from self-reports.

The two estimates can also be compared in terms of the total number of these four crime types committed by an individual offender (Table 21). For the self-reports the aggregate crime rate is just the sum of the rates for each crime type weighted by the proportion of the sample ever committing that crime type. The comparable estimates from the arrest histories are just the sum of the individual rates for the four crime types from Table 19. As indicated in Table 21, the two estimation methods result in very similar estimates with each offender committing 4 to 8 armed robberies, assaults, burglaries and auto thefts per year free.

Table 21

Comparison of Alternative Estimates of Aggregate Individual Crime Rates Derived from Rand Self-Reports and Washington, D.C. Arrest Histories

	Aggregate Individual Crime Rate*
Rand Self-Reports**	6.40
Arrest Histories by Type of Offender:***	
Robbers	5.95
Aggravated Assaulters	5.32
Burglars	8.39
Larcenists	5.93
Auto Thieves	6.94
Weapons Offenders	4.35
Drugs Offenders	5.58
All Others Offenders	4.99

*This is the total number of armed robberies, aggravated assaults, burglaries and auto thefts committed/year/offender.

**This aggregate crime rate was derived from Chaiken (1978), Table 6. It was computed by weighting the individual crime rates for each crime type in Table 20 by the proportion of the sample ever committing that crime type.

***This aggregate rate includes only armed robberies among the total individual robbery rate. The armed robbery rate is calculated as 65.8% of the total robbery rate in Table 19.

Both estimation procedures undoubtedly involve errors, due to self-report biases in one case and to the inappropriateness of assumptions about the arrest process in the other. Nevertheless, when applied to completely independent samples, the two procedures result in strikingly similar estimates of individual crime rates, both for individual crime types and for an aggregate measure. Since it is relatively unlikely that the two procedures, with their different sources of error and different data bases will result in the same wrong estimates, this suggests that the errors in both cases may not be unreasonable, and lends some credibility to both sets of estimates. It goes without saying that further replications that control for the various forms of error are required before finally accepting these estimates as valid.

7.0 CONCLUSIONS

7.1 Variations in Individual Arrest Rates During a Career

Using the arrest histories of cohorts of active offenders, this investigation isolated variations in the individual arrest rates during the careers of active offenders from variations in the size of the offender population. Contrary to previous findings of a decrease with age when arrest rates per total population are used, we found that individual arrest rates increase with age for burglary, drugs and the residual category "all other" offenses, and are trendless for robbery, aggravated assault, larceny, auto theft, and weapons offenses. At the same time, individual arrest rates are generally trendless with respect to the number of prior arrests in an individual's record and tend to increase in later cohorts for all crime types except aggravated assault, auto theft and drugs.

Controlling for time served after sentence makes no meaningful difference to these results. The estimated time served of less than one month per arrest

is not sufficient to significantly alter the variations in individual arrest rates observed during a career.

These results on the variations in individual arrest rates during a criminal career were obtained using samples of active criminals (persons with at least one arrest before and after the observation period) and controlling for variations in time served in institutions. Admittedly the results must be regarded as only preliminary because of the limited number of years the cohorts were observed (from four to seven years). Further replications with other cohorts of active criminals are needed.

These findings of increases in individual arrest rates with age and for later cohorts can be reconciled with prior findings of a decline in criminality with age from cross-sectional analyses. First, the peak in arrests per capita previously observed at younger ages can be partially attributed to a larger number of offenders actively engaging in crime at those ages and is not due to significant variation in individual arrest rates over age for those persons who remain active as offenders. Also, the younger people at any time tend to be from later cohorts whose individual arrest rates were found to be higher. Thus, the cohort effect, where people beginning their careers more recently have higher arrest rates, would also contribute to the peak in arrests at younger ages. For the same reason, the decrease in per capita arrest rates as people get older is due to the combination of the greater drop-out from criminal activity as people age (resulting in smaller numbers of active older criminals) and the lower arrest rates of older people who come from earlier cohorts.*

*These effects of lower individual arrest rates associated with earlier cohorts and a reduction in the active criminal population associated with greater drop-out with age, however, would have to be strong enough to offset the increases with age in individual arrest rates observed for selected crime types.

7.2 Estimates of Individual Crime Rates

The estimated individual arrest rates were also used to generate estimates of individual crime rates. Invoking assumptions of independence between multiple offender rates and reporting rates to the police and homogeneity in the probability of arrest for a crime, individual crime rates were estimated by dividing the individual arrest rates by the probability of arrest for a crime (reported or unreported). These individual crime rates ranged from 1.72 auto thefts/year free for offenders identified as auto thieves to 10.88 larcenies/year free for larcenists.

The estimated individual crime rates revealed:

- little specialization in crime types; instead, offenders tend to engage in many different crime types;
- some tendency to engage in related offense types, particularly property crimes and drug offenses;
- aside from the residual category of "all other" offenses, larceny is the most frequently committed offense, regardless of the type of offender.

Combining the individual crime rates for the different crime types, the different types of offenders committed from 9 to 17 "index" offenses* /year free. These estimates of the magnitude of individual crime rates are in accordance with corresponding estimates derived from self-reported crimes in a sample of California prison inmates, enhancing the credibility of both estimates, each of which is plagued by serious, but totally independent sources of error.

*The index rates reported here exclude homicide and rape which represented less than 1% of

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