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U. S. DEPARTMENT OF JUSTICE
Office of Justice Assistance, Research, and Statistics

CATEGORICAL GRANT PROGRESS REPORT

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Skidmore College (Richard Rosenfeld)	FROM: 10/1/86 TO: 12/31/89	
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"Effects of Sanctions on Criminality"	$163,422	☐ REGULAR ☐ SPECIAL REQUEST XXX FINAL REPORT
9. NAME AND TITLE OF PROJECT DIRECTOR	**10. SIGNATURE OF PROJECT DIRECTOR**	**11. DATE OF REPORT**
Jacqueline Cohen, Assoc. Director Urban Systems Institute	Jacqueline Cohen	11/9/90

1.0 PROJECT ACTIVITIES

1.1 *Research Objectives*

Year-to-year changes in crime rates are often interpreted as indicators of corresponding changes in individual criminality. Periods of increasing crime rates, for example, may arouse concerns about a general breakdown in social control and rising tide of lawlessness, while periods of declining crime rates may be credited to the effectiveness of widespread increases in punitiveness.

Underlying these accounts is a presumption that changes in the total crime rate reflect corresponding changes in the general level of criminality in the nation. Aside from changing involvement in crime, however, changes in total crime rates also reflect changes in population composition--especially the population distribution across age and race groups that are characterized by markedly different crime rates[1]. Even if there were no changes in criminality, increases in the proportional representation of subgroups with high crime rates would lead to increases in the total crime rate.

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[1] Sex is another important demographic feature that distinguishes a population in terms of inclination toward crime with males displaying markedly higher rates than females. However, since the population distribution between males and females is generally highly stable (except in periods of massive social upheaval like major wars), changes in sex composition will have little effect on aggregate crime rates.

13. CERTIFICATION OF RECEIPT BY GRANTEE CRIMINAL JUSTICE COUNCIL *(Official signature)*	14. DATE

Analyses of crime look to a variety of structural factors that may be responsible for changing crime rates. While in the long run, compositional effects may be influenced by structural variables--through their differential influence on birth patterns--in the main, interest in the structural determinants of crime is concerned more with the direct influence of structural conditions on the criminality of individuals who experience those conditions. Thus, valid indicators of changing levels of *criminality* and of the influence on crime of potential causal factors require adequate controls to isolate compositional effects from underlying changes in criminality.

The confounding effects of population composition afflict a large body of extant research on the effectiveness of criminal sanctions on crime. Whether relying on cross-sectional comparisons or time series data, most studies use aggregate population crime rates and aggregate sanction risks to assess the crime control effects of sanctions. Crude controls--like the fraction of the population who are ages 15 to 24--are generally inadequate for the large variations in crime rates observed across age and race groups. Such categories both obscure important variations in crime rates within the category and miss entirely the effects of changes elsewhere in the age distribution.

The research under this grant seeks to better isolate criminality from composition effects in total crime rates, and to estimate the impact of structural factors on changing levels of *criminality*. We use demographic-specific estimates of crime rates as indicators of criminality for different population subgroups, and use multivariate analyses to relate these subgroup criminality rates to a variety of structural factors. We are interested in accounting for both changes over time in individual subgroup rates and variations in criminality rates across the different subgroups.

1.2 *Principal Results*

1.2.1 **Age-by-Race Arrest Rates.** The research relies fundamentally on demographic-specific crime rates estimated for age-by-race subgroups. The basic input data are from the annual Uniform Crime Reports (UCR) of the number of *arrests* for the U.S., which are reported by age of the arrestee, and separately by race of the arrestee for the aggregated age categories of juveniles

(under age 18) and adults (age 18 and over)[2]. A principal element of the current research was developing estimates of the race breakdown of arrestees for more detailed age categories.

The general approach used to estimating separate age-specific arrest rates for whites and nonwhites relied on available arrest data to estimate the *ratio* of nonwhite-to-white arrest rates for adults and juveniles, in combination with age-specific arrest rates for the *total* population, to yield age-specific rates by race. *If age and race were independent* in their effects on arrest rates, it would be possible to estimate age-specific rates for whites and nonwhites by simply using the single ratio of nonwhite-to-white arrest rates found for the total population. This same ratio could be applied uniformly to arrest rates at each age to estimate separate age-specific rates for whites and nonwhites.

Preliminary analysis of juvenile and adult arrest rates by race, however, indicate the likelihood of important age-by-race interactions. For burglary arrest rates in 1975, for example, the nonwhite-to-white ratio was 2.10 for juveniles and almost double that at 3.57 for adults. Comparing juveniles to adults, burglary arrest rates declined faster with age for whites (from 749.4 for juveniles to 142.8 for adults per 100,000 population) than for nonwhites (from 1570.3 to 509.1 per 100,000 population). As a result there is a larger difference in race-specific burglary rates for adults than for juveniles.

Other race-by-age interactions were found for robbery arrest rates and for murder arrest rates. Thus, some procedure was needed that would permit variations with age in the nonwhite-to-white ratio during both the juvenile and adult ages.

1.2.2 **"Good-Line-Fits" for the Nonwhite to White Ratio.** Analyzing each year and crime type separately, the basic strategy we used is to allow age-specific *ratios* to vary along two straight lines, one across juvenile ages and the other for adult ages. Two general rules are used in specifying candidates for those straight lines. First, the aggregate ratios for juveniles and adults that were available from annual UCR data are assigned to some age within their respective age ranges. As illustrated in Figure 1, the

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[2] Throughout the analysis all national arrest counts are adjusted upward to reflect jurisdictions not reporting arrests to the UCR each year. Separate adjustments are made to age-specific and race-specific counts of arrests based on the estimated total arrests reported for the U.S. A single adjustment for each year and crime type is applied uniformly to all ages or all races. This amounts to assuming that non-reporting jurisdictions are similar in the age and race composition of their arrests to jurisdictions that do report to the UCR.

available juvenile ratio may be situated at any age from 10 to 17, and the available adult ratio may be situated at any age from 18 to 74. Second, for each candidate age location, a line is drawn through that point and then allowed to rotate. As is illustrated in Figure 2, this permits a wide range of possible variations with age in the nonwhite-to-white ratio, including opposite increasing and decreasing ratios during the separate juvenile and adult ages.

For each possible ratio line, *age-specific rates by race* are calculated from the candidate ratio at each age and the available data on aggregate age-specific arrest rates. The resulting age-by-race specific arrest rates are then combined with data on the age mix of the population to form the *estimated* total juvenile and adult arrest rates by race, and the *estimated* nonwhite-to-white ratios for juveniles and adults. Comparing the estimated to observed juvenile and adult arrest rates, and the estimated to observed juvenile and adult nonwhite-to-white ratios, provide two error measures for each candidate ratio line.

In choosing the "best" juvenile and adult ratio lines from among the candidate lines, we were guided by the general shape of these ratio lines observed for murder, robbery, and burglary in full age-by-race arrest rates that were available to us from individual records of arrests in Pittsburgh, Pennsylvania and in Wayne County (which includes the city of Detroit), Michigan. The age patterns of those ratios varied sharply for the different crime types, but the two jurisdictions displayed very similar shapes for each crime type. As illustrated in Figure 3, the ratio rose slowly over age for murder, and declined slowly over age for robbery. The ratio for burglary was distinctive, first rising sharply through the juvenile ages to a peak in the early adult years, and then declining over the remaining adult ages.

The candidate ratio lines for juveniles and adults were restricted to those with the correct slope. Then among the candidate lines, the line with the smallest error was selected as the "good-line-fit" for the nonwhite-to-white ratio[3]. The general

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[3] For the robbery and burglary ratios, which both declined with age for adults, an effort was also made to restrict the ratio to be above 1.0 through age 55, thus maintaining higher arrest rates for nonwhites than for whites at all ages. Among the candidate lines with the correct direction of slope and small errors, the "good-line-fit" ratio line for adults was selected to exceed, or if no lines exceeding the ratio of 1.0 were available, to come as close as possible to a ratio of 1.0 at age 55. This constraint on the smallest acceptable ratio sometimes meant rejecting candidate lines with smaller error rates in favor of a line meeting, or coming close to meeting the minimum ratio requirement.

criterion for selecting the juvenile and adult ratio lines was small errors between the reported and estimated *ratios* for juveniles and adults. These error rates are generally well under 1% in absolute magnitude for both the juvenile and adult ratios. The final adequacy of the resulting age-by-race arrest rate estimates was then assessed in terms of the error rates between the reported and estimated race-specific *arrest rates* for juveniles and for adults.

1.2.3 **Final Estimates of Age-by-Race Arrest Rates.** In the final estimates, the error rates for juvenile and adult *arrest rates* are generally under +/-5%, and rarely exceed +/-10%. The higher error rates of between 5 and 10% are most commonly found among the estimated robbery arrest rates for juveniles. As indicated in Figure 4, however, even in that case, the errors are very reasonable. The estimated arrest rates track the reported rates quite well from year to year. In the case of the largest error, for nonwhite juveniles in 1970, the difference between the reported and estimated rates is 10.99% at 459.0 and 509.43 arrests per 100,000 population, respectively.

Figure 5 displays the final age-by-race arrest rate estimates for robbery in 1971. The general shape of the age variation in rates is driven by the original age-specific rates for the total population. The relative magnitudes of the rates for nonwhites and whites are determined by the estimated nonwhite-to-white ratios at each age.

To examine the benefits of allowing the nonwhite-to-white ratio to vary over age, Figure 5 also presents the estimated age-by-race specific arrest rates when the ratios are fixed at the reported juvenile and adult ratios for all ages that fall within these respective age ranges. The constant ratio estimates are generally characterized by larger errors than are the age varying "good-line-fit". The constant ratio estimates are particularly bad for adults, consistently underestimating white adult arrest rates and overestimating nonwhite adult arrest rates from year to year. By failing to reflect the decline in the robbery ratio with age, the single average adult ratio is too high for older adults, inflating nonwhite rates and understating white rates at these ages. These errors at older ages are then reflected in errors in the estimated adult arrest rates by race.

1.2.4 **Transformation from Arrest Rates to Age-by-Race Crime Rates.** The age-by-race arrest rates are scaled up to demographic-specific *crime rates* using annual estimates of the ratio of total U.S. crimes to total U.S. arrests for each crime type available from

annual UCR data[4]. Relying on a single arrest-to-crime adjustment for all demographic subgroups assumes that there is no systematic bias in the arrest risk per crime for different age-by-race subgroups[5]. The adjustment, however, does accommodate differences across crime types and over time in the transformation of arrests to crimes.

Since the resulting crime rate estimates rely exclusively on UCR data on arrests and reported crimes, the validity of the rates rests fundamentally on the adequacy of UCR data as an indicator of the variations in crime over time. Historically, it has been noted that UCR data on crimes are incomplete, failing to include crimes that are not reported to, or otherwise go undetected by the police. Concern about calibrating the volume of this "hidden" or "dark figure" of crime was a major impetus in the development of an alternative source of data on the level of crime based directly on victim reports in the National Crime Surveys (NCS) of the general population. The two sources have provided annual national data on crime levels in the U.S. since 1973.

The two data sources have always differed in scale--with UCR rates being about one-half NCS rates because of unreported crimes (Figure 6). Since the mid-1980's, new concerns have emerged about the relative merits of the two data sources in reflecting the pattern of year-to-year changes in crime. These concerns have been fueled, in part, by the declines in crime rates since 1981 apparent in the NCS rates, contrasted by the much flatter, stationary crime rates over the same period suggested by the UCR series (Figure 6).

The possibly conflicting patterns received widespread media attention in 1987 when UCR data for 1986 indicated a 6% rise in serious crime rates. Attributing the increase in UCR rates to increased reporting by the public to the police, U.S. Justice

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[4] These estimates already reflect the F.B.I.'s adjustment upward in the arrest and crime counts to account for non-reporting jurisdictions each year.

[5] Based on a growing body of evidence using very different data sources on arrest practices, we are reasonably confident that there is little age or race bias in the arrest risk per crime for serious offenses like murder and robbery. A similar mix of offenders is found when data on arrests are compared to victim reports of offender attributes (Hindelang, 1978, 1981; Messner, and South, 1988). Observational data of individual police/citizen encounters indicate that seriousness of the offense is the strongest factor contributing to arrest (Reiss, 1971; Gottfredson and Gottfredson, 1980; Smith, 1984; Gove et al, 1985). Various attempts to explicitly estimate arrest risk per crime find little variation with personal attributes of the offender (Petersilia, 1983; Liska et al, 1985; Blumstein et al, 1988).

Department officials contrasted the rise in UCR rates with NCS rates for 1986 that, "remained essentially unchanged from the year earlier.[6]"

1.2.5 **UCR/NCS Correspondence.** A closer analysis of the data over time, however reveals that the two series on national crime data have been highly consistent in characterizing yearly fluctuations in crime rates. As indicated in Figure 7, for example, a simple adjustment of both rates to a common population base[7], and a factor of two transformation of UCR rates[8] reveals strong correspondence between the two series regarding annual upturns and downturns in U.S. crime rates, and this correspondence holds regardless of any changes that might have occurred in reporting rates by the public to the police. Even the apparent strong decline in NCS crime rates since 1981 is mirrored by a similar pattern in UCR rates.

Multivariate analyses were performed using data from 1973 to 1985 to identify more precisely the structure of the relationship between the two data series, especially the relative influence on UCR rates of NCS crime rates and NCS reporting rates to the police. A principal innovation in this analysis is investigation of the separate contributions of *trends* and year-to-year *deviations* from trend in the two data series (as estimated, respectively, by the fitted values and residuals from trend regressions on the rate variables).

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[6] Department of Justice Press Release of May 9, 1987; New York Times (May 10, 1987: p.20); The Washington Post (May 10, 1987: p.16); The Chicago Tribune (May 11, 1987: p.3); The Los Angeles Times (May 10, 1987: p.24).

[7] Annual crime rates reported by the two data series are based on slightly different population bases. UCR crime rates for all crime types are relative to the total population, while NCS robbery rates refer to the population age 12 and over and NCS burglary rates are scaled relative to the number of households in the nation. The two data series are standardized to the same population base in order to remove differences in their rates that result from changes in population composition over time. In particular, during the post-baby-boom years from 1973 to 1985, the population age 12 and older was increasing faster (up 18%) than the population under age 12, as was the number of households (up 27%). This contrasts with a 13% increase in the total population over the same period. Use of the faster increasing denominators in the NCS rates will inflate negative trends in NCS published rates relative to UCR rates.

[8] This adjustment corresponds to a reporting rate by the public to the police of 50%, a rate very close to those observed over time for robbery and burglary in NCS data.

The first model in Table 1 contrasts the UCR and NCS rates directly. The significant coefficient for the NCS rates (BURN and ROBN) confirms the direct relationship between UCR and NCS rates evident in Figure 7. Nevertheless, the low R^2 (below .3) indicates that yearly variation in NCS rates alone leaves considerable unexplained variance remaining in the annual UCR rates for the same crime type.

The differences between the two series are located primarily in their contrasting trends. The trend components of each rate variable indicate: (1) no trend in UCR burglary rates, but a significant decrease in NCS burglary rates over the period 1973 to 1985; (2) opposite trends for robbery rates, which increase over time in UCR data and decrease in NCS data[9]. The contrasting trends are not fully accounted for by increases in the rates of victims reporting crimes to the police. A significant increasing trend in reporting burglaries is not sufficient to offset declines in NCS burglary rates, and even the NCS "reported" burglary rate (obtained by multiplying the NCS crime rate by the victim reporting rate each year) declines over time. While not statistically significant, a similar pattern is observed for robbery.

Another factor that might account for the contrasting trends in NCS and UCR rates is early measurement problems during the starting years of the NCS surveys. Any problems that might have contributed to over-counts of crimes in the NCS surveys (e.g., crime classifications that were too broadly defined, respondents telescoping earlier crimes into the reporting period) would inflate NCS rates in earlier years. As the survey was refined and improved over time, over-counts would be reduced, and would contribute to declines in NCS rates over time[10].

For whatever reason, the UCR and NCS crime rates differ mainly in their trends over the 1973 to 85 period. The fit between annual UCR rates and NCS crime data improves substantially (R^2 = .807 for

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[9] While these trends are not statistically significant, because of the high year-to-year variance in annual robbery rates, trends of about 1% change per year are estimated.

[10] When comparing time trends in *unadjusted* UCR and NCS robbery rates between 1973 and 1980, Cook (1985: 489) also favors UCR rates over NCS rates as more reliable indicators of robbery trends during the 1970's. He concludes that, "the FBI [UCR] data probably give a more accurate indication of the true robbery rate trend than the NCS data." Cook notes that both bank robberies and criminal homicide rates--which are highly correlated with robbery rates and well recorded in official data--increased over the 1970s as did UCR robbery rates. These increases contrast with unadjusted NCS rates that remained constant.

burglary and .557 for robbery) by relying exclusively on yearly *deviations from trend* in the NCS rates (see model 2 in Table 1). Similar improvement is not observed when only the deviations in NCS reporting rates are used (model 3 in Table 1). When the deviation components are used for both the NCS crime rate and the NCS reporting rate (model 4 in Table 1), the annual UCR rates are related primarily to the NCS crime rate variable. Little or no improvement in R^2 is observed by adding the reporting rate variables (model 4 versus model 2), and the reporting rate variables are not significant for either crime type.

The final model 5 in Table 1 assesses the contribution of time trends in accounting for UCR crime rates. The differences in the trend components of the UCR and NCS crime rates do not emerge as a concern for burglary where the estimated effect of trend is negligible. Time trends, however, are a factor in robbery rates. The negative trend coefficient highlights the opposite directions of trend between UCR crime rates and NCS "reported" crime rates. This trend coefficient is significant and results in an increase of .197 in R^2 (up from .537 to .734).

Based on these analyses, the relationship between UCR and NCS crime rates for burglary and robbery can be summarized as follows:

(1) Most of the annual variation in UCR crime rates is accounted for by variation in NCS crime rates; variations in NCS reporting rates have little or no effect on UCR rates.

(2) Much of the annual variation in UCR crime rates is due to yearly *deviations* from trend as opposed to *trend* in NCS crime rates; trend makes no difference at all for burglary, but has a modest effect for robbery.

Over time the two data series tell virtually the same story about year-to-year fluctuations in crime rates. Indeed Figure 8 reveals the very high correspondence between the yearly deviations from trend for UCR and NCS crime rates, especially for burglary.

Despite recent claims to the contrary, the evidence presented here supports a conclusion of strong consistency between the two data sources on crime. Over the years they have tracked each other quite closely, at least within the serious--and perhaps less ambiguous--crime types of robbery and burglary. Within the context of the models estimated here, knowing the rates from one data source provides a basis for obtaining good estimates of the corresponding crime rates from the other data source. These results provide substantial support for use of UCR data as an indicator of the variations in crime over time.

1.2.6 **General Patterns of Variation in Age-by-Race Crime Rates.** Substantial variations in crime rates are observed, both across age-by-race subgroups and over time. Figures 9 to 20 display the varying rates for robbery (Figures 9 to 12), burglary (Figures 13 to 16), and murder (Figures 17 to 20).

Over time, the general pattern is one of increasing crime rates within age-by-race subgroups to reach peak levels after 1970. The rates within subgroups then decline through 1985. White and nonwhite rates differ somewhat over time. White rates continue to climb to peaks after 1980, while nonwhite rates peak earlier and then sustain those peak rates through 1975 for murder and through 1980 for robbery and burglary. All crime types and race groups display a distinctive pattern over age, with rates increasing to reach a peak in the late teens (robbery and burglary) or early 20s (murder) and then decreasing again for older ages[11]. Regardless of crime type, age, or year, nonwhite crime rates are always higher than corresponding white rates.

1.2.7 **Calibrating Variations in Age-by-Race Crime Rates.** Regression analysis is used to more precisely characterize the general pattern of variations in crime rates displayed in Figures 9 to 20. In addition to age, race, and period (year), a variable is included to reflect possible cohort influences associated with the very large baby boom cohorts born after World War II, as well as some interaction terms among the variables.

The AGE variable consists of the midpoint values of the following seven age groups: 10-15 (12.5), 16-17 (16.5), 18-19 (18.5), 20-24 (22), 25-34 (29.5), 35-44 (39.5), and 45 and over (midpoint = 60). Age groups are used to reduce some of the random noise found in rates estimated for individual ages. The age groups were chosen to be sensitive to the age variation in rates around peak ages, and to correspond to the age data available for a variety of exogenous macro-structural variables (e.g., incarceration risk, unemployment, family structure) that may contribute to the variation in rates across subgroups.

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[11] It should be noted that this age pattern is characteristic of aggregate population rates of arrests or crimes found in the general population. Other research examining the patterns over age only *among active offenders* fails to find the same pattern observed in aggregate population rates (Blumstein et al, 1986; Farrington, 1986; Andersson, 1990; Wikstrom, 1990). The distinctive age pattern found in aggregate population rates seems to be associated primarily with variation over age in the numbers of persons who participate in crime, with the rise during the juvenile ages reflecting increases in the numbers of offenders, and the decline during the adult years reflecting increasing termination of offending as offenders get older.

The RACE variable is coded 1 for whites and 2 for nonwhites. The subgroup of nonwhites is used instead of blacks alone for compatibility with Census Bureau data on some exogenous variables, which are only available for the combined catgory of blacks and other races through the early 1970's. The nonwhite rates primarily reflect black crime rates. The black fraction of nonwhite arrests remained in excess of 93% over the period 1965 to 1985, being highest for robbery and lowest for burglary. Over the same period, blacks also dominated the nonwhite population, but the black fraction among nonwhites declined steadily from 91% in 1965 to 80% in 1985.

The nonwhite rates, nevertheless, continue to track black rates over time. The correlation between annual nonwhite and black rates never falls below .926 for the three crime types examined, and nonwhite rates display the same year-to-year variations as are observed in black rates. (See Figure 21.) Because of the decline in the black fraction of the nonwhite population, especially during the latter half of the observation period, nonwhite crime rates increasingly understate black crime rates. Overall trends in black rates, however, are not seriously distorted in the nonwhite rates. Table 2 contrasts the arrest rate changes between 1973 and 1983 for each racial subgroup. In all cases the nonwhite change mirrors the change in black rates, and is distinct from the changes in white rates.

The PERIOD variable is just the years 1965 to 1985. The effect of the baby boom birth cohorts is reflected in a "BOOM" variable, that has the value 2 if (PERIOD - AGE) $\geq$ 1946 and $\leq$ 1964, and a value of 1 otherwise. Use of a dummy variable to reflect the key baby boom birth cohorts has the advantage of breaking the strict linear dependence among AGE, PERIOD, and COHORT, and thus permitting all three effects to be estimated in the same model.

In order to allow for possible non-linear relationships, a log/log form of regression models is used. Models containing different independent variables are contrasted using a standard F-

test of squared residuals[12] to assess the contribution of including additional attributes in accounting for the variation in demographic-specific crime rates. Three models are examined: (1) a model containing only AGE and RACE, (2) a model that adds the PERIOD and BOOM cohort variables, and (3) a final model that also includes two interactions, AxR and PxR, which permit race differences in AGE and PERIOD effects, respectively. The regression results for the three crime types are reported in Tables 3 to 5.

The main findings are:

(1) AGE and RACE alone are major factors in the variation in crime rates for all three crime types. (See the results for model 1 in Tables 3 to 5.)

(2) Nevertheless, PERIOD and BOOM do add significantly in accounting for the variation in age-by-race crime rates for all three crime types. (The F-values obtained when comparing models 1 and 2 are all highly significant.)

(3) For all three crime types, the interactions of RACE with AGE or with PERIOD add further to accounting for the variation in crime rates. (The F-values obtained when comparing models 2 and 3 are highly significant.)

(4) The RACE effect is in the expected direction with higher crime

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[12] The F-test compares pairs of regression models that share the same set of independent variables, one an unrestricted model in which all coefficients are estimated freely, and the other a restricted model in which some of the coefficients are restricted to be zero.

$$F = \frac{(SSE_r - SSE_u) / (k-g)}{SSE_u / (n-k)} \sim f_{k-g,n-k}$$

where,

SSE_r = sum of squared errors of the restricted model,
SSE_u = sum of squared errors of the unrestricted model,
g = number of variables in restricted model,
k = number of variables in unrestricted model,
n = number of offender subgroups analyzed.

If $F > f_{k-g,n-k}(\alpha)$, then the restricted and unrestricted models differ significantly (at the α level) in their explanatory power, and the additional variables included in the unrestricted model add incrementally in accounting for the variation in subgroup rates.

rates for nonwhites than for whites. (The RACE coefficient is positive and highly significant in all models.)

(a) Focusing on model 2, and ignoring any interactions with RACE, being nonwhite adds 2.1259 (3.0673*.6931) to the natural logarithm of the robbery crime rate (lnROB), for an average nonwhite-to-white ratio of 8.38 (exp[2.1259]) for robbery. For murder, the average nonwhite-to-white ratio is 8.40 (exp[2.1286], where 2.1286 = 3.0712*.6931). The average ratio is much smaller for burglary at 2.45 (exp[.8992], where .8992 = 1.2974*.6931).

(b) The significant negative interaction terms in model 3 mean that the RACE effect declines with AGE and with PERIOD. For robbery and burglary, the nonwhite-to-white ratio (NW/W) is smaller at older ages and in more recent years. For murder, the ratio is smaller only in more recent years.

(5) A strong quadratic AGE effect is found for all crime types. Crime rates increase through the juvenile and early adult years and then decrease through the older adult years.

(a) The age of peak crime rates varies considerably across the crime types, and is youngest for burglary at 14.8 years, then increases to 20.9 years for robbery, and finally peaks at the oldest age of 28.5 years for murder[13]

(b) The AGE effect is much stronger for murder than for robbery or burglary. Contrasting the contribution to the crime rate at the peak age to the crime rate at the youngest age (i.e., 12.5 years) for each crime type, the

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[13] The age at peak crime rate is determined from the coefficients of the lnAGE and lnAGEsq terms in the regressions. For,

$$Y = b_1X + b_2X^2$$

where X = lnAGE, the age at the peak crime rate is found by taking the derivative of Y with respect to X,

$$dY/dX = b_1 + 2*b_2X$$

and solving for X at dY/dX = 0.

ratio is 7.98 for murder[14], 2.21 for robbery[15], and 1.06 for burglary[16]

(c) Crime rates for both robbery and burglary display a significant interaction between AGE and RACE. The negative coefficients of lnAxlnR in model 3 imply that the change in crime rates with age is less pronounced for nonwhites than for whites. The interaction also means earlier ages for peak crime rates for nonwhites. The nonwhite robbery crime rate peaks at 18.0 years (vs. 20.9 years for whites), and the nonwhite burglary crime rate peaks at 13.1 years (vs. 14.8 years for whites).

(6) Significant quadratic PERIOD effects are observed with crime rates increasing over time to a peak in 1984 for robbery and in 1981 for murder. Burglary crime rates continue to increase steadily over time through 1985, the last year observed in the data.

(a) Burglary rates continue to increase for both whites and nonwhites throughout the observation period, but the increase for *whites is much larger* than for nonwhites. Between 1965 and 1985 the white burglary rate more than doubles,

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[14] Using the coefficients for lnAGE and lnAGEsq in model 3, the ratio of the age contributions to the murder rate is exp[34.90127-32.82446] evaluated at ages 28.5 and 12.5, respectively, to yield a ratio of 7.98 = exp[2.07681].

[15] Using the coefficients for lnAGE and lnAGEsq in model 3, the ratio of the age contributions to the robbery rate is exp[27.59965-26.80690] evaluated at ages 20.9 and 12.5 years, respectively, to yield a ratio of 2.21 = exp[.79275].

[16] Using the coefficients of lnAGE and lnAGEsq in model 3, the ratio of the age contributions to the burglary rate is exp[14.33630-14.27898] evaluated at ages 14.8 and 12.5 years, respectively, to yield a ratio of 1.06 = exp[.05732].

while the nonwhite rate increases by only 11%[17].

(b) There are significant interactions between PERIOD and RACE with nonwhite rates peaking somewhat earlier and increasing more slowly than do whites: nonwhite rates peak in 1979 for robbery (vs. 1984 for whites) and in 1971 for murder (vs. 1981).

(c) Comparing the increase in crime rates through the peak years, the *white* robbery rate in 1984 is 2.363 times the same rate in 1965, while the *nonwhite* robbery rate in 1979 is 1.632 times the same rate in 1965. For murder, the white rate increases 97% to a peak in 1981, while the nonwhite rate increases only 8% to a peak in 1971[18].

1.2.8 **Effects of Population Composition and Changing Criminality in Total Crime Rates.** Considerable variation is observed in demographic-specific crime rates across race, age, year, and birth cohort. In the presence of such variation, changes in total crime rates--which reflect a population-weighted average of the rates in individual subgroups--may be influenced substantially by changes in population composition across different subgroups, and need not reflect changing levels of criminality. For example, increases in the proportional representation of high-crime-rate subgroups in the population would contribute to higher total crime rates independently of any increases in criminality

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[17] All else being equal, the ratio of white burglary rates in 1985 to rates in 1965 is given by:

$$RATE_{1985}/RATE_{1965} = \exp[\ln RATE_{1985} - \ln RATE_{1965}]$$

$$= \exp[76.8241*(\ln(1985)-\ln(1965))]$$

$$= \exp[.77746] = 2.18$$

For nonwhites the same ratio is given by:

$$\exp[(76.8241-95.3365*.6931)*(\ln(1985)-\ln(1965)]$$

$$= \exp[.10875] = 1.11$$

[18] To some extent, the slower increases observed in nonwhite crime rates compared to white crime rates is due to the changing composition of the nonwhite population, which increasingly includes people of races other than black who are characterized by lower crime rates than blacks. The pattern in crime rates for nonwhites, nevertheless, tracks black rates reasonably well. (See section 1.2.7 above.)

within the subgroups.

Using the demographic-specific crime rates described above, it is possible to partition changes in total population crime rates between effects of *population composition* and those of changing *criminality*. In the most general formulation, the total crime rate in year t, $C(t)$, reflects a weighted sum of the demographic-specific crime rates of individual population subgroups j in the total population,

$$C(t) = \sum_j W_j(t) * C_j(t) .$$

It is easily shown that the year-to year change in the total crime rate,

$$\Delta C(t) = C(t) - C(t\text{-}1)$$

can be expressed as,

$$\Delta C(t) = \sum_j \left[\frac{W_j(t) + W_j(t\text{-}1)}{2}\right] * [C_j(t) - C_j(t\text{-}1)] \qquad (1a)$$

$$+ \sum_j \left[\frac{C_j(t) + C_j(t\text{-}1)}{2}\right] * [W_j(t) - W_j(t\text{-}1)] \qquad (1b)$$

Equation (1) partitions the year-to-year change in the total crime rate between the contribution of changing levels of criminality in (1a) and changing composition of the population in (1b).

The model in equation (1) can be generalized to accommodate several distinct composition changes. In the present analysis we are interested in changes in race composition and changes in the age composition within each race. Considering race composition first, with $C_k(t)$ the annual crime rate of race k and $p_k(t)$ the fraction of the total population who are race k in year t, the annual change in the total crime rate is:

$$\Delta C(t) = \sum_k \left[\frac{C_k(t) + C_k(t-1)}{2}\right] * [p_k(t) - p_k(t-1)] \quad (2a)$$

$$+ \sum_k \left[\frac{p_k(t) + p_k(t-1)}{2}\right] * [C_k(t) - C_k(t-1)] \quad (2b)$$

Part (2a) represents the contribution of changing race composition to changes in the total crime rate from year to year. Part (2b) includes the contribution of changes in the race-specific crime rates, $\Delta C_k(t)$, to changes in the total crime rate.

Now the annual changes in race-specific crime rates,

$$\Delta C_k(t) = C_k(t) - C_k(t-1)$$

in part (2b) can be further partitioned between the contribution of changing age composition for ages i within each race (eq.(3a)), and the contribution of changing criminality within individual race-by-age subgroups (eq.(3b)),

$$\Delta C_k(t) = \sum_i \left[\frac{\beta_{ki}(t) + \beta_{ki}(t-1)}{2}\right] * [W_{ki}(t) - W_{ki}(t-1)] \quad (3a)$$

$$+ \sum_i \left[\frac{W_{ki}(t) + W_{ki}(t-1)}{2}\right] * [\beta_{ki}(t) - \beta_{ki}(t-1)] \quad (3b)$$

for:

$W_{ki}(t)$ = the fraction of the population who are each age i within the population of race k, and

$\beta_{ki}(t)$ = The race-by-age specific crime rate for the population of age i and race k in year t.

Combining eq. (2a) with eqs. (3a) and (3b) provides the full partition of changes in the total crime rate between *composition* (for race and age separately in eqs. (4a) and (4b), respectively) and *criminality* (in eq. 4c)). The relative influence on changing crime rates of race and age composition and of changing criminality within demographic subgroups are displayed in Figures 22 to 33 for robbery (Figs. 22 to 25), burglary (Figs. 26 to 29), and murder (Figs. 30 to 33).

$$\Delta C(t) = \sum_k \left[\frac{C_k(t) + C_k(t-1)}{2}\right] * [p_k(t) - p_k(t-1)] \qquad (4a)$$

$$+ \sum_k \left(\left[\frac{p_k(t) + p_k(t-1)}{2}\right] * \sum_i \left[\frac{\beta_{ki}(t) + \beta_{ki}(t-1)}{2}\right] * [W_{ki}(t) - W_{ki}(t-1)] \right) \qquad (4b)$$

$$+ \sum_k \left(\left[\frac{p_k(t) + p_k(t-1)}{2}\right] * \sum_i \left[\frac{W_{ki}(t) - W_{ki}(t-1)}{2}\right] * [\beta_{ki}(t) - \beta_{ki}(t-1)] \right) \qquad (4c)$$

1.2.9 **Effects of Changing Racial Composition.** Figures 22, 26, and 30 display the contributions of changing demographic composition to changing crime rates over the period 1965 to 1985. For all three crime types, the racial composition effect is always positive, contributing to increases in the annual crime rate each year. Despite the changing racial composition over time--to steadily increasing fractions nonwhite in the nation's population--the racial composition effect is generally stable over time. This stability can be attributed to a slowing of the race impact as white and nonwhite crime rates have been becoming more similar, due primarily to the much weaker declines in white crime rates than in nonwhite rates after 1980 (see section 1.2.7 above).

Relative to age composition effects, the pattern of race composition effects varies across the three crime types. For robbery the racial composition effect is similar in magnitude to the age composition effects for both whites and nonwhites (Figure 22). By contrast, the impact of racial composition is smaller than the age effects for burglary (Figure 26) and larger than race-specific age effects for murder (Figure 30), especially since the mid-1970's. This pattern reflects the varying race differentials between white and nonwhite crime rates for the three crime types, which are largest for murder and smallest for burglary. The more similar the crime rates of whites and nonwhites, as in burglary, the less impact that varying racial composition will have on total crime rates.

1.2.10 **Effects of Changing Age Composition.** As expected, the effects of age composition track the aging of the baby boom birth

cohorts. The general pattern is one of increases in crime rates from age composition early in the period, followed by decreases in crime rates from age composition later in the period (Figs. 22, 26, and 30). These age effects, however, do vary by crime type reflecting differences in the patterns of age variations in crime rates for the three crime types. As the bulk of the baby boom cohorts reached the ages of peak property offending in the mid and late teens in 1971, the increases in crime rates from age composition also peaked for both robbery and burglary (Figures 22 and 26). For murder, the period of increasing contributions to rising crime rates is extended longer, with the peak for age composition effects not occurring until 1975-76 for murder (Figure 30). This reflects the older ages of peak offending that are characteristic of violent crimes.

The age composition effects are more pronounced for nonwhites than for whites in robbery and murder, reflecting the much larger participation by nonwhites in these two offenses. For burglary, where white offenders dominate, the age composition effect of whites is stronger. Interestingly, by 1985 robbery and burglary were beginning to display the start of new upturns in the age composition effects. This recent upturn from age composition probably signals the leading edge of a new trend toward higher crime rates as the echo-boom cohorts (i.e., the larger cohorts of children born to baby-boom parents) start to reach the crime prone ages.

1.2.11 **Effects of Changing Criminality.** Figures 23, 27, and 31 display the contributions of criminality to changing crime rates for robbery (Fig. 23), burglary (Fig. 24), and murder (Fig. 31). The changes in white and nonwhite criminality are plotted separately in part (a) of these figures; part (b) contrasts the observed total crime rate to that expected from annual changes in criminality alone. Despite the differentials between whites and nonwhites in their raw race-specific crime rates, the annual contributions of their changing criminality to changes in total crime rates are very similar for whites and non-whites.

The most distinctive feature of the criminality effects is their tendency to change direction from one year to the next, moving up and down in changes of similar magnitude. Such changes could result from a process that is largely stable, but subject to random noise. However, some longer term trends in criminality are also evident.

White criminality effects display the same pattern for all three crime types. Increases in white criminality contribute to slow but steady increases in expected annual crime rates until the late 1970's when the expected crime rates stabilize as annual changes in criminality level off varying around a mean of zero. (This pattern is most evident in part (b) of Figures 23, 27, and 31.) The

patterns for *nonwhite criminality* differ somewhat by crime type. For burglary, nonwhite criminality does not display any systematic trends up or down, but instead varies around a mean of zero over the entire period. For robbery there is an early sharp rise in nonwhite criminality until 1970 that is followed by stable variation around a mean of zero. Nonwhite criminality for murder starts the period stable, varying around a mean of zero until 1975, when nonwhite criminality displays a marked decline.

1.2.12 **Total Crime Rates.** Figures 24, 28, and 32 compare the relative contributions of population composition (race and age combined) with those of criminality (whites and nonwhites combined) in determining annual changes in total crime rates. While the composition effects are always smaller than the contributions of changing criminality, the contribution of composition is appreciable. Ignoring the positive and negative signs that indicate the direction of the effects, and focusing on the absolute magnitude of composition and criminality effects, on average, composition effects represent 17.3% and 18.7% of the total change in crime rates for robbery and burglary, respectively, and 27.3% of the annual change in total murder rates[19].

Figures 25, 29, and 33 present the annual total crime rates actually observed for the three crime types, along with the change in these crime rates attributed to changes in criminality. The year-to-year rises and falls in total annual crime rates closely mirror the pattern observed in the year-to-year changes in criminality. All three crime types display distinctive upward trends through the early 1980's. Robbery and burglary reach peaks that are more than double the 1966 crime rates, and murder increases by 50%. For burglary (Figure 29), the changes in criminality alone closely track the total crime rate. For robbery and murder (Figures 25 and 33, respectively), the contribution of criminality during the first half of the period is not sufficient to account for the steady rise in total crime rates through the mid-1970's; the combined effects of age and race composition are important factors in the early rise of crime rates for robbery and murder.

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[19] In this analysis, the combined composition and criminality effects are obtained by summing the absolute value of each of the individual components. Where the two effects are in opposite directions, perhaps with criminality contributing to an increase in the total crime rate and composition contributing to a decrease, the combined absolute effects will be larger than the change in crime rate that is actually observed that year. The relative contribution of composition is obtained as the percentage of the combined absolute effect associated with composition.

1.2.13 **Accounting for Variations in Criminality.** The previous analyses have isolated the contribution of changing criminality to annual changes in population crime rates. While this contribution is substantial, total crime rates are an imperfect indicator of changing levels of criminality, especially for robbery and murder. Not only are total population crime rates influenced by changes in population composition, the pattern of year-to-year changes observed in total crime rates need not reflect changes for individual population subgroups.

Important differences between the patterns of white and nonwhite criminality are noted above, with white crime rates exhibiting more pronounced variations with age and time than do nonwhite crime rates. While nonwhite crime rates tend to stabilize during the latter half of the observation period, white crime rates continue to increase throughout much of the period. Also whites exhibit sharper changes in rates over age than do nonwhites.

The age-by-race specific crime rates developed in this research represent an important advance in isolating variations in criminality from changes in population composition. The final phase of this research will involve analyses of various structural factors associated with changing criminality through multivariate analyses applied to the demographically disaggregated crime rates. These analyses will seek to account for short-term variations and longer-term trends in criminality within subgroups, as well as differences across the demographic subgroups using a variety of structural indicators of economic and social conditions, including changes in the risk of incarceration.

1.3 *Continuing Research*

A number of structural variables have been identified for use in the multivariate analyses. These variables reflect a wide array of causal factors previously considered in analyses of population crime rates. Relying on published data from Current Population Reports of the Census Bureau and data from the Bureau of Labor Statistics, most of the measures in Table 6 can be estimated for the same age-by-race subgroups that are used in the crime rate measures.

Because of the very large volume of data involved, we were not able to fully complete the data collection effort by the closing date of the grant. We, nevertheless, are continuing our work on this research in order to complete the data collection and multivariate analyses. The results of the analyses and the completed data set will be submitted to NIJ as soon as this effort is complete.

2.0 INTERMEDIATE PRODUCTS

Throughout the course of this project, the results of the research have been made available to the National Institute of Justice and to wider audiences of researchers and practitioners. The intermediate products include:

1. Twelve quarterly progress reports submitted to the National Institute of Justice Program on Crime Control and Criminal Careers reporting intermediate results.

2. Presentations at the annual meetings of grant recipients in NIJ's Program on Crime Control and Criminal Careers.

3. Presentations at professional meetings:

   a) Rosenfeld, R. (1987) "Determinants of Change in Age-Race Specific Crime Rates, 1965 to 1985." Presentation at annual meeting of American Society of Criminology, Montreal, Canada, November 1987.

   b) Blumstein, A., J. Cohen, and R. Rosenfeld (1989) "Compositional and Contextual Effects of Age on Crime Rates." Presentation at annual meeting of American Sociological Association, San Francisco, CA, August, 1989.

   c) Rosenfeld, R. (1989) "Economic Inequality and Age-Race Specific Crime Rates: A Cross-section Time Series Analysis." Presentation at annual meeting of American Society of Criminology, Reno, NV, November, 1989.

4. Publications and Working Papers[20]:

   * Blumstein, A., J. Cohen, and R. Rosenfeld (1990) "Trend and Deviation in Crime Rates: A Comparison of UCR and NCS Data for Burglary and Robbery." Paper in final preparation stage for forthcoming publication in Criminology.

5. Data of annual age-by-race specific arrest rates and crime rates in the U.S. from 1965 to 1985[21].

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[20] Copies of the items with an asterisk (*) are enclosed. Two copies are enclosed, one for the grant monitor and one to be forwarded to NCJRS.

[21] The data and documentation are enclosed.

3.0 FUTURE PRODUCTS

Drawing on the continuing results of the analysis, several future products are planned, including:

1. Cohen, J., "Estimating Age-by-Race Specific Crime Rates in the U.S., 1965 to 1985," for submission to the Journal of Quantitative Criminology.

2. Blumstein, A., J. Cohen, and R. Rosenfeld, "Age, Race, Period, and Cohort Effects on Crime Rates, 1965 to 1985," for submission to Criminology or the Journal of Quantitative Criminology.

3. Cohen, J. and R. Rosenfeld, "Effects of Sanctions on Criminality: Analysis of Demographically Disaggregated Crime Rates," for submission to Criminology, Social Forces, or the American Sociological Review.

4. Final data that augments the arrest rates and crime rates with demographically disaggregated measures of the variety of exogenous factors (see Table 6) thought to potentially affect offending rates.

Copies of these additional papers will be submitted to NIJ as they become available.

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Table 1. Alternative Models Relating UCR Crime Rates to NCS Data

a. UCR Burglary Crime Rate, BURU (1973-85)

NCS Variables[a]	1	2	3	4	5
Intercept	620.082 (t= 1.886)	1424.431*** (t= 86.778	1429.328*** (t= 52.167	1426.303*** (t= 97.002)	1401.565*** (t= 5.392)
BURN	.276* (t= 2.457)				
BURN(D)		.661*** (t= 7.152)		.544*** (t=5.315)	.544*** (t= 5.045)
BREP(D)			9096.862*** (t= 3.372)	3477.926 (t= 1.941)	3467.063 (t= 1.833)
BURNREP(T)					.017 (t= .095)
Adj R^2	.296	.807	.464	.846	.829

b. UCR Robbery Crime Rate, ROBU (1973-85)

Intercept	83.656 (t= 1.464)	211.473*** (t= 50.473)	210.703*** (t= 38.274)	211.228*** (t= 49.651)	578.835*** (t= 4.556)
ROBN	.249* (t= 2.247)				
ROBN(D)		.368** (t= 4.010)		.323* (t= 2.907)	.329** (t= 3.897)
RREP(D)			713.790 (t= 2.113)	227.252 (t= .733)	198.604 (t= .844)
ROBNREP(T)					-1.319* (t= -2.894)
Adj R^2	.252	.557	.224	.537	.734

Table 1. Alternative Models Relating UCR Crime Rates to NCS Data (Continued)

Significance in a 2-tailed test:

$^{*}p \leq .05$
$^{**}p \leq .01$
$^{***}p \leq .001$

[a]The variables are defined as follows:

BURU, ROBU	-	Annual UCR crime rates for burglary and robbery (reported crimes per 100,000 population);
BURN, ROBN	-	Annual NCS crime victimization rates for burglary and robbery (as adjusted to reflect rates per total resident population);
BURN(D), ROBN(D)	-	Yearly deviations from the simple time trend in annual NCS crime victimization rates for burglary and robbery;
BREP(D), RREP(D)	-	Yearly deviations from the simple time trend in annual NCS rates of victims reporting crimes to the police for burglary and robbery;
BURNREP(T), ROBNREP(T)	-	Annual time trend values of NCS "reported" crime rates for burglary and robbery (obtained from the product of NCS crime victimization rates and NCS reporting rates).

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BURN	.276* (t= 2.457)				
BURN(D)		.661*** (t= 7.152)		.544*** (t=5.315)	.544*** (t= 5.045)
BREP(D)			9096.862*** (t= 3.372)	3477.926 (t= 1.941)	3467.063 (t= 1.833)
BURNREP(T)					.017 (t= .095)
Adj R^2	.296	.807	.464	.846	.829

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ROBN	.249* (t= 2.247)				
ROBN(D)		.368** (t= 4.010)		.323* (t= 2.907)	.329** (t= 3.897)
RREP(D)			713.790 (t= 2.113)	227.252 (t= .733)	198.604 (t= .844)
ROBNREP(T)					-1.319* (t= -2.894)
Adj R^2	.252	.557	.224	.537	.734

Table 2 Comparison of Nonwhite and Black Arrest Rates Over Time

Subgroup	Murder	Robbery	Burglary
Adults:			
1973 Black Rate	48.99	253.51	320.78
1983 Black Rate	46.69	334.39	497.55
Percentage Change	- 4.7	+31.9	+55.1
1973 Nonwhite Rate	44.02	227.02	293.00
1983 Nonwhite Rate	38.84	275.84	415.57
Percentage Change	-11.8	+21.5	+41.8
1973 White Rate	4.04	18.08	75.57
1983 White Rate	5.89	27.56	118.77
Percentage Change	+45.8	+52.4	+57.17
Juveniles:			
1973 Black Rate	16.91	402.32	1005.94
1983 Black Rate	14.98	557.30	961.43
Percentage Change	-11.4	+38.5	- 4.4
1973 Nonwhite Rate	15.86	369.04	949.46
1983 Nonwhite Rate	12.88	471.25	842.20
Percentage Change	-18.8	+27.7	-11.3
1973 White Rate	1.53	28.82	397.44
1983 White Rate	2.81	43.76	482.76
Percentage Change	+83.7	+51.8	+21.5

Table 3. Variation in Demographic Specific Robbery Rates

Variable	Coefficient	Standard Error	t-Stat	Model Statistic
MODEL 1				
Constant	- 21.4489	1.1722		
lnRACE	3.0673	.0734	41.764	
lnAGE	18.2677	.7184	25.427	
lnAGEsq	- 3.0673	.1080	28.580	
Adj R^2				.938
# Cases				294
SSE[a]				55.2365
MODEL 2				
Constant	- 542263	158341		
lnRACE	3.0673	.0635	48.312	
lnAGE	17.7067	.6382	27.743	
lnAGEsq	- 2.9842	.0972	30.704	
lnPERIOD	142853	41733	3.423	
lnPERIODsq	- 9408.7	2749.8	3.422	
lnBOOM	.3143	.0824	3.814	
Adj R^2				.954
# Cases				294
SSE				40.9102
F-Test				33.503*
MODEL 3				
Constant	- 542446	123792		
lnRACE	508.7868	122.8515	4.141	
lnAGE	18.1508	.5002	36.290	
lnAGEsq	- 2.9842	.0760	39.273	
lnPERIOD	142878	32267	4.379	
lnPERIODsq	- 9408.8	2149.8	4.376	
lnBOOM	.3143	.0644	4.879	
lnAxlnR	- 1.2815	.0989	12.957	
lnPxlnR	- 66.1018	16.1895	4.083	
Adj R^2				.972
# Cases				294
SSE				24.8537
F-Test				92.061*

* F-value is significant at the .001 level.

[a] Sum of Squared Error

[n] Except where noted by "n", all coefficients are significant at the .001 level.

Table 4. Variation in Demographic Specific Burglary Rates

Variable	Coefficient	Standard Error	t-Stat	Model Statistic
MODEL 1				
Constant	- 6.3898	1.0581		
lnRACE	1.2974	.0663	19.571	
lnAGE	11.0637	.6485	17.061	
lnAGEsq	- 2.0944	.0975	21.482	
Adj R^2				.941
# Cases				294
SSE[a]				45.0037
MODEL 2				
Constant	-337.9090	52.3614		
lnRACE	1.2974	.0607	21.379	
lnAGE	10.3967	.6091	17.069	
lnAGEsq	- 1.9721	.0927	21.276	
lnPERIOD	43.7830	6.9012	6.344	
lnBOOM	.3737	.0764	4.889	
Adj R^2				.951
# Cases				294
SSE				37.4532
F-Test				29.030*
MODEL 3				
Constant	-589.4000	66.5888		
lnRACE	726.9450	135.4596	5.367	
lnAGE	10.6344	.5506	19.313	
lnAGEsq	- 1.9721	.0836	23.591	
lnPERIOD	76.8241	8.7757	8.754	
lnBOOM	.3737	.0689	5.421	
lnAxlnR	- .6859	- .6859	6.289	
lnPxlnR	- 95.3365	-95.3365	5.341	
Adj R_2				.960
# Cases				294
SSE				30.2523
F-Test				34.037*

* F-value is significant at the .001 level.

[a]Sum of Squared Error

[n] Except where noted by "n", all coefficients are significant at the .001 level.

Table 5. Variation in Demographic Specific Murder Rates

Variable	Coefficient	Standard Error	t-Stat	Model Statistic
MODEL 1				
Constant	- 33.4579	1.0864		
lnRACE	3.0712	.0681	45.120	
lnAGE	21.5881	.6658	32.422	
lnAGEsq	- 3.2424	.1001	32.388	
Adj R^2				.913
# Cases				294
SSE[a]				47.4464
MODEL 2				
Constant	- 568204	159527		
lnRACE	3.0712	.0640	48.014	
lnAGE	20.9607	.6430	32.597	
lnAGEsq	- 3.1274	.0979	31.938	
lnPERIOD	149738	42045	3.561	
lnPERIODsq	- 9865.6	2770.4	3.561	
lnBOOM	.3514	.0830	4.233	
Adj R^2				.923
# Cases				294
SSE				41.5300
F-Test				13.628*
MODEL 3				
Constant	- 568628	143364		
lnRACE	1172.3759	142.2745	8.240	
lnAGE	20.8950	.5792	36.073	
lnAGEsq	- 3.1274	.0880	35.539	
lnPERIOD	149796	37786	3.964	
lnPERIODsq	- 9865.9	2489.7	3.963	
lnBOOM	.3514	.0746	4.711	
lnAxlnR	.1898	.1145	1.657[n]	
lnPxlnR	-154.1730	18.7491	8.223	
Adj R^2				.938
# Cases				294
SSE				33.31977
F-Test				35.114*

* F-value is significant at the .001 level.

[a] Sum of Squared Error.

[n] Except where noted by "n", all coefficients are significant at the .001 level.

Table 6. Analysis Variables and Sources of Data

Variable	Estimate *	Data Source
Offending Rates:		
Arrest Rate per 100,000 Population	$\frac{\text{Arrests}(i,j,k,t)}{\text{Population}(i,j,t)}$	Independent analysis of arrest data from Federal Bureau of Investigation (Annual)
Crime Rate per 100,000 Population	$\frac{\text{Crimes}(i,j,k,t)}{\text{Population}(i,j,t)}$	Independent analysis of crime data from Federal Bureau of Investigation (Annual)
Incarceration Risk:		
Inmate Rate per 100,000 Population	$\frac{\text{Inmates}(i,j,k,t)}{\text{Population}(i,j,t)}$	Kleiman et al (1988) combined with independent analysis of data from national surveys of state prison inmates in 1974, 1979, and 1983.
Expected Time Served (Years) in Prison per Crime	$\frac{\text{Inmate Rate}(i,j,k,t)}{\text{Crime Rate}(i,j,k,t)}$	
Expected Time Served (Years) in Juvenile Facilities by Adjudicated Delinquents	$\frac{\text{Juvenile Inmates}(t)}{\text{Crimes}(j,t)}$	Bureau of Justice Statistics (No Date, 1977, 1979, 1989) combined with population estimates for juveniles (< 18)

* Variables are estimated for i = race, j = age, k = crime type, and t = year.

Table 6. Analysis Variables and Sources of Data (continued)

Variable	Estimate *	Data Source
Family Structure:		
Percent Population Residing in Male Headed Households or with Unrelated Males (%MHH)	$\frac{\text{Population(i,j,t) Residing in Male Headed Households or with Unrelated Males}}{\text{Total Population(i,j,t)}}$	Bureau of Census (annual 1970b to 1973b, and 1977b to 1987b)
Percent of Population Residing in Female Headed Households or with Unrelated Females (%FHH)	$\frac{\text{Population(i,j,t) Residing in Female Headed Households or with Unrelated Females}}{\text{Total population(i,j,t)}}$	Bureau of Census (annual 1970b to 1973b, and 1977b to 1987b)
Percent of Population Residing in Households of Unrelated Persons	$\frac{\text{Population(i,j,t) Residing in Households of Unrelated Persons}}{\text{Total Population(i,j,t)}}$	Bureau of Census (annual 1977 to 1987)
Percent of Juveniles (<18) Who Reside With Mother Only	$\frac{\text{Juvenile Population(i,j,t) Residing with Mother Only}}{\text{Total Population(i,j,t)}}$	Bureau of Census (annual 1968a to 1986a)
Percent of Juveniles (<18) Who Do Not Reside With Either Parent	$\frac{\text{Juvenile Population(i,j,t) Not Residing With Parents}}{\text{Total Population(i,j,t)}}$	Bureau of census (annual 1968a to 1986a)
Percent of Males Who Are Not Living in Families	$\frac{\text{Male Population(i,j,t) Not Living in Families}}{\text{Total Population(i,j,t)}}$	Bureau of Census (annual 1968a to 1986a)

* Variables are estimated for i = race, j = age, k = crime type, and t = year.

Table 6. Analysis Variables and Sources of Data (continued)

Variable	Estimate *	Data Source
Employment:		
Labor Force Participation Rate	$\frac{\text{Civilian Noninstitutionalized Labor Force}(i,j,t)}{\text{Civilian Noninstitutionalized Population}(i,j,t)}$	Bureau of Labor Statistics (1988)
Unemployment Rate	$\frac{\text{Unemployed Workers}(i,j,t)}{\text{Civilian Noninstitutionalized Labor Force}(i,j,t)}$	Bureau of Labor Statistics (1988)
School Enrollment and Employment:		
Percent of Young People Who Are Enrolled in School and Employed	$\frac{\text{Population}(i,j,t) \text{ in School and Employed}}{\text{Total Population}(i,j,t)}$	Bureau of Labor Statistics (1985a, 1985b, and 1986)
Percent of Young People Enrolled in School and Not in Labor Force	$\frac{\text{Population}(i,j,t) \text{ Enrolled in School and Not in Labor Force}}{\text{Total Population}(i,j,t)}$	Bureau of Labor Statistics (1985a, 1985b, and 1986)
Percent of Young People Not in School or in Labor Force	$\frac{\text{Population}(i,j,t) \text{ Not in School or in Labor Force}}{\text{Total Population}(i,j,t)}$	Bureau of Labor Statistics (1985a, 1985b, and 1986)

* Variables are estimated for i = race, j = age, k = crime type, and t = year.

Table 6. Analysis Variables and Sources of Data (continued)

Variable	Estimate *	Data Source
Educational Attainment:		
Percent of Population With High School Education or More	$\frac{\text{Population}(i,j,t) \text{ Completing 4 Years of High School or More}}{\text{Total Population}(i,j,t)}$	Bureau of Census (annual 1971 to 1987)
Poverty:		
Percent of Population Below Poverty Level	$\frac{\text{Population}(i,j,t) \text{ Below Poverty}}{\text{Total Population}(i,j,t)}$	Bureau of Census (annual 1970b to 1973b, and 1975b to 1987b)
Percent of Population Residing in Male Headed Households and in Poverty	$\frac{\text{Population}(i,j,t) \text{ in MHH and in Poverty}}{\text{Total Population}(i,j,t)}$	Bureau of Census (annual 1970b to 1973b, and 1977b to 1987b)
Percent of Population Residing in Female Headed Households and in Poverty	$\frac{\text{Population}(i,j,t) \text{ in FHH and in Poverty}}{\text{Total Population}(i,j,t)}$	Bureau of Census (annual 1970b to 1973b, and 1977b to 1987b)
Competition/Socialization:		
Cohort Size	$\frac{\text{Population}(i,j,t)}{\#\text{Years in Cohort}}$	Bureau of Census Estimates U.S. Population by Age and Race

* Variables are estimated for i = race, j = age, k = crime type, and t = year.

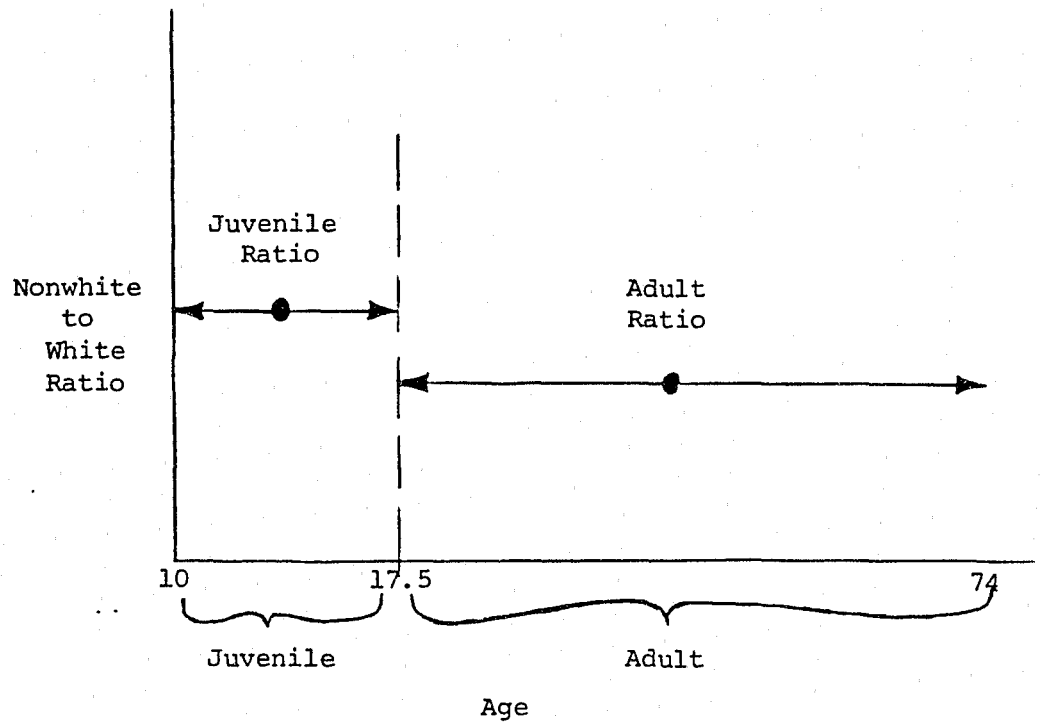


Figure 1. Positioning Juvenile and Adult Nonwhite-to-White Ratios Within Their Respective Age Ranges

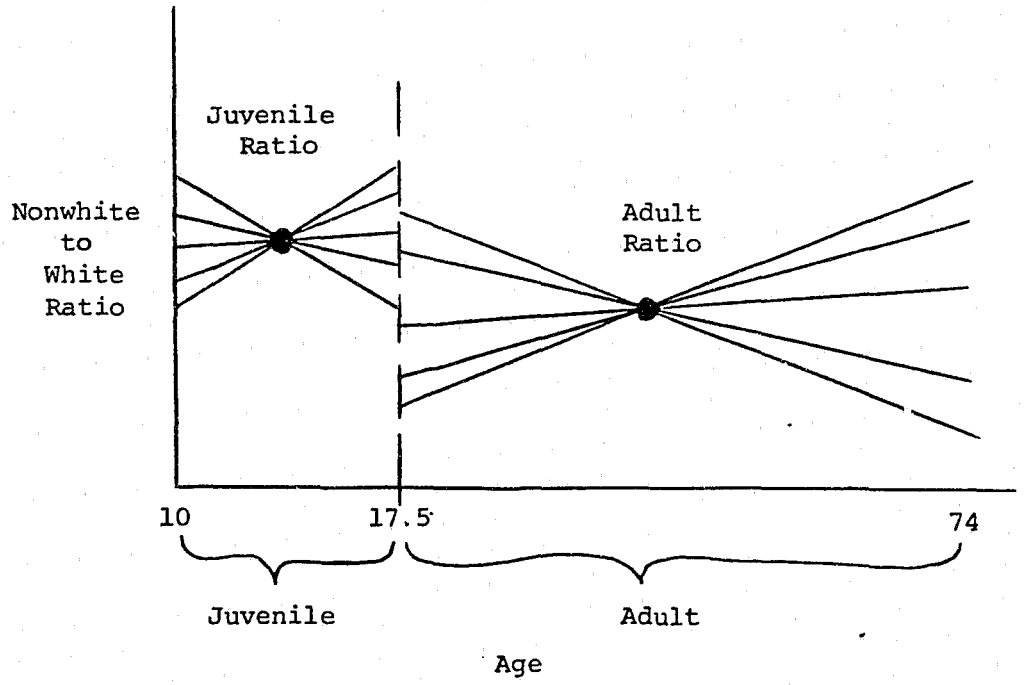


Figure 2. Rotating the Nonwhite-to-White Ratio to Permit Age Variations in the Ratio

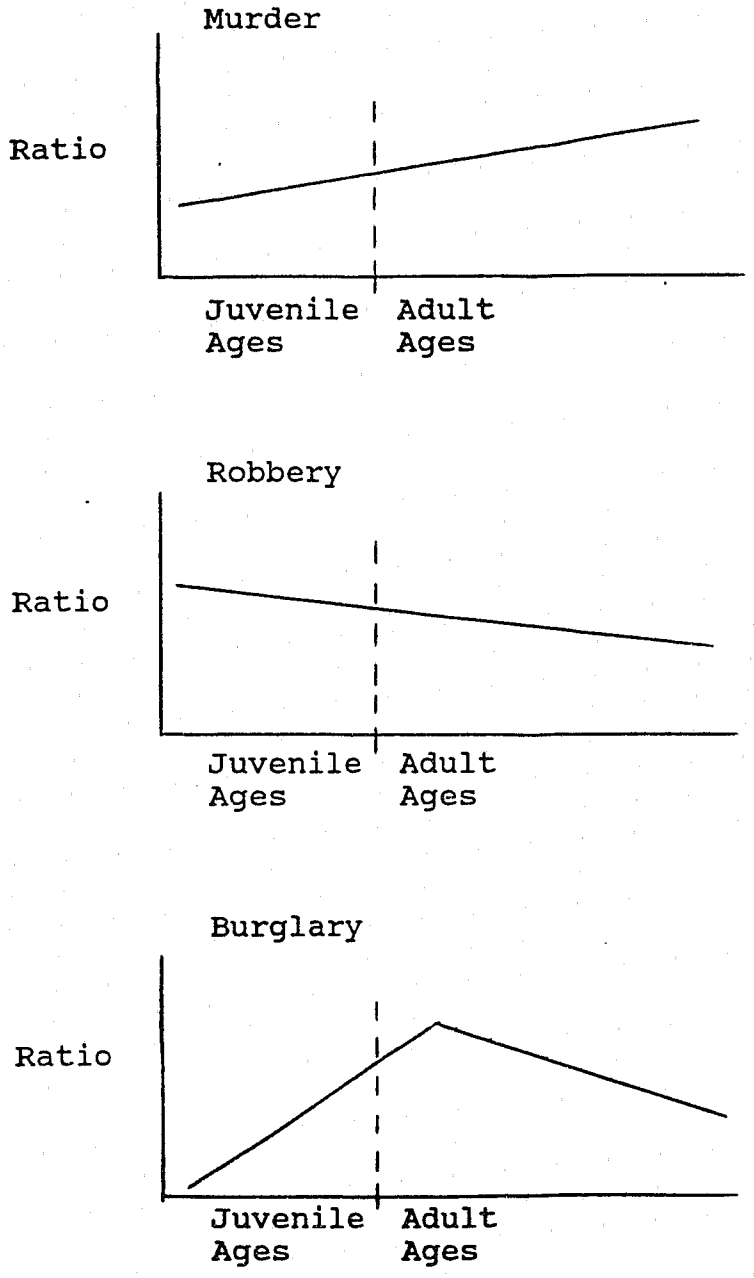
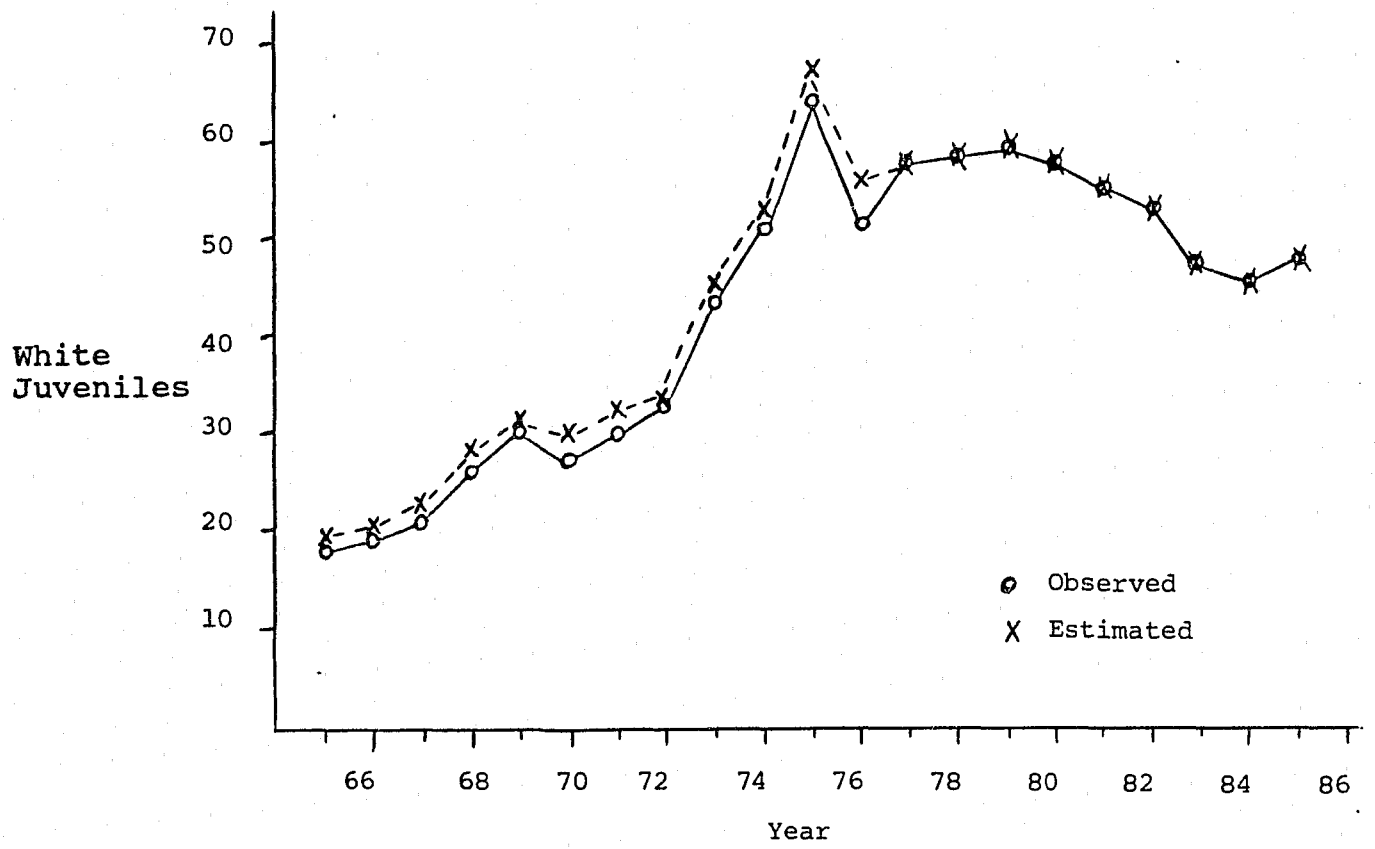


Figure 3. Variation in the Shape of Ratio Line for Nonwhite-to-White Arrest Rates, Pittsburgh and Wayne County*

* The full race-by-age arrest rates were calculated from data on the age and race of arrestees available from individual records of arrests in these jurisdictions.



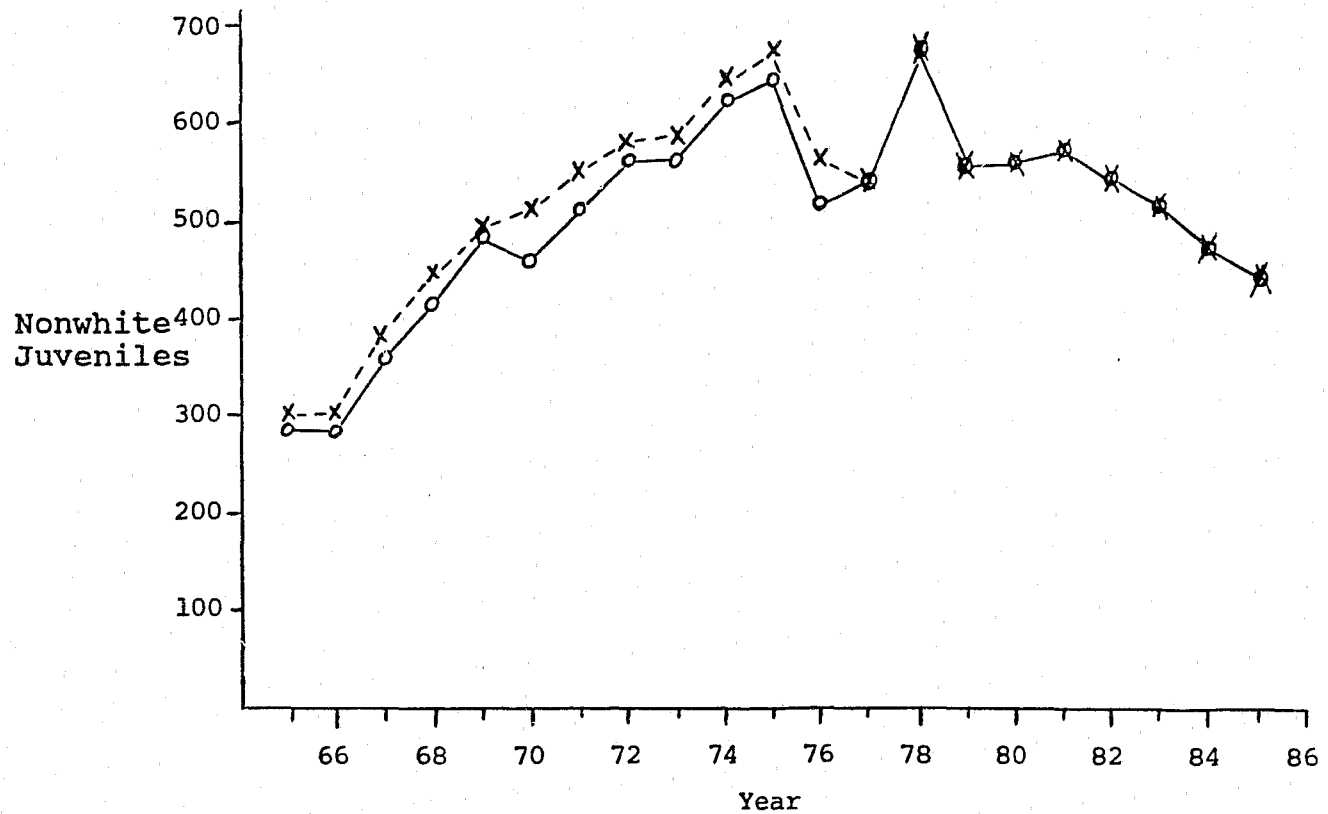


Figure 4. Comparison Between Reported and Final Estimated Robbery Arrest Rates for Juveniles by Year

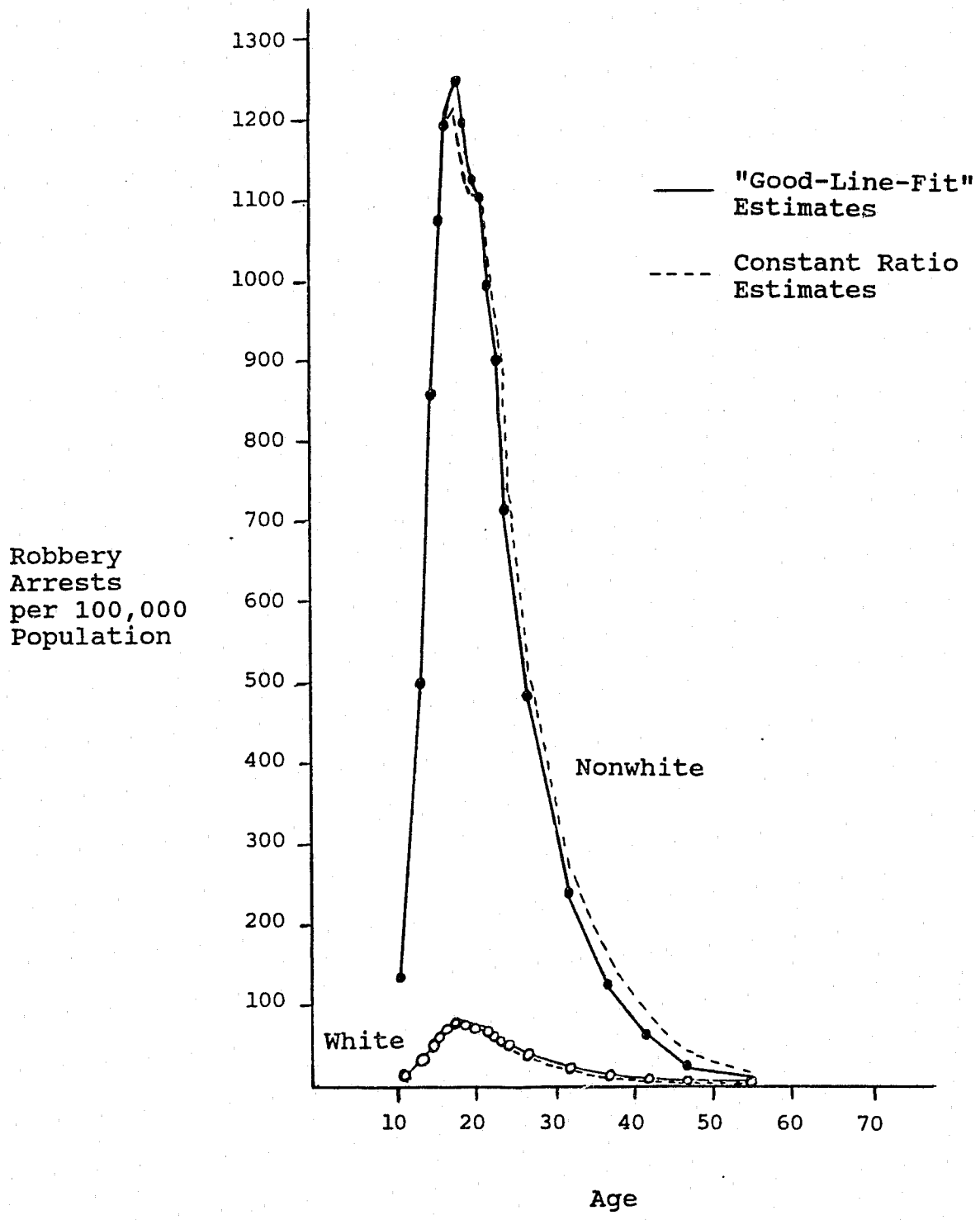
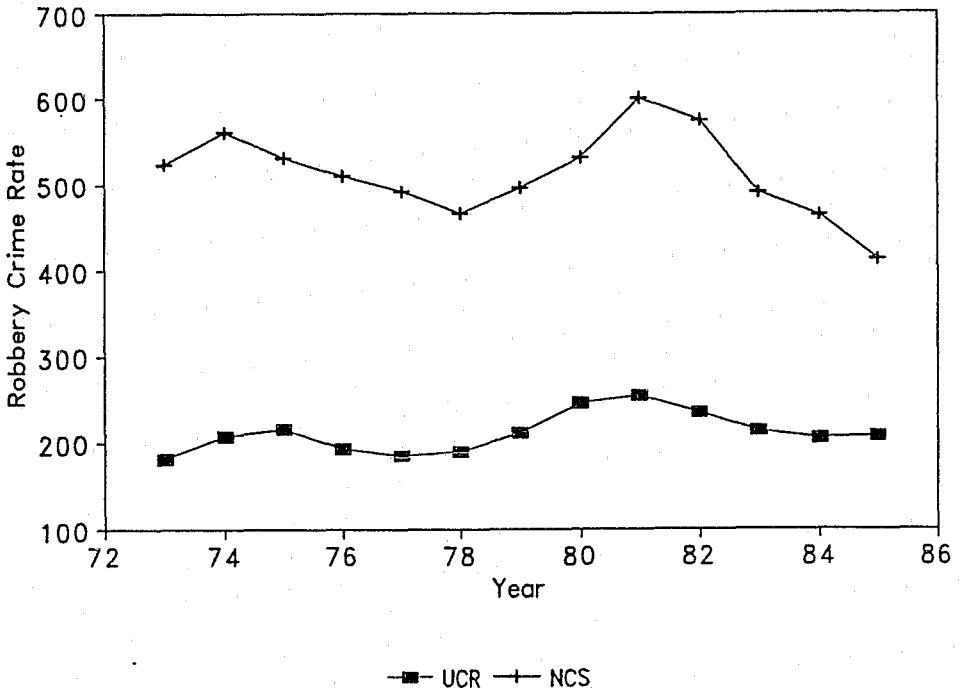
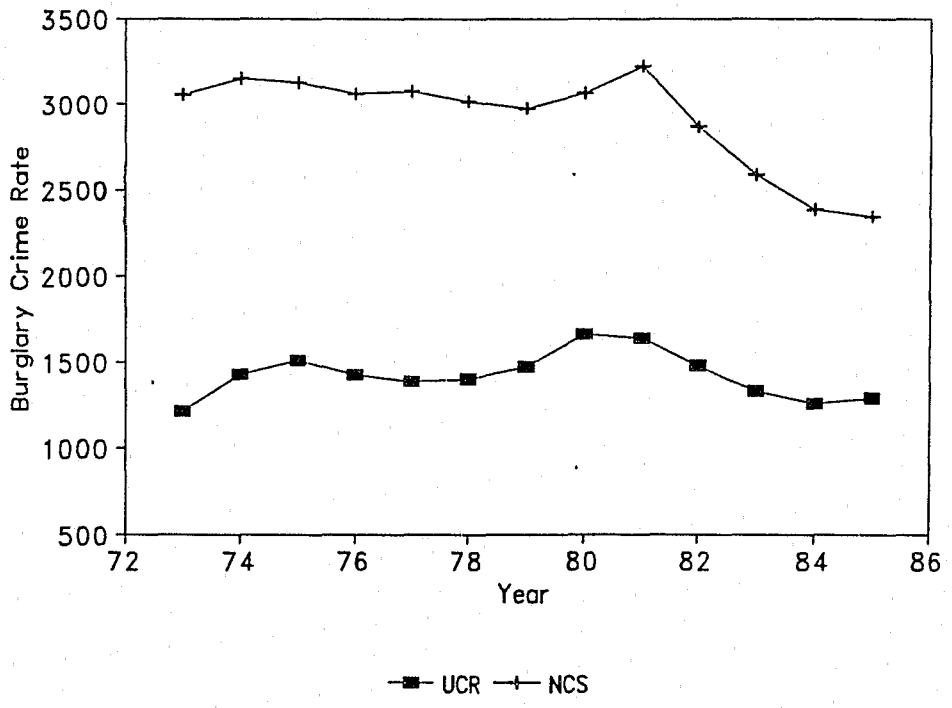


Figure 5. Final Race-by-Age Specific Arrest Rate Estimates for Robbery in 1971

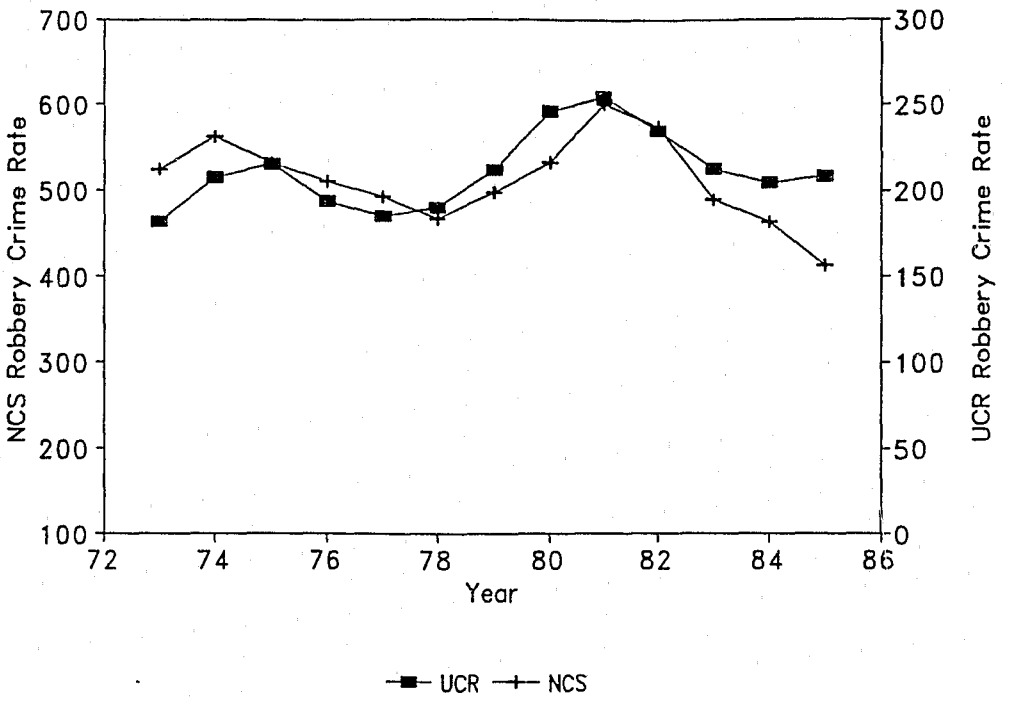


a) Robbery

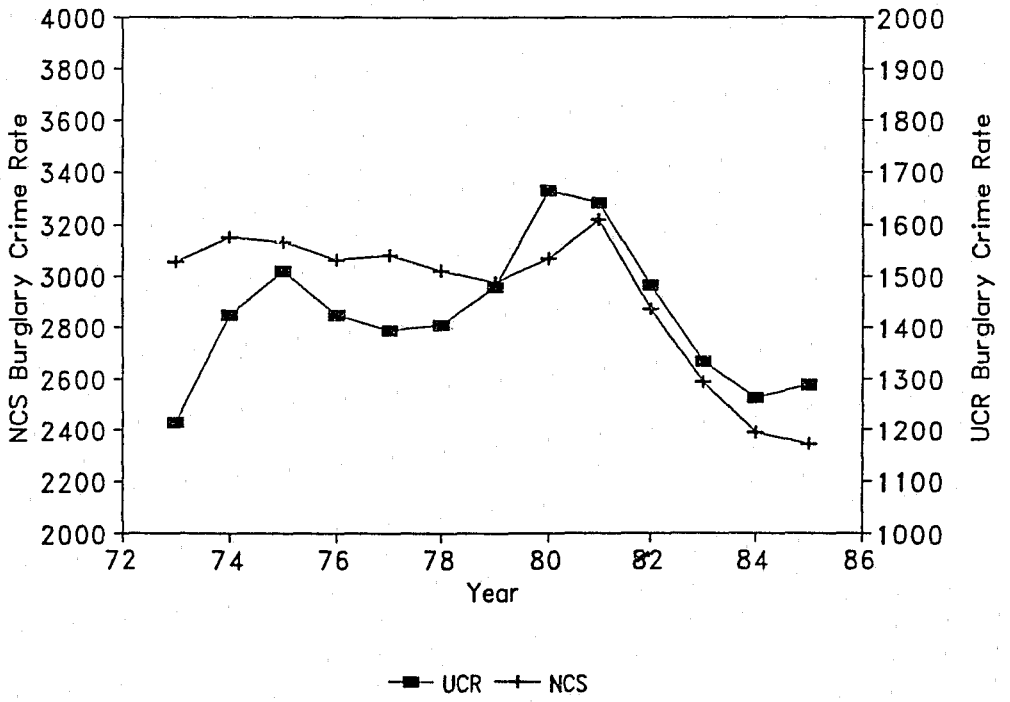


b) Burglary

Figure 6. Comparison of Annual Uniform Crime Reports (UCR) and National Crime Survey (NCS) Crime Rates per 100,000 Population, 1973 to 1985

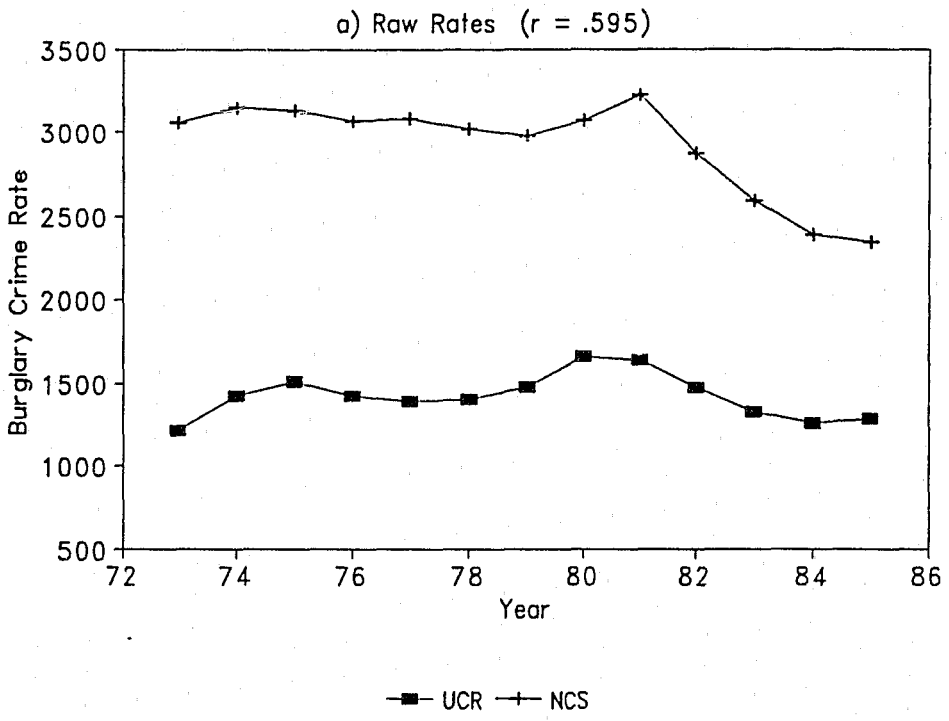


a) Robbery



b) Burglary

Figure 7. Rescaled Comparison of Annual Uniform Crime Reports (UCR) and National Crime Survey (NCS) Crime Rates per 100,000 Population, 1973 to 1985



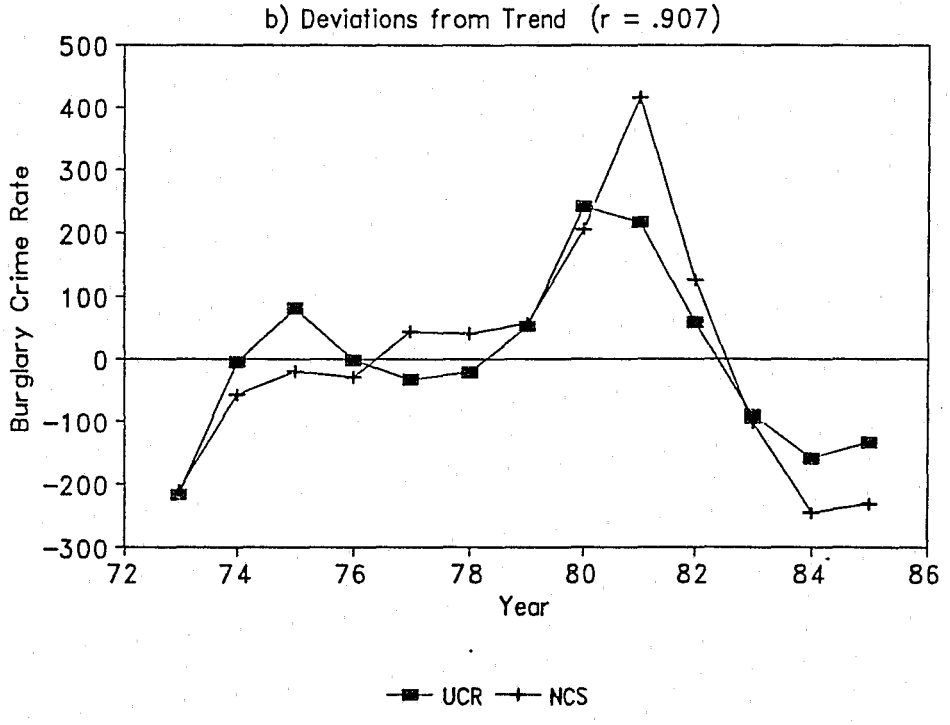


Figure 8. Yearly Variations Between Uniform Crime Reports and National Crime Survey Burglary Crime Rates

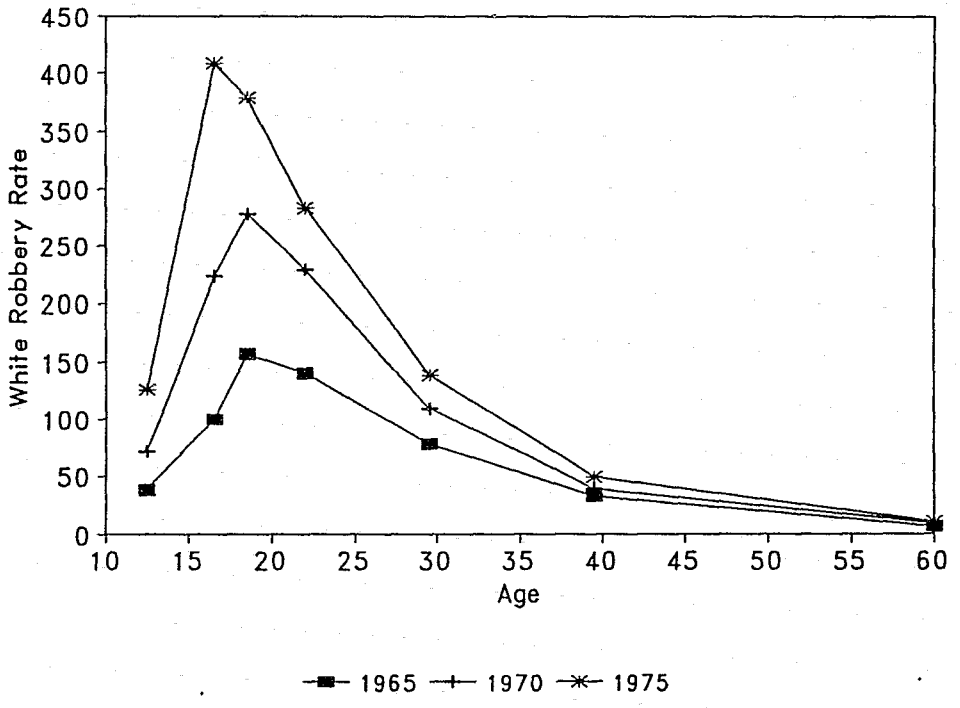


Figure 9. Demographic-Specific Crime Rates:
White Robbery Rates, 1965 to 1975

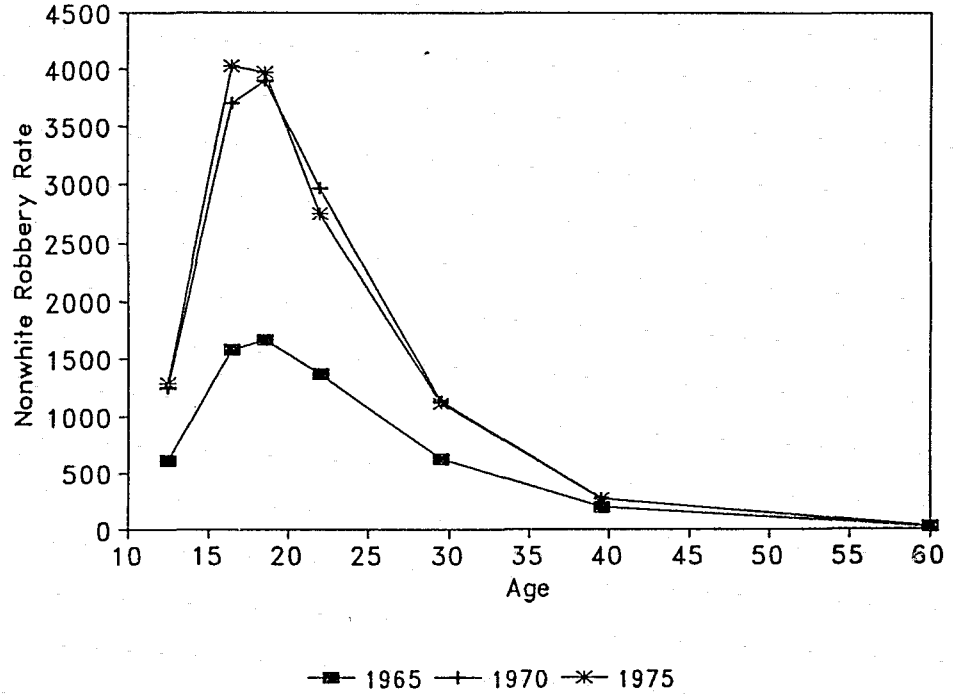


Figure 10. Demographic-Specific Crime Rates: Nonwhite Robbery Rates, 1965 to 1975

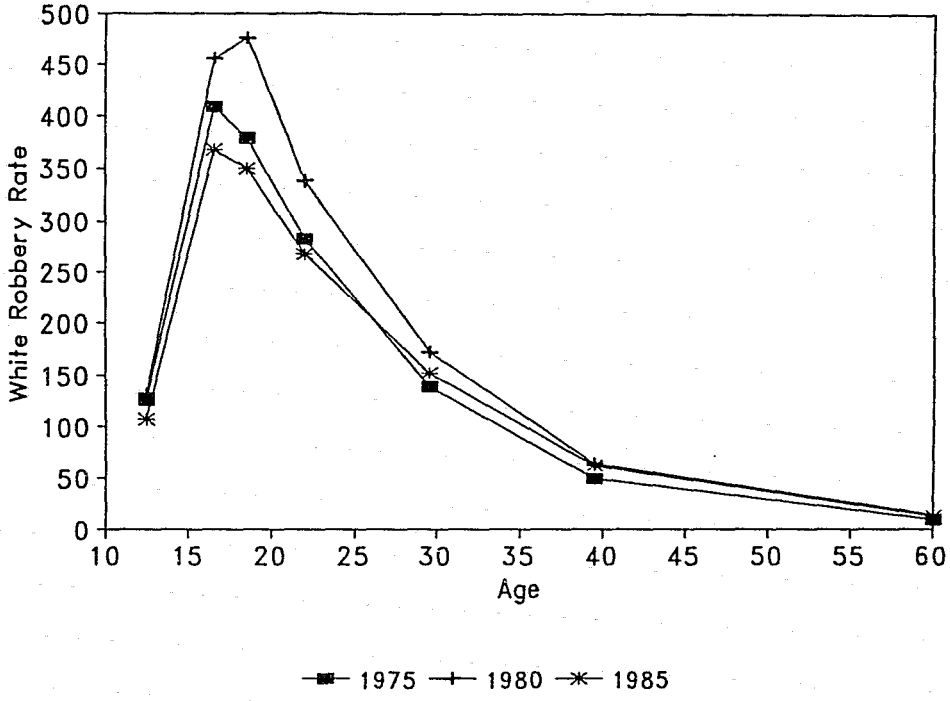


Figure 11. Demographic-Specific Crime Rates: White Robbery Rates, 1975 to 1985

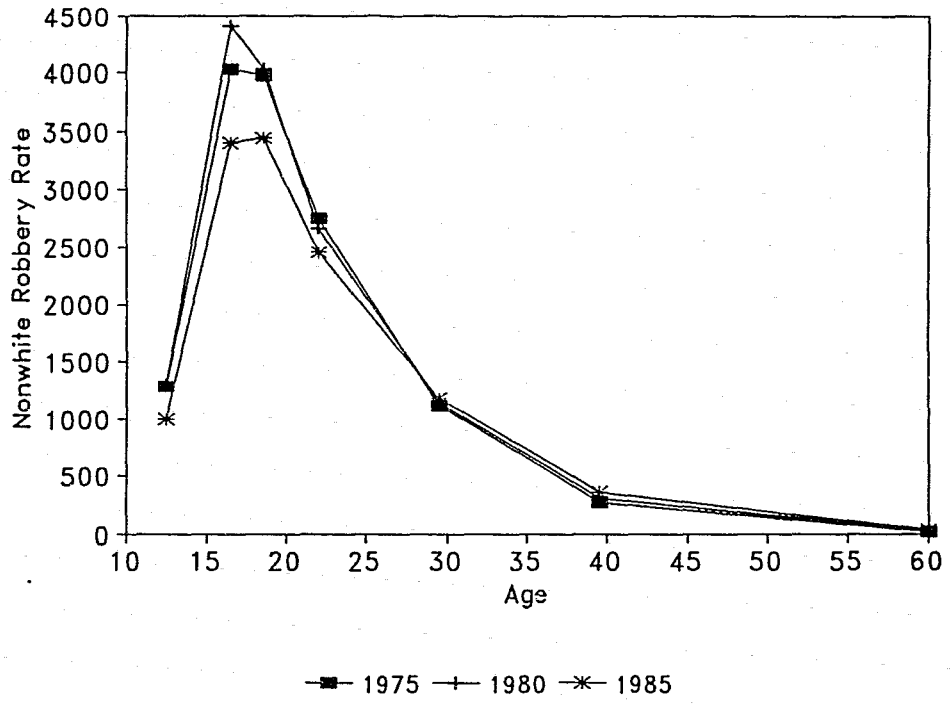


Figure 12. Demographic-Specific Crime Rates: Nonwhite Robbery Rates, 1975 to 1985

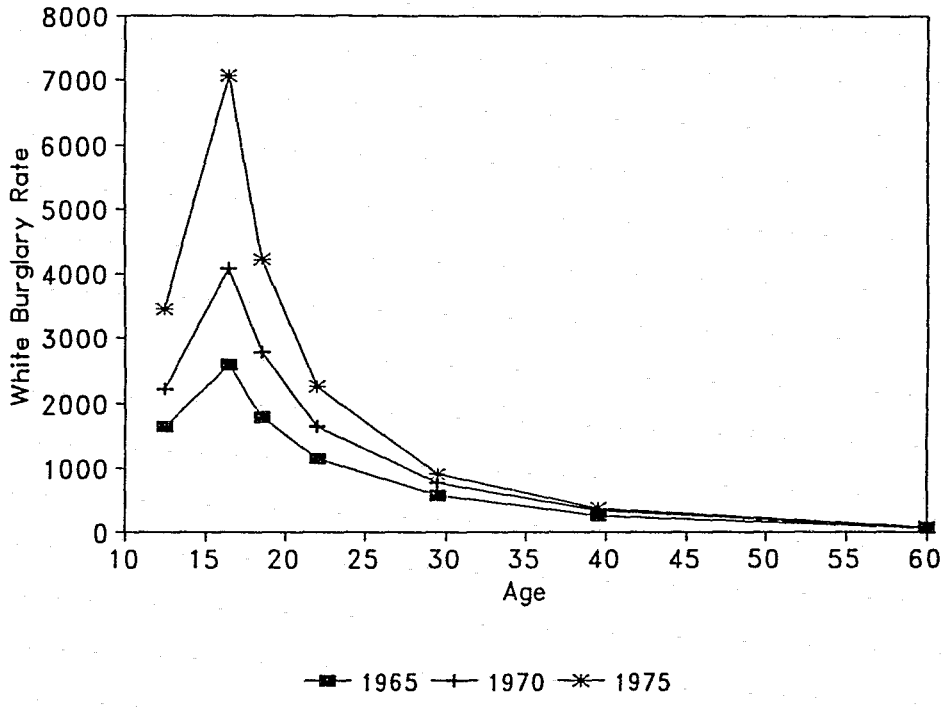


Figure 13. Demographic-Specific Crime Rates: White Burglary Rates, 1965 to 1975

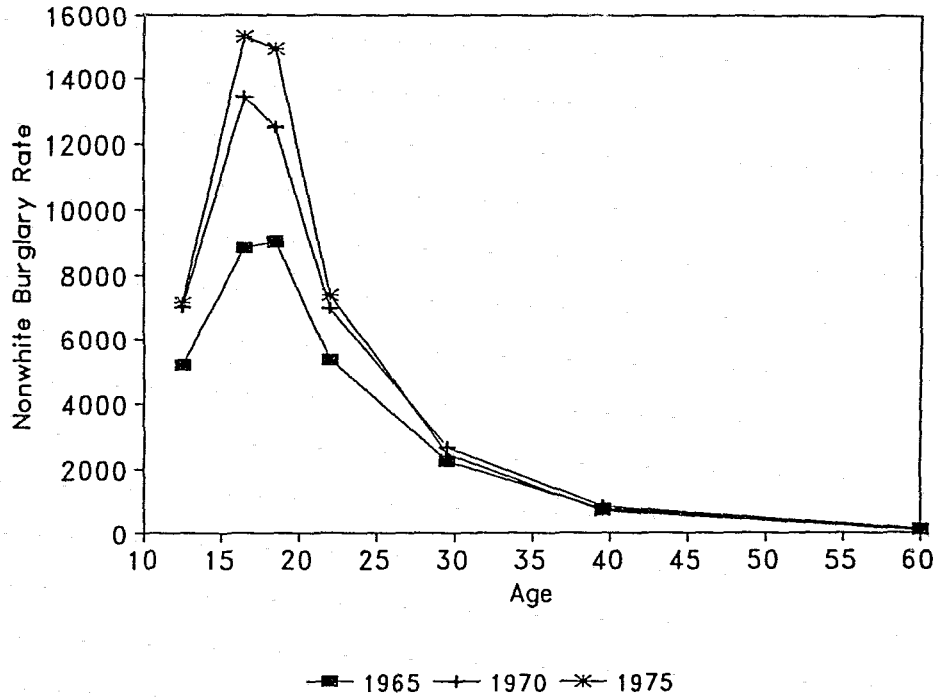


Figure 14. Demographic-Specific Crime Rates: Nonwhite Burglary Rates, 1965 to 1975

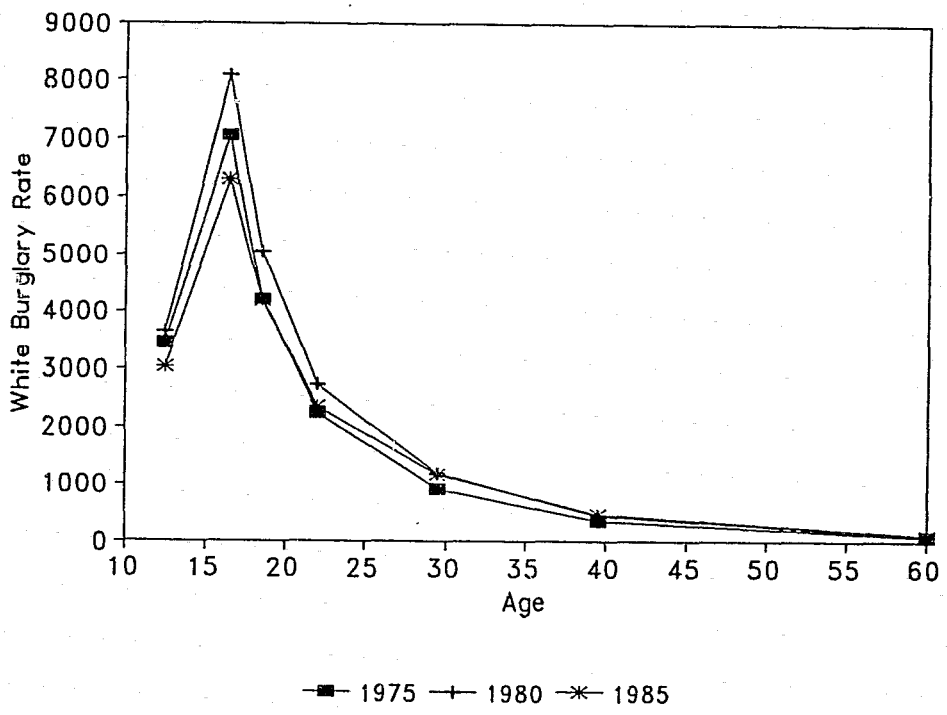


Figure 15. Demographic-Specific Crime Rates: White Burglary Rates, 1975 to 1985

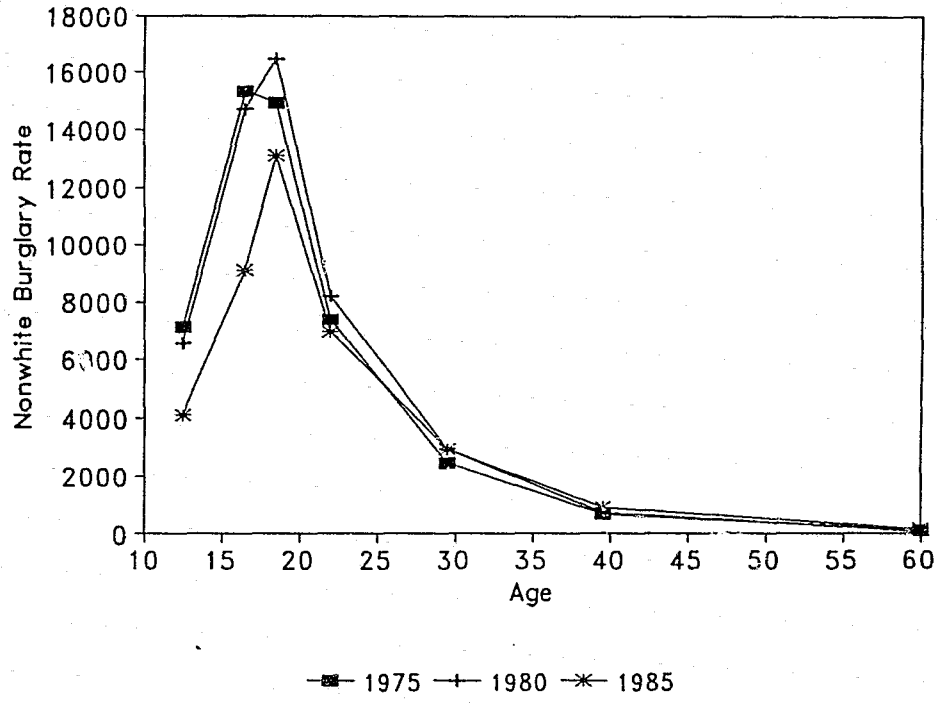


Figure 16. Demographic-Specific Crime Rates: Nonwhite Burglary Rates, 1975 to 1985

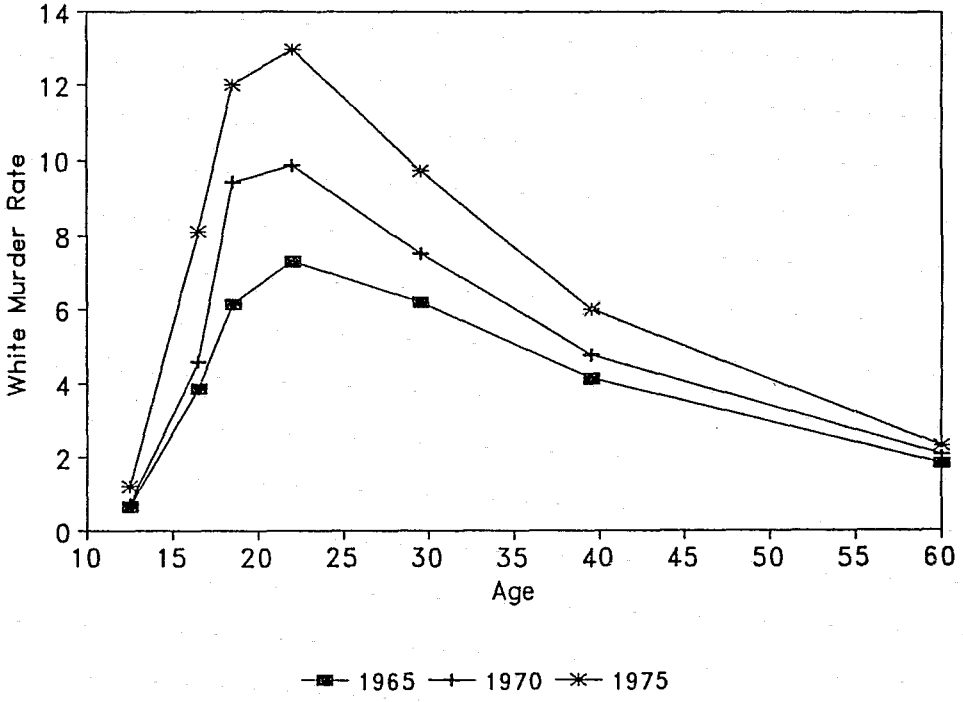


Figure 17. Demographic-Specific Crime Rates: White Murder Rates, 1965 to 1975

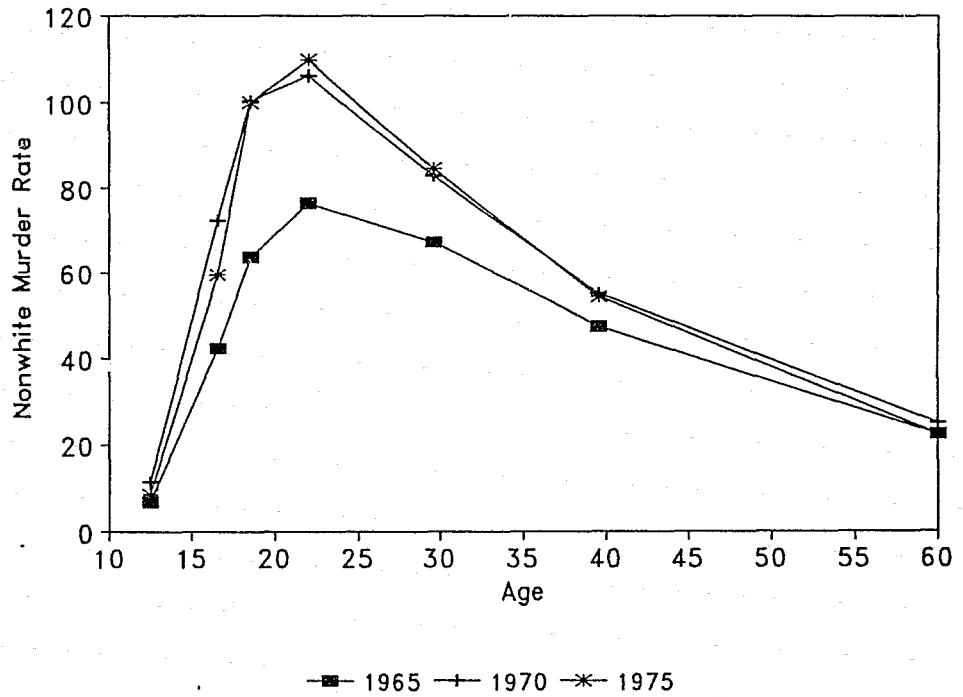


Figure 18. Demographic-Specific Crime Rates: Nonwhite Murder Rates, 1965 to 1975

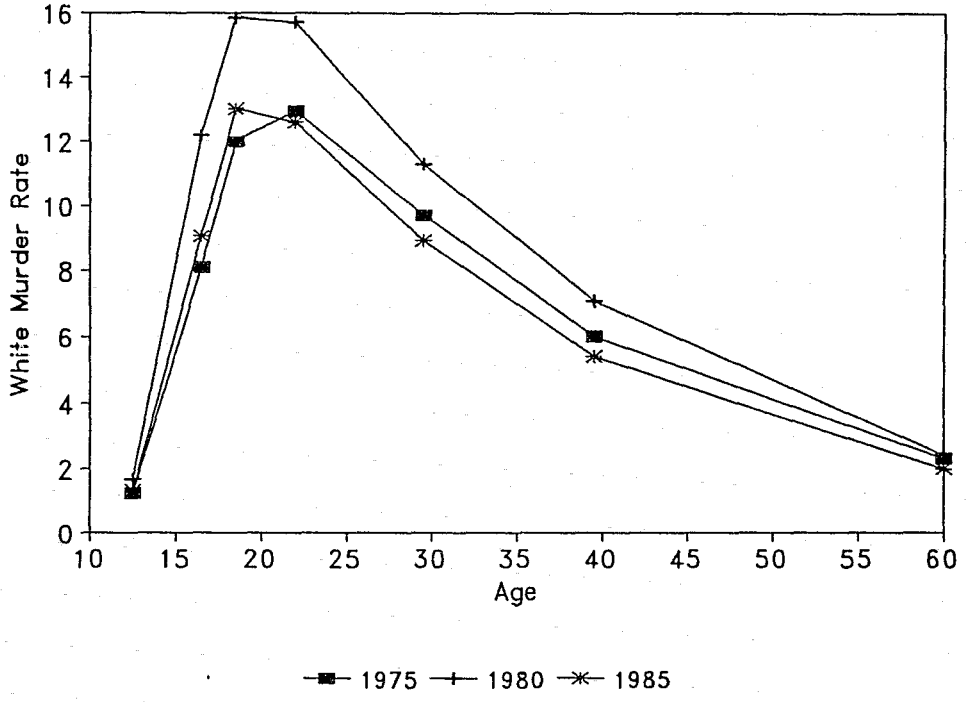


Figure 19. Demographic-Specific Crime Rates: White Murder Rates, 1975 to 1985

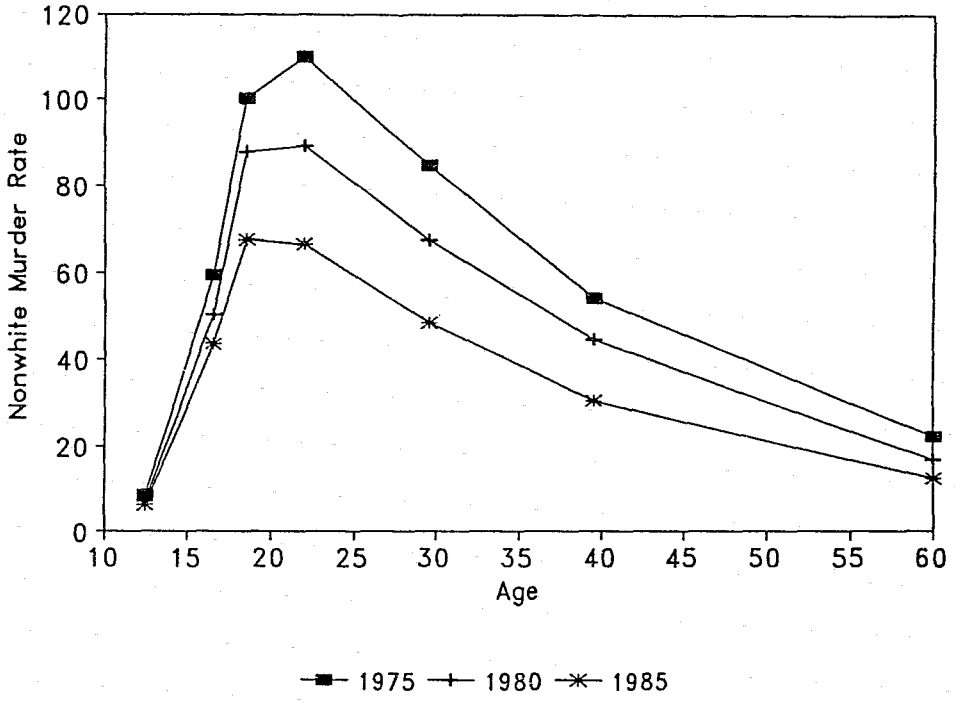


Figure 20. Demographic-Specific Crime Rates: Nonwhite Murder Rates, 1975 to 1985

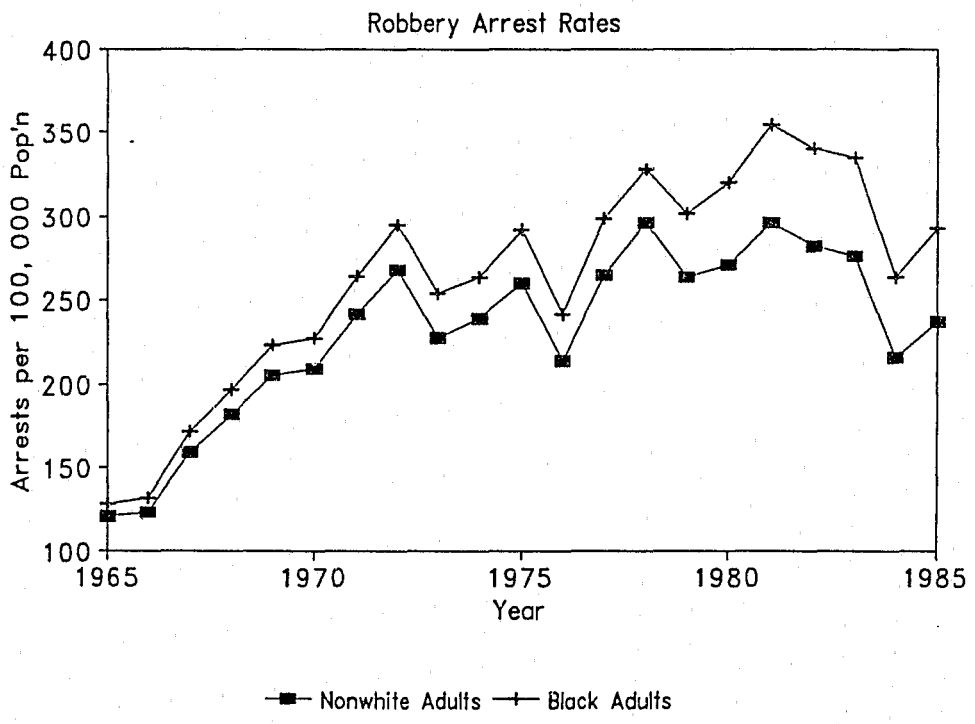


Figure 21. Annual Robbery Arrest Rates for Nonwhite and Black Adults

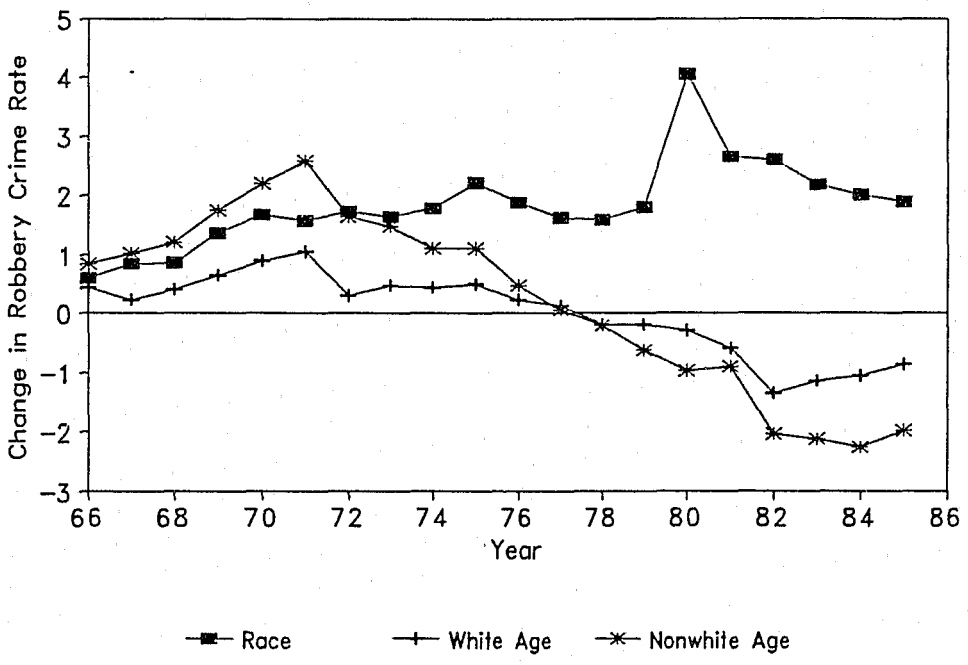
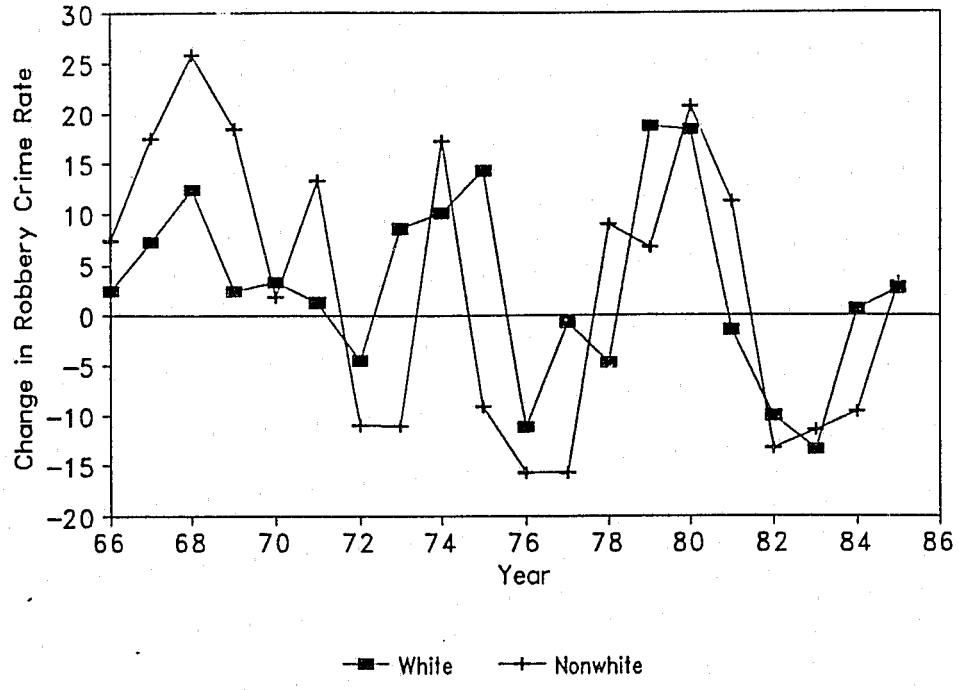
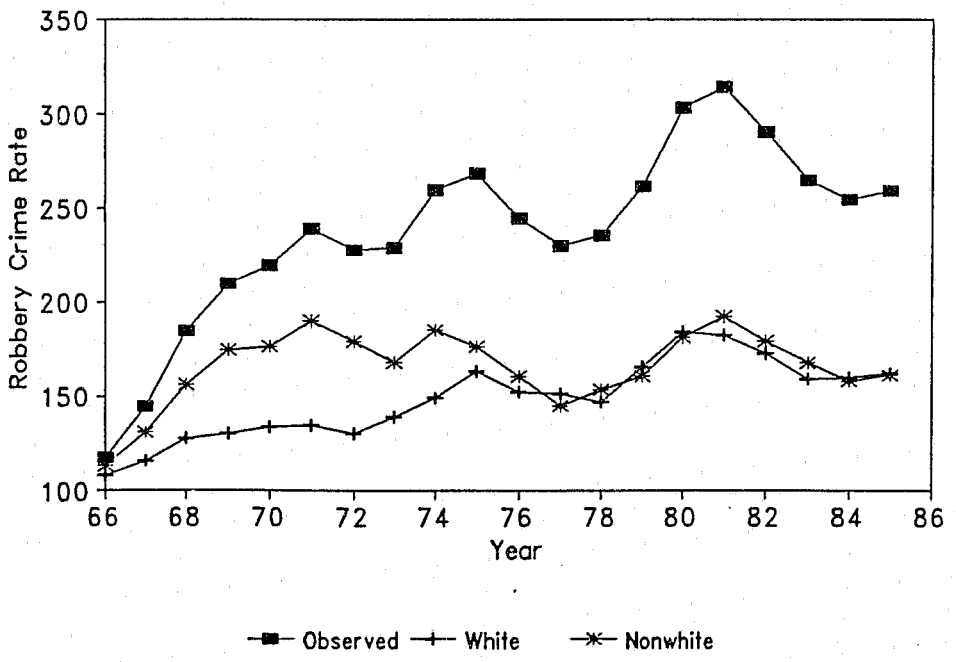


Figure 22. Contribution of Changing Population Composition to Changing Robbery Rates



a. Yearly Changes in White and Nonwhite Criminality



b. Total Crime Rate Resulting from Changes in Criminality

Figure 23. Components of Change in Robbery Criminality

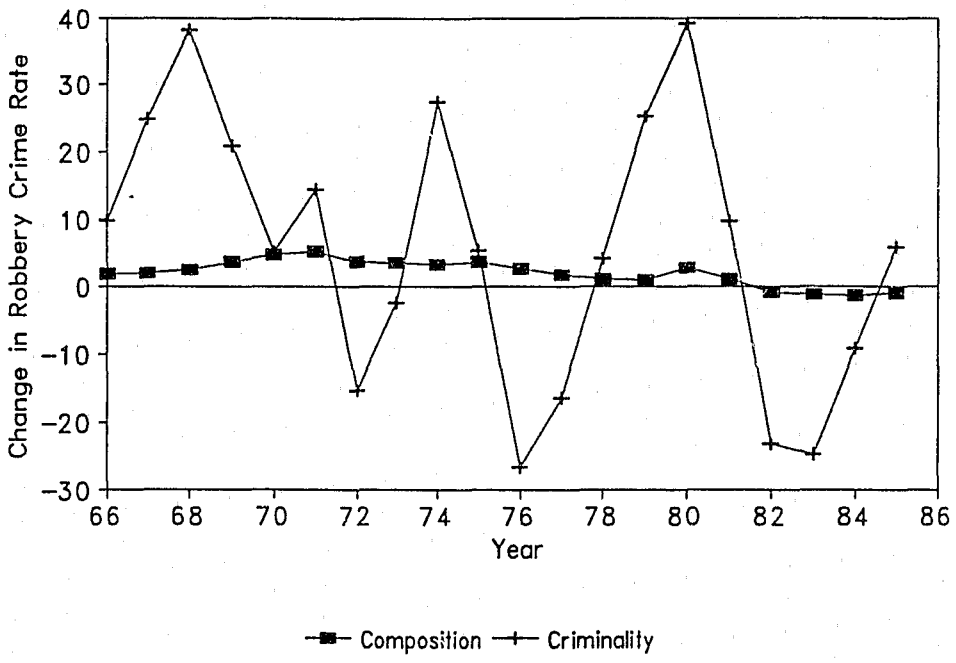


Figure 24. Components of Change in Robbery Crime Rates

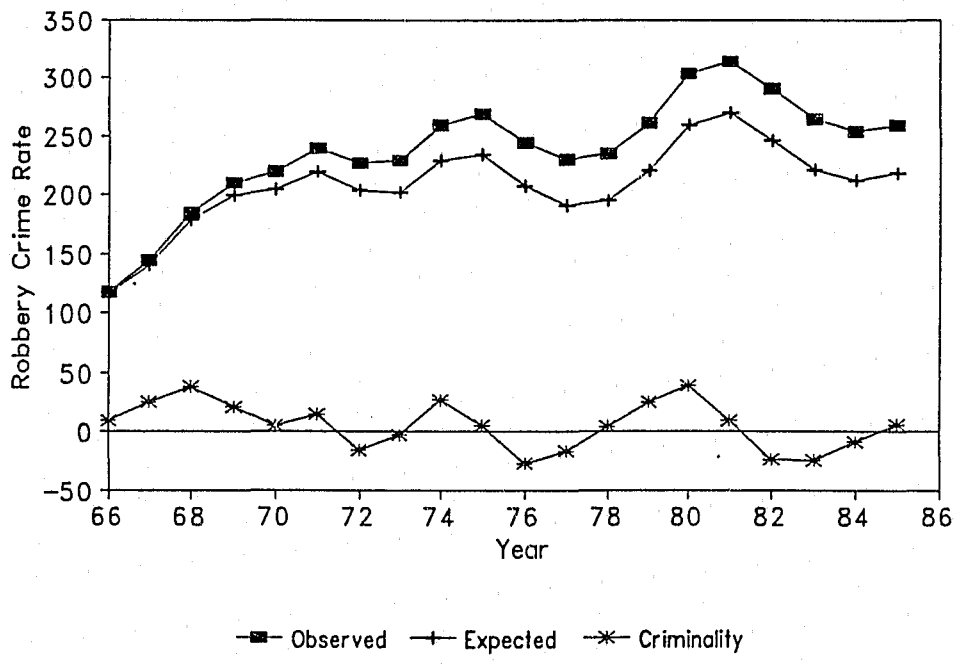


Figure 25. Contribution of Changing Criminality to Robbery Crime Rates

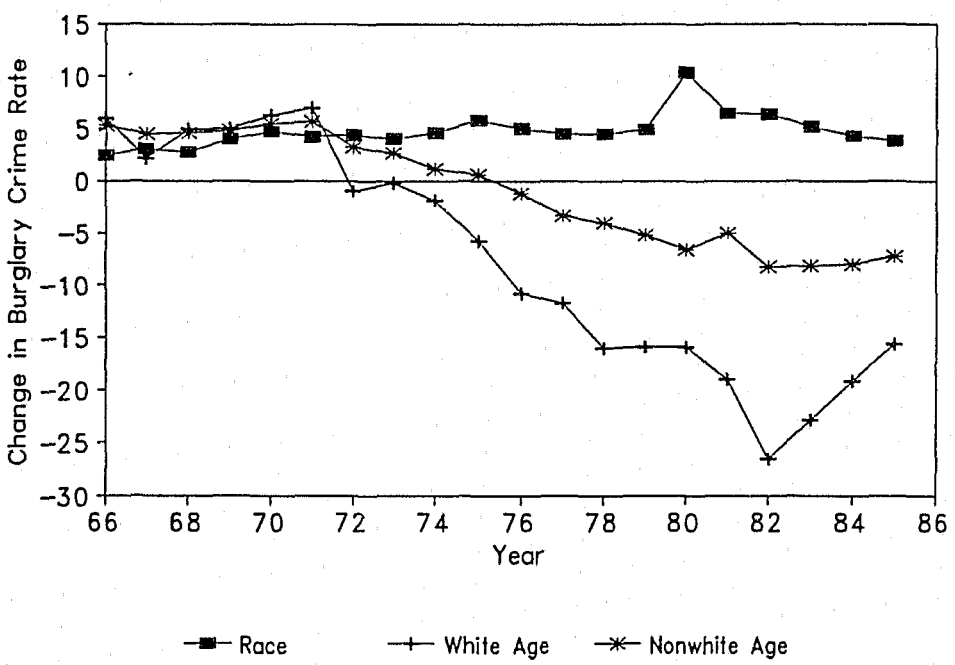
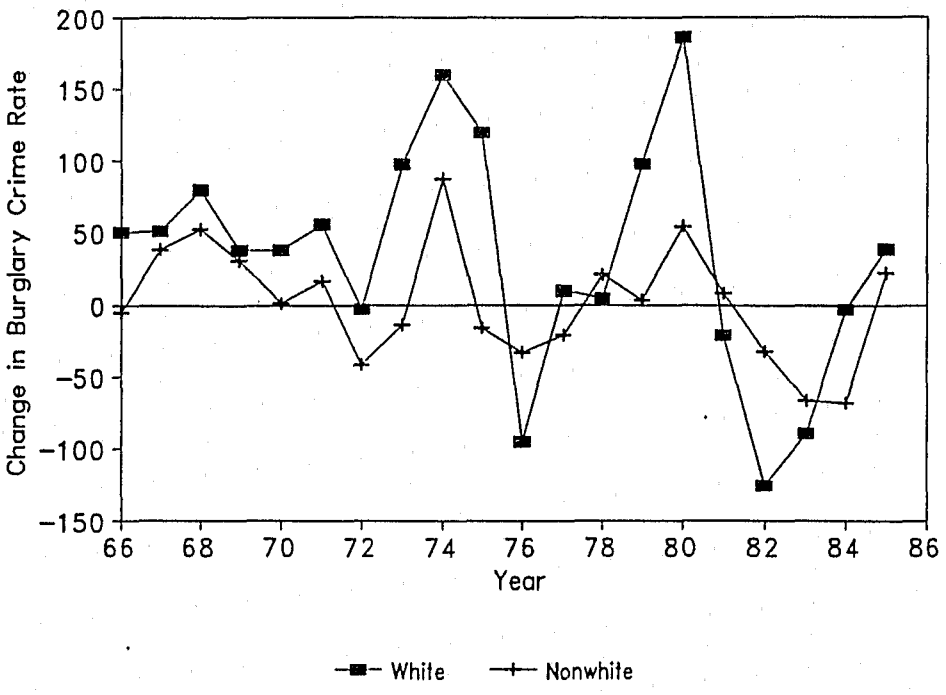
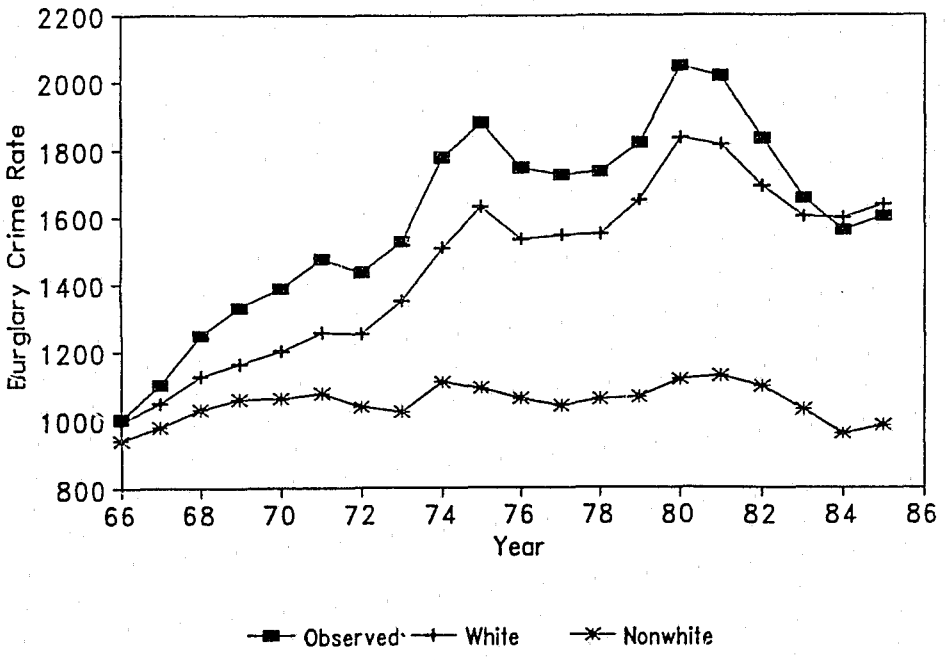


Figure 26. Contribution of Changing Population Composition to Changing Burglary Rates



a. Yearly Changes in White and Nonwhite Criminality



b. Total Crime Rate Resulting from Changes in Criminality

Figure 27. Components of Change in Burglary Criminality

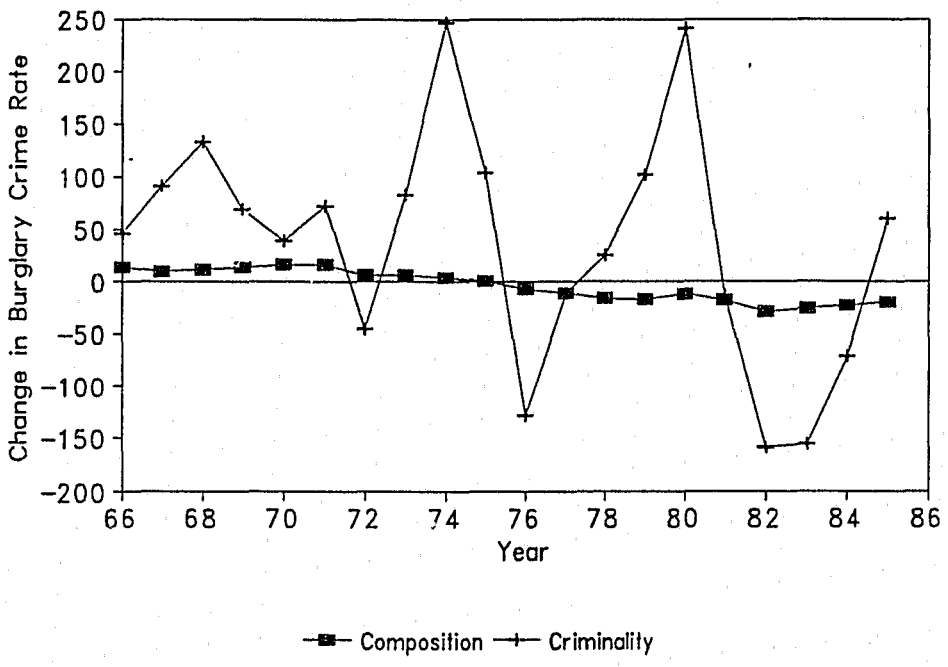


Figure 28. Components of Change in Burglary Crime Rates

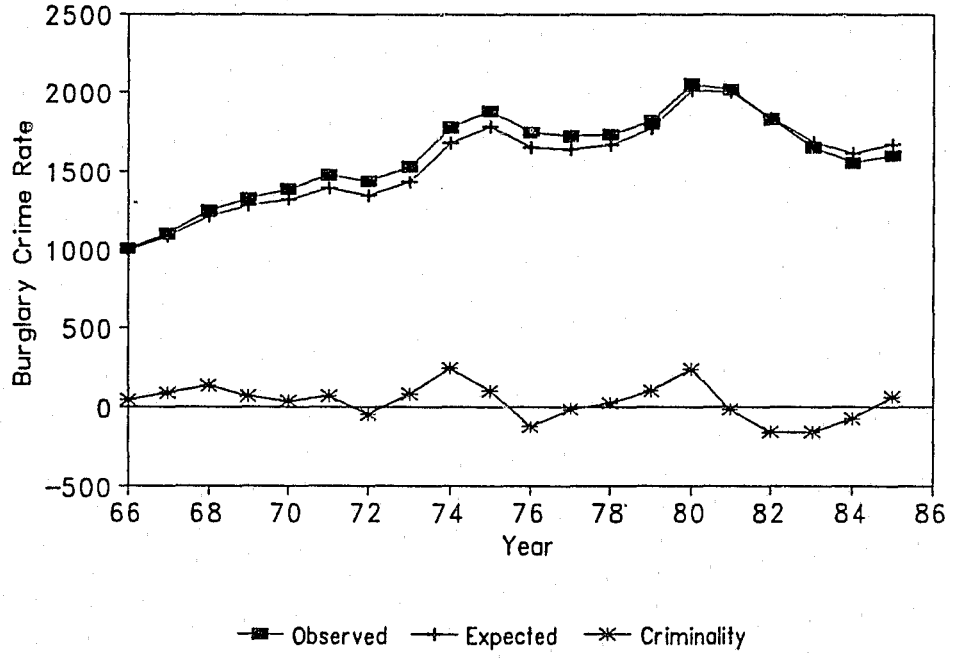


Figure 29. Contribution of Changing Criminality to Burglary Crime Rates

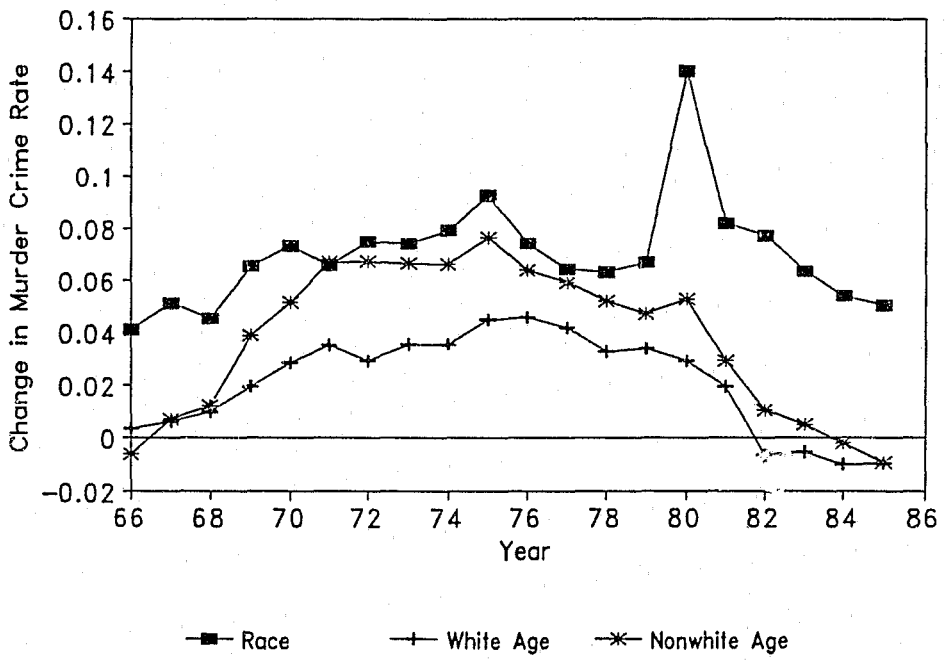
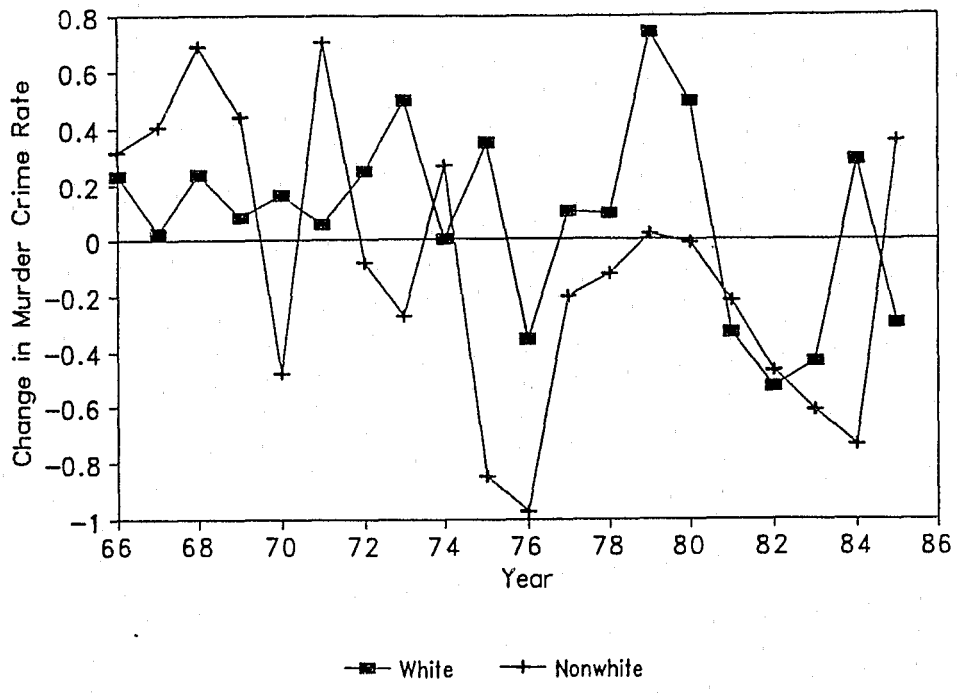
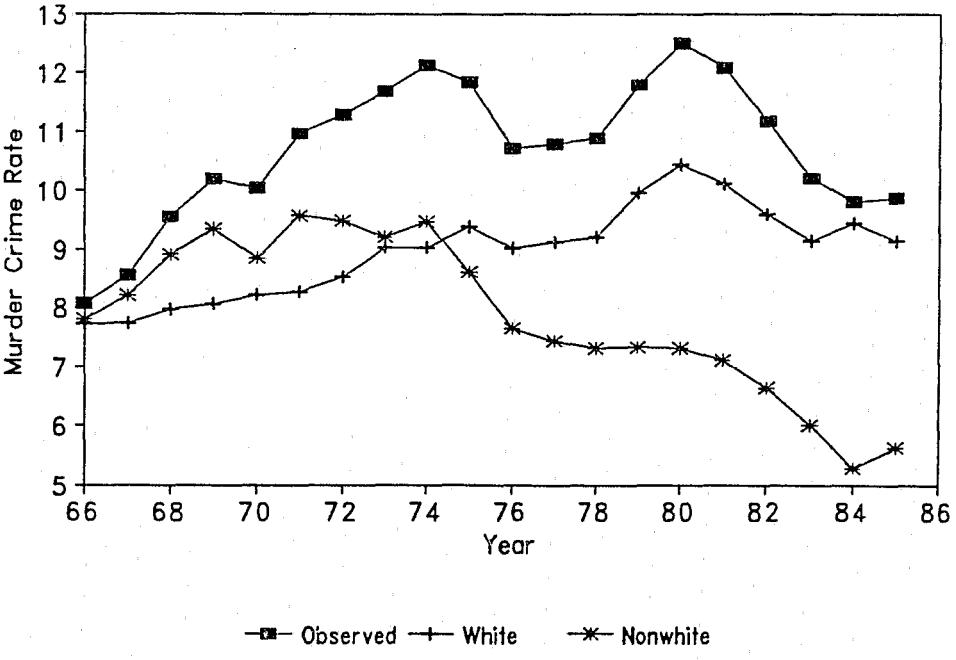


Figure 30. Contribution of Changing Population Composition to Changing Murder Rates



a. Yearly Changes in White and Nonwhite Criminality



b. Total Crime Rate Resulting from Changes in Criminality

Figure [illegible] Components of Change in Murder Criminality

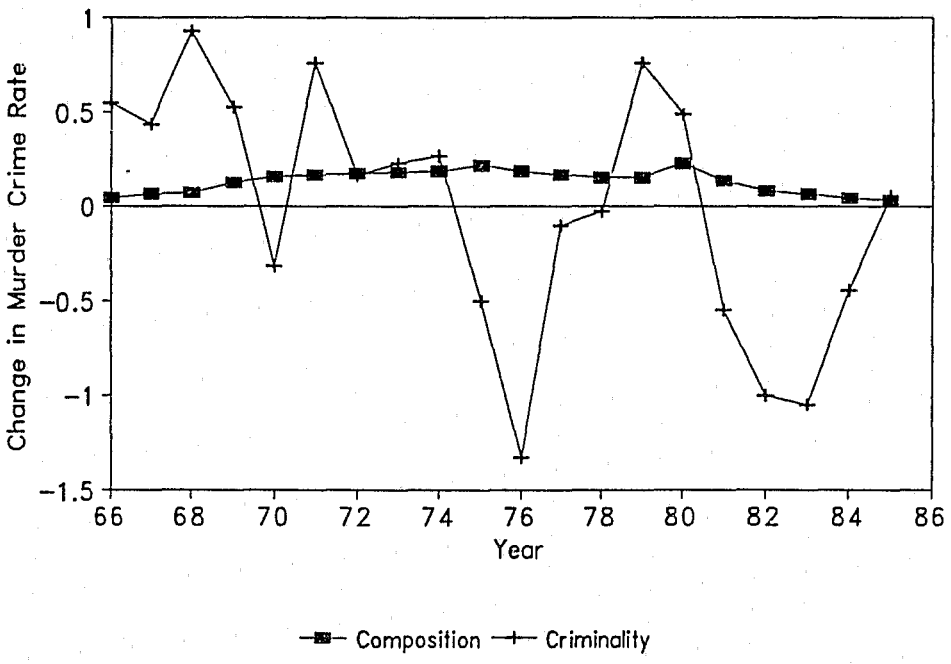


Figure 32. Components of Change in Murder Crime Rates

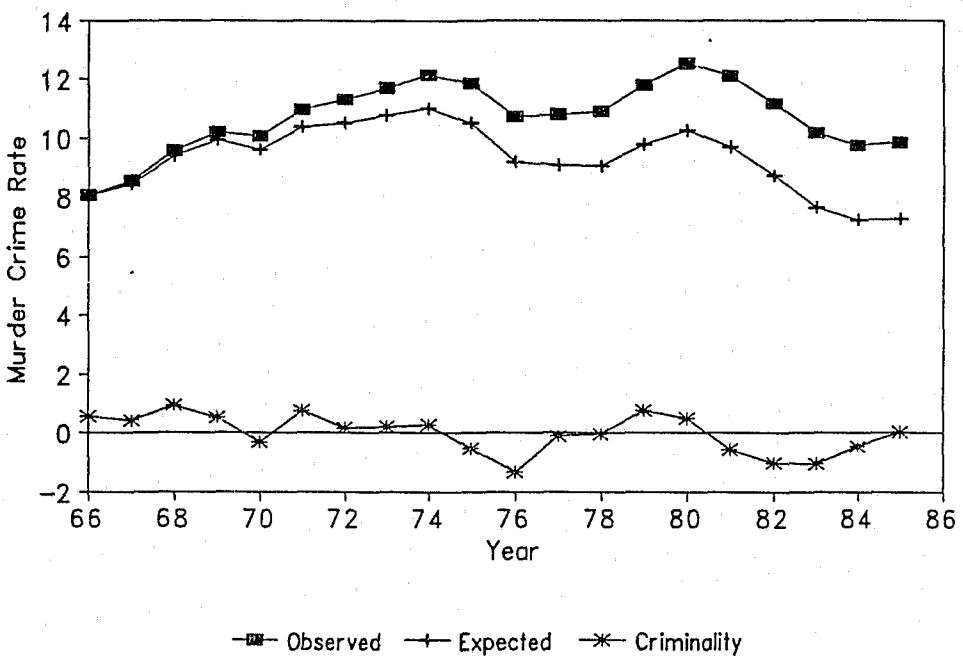


Figure 33. Contribution of Changing Criminality to Murder Crime Rates