THE COHORT FACTOR IN THE GROWTH OF CRIME[1]

Irving Leveson, Hudson Institute

Introduction

Some explanations of the rise in crime suggest influences which are a characteristic of the period observed. A decrease in the availability of jobs or a decline in the likelihood of punishment might lead concurrently or with a short lag to an increase in crime in each age group. Other potential explanations, however, depend primarily on the characteristics which the individuals bring with them as they enter the ages at which crimes are committed in significant numbers. An increase in parental permissiveness, for example, might produce a new generation of children which is more likely to go on to commit crime at older ages.

Explanations of the latter type can be characterized by a cohort process in which crime increases as successive cohorts are replaced by others more likely to commit crime than their predecessors. Shifts in criminality from one cohort to the next result from the combined effects of the contributions of behavioral forces which it may not be possible to separately identify and measure.

The objective of this analysis is to determine the separate contributions to the rise of crime of cohort effects and period effects. The separation of the cohort from period effects has presented a significant problem in the interpretation of social data. While the basic concepts have long been understood, in the simplified empirical procedures which are in common use the cohort and period effects are intermixed. Examination of data on specific cohorts--looking at one age one year, the next age in the next year, etc.--as a means of trying to identify a constant group of persons under constant conditions also combines period and cohort effects since period forces can produce shifts and rotations in age profiles.[2] Significant improvements in methodology for estimating age, period and cohort effects in observations on individuals have occurred during the last several years.[3]

The present analysis separates age, period and cohort effects in aggregate data. Information over time by single years of age is examined, making use of the fact that a cohort effect implies that a rise at one age in one year will be associated with a rise at the next age in the next year. Shifts between successive cohorts, free of period effects, are estimated in order to determine their contribution to the growth of crime. The separation of cohort and period effects makes it possible to test and measure various notions about the way in which a cohort process works. At the same time it is possible to obtain clearer measures of the static age profiles--age patterns that exist in a constant population under constant conditions.

A View of the Crime Growth Process

The nature of a cohort process is illustrated in Figure 1. Panel A shows a rising trend in crime rates for 15 year olds. The trend line is shifted upward when a new generation appears which is more crime prone than its predecessors. The upward shift is a "cohort effect" and the underlying trend a "period effect." Panel B shows the effects of the same change on the crime rate of all persons age 15-24. As a result of the cohort effect, in one year the crime rate for 15 year olds rises, in the next year the rate for 16 year olds rises and so on. As time passes a larger proportion of 15-24 year olds is composed of persons with the greater tendency to commit crime. The average crime rate for all 15-24 year olds rises until all 15-24 year olds are from the new group. During this growth period a new trend is established which is the sum of both cohort and period effects. After the new level is reached for 24 year olds the slope of the crime trend will return to its original level but crime will grow from a higher rate.

Figure 1 deals only with a once and for all change. Cohort effects may also operate in the form of a trend factor which makes each succeeding group of 15 year olds more likely to commit crime than its predecessors. In Panel A of Figure 2 the crime rate of 15 year olds rises from year-to-year as the result of the continuous arrival of groups increasingly likely to commit crime. The observed increase in crime along the solid line is the sum of the effects of this cohort trend and the period trend of the dotted line. In a period during which such a cohort trend is being introduced the average crime rate of 15-24 year olds rises by increasing absolute amounts (Panel B). After the new trend has reached the 24 year olds the slope of the trend will continue at its high level as each age in the 15-24 year group is becoming more crime prone than its predecessors.

Social variables affecting crime which themselves have a trend would be expected to produce such a cohort trend effect. This can be expected to occur commonly and it is this form with which we will deal. It is apparent that in the presence of such patterns prediction based on observed trends may be inappropriate. If trends in social variables producing cohort effects are about to change or if the base period for prediction contains the effects of changes in trends which are not likely to continue, serious error may result.

Separation of Age, Period and Cohort Effects

Cohort and period effects are intermingled in observed patterns of crime rates by age as well as in trend data. Curve 1 in Figure 3 shows a static age-crime profile. If there were no underlying trend in crime rates within age groups there would still be a tendency for crime rates to rise and fall as persons entered more crime-prone years and moved out of them. Crime rates for a cohort which became 15 years of age in 1952, for example, might be greater in 1953 at age 16, rising from point A to point B. If crime rates rose in all age groups from one period to the next the age-crime profile would be higher each year than the year before. The crime rate of 16

year olds in 1953 would rise by the sum of the general rise BC and the movement along the age profile AB. Observed movements of crime rates under the influence of such a general trend would trace out a new and steeper curve (II) passing through points A and C.

The introduction of a cohort trend effect in addition to the general trend is shown in Curve III. The "class of 1953" begins with a higher crime rate than the "class of 1952." The difference is the sum of the greater general tendency for crime in 1953 than in 1952 (AD=BC) and the greater tendency for the new cohort to commit crime DE. The slope is parallel to Curve II because the new cohort is also subject to a trend. Observed relationships such as Curve II and Curve III differ from the static age profiles of Curve I by both period and cohort effects and the usual method of plotting values by age over time will not separate them.

We can statistically separate cohort effects from period effects by estimating the equation

$$I_{ij} = a_1 + b_{11} I_{i-1,j-1} + b_{12} P_j \qquad (1)$$

where I_{ij} is the arrest rate for the ith age in year j (for example 16 year olds in 1953), $I_{i-1,j-1}$ is the arrest rate for the preceding age in the preceding year (for example 15 year olds in 1952) and P_j is a measure of period forces affecting crime. The response coefficient b_{11} measures the importance of the cohort effect as the amount that the number of arrests will rise in one year when there is an increase of one arrest in the preceding age in the preceding year. The size of b_{11} will depend on the relative size of cohort and period effects.

Empirical Tests

Equation I was estimated for city arrest rates of all index crimes, index violent crimes, index property crimes and the seven categories of index crimes over the period 1952 to 1973. In the set of equations for each crime the arrest rate of persons age 25 and over was used to represent period effects. The arrest rate of persons one year younger in the preceding year measured the crime factors peculiar to a cohort. The analysis was performed for each age 16-24. The estimated equations for violent crime are presented in Table 1.

Typically, 95 percent of the variation in the age-specific arrest rates for violent crime was associated with the explanatory variables. Most of the estimates of response coefficients to cohort and period effects are statistically significant at very high levels. An increase of 100 violent crimes at one age is associated with a rise of 50-60 crimes in the next age in the following year. There is a tendency for cohort response rates to be lower after age 20. Property crime rates also show highly significant cohort responses (Table 2). They are somewhat smaller, however--typically .4-.5. A smaller response after age 20 is also evident.

Shifts in Age-Arrest Profiles

A measure of the contribution of cohort effects to the rise in crime can be obtained by examining shifts in age profiles. Gross age profiles in the data on arrest rates for 15-24 year olds from 1947-1973 are similar to those observed in other studies. The gross age profiles for violent and property crimes are shown in Figures 4 and 5. Arrest rates are plotted for each cohort. The year assigned to each curve is the year in which that cohort was age 15. The age-arrest profile of the "class of 70" is far higher than the "class of 52," reflecting the influence of both period and cohort effects. Because period effects produce a rise in arrest rates over time the shapes of the age profiles give a distorted picture of age patterns which would exist with other conditions unchanged. The patterns in the gross data show apparent tendencies for violent crime arrest rates to rise sharply with age in the teen years and then level off and for arrest rates for property crimes to decline with advancing age.

We can make use of the estimates of the strength of period effects to derive net age-arrest profiles which indicate the age patterns in arrest rates when period effects are removed. Net age-arrest rates (N_{ij}) were derived by standardizing the gross age-specific arrest rates to the 1973 period effects.

$$N_{ij} = I_{ij} + b_{12} (\hat{P}_j) \qquad (2)$$

The measure of period effects--the arrest rate for persons age 25 and over--was subtracted in each year from its 1973 value to obtain $\hat{P}$. This period difference was multiplied by the period response coefficient for each age group separately. The result was added to the gross arrest rate for that age in that year in order to obtain the arrest rate that would have been observed in that age in that year if the 1973 period effect had prevailed. The procedure was repeated for each crime using information specific to that crime.

Net age-arrest profiles with the period effects removed are shown for violent crimes in Figure 6. The differences between the net and gross patterns are striking. When period factors contributing to the rise in arrest rates are removed the violent crime age profiles are much closer together and no longer show a steep increase in the teenage years. Comparison of Figures 5 and 7 also indicate that for property crime the cohort profiles have become close together.

In order to estimate the extent of cohort shifts over time an equation was fitted to the net age-arrest profiles. The arrest rate is a function of age for each cohort and the level of the age-arrest relationship varies from year to year. ${}_nN_{ij}$, the net arrest rate for the i th age group in the j th year, is given by:

$${}_nN_{ij} = a_2 + b_{21}A + \Sigma (b_{22}D_1 + \ldots b_{2,n}D_{n-1}) \qquad (3)$$

where A is age and D_1 to D_{n-1} is a set of dummy variables which take on values of zero and 1 for each of the n-1 cohorts. Data were used for all cohorts which were included completely in the period 1952-1973.[4] The last group reaching age 24 in 1973 was 16 years old in 1965. Thus, the last dummy variable denotes the class of '65. The ratio of any year's cohort position to the position of the 1952 cohort is obtained by taking $e^{b2,n}$.

Indexes of arrest rates attributable to cohort shifts are shown in Table 3. Values for the cohorts 1963-65 are significantly different from those of the class of '52. Between 1952 and 1965 cohort influences produced a rise in arrest rates for index property crimes of 18.1 percent, an average growth of 1.3 percent per year. Cohort shifts raised the violent crime arrest rate by even more, 28.6 percent, or 2.0 percent per year. The effect on homicides is particularly striking. Cohort shifts accounted for a rise of 40.3 percent in homicide arrest rates between 1952 and 1965, an annual growth rate of 2.6 percent. The indexes show a sharp jump after 1962. Cohort effects were about the same size for violent and property crimes between 1952 and 1960. After 1960, however, the violent crime effects were much greater.

These tests do not indicate whether cohort shifts had a greater impact after the early 1960s. Inspection of Figures 4 and 5 suggests, however, that a sharp jump also occurred in 1966 for both violent and property crimes and continued to 1968 for violent crimes. No upward shifts are indicated in the remainder of the decade.

Figure 6 shows a pattern of upward shifts in age profiles of violent crime arrest rates at a higher percentage rate for the youngest offenders. Tests of this pattern were conducted by estimating separate equations for each cohort and comparing successive age slope coefficients. The equations confirm the observation that the particularly rapid upward shift of the cohort profiles has contributed to the rapid growth of youth crime.[5]

[1]This paper is excerpted from Irving Leveson, The Growth of Crime, Hudson Institute, July, 1975, Chapter 5.

[2]The combination of a cohort and period effects has typically been used as a measure of cohort effects alone, both in aggregate analyses and in longitudinal studies of the behavior of individuals. See A. Joan Klebba, "Homicide Trends in the United States, 1900-1974," Public Health Reports, 90, No. 3 (May/June, 1975), pp. 195-204 and Marvin Wolfgang, Robert Figlio and Thorsten Sellin, Delinquency in a Birth Cohort, Chicago: University of Chicago Press, 1972. Klebba notes that the 15-19 year old population in 1972 had a higher homicide death rate than the cohort 5 years earlier and suggests that as a result 20-24 year olds can be expected to show an increase in homicide rates in the future.

[3]Important advances have been made using multiple classification analysis. See Karen Mason, et al., "Some Methodological Issues in Cohort Analysis of Archival Data," American Sociological Review, 38, No. 2 (April, 1973), pp. 242-258 and H. Winsborough, "Age, Period and Cohort Effects on Earnings by Race," Social Indicator Models, edited by Kenneth Land and Semour Spilerman, New York: Russell Sage Foundation, 1975, pp. 201-217.

[4]Equations with age in the linear form yielded nearly identical estimates of cohort shifts.

[5]Tests were conducted to verify that this pattern was not an accidental result of the way in which period effects were measured. Equations in Tables 1 and 2 were reestimated including alternative measures of youth unemployment as an additional period variable. The cohort response coefficients were affected insufficiently to account for this pattern. Furthermore, if it were the result of insufficient control for youth unemployment a rotation of age profiles would have been expected for property crimes as well.

FIGURE 1

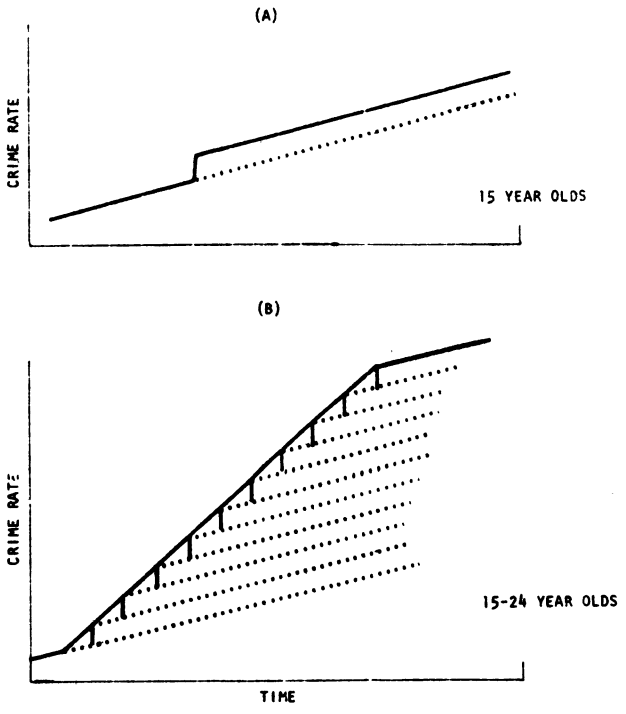

FIGURE 2

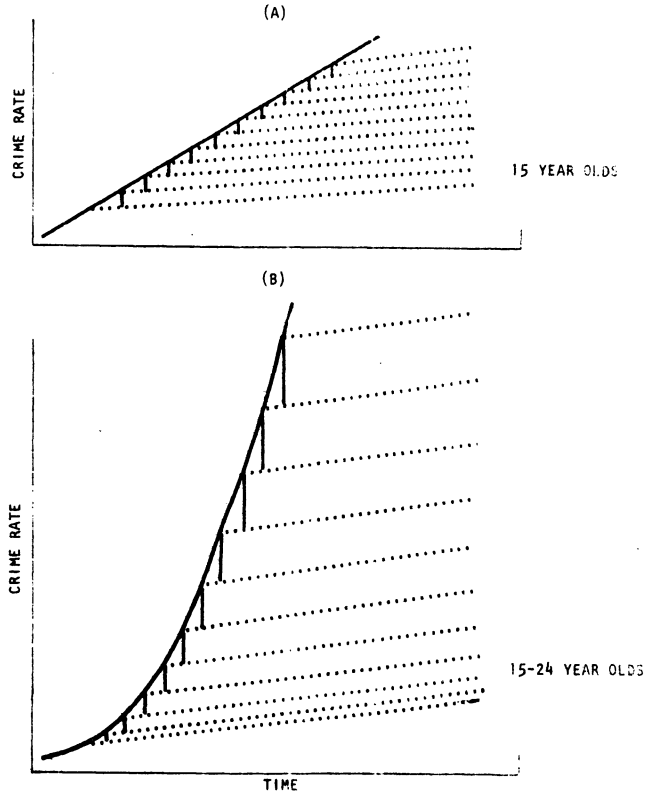

Table 1

RESPONSES OF VIOLENT CRIME ARREST RATES FOR PERSONS AGE 16-24 TO COHORT AND PERIOD EFFECTS

Age	Constant Term	Cohort Response	Period Response	Coefficient of Determination
16	-90.4	.903 (8.755)	1.885 (3.344)	.978
17	-171 6	.627 (5.107)	3.051 (3.887)	.969
18	-29.6	.621 (3.454)	1.927 (1.629)	.923
19	-20.3	.641 (5.454)	1.491 (2.13)	.945
20	-56.4	.736 (6.230)	1.296 (2.034)	.950
21	-85.0	.657 (5.027)	2.084 (3.139)	.949
22	-59.6	.482 (4.761)	2.156 (3.931)	.960
23	-67.1	.318 (1.545)	2.707 (2.932)	.878
24	-261.8	.348 (2.397)	4.448 (7.417)	.968

Note: t ratios are in parentheses.

FIGURE 3

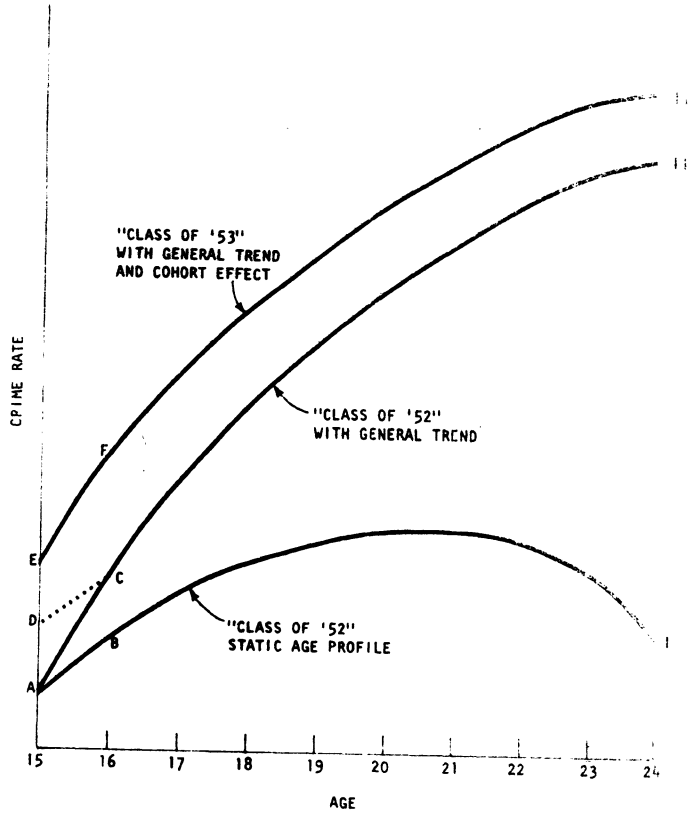

Table 2

RESPONSES OF PROPERTY CRIME ARREST RATES FOR PERSONS AGE 16-24 TO COHORT AND PERIOD EFFECTS

Age	Constant Term	Cohort Response	Period Response	Coefficient of Determination
16	650.6	.560 (4.518)	4.107 (2.086)	.879
17	-233.7	.294 (3.173)	8.566 (5.952)	.933
18	-344.1	.521 (3.701)	4.795 (2.598)	.941
19	-88.9	.544 (2.891)	3.771 (2.217)	.932
20	-234.6	.520 (3.527)	3.096 (2.324)	.947
21	-289.2	.461 (3.667)	3.783 (3.779)	.953
22	-126.2	.364 (3.571)	3.055 (4.001)	.966
23	-200.2	.128 (.916)	4.105 (5.270)	.957
24	-497.7	.289 (2.827)	4.948 (10.133)	.989

Note: t ratios are in parentheses.

FIGURE 4

GROSS AGE PROFILES OF CITY ARRESTS FOR PROPERTY CRIMES
(PER 100,000 PERSONS)

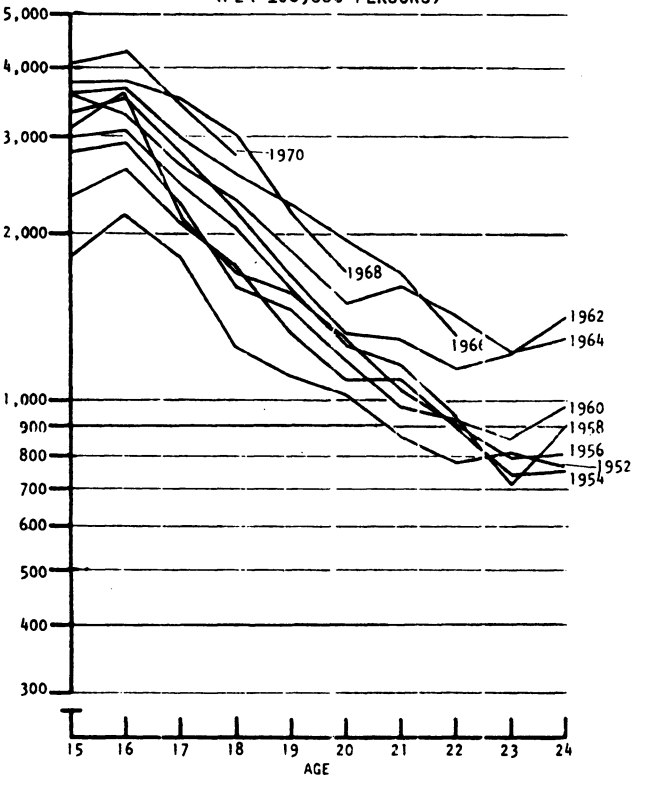

FIGURE 5

GROSS AGE PROFILES OF CITY ARRESTS FOR VIOLENT CRIMES
(PER 100,000 PERSONS)

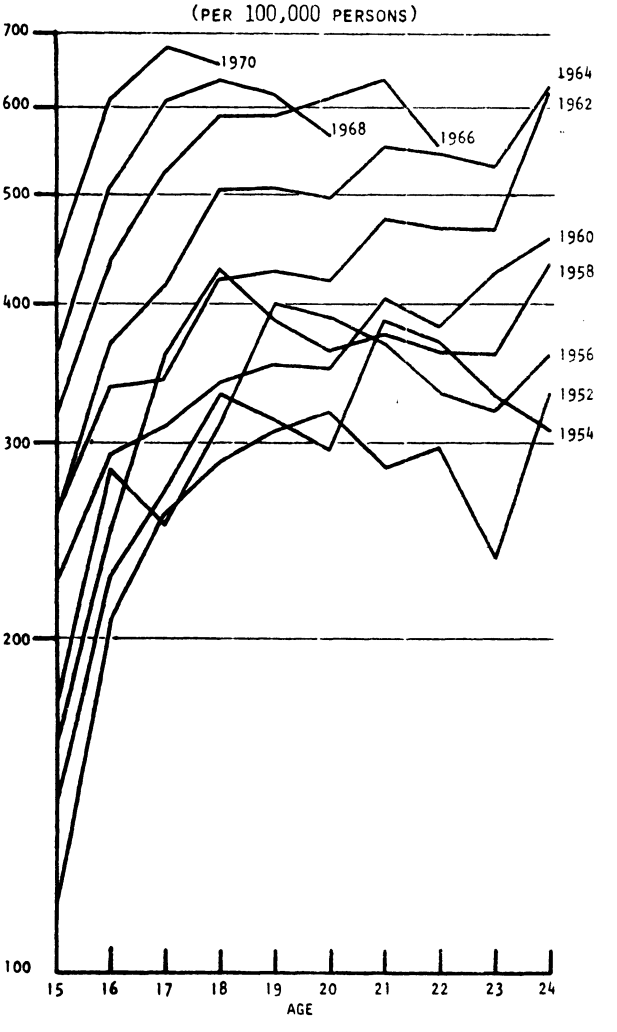

FIGURE 6

NET COHORT AGE PROFILES OF CITY ARRESTS FOR VIOLENT CRIMES
(PER 100,000 PERSONS)

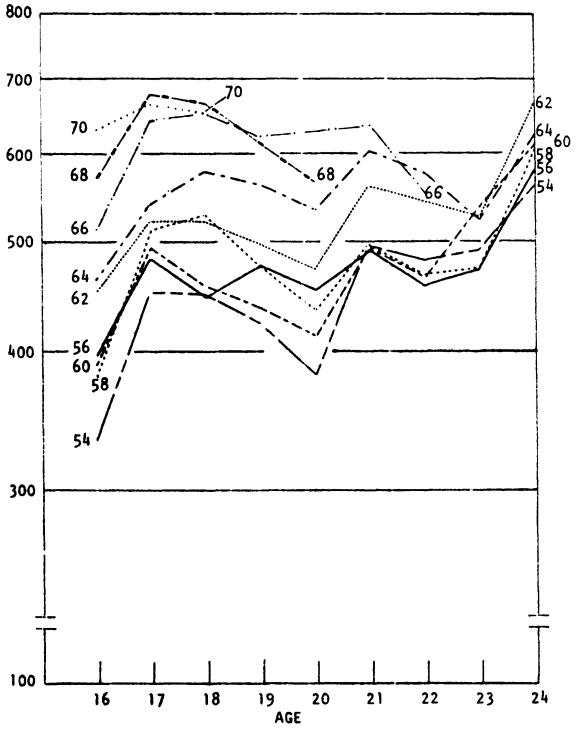

Table 3

INDEXES OF ARREST RATES
ATTRIBUTABLE TO COHORT SHIFTS
(1952 = 100)

Cohort	Violent	Property	Homicide
1952	100.0	100.0	100.0
1953	97.7	97.9	100.9
1954	99.6	102.2	102.1
1955	102.4	101.2	104.1
1956	107.5	110.8	116.0
1957	108.7	111.3	115.3
1958	107.5	109.0	116.3
1959	111.3	110.9	123.3
1960	108.8	108.2	118.5
1961	109.0	105.1	116.8
1962	111.9	106.2	122.8
1963	155.7	118.8	134.9
1964	125.9	120.1	136.0
1965	128.6	118.1	140.3

FIGURE 7

NET COHORT AGE PROFILES OF CITY ARRESTS FOR PROPERTY CRIMES
(PER 100,000 PERSONS)