Changes in Age and Crime

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Several researchers have investigated possible relationships between age and crime. Using different data and methodologies they have often attained contradictory results (cfr. Levin 1999, Maxim 1985). Here I apply a decomposition method developed by Vaupel and Canudas (2002) to explore this problem. I also present some indications on why some methods may not be useful to analyze age and crime relationship. The data and methodology used here indicate that age and crime are nonlinearly related, and proportional changes in age groups can explain at least half of proportional fluctuations in crime rates.

Introduction

Levitt (2004) states "Crime fell sharply in the United States in the 1990s, in all categories of crime and all parts of the nation. Homicide rates plunged 43 percent from the peak in 1991 to 2001, reaching the lowest levels in 35 years. The Federal Bureau of Investigation's (FBI) violent and property crime indexes fell 34 and 29 percent, respectively, over the same period. These declines occurred essentially without warning" (p. 163). This author lists six commonly cited factors that are used to explain crime rates decline, among them he notes population aging. But he found no evidence to support this argument. On the contrary, Levitt attributes crime rates decline to increases in the number of police, the rising prison population, the waning crack epidemic and the legalization of abortion.

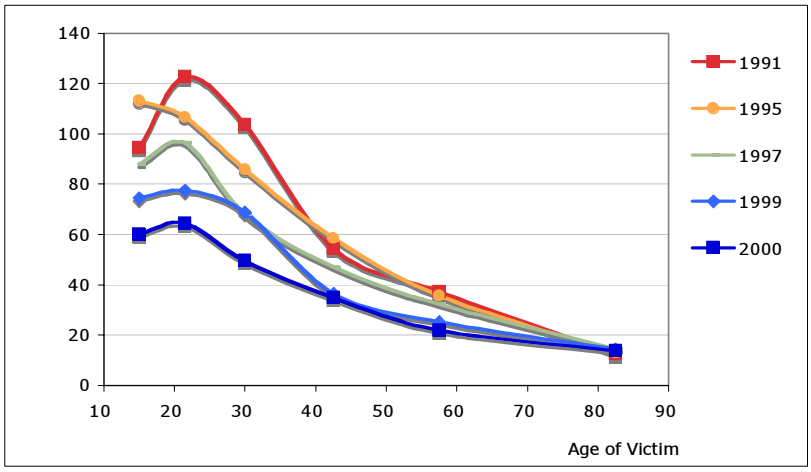
Levitt analysis is based on homicide incidence because, he explains, is the most accurately measured and most serious crime and thus provides a useful benchmark. Homicide rate experienced a steady increase during 1960-1980, then it fluctuated during 1980-1990, and it drastically decreased during 1991-2000. He also claims that the same pattern observed for homicide is present for every major crime category.

Levitt (2004) discards population aging as a sound explanation for crime rate decline. He states that baby boom echo is leading to a temporary increase in the number of teenagers and young-adults "Between 1995 and 2010, the number of 15-24 year olds is projected to increase by roughly 20 percent, and the share of the population between the ages of 15 and 24 will increase from 13.7 percent to 14.6 percent" (p. 171). However, he also notes that this age group represented 18.7 percent of the population in 1980, and it is important to take into account that the share of this age group is declining in comparison to years when crime rates reached their peaks. This author also cites a former paper of him (Levitt 1999) where he used an Oaxaca-decomposition to analyze the importance of age distribution changes in crime rate decline. He concluded that demographic shifts are not an important factor in the drop of violent crime incidence.

The results of Levitt are counterintuitive because violent crime victimization and homicides have very specific age patterns (Fig 1 and 2). Therefore it seems reasonable to expect that changes in the age distribution will imply changes in these crime rates.

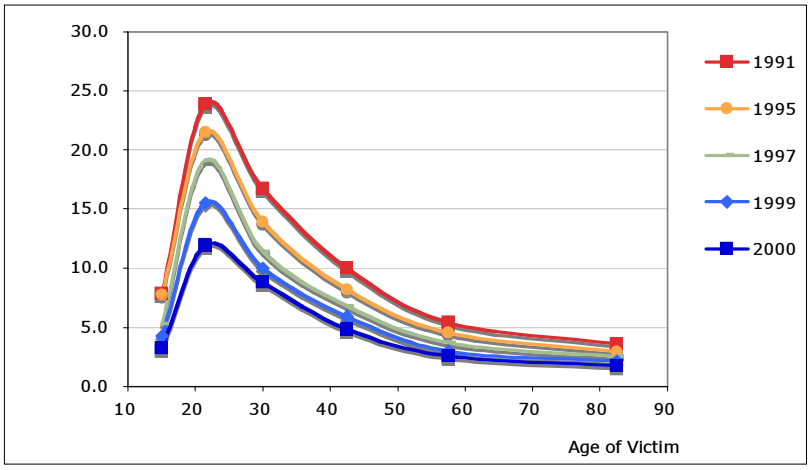
Furthermore, other researchers have also argued convincingly about the close relationship between changes in the age distribution and crime rates. Perhaps, the most influential paper was written by Hirschi and Gottfredson (1983) where they argued that age has a direct causal influence on crime. Cohen and Land (1987) used a time series model with a single age composition index that concentrated exclusively on the relative frequency of adolescents and young adults in the population. They noted that teenagers and young adults are more likely to be offenders and also victims of crimes; they explain that these two types of effects are combined in their single age structure index. They concluded that "for both murder and vehicle theft, a combination of trends in age composition, criminal opportunities, economic cycles, and imprisonment rates is sufficient to explain most of the variance in trends and fluctuations in annual rates over the last four decades. Note that age structure is of substantial importance in both cases" (p. 180).

Fig 1. Serious Violent Crime Rates



Source: Own elaboration data from Bureau of Justice Statistics (2006)

Fig 2. Murder Rates



Source: Own elaboration data from Bureau of Justice Statistics (2006)

Maxim (1985) used a logit model to test Easterlin hypothesis. He explains that Ryder and Easterlin suggested "that in addition to age structure, fluctuations in the size of birth cohorts can have a profound impact on the volume of crime a society can expect to experience" (p. 661). Maxim notes that Easterlin hypothesis implies that crime rates will fluctuate according to the relative cohort size. He also explains that the main

idea is that "population size tends to fluctuate much faster than the social structure can adapt to those fluctuations. As a consequence, social resources and life opportunities will differ for abnormally large or small cohorts. While the social structure will eventually adapt to the changing population base, there will be lag times during which large contiguous cohorts will face shortages, or small cohorts will be blessed with a surplus of riches… Delinquency - particularly 'official' delinquency- is moderated by the limits of elasticity in the capacity of social control agencies to respond to delinquent behavior" (p. 663-663). Maxim used a logit model to test this idea; his conclusion was "The data suggest that Easterlin's hypothesis is, in fact, a credible one" (p. 661).

Maxim's (1985) conclusion throws away one argument of Levitt (2004): it is not the absolute number of individuals in specific age groups but the relative cohort size what is related to changes in crime rates. Therefore, Levitt's data and conclusions should be revisited in order to explore the relationship implied by the relative changes of the age groups. In the next section I will revisit the period of crime rates decline in the United States 1990-2000. As Levitt explaines, homicide rates are the most accurately measured and they provide a useful benchmark, so I will focus on violent crimes and homicides. I will use the decomposition method developed by Vaupel and Canudas (2002). These authors explicate that their formula decomposes a change in a population average into two components: one captures the effect of direct change in the characteristic of interest, and the other captures the effect of compositional change, which is the change attributable to a difference in population structures. I will use public data from the Bureau of Justice Statistics (2006) of arrests and victimization rates of violent crimes, non-fatal violent crimes and murder. The data is assembled in non-customary age groups, so I had to calculate the size of these particular age groups from single age distributed population data from the US Census Bureau (2006) for murder rates. Data is shown in Appendix.

Decomposition of Differences in Crime Rates

The formula presented by Vaupel and Canudas (2002) is given for a continuous setting. In an unpublished work Vaupel, Canudas and Zhang (2006) presented this formula for a discrete setting. The discrete decomposition of differences is given by

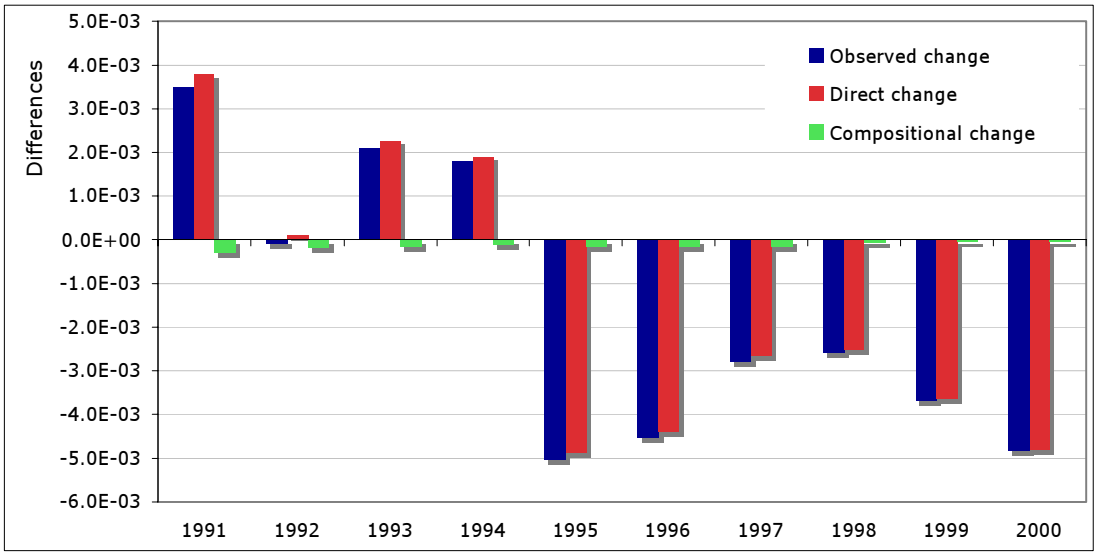
$$\Delta\bar{v} = \overline{\overline{\Delta v}} + \overline{\overline{\left(\frac{\mathrm{cov}(v, w')}{1 + w'}\right)}} \qquad (1)$$

where
v = variable of interest, crime rates.
w = set of weights, sizes of age groups
Δv = delta stands for differences in the variable
$\bar{v}$ = one bar indicates weighted average, double bar represents double weighted average
w' = an acute accent stands for relative differences in the variable

The left hand side of the equation stands for the differences in the averages of the variable of interest (observed changes in the crime rates). The first part of the right hand side stands for the direct changes in the variable, and the second part represents the compositional change. It is important to note that the method is based on the

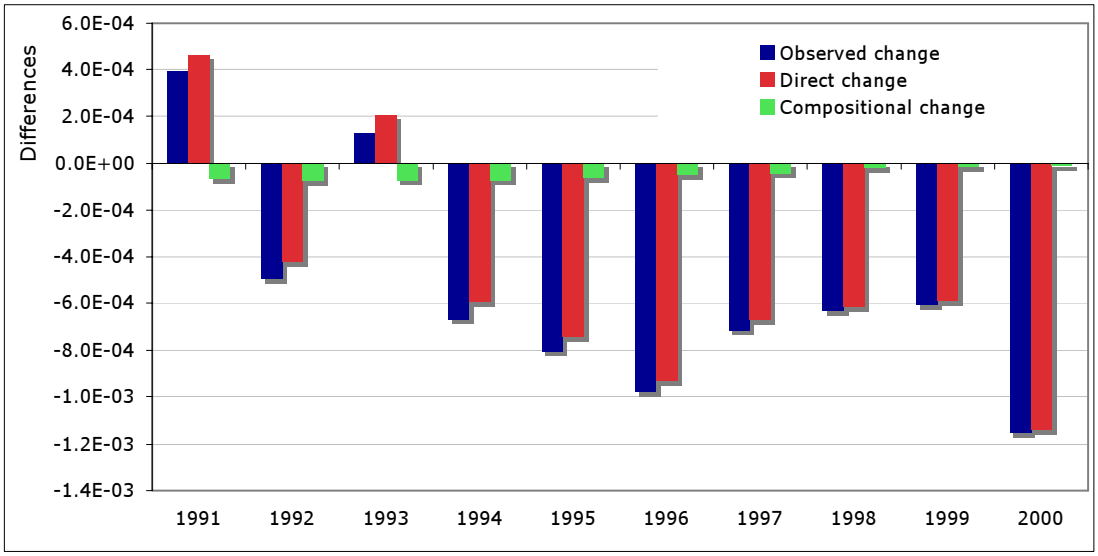
covariance between the variable of interest and the relative changes in the number of individuals inside each age group. So it seems that the method allows testing the Easterlin hypothesis in the way suggested by Maxim (1985) over the data used by Levitt (2004): homicides in US during the decline of crime rates 1990-2000. The results are shown in the following graphs. Figure 3 shows the decomposition of violent crime rates, and Figure 4 shows the decomposition of homicide rates.

Fig 3. Decomposition of Differences in Violent Crime Rates



Source: Own calculations

Fig 4. Decomposition of Differences in Murder Rates

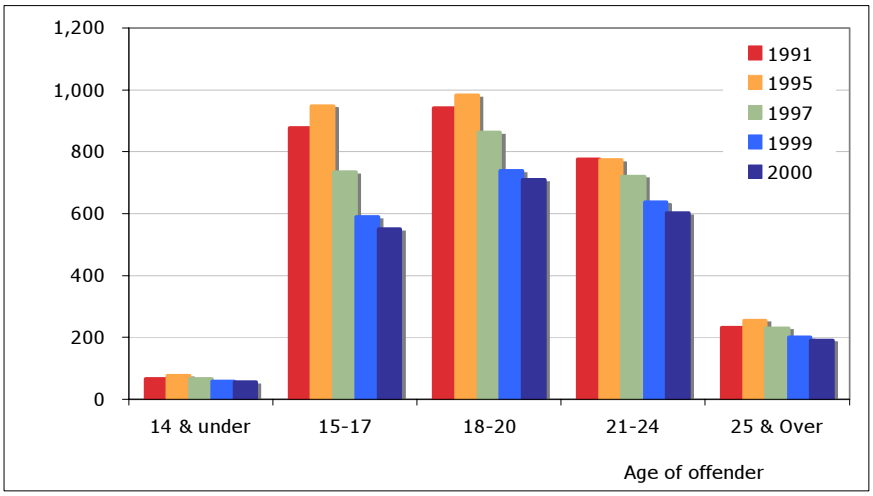


Source: Own calculations

At first sight it seems that Levitt's (2004) conclusion is correct and proportional changes in age cannot explain changes in crime rates. But then again this result is counterintuitive if we remember the very specific victimization age patterns. Furthermore, even the age patterns of arrested offenders follow regular and specific shapes (Figure 5 shows rough age patterns of arrests rates for violent Index offenses. Figure 6 shows the decomposition of differences in the arrest rates for violent Index offenses). However, when decomposing arrest rates the same puzzling results are

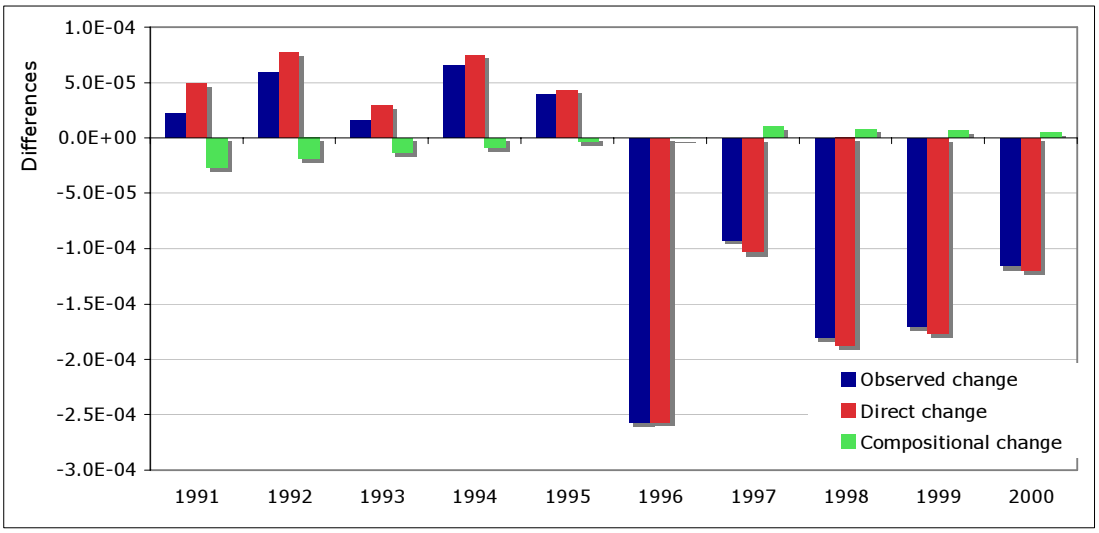
obtained. The decomposition of differences in victimization and arrest rates seems to indicate that changes in the age distribution are non important for fluctuations in crime rates, but this result may be an artifact of the methodology.

Fig 5. Arrest rates for violent Index offenses by age group of the offender



Source: Own elaboration data from Bureau of Justice Statistics (2006)

Fig 6. Decomposition of Differences in Arrests Rates for Violent Index Offenses



Source: Own calculations

When looking at the age patterns of victims and offenders it becomes evident that age changes do not have additive effects on crime rates: when the relative size of young age groups decreases there are less potential criminals but there are also less potential victims. The changes that the age variable implies should be proportional ones. Then we should not expect to find a linear relationship between these two variables. There are other circumstantial indicators that imply the existence of a nonlinear relationship: according to the Bureau of Justice Statistics (2006) young prison inmates were more likely than older inmates to use firearms when they committed their current offense, and multiple victim homicides are more likely to involve guns than single victim homicides. Therefore, when the relative size of young age groups decreases there are less potential criminals, less potential victims, but also less offenders who use firearms, and because the use of guns is related to multiple homicides then there are

also less multiple victim homicides. As Nathan Keyfitz (1998) puts it “A little thought will show that we live in an essentially nonlinear world” (p.1).

Other researchers have also argued for nonlinear relationships between age and crime. Maxim (1985) described a social process that directs agencies of social controls, he stated that “If the process outlined is a valid explanation of the behavior of young people in the 1960s and early 1970s, then it would not be surprising to see juvenile crime rates related to cohort size by some non-linear function” (p. 664). When analyzing relationships among sex, age and crime, Farrington (1986) noted that even if it is possible to calculate an ‘average’ strength of the association between these variables the use of any average would be misleading. Farrington also explains “It is not easy to summarize the relation between age and crime. In general, measures of association in the social sciences assume linear (straight line) relations. The product-moment correlation, for example, essentially measures how closely the relation between two variables approximates a straight line. A low correlation is usually interpreted as indicating no relation between the variables, whereas in fact it may reflect a nonlinear relation. Where two variables have a nonlinear relation (as in the case of age and crime), there is no generally accepted method of measuring strength of association” (p. 239).

The covariance operator, as many other statistical measures of association, can only detect linear relationships. Therefore the decomposition method used in this section cannot detect nonlinear relationships; other methodologies based on linear models and averages differences, like Oaxaca (1973) decomposition, present the same problem. No wonder now that results from these methodologies turned out counterintuitive. Fortunately Vaupel, Canudas and Zhang (2006) have extended their decomposition method in order to assess proportional changes in the variable of interest.

Decomposition of Relative Differences in Crime Rates

The discrete decomposition of relative differences presented by Vaupel, Canudas and Zhang (2006) is given by

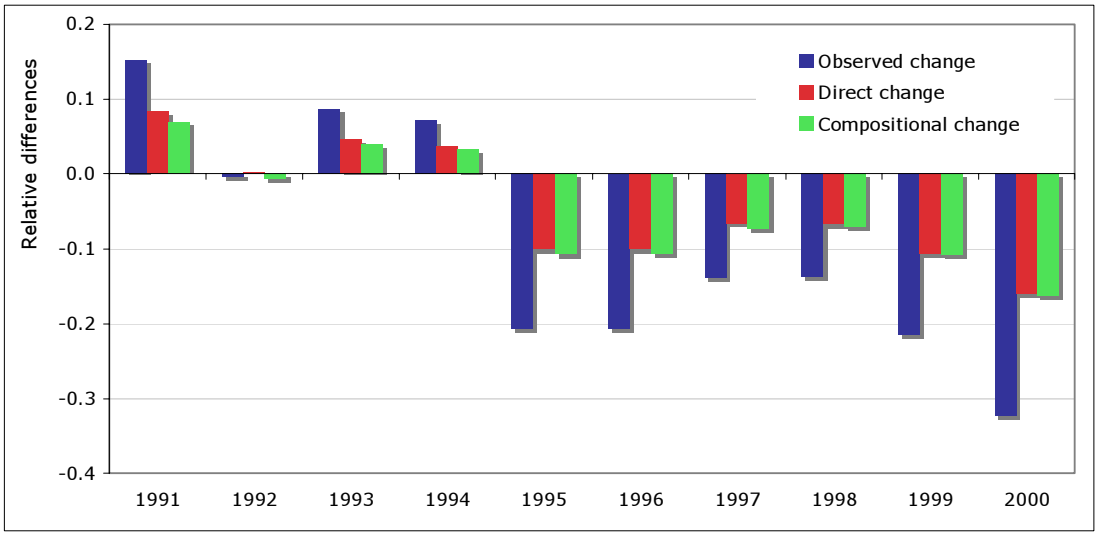
$$(\bar{v})' = \overline{\overline{\left(\frac{\Delta v}{\bar{v}}\right)}} + \overline{\overline{\left(\frac{\frac{\overline{\Delta w}}{\bar{w}} - \overline{(w')}}{1 + w'}\right)}} \qquad (1)$$

where v = variable of interest, crime rates.
w = set of weights, sizes of age groups
Δv = delta stands for differences in the variable
$\bar{v}$ = one bar indicates weighted average, double bar represents double weighted average
w' = an acute accent stands for relative differences in the variable

Here the left hand side of the equation stands for the relative differences in the averages of the variable of interest (observed changes in the crime rates). Again, the first part of the right hand side stands for the direct changes in the variable, while the

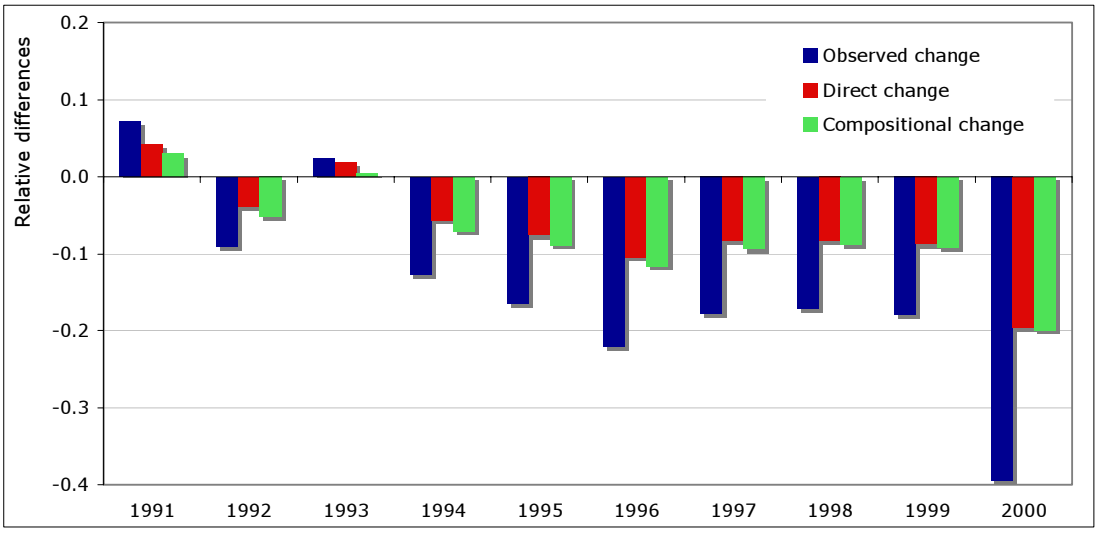
second part represents the compositional change. This modified decomposition is more suitable for testing Easterlin hypothesis in the way suggested by Maxim (1985). The results are shown in the following graphs. Figure 7 shows the decomposition of violent crime rates, and Figure 8 shows the decomposition of homicide rates. Note that the relative differences can be plotted with the same scale over the axis, so both figures are comparable.

Fig 7. Decomposition of Relative Differences in Violent Crime Rates



Source: Own calculations

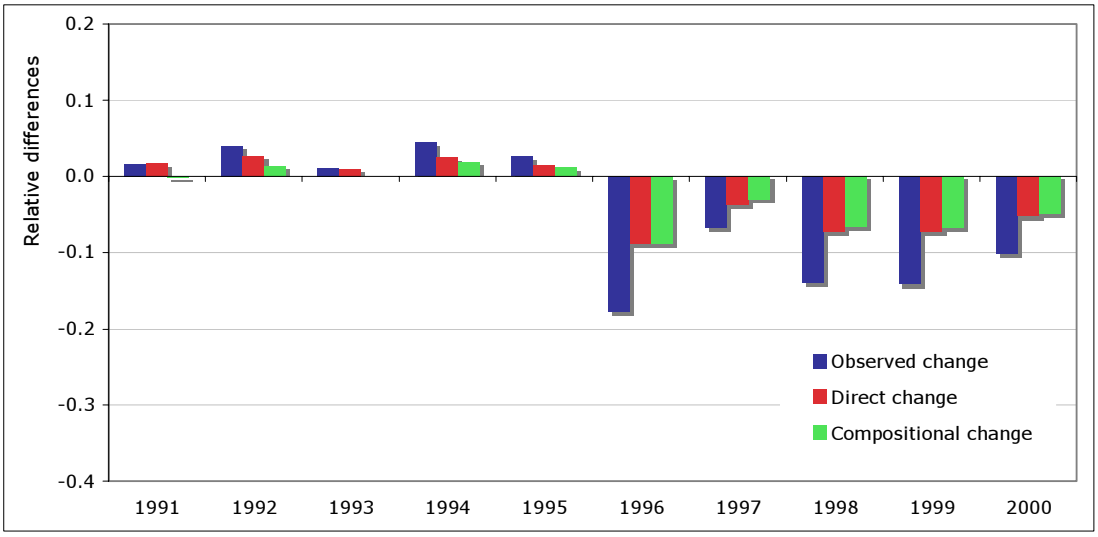
Fig 8. Decomposition of Relative Differences in Murder Rates



Source: Own calculations

Now results agree with the intuition derived of the age specific patterns of victimization. From 1995 and onwards, compositional change accounts for more than half of the decrease in violent crime and murder rates. The different tendencies in the year 1994 can be due to differences in the age patterns (compare Fig 1 and 2), violent crime rates are slightly shifted towards old ages so, as population ages, it is expected to see a decrease in murder before than a decrease in violent crime rates (compare Fig 7 and 8). The following graph, Figure 9, shows the decomposition of the relative differences in the arrest rates for violent offenses.

Fig 9. Decomposition of Relative Differences in Arrests Rates for Violent Index Offenses



Source: Own calculations

The relative differences in the arrest rates (Fig 9) are smaller than in crime rates (Fig 7 and 8). It is interesting to note that relative reductions in arrest rates occurred later than in crime rates, and also that before their onset of decrease the relative arrest differences were very close to zero. These observations agree with Easterlin's ideas, explained by Maxim (1985), about rate ceilings implied by institutional constraints and time lags in the responses of the institutions, which create a "certain amount of 'stickiness' in rates in situations where cohort size is generally to decline" (p. 664).

Table 1. Attributable Compositional Change to Relative Changes in Crime Rates, shown in percentage.

Year	Violent crime victimization rates	Murder victimization rates	Arrests rates violent crime offenders
1991	45.74	41.72	-9.44
1992	172.72	57.59	33.81
1993	45.95	21.21	4.70
1994	46.85	55.56	43.22
1995	51.59	53.92	45.41
1996	51.55	52.53	50.05
1997	52.47	53.09	44.51
1998	51.22	51.47	47.90
1999	50.54	51.30	48.08
2000	50.39	50.45	48.26

Percent contributions bigger than 100% o smaller than 0% mean that direct or compositional change went in opposite direction than observable change

Source: Own calculations

As shown in the figures in this section and in Table 1, relative decrease in age groups (compositional change) accounts for more than half of the relative reduction in violent crimes and murder rates in the United States during 1990-2000. For this same period,

the same compositional change accounts for slightly less than half of the reduction in arrest rates of violent Index offenders. From results presented in this section about violent crime, murder and arrest rates decrease, it is reasonable to express the same conclusion as Maxim (1985): the data and methodology used for its analysis suggest that Easterlin's hypothesis is, in fact, a credible one.

The decomposition shown here also implies that there are other variables not related to relative changes in the age groups that influenced crime rates decline. The combination of these factors should account for almost half of the decline in crime rates. Perhaps these other pieces of the puzzle are associated to the factors that Levitt (2004) put forward: increases in the number of police, the rising prison population, the waning crack epidemic and the legalization of abortion. But before trying to establish a relationship between new variables and crime rates, the relationship between age changes and these new factors must be assessed. Finally, is important to remember that age has not a 'direct causal effect' on crime as Hirschi and Gottfredson (1983) suggested. Maxim (1985) clarifies that age is related to crime because it is a good proxy of biological, physiological and social development. Also the relative changes in age groups are not crime direct predictors, these changes are a proxy of unsatisfactory adjustments between population needs and institutional responses; Maxim explains this point using baby boom cohort as an example "Ryder goes on to note that the cohorts entering adulthood in the late 1960s had the misfortune to be raised in crowded housing, crammed together in schools, and faced with a glutted labor market primarily because of their large sizes"

Discussion

Changes in age and crime are closely related, but this relationship is nonlinear and conventional statistical methods are unable to detect it. Even the results shown here are statistical approximations to the 'strength' of this association. More suitable studies should include longer time series and more detailed data, and analysis should be done with special nonlinear techniques. However, results shown here are enough to prove that fruitful research can be done on age and crime nonlinear dynamics.

On the other hand, the regular age specific patterns in crime and victimization rates, and the results shown here, also suggest that a detailed demographic analysis over crime rates would be fruitful. Demographic standardization techniques can be applied to compare crime incidence among populations, survival analysis can be used to estimate and compare victimization hazard rates, and demographic models and indicators can be modified in order to describe crime levels and trends.

Appropriate measurement of crime levels and trends, and also of age and crime nonlinear relationship, is of importance for societies and policy decisions. For example, age-standardized victimization rates should be used as relevant discrimination indicators among subpopulations. If age changes imply crime fluctuations, as suggested by results shown here, then demographic events as baby booms or population aging have direct consequences in the wellbeing and security of the population. If this relationship can be correctly estimated social responses, as increasing institutional flexibility to demographic changes, could help to prevent crime incidence.

Appendix

Table A1. Violent crime victimization rates by age, per 1000

Year	12-15	16-19	20-24	25-34	35-49	50-64	65& over
1990	101.1	99.1	86.1	55.2	34.4	9.9	3.7
1991	94.5	122.6	103.6	54.3	37.2	12.5	4
1992	111	103.7	95.2	56.8	38.1	13.2	5.2
1993	115.5	114.2	91.6	56.9	42.5	15.2	5.9
1994	118.6	123.9	100.4	59.1	41.3	17.6	4.6
1995	113.1	106.6	85.8	58.5	35.7	12.9	6.4
1996	95	102.8	74.5	51.2	32.9	15.7	4.9
1997	87.9	96.3	68	47	32.3	14.6	4.4
1998	82.5	91.3	67.5	41.6	29.9	15.4	2.8
1999	74.4	77.5	68.7	36.4	25.3	14.4	3.8
2000	60.1	64.4	49.5	34.9	21.9	13.7	3.7

Source: Bureau of Justice Statistics (2006)

Table A2. Murder victimization rates by age, per 1000

Year	12-17	18-24	25-34	35-49	50-64	65 & over
1990	7.1	21.1	16.8	9.9	5.2	3.6
1991	7.9	23.9	16.7	10.0	5.4	3.6
1992	8.0	23.4	16.1	9.4	5.0	3.4
1993	8.5	24.4	16.1	9.5	4.9	3.4
1994	7.8	23.6	15.4	8.9	4.5	3.1
1995	7.8	21.5	13.9	8.2	4.5	2.9
1996	6.4	19.5	12.3	7.7	4.2	2.6
1997	5.2	19.1	11.4	6.8	3.7	2.5
1998	4.5	17.4	10.6	6.5	3.3	2.2
1999	4.2	15.5	10.0	5.9	3.0	2.1
2000	3.2	11.9	8.8	4.8	2.6	1.8

Source: Bureau of Justice Statistics (2006)

Table A3. Violent Index crime arrests by age, per 100 000

Year	14 & under	15-17	18-20	21-24	25 & over
1990	60.0	813.8	883.4	771.5	234.3
1991	65.2	876.1	941.0	775.1	231.8
1992	70.3	886.8	960.1	781.4	239.6
1993	74.4	938.2	972.7	763.0	240.4
1994	81.5	977.1	978.5	770.1	246.2
1995	77.2	947.1	982.7	773.1	255.7
1996	69.1	851.4	921.4	722.3	233.0
1997	65.7	733.2	862.8	720.8	230.0
1998	59.3	661.9	811.5	676.3	214.8
1999	57.7	589.0	737.6	637.8	200.9
2000	55.0	549.5	709.9	601.8	190.7

Source: Bureau of Justice Statistics (2006)

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