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When Choice of Data Matters: Analyses of U.S. Crime Trends, 1973–2012

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Abstract
Objectives This study uses UCR and NCVS crime data to assess which data source appears to be more valid for analyses of long-term trends in crime. The relationships between UCR and NCVS trends in violence and six factors from prior research are estimated to illustrate the impact of data choice on findings about potential sources of changes in crime over time.
Methods Crime-specific data from the UCR and NCVS for the period 1973–2012 are compared to each other using a variety of correlational techniques to assess correspondence in the trends, and to UCR homicide data which have been shown to be externally valid in comparison with other mortality records. Log-level trend correlations are used to describe the associations between trends in violence, homicide and the potential explanatory factors.
Results Although long-term trends in robbery, burglary and motor vehicle theft in the UCR and NCVS are similar, this is not the case for rape, aggravated assault, or a summary measure of serious violence. NCVS trends in serious violence are more highly correlated with homicide data than are UCR trends suggesting that the NCVS is a more valid indicator of long-term trends in violence for crimes other than robbery. This is largely due to differences during the early part of the time series for aggravated assault and rape when the UCR data exhibited consistent increases in the rates in contrast to general declines in the NCVS. Choice of data does affect conclusions about the relationships between hypothesized explanatory factors and serious violence. Most notably, the reported association between trends in levels of gasoline lead exposure and serious violence is likely to be an artifact associated with the reliance on UCR data, as it is not found when NCVS or homicide trend data are used.

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Conclusions The weight of the evidence suggests that NCVS data represent more valid indicators of the trends in rape, aggravated assault and serious violence from 1973 to the mid-1980s. Studies of national trends in serious violence that include the 1973 to mid-1980s period should rely on NCVS and homicide data for analyses of the covariates of violent crime trends.

Keywords Crime trends · Violence trends · Lead exposure · NCVS · UCR

Introduction

The National Crime Victimization Survey (NCVS) and the Uniform Crime Reports (UCR) are widely acknowledged as the nation's two sources of data on crime trends (Barnett-Ryan et al. 2014). National crime estimates from the UCR are derived from police record systems, while those from the NCVS come from surveys of the population. Not surprisingly, the NCVS and UCR typically yield different information about the level of crime and can also provide opposing evidence about changes in crime over time. The latter problem is a particular concern for the study of crime trends, and many have argued that an uncritical use of either data source can result in misleading conclusions about the importance of factors that may be associated with crime trends (e.g., Biderman and Lynch 1991; O'Brien 1996; Loftin and McDowall 2010). While the similarities and differences between the two national data series have been studied using a variety of approaches (see, e.g., Lynch and Addington 2007; McDowall and Loftin 2007; Ansari and He 2012), less attention has been paid to determining when the choice of NCVS or UCR data matters and which data source is more valid for assessing particular research questions.

In this paper, we address these issues by comparing UCR and NCVS crime-specific trends for the period 1973–2012. We also compare each of the series to homicide trends—a type of crime for which there is additional evidence of external validity from mortality records. We argue that when discrepant findings about trends and covariates emerge between UCR- and NCVS-based analyses of violence, it is particularly important to consider comparisons to homicide trends (O'Brien 1996). To illustrate the importance of data choice for the study of national trends in serious violence, we also compare the relationships between UCR, NCVS and homicide data to trends in six key factors that have been hypothesized in the literature to be associated with crime. These factors include levels of gasoline lead exposure, four measures of socioeconomic conditions (unemployment, young adult disengagement, consumer pessimism and inflation) and the incarceration rate. As we will show below, only one of these factors (gasoline lead exposure) is significantly related to UCR violence trends, while each of the other factors are related to homicide and NCVS violence trends in their expected ways.

Background

To date, research on crime trends most often relies on police-based data from the UCR and the Supplementary Homicide Reports (SHR). One of the key reasons for this is that the UCR and SHR can provide not only national data, but subnational information about crime as well. The availability of subnational UCR data increases the analytic possibilities for

longitudinal analyses of crime with relatively short time series. However, because UCR crime data come from law enforcement agencies, researchers must be concerned with how crime trends may be affected by changes over time in victim reporting rates (Baumer and Lauritsen 2010), police-data recording practices (e.g., Berg and Lauritsen 2015), and participation in the national UCR program (e.g., Maltz and Targonski 2002; Lynch and Jarvis 2008). The NCVS which is derived from surveys from representative household-based samples of the U.S. population, provides an alternative to UCR data on crime trends.

Over the past several decades, a growing body of research has assessed the strengths and weaknesses of the UCR and NCVS national data systems for measuring various types of crime trends (see, e.g., Biderman and Lynch 1991; Blumstein et al. 1991; O'Brien 1996; Lynch and Addington 2007; McDowall and Loftin 2007). Generally speaking, this body of research has suggested that the NCVS and UCR national trends are in agreement for the crimes of robbery, burglary and motor vehicle theft and thus substantive conclusions about the covariates of these trends should be similar regardless of the source of the data source. There is less consistency between the NCVS and UCR however, for other crimes, such as aggravated assault and rape. This appears to be the case particularly during the 1970s and 1980s when UCR estimates of these crimes were much lower and trending upward, and the NCVS rates were much higher and trending downward (e.g., Jensen and Karpos 1993; Rosenfeld 2007).

Analyses of nonlethal violent crime trends using the UCR have raised concerns about police recording of aggravated assaults and rape. To discern the sources of the divergences between the UCR and NCVS aggravated assault trends, Rosenfeld (2007) analyzed gun and non-gun aggravated assaults from 1980 to 2001 in order to examine whether the divergences were greater in non-gun assaults, which would be expected if police discretion played an important role in the recording of such violence. According to the "police productivity" hypothesis (O'Brien 1996), increased computerization of patrol and crime records systems, as well as adoption of 911 systems and records of calls for service, helped facilitate increasingly greater levels of crime recording by the police over time. In addition to this hypothesis, Rosenfeld (2007) argued that levels of sensitivity to violence against women rose during the 1980s and 1990s, which also facilitated growth in police recording and formal handling of domestic violence, particularly non-gun violence. Rosenfeld's comparison of the disaggregated NCVS and UCR aggravated assault trends showed greater divergences and changes in the non-gun assault category than in the gun assault category which are consistent with both hypotheses. Thus, although no direct systematic measures of police recording practices over time exist, it appears that changes in police data recording practices help to account for the divergent trends in the UCR and NCVS measures of aggravated assault.

Jensen and Karpos (1993) have addressed similar hypotheses about differing UCR and NCVS rape trends for the period 1973–1990. During this period, the UCR rape trend increased more than twofold, while the NCVS trend showed a general decline. Jensen and Karpos' analysis of UCR and NCVS rape data concluded that although the two data series cover relatively short time periods, the increase in the UCR rates during the 1970s and 1980s primarily reflected changes in the management of rape cases by police. Jensen and Karpos drew this conclusion from their finding that increases in UCR rates paralleled data on changes in several police organizational factors that may well have decreased the rate of which rapes known to the police were "unfounded." More specifically, increases in UCR rape rates were accompanied by increases in the percent of police officers who were female, in the percent of police departments with established relationships with rape crisis centers, and in the percent of departments that reported changes in their rape investigation

practices such as the establishment of specialized units or increased training for officers. Jensen and Karpos also noted that the general declines observed in the NCVS rape rate were consistent with decreases in women's fear of crime that were observed in public opinion survey data during this period. The research by Jensen and Karpos (1993) and Rosenfeld (2007) is very informative. Yet, as these authors acknowledge, the measures necessary for directly testing how police practices affect crime recording practices were unavailable in the 1970s and 1980s—the period exhibiting inconsistent trends in UCR and NCVS rates of aggravated assault and rape. Consequently, the evidence provided by these studies regarding the police productivity hypothesis can be considered consistent, yet not conclusive.

Aside from these crime-specific studies, there is a more general body of research that compares UCR and NCVS trends, and these studies vary in methodological approach. Most recently, Ansari and He (2012) reexamined the similarities and differences between crime-specific UCR and NCVS data trends from 1973 to 2008 and provided a useful summary of research on convergences and divergences in the trends (for comparisons through 2003, see McDowall and Loftin 2007). Ansari and He (2012) found that conclusions about the similarities and differences in UCR and NCVS trends depend on both researchers' definitions of convergence and statistical methodology. For example, when they defined convergence to occur when the correlation coefficients exceeded .80, the authors found that UCR and NCVS trends in robbery, burglary, and motor vehicle theft were in agreement from 1973 to 2008. As previous research had suggested, Ansari and He's findings showed that there was agreement between the UCR and NCVS in the long-term trends in these property crimes and in robbery.

When examining correlations in the levels of crime in split-time periods using the two data series, Ansari and He (2012) also found strong correlations (>.80) for aggravated assault and larceny theft, but only for the period beginning after the mid-1980s. Even though the aggravated assault and larceny data for the earlier period were not in agreement across the two data sources, changes in period-specific correlations suggested that the UCR and NCVS trends in each type of crime may have been converging over time. (Rape rates were not included in the analysis by Ansari and He.) The authors also conducted regression analyses of the differences in NCVS and UCR crime rates over time and this approach confirmed the findings from the correlational analyses.

Ansari and He (2012) also used cointegration analyses, which test whether the trends from the two data series are linked by a common stochastic process. This set of results suggested that only the NCVS and UCR trends in burglary were cointegrated during the 1973–2008 period; that is, the two series exhibited a long-term equilibrium, where the NCVS or UCR series occasionally drifted away from each other, yet returned to approximate the underlying trend.

Thus, using a variety of methods, Ansari and He demonstrated that analyses of burglary trends should be robust regardless of data series used, but that some caution may be warranted when studying trends in other crime types. This multi-method approach provides a useful and nuanced framework for assessing the similarities and differences in the UCR and NCVS crime trends as neither series contains complete information about trends in these crime types. Of course, because data on crime trends are inherently dynamic, conclusions about the convergence or divergence of the UCR and NCVS series can change as additional years of data become available.

Although the existing comparisons of UCR and NCVS crime-specific trends are informative, the question of which data source is more valid for purposes of understanding long-term crime trends when the trends do not agree has not been addressed. Moreover, the

research on UCR and NCVS crime-specific trends suggests that this is of particular importance when the analysis is focused on trends in serious violence. Because prior research suggests that the UCR and NCVS data produce different trends in aggravated assault and rape, particularly during the 1970s and 1980s, summary measures of serious violent crime also may need to be used with caution. Yet, composite measures of serious violent crime are frequently used by researchers in crime trend analyses (e.g., Nevin 2000; Reyes 2007a, b, using the UCR; Lauritsen and Heimer 2010, using the NCVS). A summary measure of serious violence is simply the sum of the rates of aggravated assault, robbery, and rape, and because both the UCR and NCVS data indicate that aggravated assaults occur at roughly twice the rate of robbery (the next most frequent form of violence in each data series), the summary measure will be dominated by the levels and trends in aggravated assault regardless of whether the data employed are from the UCR or the NCVS. For purposes of understanding trends in serious violent crime, it is necessary to conduct ongoing assessments that compare each series' summary measure of violence, and each of its component measures, and to update and re-examine the trends with data from the more recent period.[1]

If serious violent crime (or other) trends are found to differ across UCR and NCVS data during some time periods, it becomes important to make a judgment about which source of data may be a more valid indicator. As noted by O'Brien (1996), a useful approach for assessing this type of validity at the national-level is to compare serious violent crime trends to homicide trends because homicide data are particularly well-measured. Homicide rates have been shown to be similar in level and trend to other mortality records, such as those gathered from the Centers for Disease Control (see, e.g., Smith and Cooper 2013), and homicide may be thought of as a subcategory of serious violent incidents in which the outcome is lethal in nature. If the homicide trend is more highly correlated with the UCR serious violent crime trend than the NCVS trend, it would be reasonable to infer that UCR data provide a more valid measure for assessing trends in violence (and vice versa). O'Brien (1996) used this approach based on the assumption that different forms of violent crime are likely to share common causes and that police practices for recording crime are much more likely to affect nonlethal violent crimes than homicides. O'Brien found evidence that a UCR summary measure of (nonlethal) serious violence exhibited a different trend than did homicide during the 1973–1992 period, but we are unaware of any research that has reexamined this issue by incorporating more recent data or by making comparisons to trends found in the NCVS. Also, existing analyses do not provide detail on how trends in subtypes of nonlethal violence (such as rape, robbery, and aggravated assault) compare to those of homicide. In this paper we examine how homicide trends are related to UCR and NCVS violent crime trends to provide additional information to help inform choices about data selection for studies of long-term trends in violent crime.

Current Study

To provide new information on how NCVS and UCR crime data compare and how choice of data may affect our understanding of the sources of violent crime trends, our analysis has two components. First, UCR and NCVS national rates of rape, robbery, aggravated assault, burglary, and motor vehicle theft are compared and investigated alongside

[1] Rosenfeld's (2007) analysis of aggravated assault trends are based on data through 2001, while Jensen and Karpos' (1993) analysis of rape trends include data through 1990.

homicide rates obtained from the SHR to assess the similarities and differences across crime types and data sources. Second, we illustrate when and how choice of data matters by examining the associations between UCR and NCVS national trends and a variety of covariates of crime trends including lead exposure, incarceration rates, and four measures of social and economic conditions—unemployment, young adult disengagement from social institutions, consumer pessimism, and inflation. Our purpose here is not to reassess all of the details of prior convergence analyses or attempt to reconcile the technical differences between the UCR and NCVS data series. Rather, we seek to add to our knowledge about the validity of long-term crime trend data and to show how the choice of data can be important for conclusions about the relationships between national conditions and crime.

Crime Data

Our comparison of UCR and NCVS national crime trends uses data for the period 1973–2012. National rates of homicide, rape, robbery, aggravated assault, burglary, and motor vehicle theft come from the UCR data tool available at the FBI website (http://www.ucrdatatool.gov/). National rates of these same crime types in the NCVS are estimated from publicly available National Crime Survey (NCS) and NCVS annual data files.[2] Unlike the rates available in most printed reports, we estimate the NCS and NCVS rates to include series victimizations (high-frequency repeated incidents in which the victim is unable to recall the details of each event), counting them as one incident. Adjustment weights are used to account for the change in NCVS methodology that occurred in 1992, making the NCS rates for 1973–1992 comparable to the NCVS 1993–2012 rates (see, e.g., Kindermann et al. 1997; Lauritsen and Heimer 2010). We also use the NCVS data to estimate crime rates for incidents that victims say were reported to the police. These rates allow us to further explore the extent to which changes in victim-reporting versus police crime-recording may account for some of the divergences in the overall long-term crime trends.

Covariate Data

To illustrate how the choice of NCVS and UCR data may affect conclusions about national conditions and crime, we examine trends in a variety of factors that have been hypothesized or shown in prior macro-level research to be associated with trends in crime, including gasoline lead exposure (e.g., Nevin 2000; Reyes 2007a, b), unemployment (e.g., Cantor and Land 1985), young adult disengagement from social institutions (e.g., Thomas and Shihadeh 2013), consumer pessimism (e.g., Rosenfeld and Fornango 2007), inflation (e.g., Rosenfeld 2015) and incarceration (e.g., Baumer 2008; Rosenfeld and Fornango 2007). Of these six covariates, lead exposure is the only one that is hypothesized to operate as a cohort effect rather than a period effect (see McCall and Land 2004). Lead levels are hypothesized to affect crime by affecting young children's brain development and the consequences of this on crime are not expected to manifest until the children reach late adolescence and early adulthood. The influences of the socioeconomic factors are expected to capture economic and social conditions and covary with crime trends. Incarceration rates are hypothesized to be associated with crime in the subsequent year because they

[2] Data for these analyses are available in ICPSR data sets 7635, 8608, 8864, 4699, and 34907. For more information, see http://icpsr.umich.edu/NACJD/NCVS.

either remove offenders from opportunities to commit crime or because they deter others from committing crime.

To measure trends in lead exposure, we follow the methods used by Nevin (2000) and include an indicator of gasoline lead consumption that was compiled by the U.S. Geological Society for 1950–1995, then lagged 23-years.[3] Consumption of tetraethyl lead in gasoline is used as a proxy measure for exposure to lead because gasoline lead was recognized as the largest source of lead to the environment during the years when lead was a regular additive to gasoline (U.S. Environmental Protection Agency 1985). The U.S. Geological Society reports U.S. consumption of tetraethyl lead in gasoline in their annual Bureau of Mines Minerals Yearbooks.[4] By 1987, tetraethyl lead consumption had decreased considerably and by 1990 it had been virtually phased out (Woodbury 1991). For each year in our study, we calculated lead consumption per capita as the U.S. consumption of tetraethyl lead (in short tons) divided by the U.S. population (U.S. Census Bureau, no date).

We assess the correspondence between our crime data and four indicators of national socioeconomic conditions. We measure unemployment trends for 1973–2012 as the percentage of noninstitutionalized persons age 16 or older in the civilian labor force who are not working but actively looking for work (Bureau of Labor Statistics, no date-a). We also include a measure of "disengaged young adults" following research by Thomas and Shihadeh (2013) that shows that the proportion of youth ages 16–19 not in school, the workforce, or the military is positively associated with crime. Specifically, we use data from the NCVS annual files to compute the percentage of persons ages 25–30 in the U.S. who are not engaged in the conventional institutions of work or military service for each year in our study.[5] We include an annual national measure of "consumer pessimism" following research by Rosenfeld and Fornango (2007). Consumer pessimism is the inverse of the Index of Consumer Sentiment and captures the subjective experiences of economic hardship (2007:740). The last socioeconomic factor that we consider is the annual inflation rate. Recent research has also suggested that higher rates of inflation are associated with increases in crime trends (Rosenfeld 2015). Our measure of the annual inflation rate is based on consumer price index data available from the Bureau of Labor Statistics (no date-b) and measures the average year-to-year changes in prices paid by consumers for a set of basic goods and services, such as automobiles, gasoline, food, and clothing.

Finally, we assess the association between crime trends and trends in annual national incarceration rates (lagged 1 year). Research shows that trends in incarceration rates are negatively correlated with trends in crime rates (Baumer 2008; Rosenfeld and Fornango 2007). We obtain these data for each year in our study from the Bureau of Justice Statistics (1986; no date).

[3] Research by Nevin and others (e.g., Reyes 2007a, b) use different lags in lead exposure to best fit the UCR crime trend data. For example, Nevin (2000) uses a best-fit lag structure in which lags of 15–28 years in gasoline lead exposure were tested against each crime type and the lag with the highest R^2 and lowest p value was selected. Nevin (2000) uses a lag of 23 years for violent crime, which we have replicated here, though we also produce the same substantive findings when using a 22-year lag (following Reyes 2007a).

[4] Prior to 1978, U.S. consumption of tetraethyl lead in gasoline was reported in short tons. The U.S. Geological Society began reporting these data in metric tons after 1978. Therefore, we multiplied metric tons by 1.10231 to convert the data into short tons (see U.S. Energy Information Administration 2015).

[5] Persons over age 25 are typically beyond the age of college completion. The NCVS does not measure current college enrollment across all years for persons over age 25, therefore we rely on work and military service as indicators of young adult engagement in conventional social institutions.

Methods

To assess how choice of data matters for purposes of studying crime trends, we begin with visual comparisons of UCR and NCVS crime trends (including trends for crimes that victims say were reported to the police) for 1973–2012. Correlations between each of the trends in homicide, rape, robbery, aggravated assault, burglary, and motor vehicle theft are presented in both levels and log levels. We present logged rates in the figures because this transformation stabilizes the variance in the series.[6] We also examine the trend in a summary indicator of serious violent crime (composed of rape, robbery, and aggravated assault). First-difference correlations in the trends are presented to show how short-term periodic fluctuations covary among the crime types, and split-series correlations are used to determine how the relationships between the UCR and NCVS trends vary across temporal periods.

Our comparisons of the UCR and NCVS crime series and our covariates focus on serious violent crimes because we find that burglary and motor vehicle theft trends exhibit a high degree of correspondence (consistent with previous research). Log-level correlations between each measure of violent crime and each covariate are reported, followed by split-series correlations between serious violent crime and lead exposure, inflation, and incarceration. These additional examples show when the choice of violent crime data is important for conclusions about the correlates of long-term trends in violence.

Findings

National Crime Trends

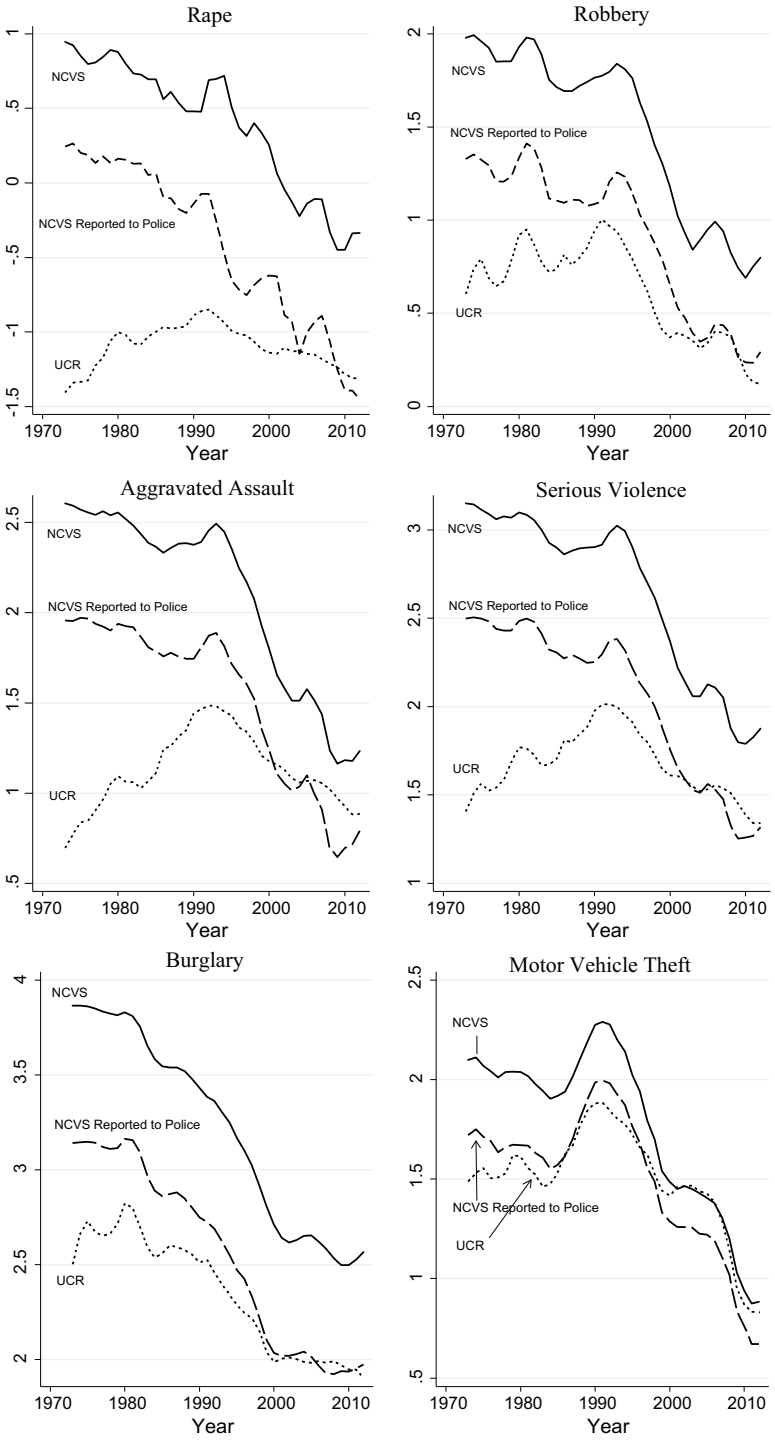
Figure 1 depicts the logged UCR and NCVS crime trends for 1973–2012 for each crime type. Compared to those shown most recently in Ansari and He (2012), these figures include the additional trends for NCVS-based rates of crimes reported to police, rape as well as the serious violence summary measure, and four extra years of data (2009–2012).

The figures show that the trends in UCR and NCVS violent crime differ in important ways, particularly during the 1970s and early to mid-1980s when the NCVS data suggest high and generally decreasing rates, while the UCR data suggest lower and increasing rates. As is evident in the figures, this is due in large part to the differences in the trends in rape and aggravated assault rates in the early period, and also to small differences in early trends in robbery rates. For the most part, beginning in the late 1980s, both UCR and NCVS data exhibit increases, followed by a general long-term decline with a brief increase around 2006.[7]

According to NCVS data, rape rates were highest in the early 1970s, at the start of the series, and generally declined until the late 1980s when, along with other forms of violence, they began to increase. In contrast, the UCR data suggest that rape trends were at their lowest in the 1970s and increased substantially during the early part of the series. Beginning in the late 1980s, both UCR and NCVS data for rape suggest downward trends,

[6] To minimize the effect of sampling error and make it easier to compare long-term trends, three-year moving averages are used for the NCVS trends. Figures and analyses based on unsmoothed NCVS rates exhibit no substantive differences from those based on the smoothed rates and are available upon request from the authors.

[7] The only trend to not exhibit an increase around 2006 was the UCR series for rape.


Rape
NCVS
NCVS Reported to Police
UCR
1
.5
0
-.5
-1
-1.5
1970
1980
1990
2000
2010
Year
Robbery
NCVS
NCVS Reported to Police
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Aggravated Assault
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Serious Violence
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NCVS Reported to Police
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3
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Burglary
NCVS
NCVS Reported to Police
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NCVS Reported to Police
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◀**Fig. 1** Logged NCVS and UCR crime rates, 1973–2012. NCVS crime rates are per 1000 persons ages 12 and older; UCR rates are per 1000 persons

although there are fairly large differences in levels across the two sources of data. It is evident from the figure that changes in victim reporting to the police do not account for the differences between the NCVS and UCR rape rates or their trends in the first half of the time series. This visual evidence suggests that changes in police recording of such incidents are likely to have played a prominent role in the divergent trends until approximately the late 1980s.

A similar story appears in the aggravated assault series, but much less so with robbery. According to the UCR data, aggravated assault rates were lowest during the early 1970s and increased markedly until the early 1990s, when they began to decline. The NCVS, by comparison, shows a generally decreasing trend in aggravated assault from the early 1970s until the mid-1980s, when the rates began to increase. In both the UCR and NCVS data, aggravated assault rates decline after the early 1990s. As was the case for rape, changes in victim reporting of aggravated assault to the police do not account for the differences between the NCVS and UCR rates or their trends prior to the late 1980s. Robbery trends are most similar across the two data series, though the UCR data suggest a small increase (with fluctuations) from 1973 to the early 1990s, while the NCVS data suggest a small decrease (with similar short-term fluctuations) during the same period.

When the three types of violence are combined into a summary measure of serious violent crime, the patterns in the UCR suggest a different trend from those found in the NCVS from 1973 to roughly 1988, even though a short-term increase appears in both series around 1980, and both exhibit a long-term decrease after the early 1990s. Differences in victim reporting of serious violence to the police do not account for the distinct NCVS and UCR trends for the period 1973 to the mid-1980s. A very important substantive contrast in these trends is that the UCR data suggest that serious violence was *lower* in the mid-1970s than it was in 2000 after the large crime decline of the 1990s, whereas the NCVS data show that violence was *much higher* throughout the 1970s and 1980s than in the years following the crime decline. Robbery was the only form of violence in the UCR data that was found to be higher in the mid-1970s than after the decline of the 1990s, while the NCVS data show that all three subtypes of violence were higher earlier rather than later in the series.

In contrast to the findings for serious violent crime, long-term trends in the property crimes of burglary and motor vehicle theft in the NCVS and UCR are quite similar throughout the series. NCVS rates of burglaries reported to the police are somewhat higher than those reported in the UCR in the earlier time periods, but the long- and short-term trends are similar. Motor vehicle theft rates (which have the highest rates of crime reporting by victims) also appear quite comparable in their long- and short-term trends throughout the entire period.

Table 1 presents correlation coefficients summarizing the relationships between the trend lines shown in Fig. 1. The first column of panel A reports the correlations between the UCR and NCVS trend for each type of crime, while panel B reports the correlations for the log-transformed trends. In addition to the correlations in levels shown in panels A and B, first-difference correlations are shown in panel C to reveal how year-to-year fluctuations in NCVS and UCR rates are associated across the data series. As expected based on the figures, the log-level correlations (panel B) for rape and aggravated assault UCR and NCVS trends are low and not significant ($r = .28$ and .21, respectively), while the correlations between UCR and NCVS rates of these crimes reported to the police are similarly

Table 1 Correlations between UCR and NCVS[a] crime trends by type of crime: U.S. 1973–2012

	UCR–NCVS Crime-specific	Homicide and	
		UCR	NCVS
A. Level correlations			
Serious violence	.49*(.47*)	.58*	.96*(.96*)
Rape	.19 (.11)	.42*	.92*(.89*)
Robbery	.86*(.86*)	.93*	.96*(.95*)
Aggravated assault	.16 (.16)	.23	.96*(.96*)
Burglary	.95*(.96*)	.92*	.87*(.88*)
Motor vehicle theft	.85*(.91*)	.74*	.96*(.93*)
B. Log-level correlations			
Serious violence	.58*(.57*)	.62*	.96*(.96*)
Rape	.28 (.24)	.41*	.93*(.92*)
Robbery	.91*(.91*)	.95*	.97*(.96*)
Aggravated assault	.21 (.20)	.21	.96*(.96*)
Burglary	.98*(.98*)	.94*	.93*(.92*)
Motor vehicle theft	.89*(.89*)	.78*	.97*(.94*)
C. First-difference correlations			
Serious violence	.47*(.49*)	.85*	.49*(.46*)
Rape	.23 (.13)	.65*	.18 (.10)
Robbery	.59*(.57*)	.87*	.51*(.46*)
Aggravated assault	.49*(.42*)	.70*	.45*(.36*)
Burglary	.61*(.71*)	.63*	.43*(.45*)
Motor vehicle theft	.74*(.76*)	.69*	.63*(.63*)

* $p \leq .05$, two-tail test

[a] Correlations based on NCVS total rates appear first, followed by NCVS reported to police rates in parentheses

low. The associations between UCR and NCVS robbery trends are much higher (r = .91, $p \leq .05$ for overall NCVS rates and for reported to police rates).[8] Trends in the summary measure of serious violence are significantly correlated with each other (r = .58, $p \leq .05$), and similar in magnitude (r = .57) when reporting to the police is taken into account. Though the long-term correlation is statistically significant, the figures clearly suggest that it is driven by greater agreement between the UCR and NCVS rape and aggravated assault trends beginning in the mid- to late-1980s. However, the moderate magnitude of this correlation suggests that analyses of trends in serious violence and their covariates are likely to be contingent on choice of data.

Like robbery, the UCR and NCVS burglary and motor vehicle theft log-level trends are strongly correlated with one another from 1973 to 2012 (r = .98 and .89, $p \leq .05$, respectively). These trends also show that rates of reporting these crimes to police do not alter the magnitude of these correlations. For these property crimes then, the relationships between their trends and potential covariates are likely to be described similarly regardless of whether UCR or NCVS data are chosen for the analysis.

The second and third columns of Table 1 help assess the validity of the UCR and NCVS serious violence trends by showing how they are correlated with homicide trends. With the exception of robbery, the violence trends based on NCVS data are much more highly

[8] Not surprisingly, these correlations are only somewhat different from those reported for 1973–2008 in Ansari and He (2012). For robbery and aggravated assault, their correlations are .83 and .02, respectively, and for burglary and motor vehicle theft they are .95 and .84.

correlated with homicide than the violence trends based on UCR data. In the case of rape, the log-level NCVS correlation with homicide is more than twice that of the UCR (r = .93 vs .41, $p \leq .05$), and there is even a greater difference in the correlation for aggravated assault (r = .96, $p \leq .05$, vs .21, ns). For robbery, the NCVS and UCR trends are equally correlated with homicide (r = .97 vs .95, $p \leq .05$). The relationship between the summary measure of serious violence and homicide is also notably stronger in the NCVS data

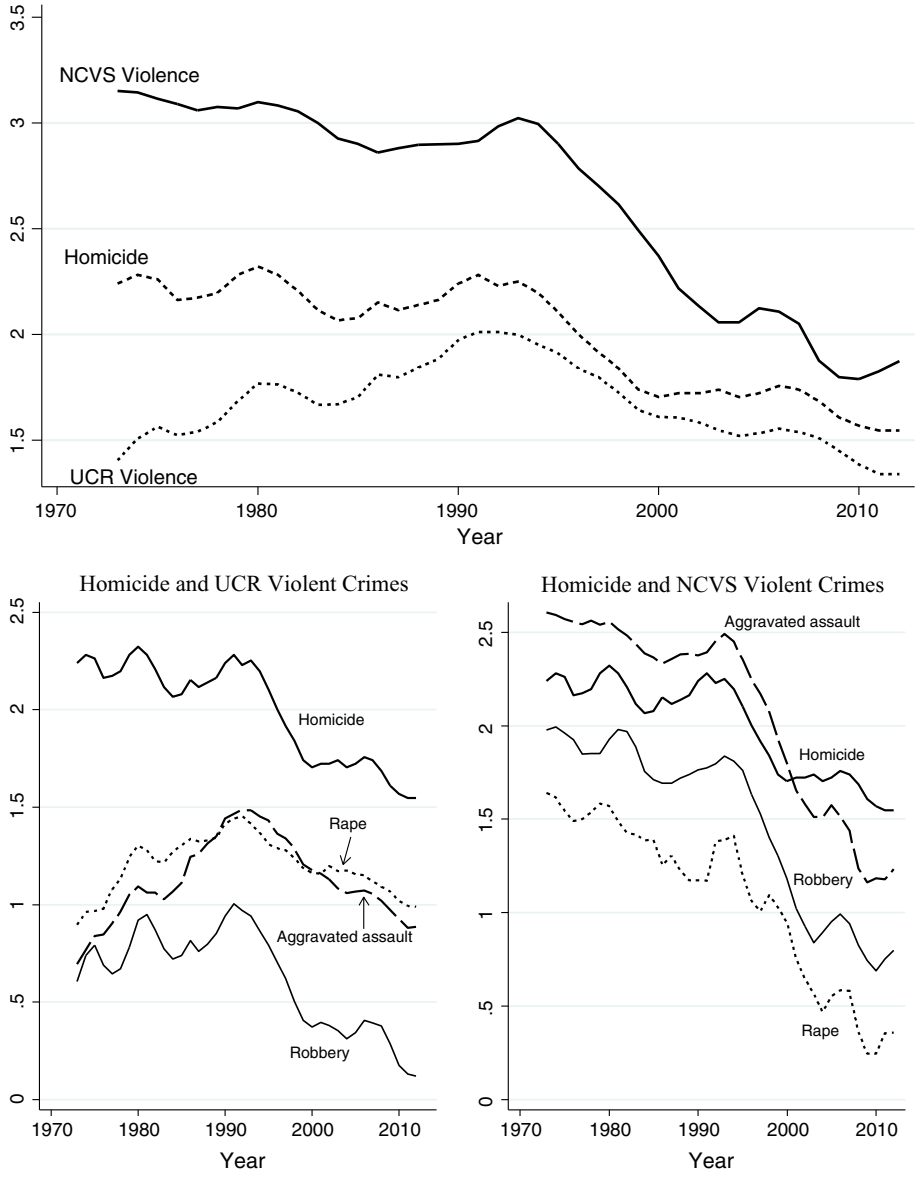

Fig. 2 Logged homicide and NCVS and UCR violent crime rates, 1973–2012. Logged homicide rates are per 100,000 persons. UCR and NCVS rape rates rescaled to improve visual trend comparisons

(r = .96 vs .62, $p \leq .05$). Both NCVS and UCR burglary trends are highly correlated with the homicide trends (r = .93 vs .94, $p \leq .05$), while the NCVS and UCR trends in motor vehicle theft trends also are generally consistent in magnitude (r = .97 vs .78, $p \leq .05$). In addition, when the NCVS trends based on victim reporting to the police are examined, they are similar in their associations with homicide trends.

Panel C (column 1) of Table 1 shows the pattern of associations expressed in terms of first-difference correlations which capture the degree to which year-to-year fluctuations are similar in the two data series once the long-term trend is taken into account. The first-difference correlations show a positive and significant relationship between the short-term fluctuations in the NCVS and UCR data across all crime types except rape, which because of its lower base rate exhibits the greatest year-to-year fluctuation in the NCVS. Short-term fluctuations in crime, therefore, often coincide in the two data series even during periods in which the two series are trending in different directions (e.g., in serious violence during the earlier part of the series).

This pattern is also found when the annual fluctuations in homicide are compared to crime-specific patterns in the UCR and NCVS (see columns 2 and 3 of panel C). Here, the first-difference correlations are larger between homicide and crime-specific UCR data than for NCVS data. As O'Brien (1996:200) argues, this is expected because homicide and UCR nonlethal crime data are derived from law enforcement records and therefore they share both method and trait variance, while the homicide and NCVS data share only trait variance (as both are measures of crime). O'Brien reports similar findings in his comparison of homicide and a summary measure of nonlethal violence in the UCR for the period 1973–1992 and argues that when high correlations exist in first-differences but are lesser in magnitude in levels, it suggests that the series are related to important variables associated with time—in this instance because police productivity and practices with respect to crime recording are believed to have changed over time.

Figure 2 shows the logged homicide trends alongside NCVS and UCR serious violence trends.[9] Here it is evident why the correlations between homicide and serious violence, rape, and aggravated assault are higher when NCVS data are used. NCVS data more closely follow the homicide trend from 1973 to about the mid-1980s than do the UCR data. Homicide data suggest that violence was higher during the period prior to the crime decline of the 1990s, while the UCR serious violence trends suggest generally continuous increases prior to the 1990s.

When specific types of violence in the UCR data are considered separately, the robbery and homicide data show similar trends in the earlier period; in the same time period, the rape and aggravated assault trends are similar to one another, yet distinct from homicide and robbery. Our comparative examination of the full set of NCVS and UCR violence trends suggests that the UCR rape and aggravated assault (and hence serious violence) trends are anomalous from 1973 to the mid-1980s. Thus, to the extent that trends in violence are expected to share common causes over time, the UCR data (with the exception of robbery), do not appear to be valid indicators of the long-term trends in nonlethal violent crime trends during the early part of this time series.

[9] To better see the crime-specific trend correspondence in these figures, the UCR rape rates are multiplied by 10 and the NCVS rape rates are multiplied by 2 prior to log transformation.

Covariates of National Trends by Choice of Data

To examine how UCR and NCVS trends in the level of crime are associated with several covariates, we focus our attention on violent crimes because these crime types show greater discrepancies in the long-term trends than do the property crimes of burglary and motor vehicle theft (see Table 2). We also limit our next set of comparisons to the time period during the first 30 years of the series (1973–2002) because this period has been the focus of prior research and it includes the part of the series that exhibits the most inconsistencies in the long-term trends.[10] Table 2 displays the log-level correlations between the six factors noted earlier; levels of gasoline lead exposure, unemployment, young adult disengagement, consumer pessimism, inflation and incarceration rates.

Column 1 of Table 2 shows the relationships between the lagged measure of gasoline lead exposure and its associations with the various measures of violence. These values suggest, consistent with Nevin (2000) and Reyes (2007a, b), that there is a strong relationship between the level of serious violence as measured in the UCR and a lagged measure of lead exposure (.85, $p \leq .05$), and that each UCR crime-specific measure of nonlethal violence is significantly and positively correlated with lead exposure. However, the findings also indicate that no similar significant relationship is found between lead exposure and homicide (.11, ns) or between lead exposure and any of the NCVS violence measures.

In contrast, the trends in unemployment, young adult disengagement, consumer pessimism, inflation and incarceration exhibit distinctly different relationships with homicide, and UCR and NCVS violence trends. Consistent with prior research (in either temporal or cross-sectional models), homicide rates are found to be higher when rates of unemployment ($r = .60$, $p \leq .05$), young adult disengagement ($r = .52$, $p \leq .05$), consumer pessimism ($r = .79$, $p \leq .05$) and inflation ($r = .69$, $p \leq .05$) are higher, and higher rates of incarceration are negatively correlated with homicide in the following year ($r = -.71$, $p \leq .05$). When trends in the NCVS measures of serious violence are compared to these factors, the correlations are consistent with those found for homicide. For example, correlations between the NCVS measure of serious violence (as well as each of the crime-specific measures) and these covariates suggest that serious nonlethal violence rates also are greater during periods of higher unemployment ($r = .59$, $p \leq .05$), young adult disengagement ($r = .62$, $p < .05$), consumer pessimism ($r = .64$, $p < .05$), and higher rates of inflation ($r = .68$, $p \leq .05$). In addition, the correlation with the lagged incarceration rate is similar to that found for homicide ($r = -.79$, $p \leq .05$).

Aside from homicide, only UCR robbery rates show similar positive and significant relationships with unemployment ($r = .62$, $p \leq .05$), consumer pessimism ($r = .61$, $p \leq .05$), and inflation ($r = .40$, $p \leq .05$). Moreover, the UCR summary violence measure and UCR rape and aggravated assault data would suggest that these crime types are significantly *lower* when levels of young adult disengagement from social institutions is higher ($r = -.61$, $-.61$, and $-.84$, $p \leq .05$, respectively), and that incarceration is associated with significant subsequent *increases* in these crimes.

[10] We also note that recent crime trends research suggests that the relationships between factors such as consumer pessimism and violence appear to change beginning in the early 2000s (e.g., Lauritsen and Heimer 2010). Existing research has not yet accounted for such changes, but these changing relationships suggest that other factors associated with the more recent period may be moderating these relationships (e.g., perhaps through improvements in policing, other macro-social changes, or a combination of such factors).

Table 2 Log-level correlations between violent crime trends and selected covariates by type of crime and data source: U.S. 1973–2002

	Gasoline lead[a]	Unemployment	Young adult disengagement	Consumer pessimism	Inflation	Incarceration[b]
Homicide	.11	.60*	.52*	.79*	.69*	−.71*
UCR						
Serious violence	.85*	.08	−.61*	−.03	−.29	.48*
Rape	.74*	.07	−.61*	−.13	−.36*	.53*
Robbery	.41*	.62*	.18	.61*	.40*	−.35
Aggravated assault	.85*	−.21	−.84*	−.34	−.57*	.77*
NCVS						
Serious violence	.00	.59*	.62*	.64*	.68*	−.79*
Rape	−.21	.55*	.75*	.63*	.74*	−.87*
Robbery	.00	.62*	.62*	.65*	.68*	−.77*
Aggravated assault	.03	.57*	.57*	.63*	.67*	−.78*

* $p \leq .05$, two-tail test

[a] Gasoline lead measure is lagged 23 years

[b] Incarceration measure is lagged 1 year

Thus, the relationships between UCR measured nonlethal violence and each of these socioeconomic factors and incarceration rates are quite different—either not significant, or significant and in the *opposite direction* than expected based on theory and prior research. In addition, the relationships between the covariates and the crime-specific UCR measures are found to vary depending on type of violence, as our earlier findings suggested. Only the UCR measure of robbery exhibits trend correlations that are often consistent in direction with the trend correlations for homicide and NCVS violence. Moreover, across this set of covariates, gasoline lead exposure is the only measure that is positively associated with the UCR nonlethal violent crime trends and unrelated to homicide trends.

The trends in UCR and NCVS serious violence, homicide, and lead exposure are displayed in Fig. 3 for 1973–2002, the period similar to that used by Reyes (2007a, b) and Nevin (2000).[11] We include this figure to visually illustrate the points above. Specifically, the patterns in Fig. 3 show clearly how associations between crime and lead exposure are conditional on the choice of crime data. This figure shows the fairly tight coupling between the trend in UCR serious violence and lagged levels of lead in gasoline during this period. Indeed, the UCR measure of violence increased rather continuously between the early 1970s and early 1990s, corresponding with increases in lead in gasoline 23 years prior. In conjunction with individual-level research showing the negative health effects of childhood lead exposure, this apparently similar trend is what prompted the hypothesis that

[11] For purposes of display, the logged lead estimate used in this figure is multiplied by 5.25 to better illustrate its similarities to the UCR serious violent crime measure.

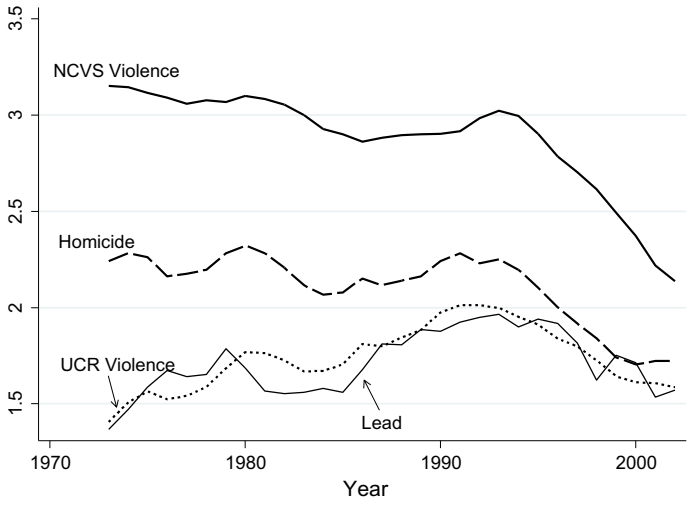

Fig. 3 Logged rates of gasoline lead exposure, homicide, and NCVS and UCR serious violence, 1973–2002. *Note* gasoline lead measure is lagged 23 years and rescaled to improve visual trend comparisons

changes in childhood lead exposure are associated with violence trends roughly 20 years later when those cohorts of children become young adults.

Yet Fig. 3 also shows that serious violence as measured by the NCVS and the SHR homicide data was not much higher in the early 1990s than it had been at several points during the 1970s and 1980s. The findings we present here suggest that the increasing serious violence trend in the UCR data in the 1970s and early 1980s is a less valid indicator of the trend in violence than are homicide and NCVS violence trends because the UCR measure is dominated by the types of violence that are particularly problematic in police data in the 1970s and 1980s. While Reyes (2007a, b) and others investigating the lead trend hypothesis (such as Nevin, discussed in Drum 2013) offer extensive sensitivity and diagnostic analyses of the validity of the lead measures, these papers do not question the validity of the UCR data for studying long-term trends. Our analysis reveals the problems inherent in such an approach.

Our final illustration of how choice of data affects findings about the covariates of crime trends displays split-series correlations between the UCR and NCVS summary serious violence measures (see Table 3). It also shows the correlations between three of the covariates (gasoline lead exposure, inflation and incarceration rates) and the UCR and NCVS serious violence measures and homicide, using twenty-one, rolling 20-year time periods to reveal how the selection of the time period under investigation can influence correlations in a way that is not apparent in an overall single-period correlation. As suggested by our earlier figures, the association between the NCVS and UCR serious violence summary measures is *negative* in the early periods and strong in magnitude and *positive* in the later years. For example, from 1973 to 1992, the correlation between the NCVS and UCR nonlethal violence measures is negative ($r = -.71$, $p \leq .05$), and this relationship continues to be negative until the 1979–1998 period, when the correlation becomes zero. Starting with the periods beginning in the mid-1980s, the correlation between the NCVS and UCR summary violence measure is positive and >.80, thus

Table 3 Split-series log-level correlations between UCR and NCVS serious violent crime trends, homicide and three covariates

Period	Serious violence NCVS–UCR	Gasoline lead[a]			Inflation			Incarceration[b]		
		UCR	NCVS	Homicide	UCR	NCVS	Homicide	UCR	NCVS	Homicide
1973–1992	−.71	.84	−.59	.06	−.42	.78	.71	.93	−.86	−.27
1974–1993	−.60	.82	−.45	.18	−.49	.77	.64	.94	−.75	−.15
1975–1994	−.52	.81	−.35	.30	−.47	.71	.58	.92	−.65	−.06
1976–1995	−.48	.80	−.34	.26	−.44	.70	.58	.90	−.63	−.09
1977–1996	−.39	.82	−.39	.09	−.45	.70	.60	.84	−.66	−.29
1978–1997	−.25	.83	−.34	.03	−.41	.70	.63	.74	−.69	−.45
1979–1998	.01	.86	−.11	.17	−.25	.72	.68	.57	−.70	−.55
1980–1999	.29	.85	−.08	.15	−.05	.66	.65	.34	−.71	−.59
1981–2000	.49	.81	.02	.21	.03	.50	.53	.16	−.70	−.60
1982–2001	.61	.85	.31	.42	.15	.40	.48	.02	−.68	−.61
1983–2002	.72	.87	.51	.58	.36	.49	.54	−.14	−.68	−.64
1984–2003	.83	.85	.74	.67	.41	.50	.56	−.32	−.68	−.68
1985–2004	.91	.85	.83	.71	.47	.46	.55	−.50	−.71	−.74
1986–2005	.95	.86	.88	.75	.43	.38	.49	−.64	−.74	−.80
1987–2006	.96	.83	.88	.73	.43	.41	.55	−.72	−.77	−.83
1988–2007	.97	.83	.87	.72	.42	.38	.54	−.81	−.81	−.88
1989–2008	.97	.79	.87	.69	.33	.24	.44	−.88	−.83	−.92
1990–2009	.97	.78	.86	.69	.40	.40	.42	−.94	−.86	−.96
1991–2010	.98	.80	.86	.71	.36	.37	.38	−.95	−.89	−.97
1992–2011	.98	.83	.85	.74	.24	.28	.26	−.94	−.91	−.96
1993–2012	.97	.83	.85	.75	.22	.26	.24	−.93	−.92	−.96

[a] Gasoline lead measure is lagged 23 years

[b] Incarceration measure is lagged 1 year

suggesting convergence in these measures over time and a stable correspondence in violence trends beginning after the mid-1980s (see column 1, Table 3).

Not surprisingly then, Table 3 also shows that the relationships between trends in the covariates and violence vary according to period of investigation. For example, the log-level correlation between trends in gasoline lead exposure and NCVS violence from 1973 to 2002 is .00 (see Table 2), but here we see that from 1973 to 1992 the coefficient is −.59, and that in the 1993–2012 period, the coefficient is .85. A similar irregular pattern of null and then positive correlation is found between lead exposure and homicide. In contrast, the associations between lead exposure and UCR violence for these same periods are fairly consistent over time (.84 in 1973–1992, and .83 in 1993–2012) because the lagged measure of gasoline lead exposure increased and then declined in a manner similar to the pattern in the UCR violence summary measure.

In the second covariate example, inflation rates show consistently positive correlations with homicide and NCVS violence, though both of these associations diminish in strength over time. In contrast, the correlations between inflation and the UCR violence measure are mixed over time; negative in the earlier periods, and becoming positive, though somewhat weaker in magnitude in later periods.

Incarceration rates are used for the third example and here we also find that the pattern in the correlations based on the UCR serious violence measure stands in contrast to the patterns based on homicide data and the NCVS measure of serious violence during the earlier periods. The UCR data would suggest that increases in incarceration were associated with subsequent *increases* in nonlethal violence, while the NCVS data would suggest a negative relationship between the two. The homicide data suggest that incarceration rates had little association with homicide during the early period. Because the three measures of violence exhibit consistent trends during the later periods, it is not surprising that their correlations with incarceration (or the other covariates) become more consistent over rolling time periods.

Discussion

This research revisits the issue of divergence in long-term trends in UCR and NCVS crime data to show when the choice of data matters for analyzing and understanding crime trends, and which data source may be more valid for the 1973–2012 period. Prior research on divergences in NCVS and UCR crime trends has focused on specific types of crime for certain periods, but has not compared a full set of crimes simultaneously alongside comparisons with trends in serious nonfatal violence, homicide and hypothesized covariates. Though prior research has noted the lack of correspondence in NCVS and UCR rape and aggravated assault trends during the 1970s, analyses of the factors associated with serious violence trends often rely on only one data source (most often the UCR) and operate under the assumption that the data chosen are a valid indicator of the trend across all time periods.

For purposes of studying 1973–2012 national trends in robbery, burglary, and motor vehicle theft, our findings replicate those from past research and show that the choice of NCVS or UCR data is unlikely to affect conclusions about the factors associated with these long-term trends. However, with the exception of robbery, the UCR and NCVS data produce trends in serious nonfatal violence that stand in direct contrast to each other prior to the mid-1980s. While the UCR data suggest that serious violence was *lower* in the mid-

1970s than it was after the crime decline of the 1990s, the NCVS data indicate that the level of serious nonfatal violence was much higher throughout the 1970s and 1980s than in the years following the crime decline. Such large discrepancies in trends should not be ignored by analysts.

Researchers studying crime trends and their covariates must make a critical and informed judgment as to which data source represents a more valid indicator of those trends, and we argue that the multipronged approach used here provides a good basis for doing so. Existing evidence suggests that the increases in UCR trends in rape and aggravated assault (and hence serious violence) during the 1970s and early 1980s primarily reflect changes in police practices of handling and recording such crimes.[12] We show here that even with consideration of victim reporting to the police, the NCVS trends in rape, aggravated assault and the summary measure of serious violence correspond much more closely to homicide trends during the early and later part of the time series than do the UCR trends in these crimes.

We also show that for purposes of analyzing the covariates of trends in serious violence, the choice of data matters. Though these illustrations were not intended to resolve specific empirical questions about the *independent* influence of any specific factor on violence trends, they nonetheless indicate that only one of these factors—gasoline lead exposure—is significantly related solely to UCR nonfatal violence trends for this period and unrelated to NCVS and homicide trends. In contrast, each of the other factors (socioeconomic and incarceration rates) is consistently correlated with homicide and NCVS violence trends in their hypothesized ways. And with the exception of robbery, none of the socioeconomic factors or the incarceration rates is associated with the UCR violent crime measures in ways that are consistent with prior research and theory. These inconsistencies provide further evidence to suggest that the UCR serious violence trends are problematic when they include the 1970s to mid-1980s period, as well as evidence to indicate that the relationship between gasoline lead exposure and serious violence is likely artifactual.

Our example based on the lead exposure hypothesis found that trends in lead exposure were associated only with UCR nonlethal violence rates, and not with NCVS violence rates or homicide rates. Support for the lead exposure hypothesis appears to be driven by the early UCR trends in aggravated assault and rape which importantly, appear to be affected by changes in police recording practices over time. Because lead exposure was found *not* to be associated with homicide or with property crime trends in previous analyses (see, e.g., Reyes 2007a, b), our findings challenge support for the claims that reductions in childhood lead exposure are responsible for more than half of the decline in violence in the U.S.[13] To be sure, these results do not speak directly to cross-national data that may show similar patterns, but a convincing analysis of how trends in lead exposure, or trends in any other covariate are associated with crime in other countries or (subnational) places must also demonstrate that the findings elsewhere are robust across crime data recording systems. Though our findings reveal little about how children's lead exposure may affect their own involvement in crime years later, our national-level evidence challenges some of the key foundations on which these claims have been based (e.g., Nevin 2000; Drum 2013). In a more extensive set of analyses of this issue, McCall and Land (2004) also have

[12] It is also the case that both aggravated assault and rape are crimes that are much more likely to be committed by non-strangers and to involve women as victims—incidents that in the past were more often considered to be private affairs and not conform to stereotypical views of crime.

[13] Reyes (2007a:2) claims that "…between 1992 and 2002, the phase-out of lead from gasoline was responsible for approximately a 56 % decline in violent crime.".

challenged the lead hypothesis by conducting age-period-cohort analyses of homicide data. McCall and Land found that trends in homicide were not significantly influenced by cohort levels of lead exposure.

It would be hard to accept a claim that the UCR serious violence data are more valid indicators of violence trends than homicide data, which have been externally validated against medical examiner records, or than NCVS violence trends which are not filtered by victim-reporting or police-recording processes. Supporters of such a claim would need to show what historical or period factors are likely to have accounted for the similar trends in both the homicide records and in the NCVS survey results during the early as well as the later time periods. We therefore conclude that for purposes of studying long-term trends in serious violent crime in the U.S. since the 1970s, the weight of the evidence indicates that the NCVS violence data and homicide data are likely to produce more valid findings than the UCR nonfatal violence data.

Finally, as noted earlier, most analyses of crime trends rely on data from the UCR and the SHR because they are available at the subnational level and increase the analytic possibilities for longitudinal analyses of crime with relatively short time series. Of course, national crime trends represent the summation of trends in subnational areas and our national findings suggest that subnational UCR violence data in many places such as states and cities also are likely to be problematic in their depiction of trends during the 1970s and 1980s. It may be the case that some subnational areas, such as some large urban areas, have UCR nonlethal violence data that are consistent in their trends with NCVS data (see, e.g., Berg and Lauritsen 2015) and with homicide data. This is an important area of future research but also challenging because the NCVS data are currently only publically available for the forty largest metropolitan areas for the period 1979 through 2004, thus missing most of the 1970s when the discrepancies in the trends are most problematic. Additional research that includes the development of the necessary data infrastructure would be necessary to assess the validity of subnational UCR trends in nonfatal violence. This will help ensure that substantive conclusions based on these types of trend analyses are warranted. Until local variations in police-based UCR data are better understood, we urge caution in the use of subnational UCR violent crime trends in panel models for crimes other than robbery and homicide.

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