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The Future of Crime in Chicago and the Impact of Reducing the Prison Population on Crime Rates

Richard Rosenfeld
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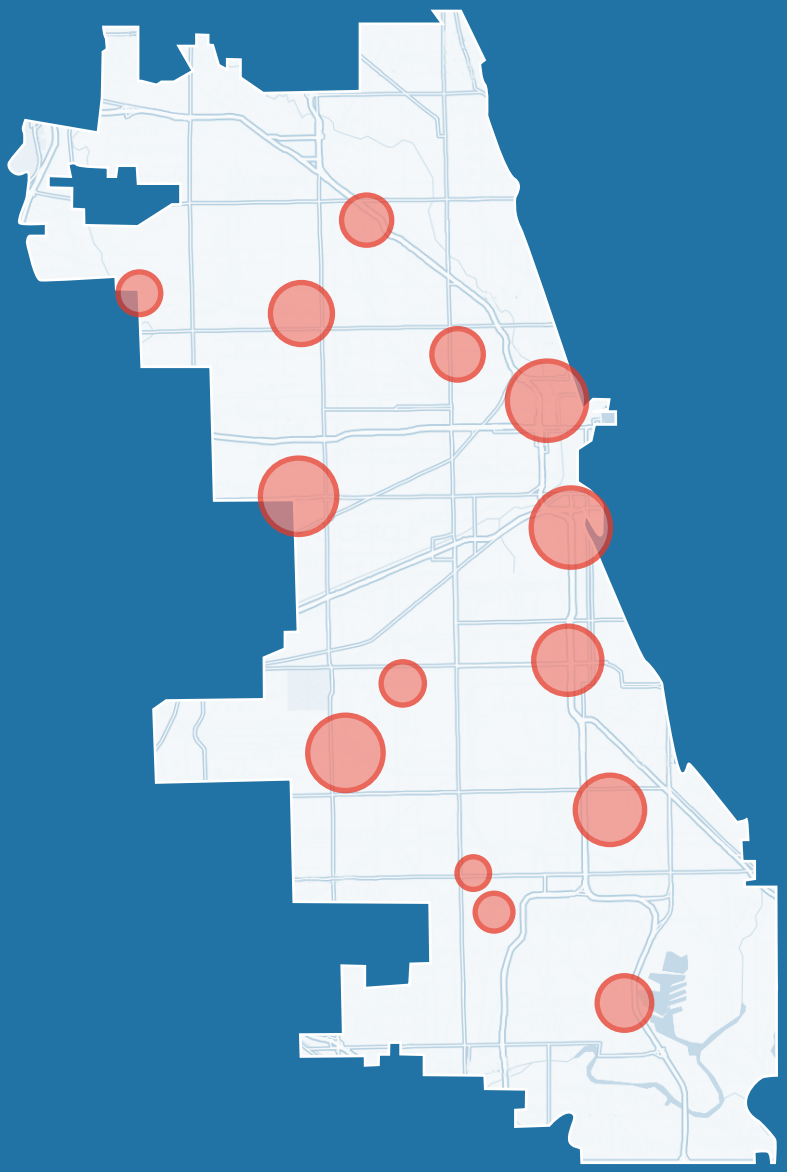

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Summary

Policymakers have a strong interest in knowing whether crime rates are likely to increase or decline over the near term, the typical planning horizon for crime-control policies. Knowledge to guide policymaking is especially relevant at the state and local level, where crime policy is most often enacted in the United States. Our assessment of crime trends in Chicago, based on a parsimonious and robust forecasting model, suggests that the violent crime rate will increase in 2021 and 2022 and then begin to decline, while the property crime rate will gradually decrease through 2025. Our analysis suggests that policymakers could pursue a sizable reduction in the state prison population without producing notable increases in crime. We conclude with recommendations for the optimal implementation of such a reduction in imprisonment: it should proceed in a measured way over a number of years and be counterbalanced by enhanced community-based monitoring and support.

Introduction

Major changes in America's crime rates have occurred since the 1960s. After several decades of relative stability, a significant, unanticipated uptick in crime began in the mid-1960s, reaching historic peaks in the early 1980s and then again in the early 1990s. Between 1960 and 1991, crime rates more than tripled. Just as unexpectedly, crime then started what became a long and steady decline, eventually returning to mid-1960s levels. Crime trends in Chicago have followed these national trends.

This historical volatility means policymakers are uncertain whether crime rates will continue their current long-term decline, stabilize, or begin once again to increase. The ability to forecast near-term changes would be immensely useful to those responsible for choosing among crime policy options. While a reasonable body of research has identified factors associated with past crime rates (e.g., Rosenfeld 2011; Rosenfeld and Levin 2016), little attention has been paid to projecting future crime rates.

With funding from The Harry Frank Guggenheim Foundation (HFG), we developed a model for predicting crime rates based on factors that were associated with the rapid increase and subsequent decline in US crime rates from 1960 to 2021, with forecasts to 2025.[1] While a national-level overview is useful, it is simply the weighted average of the conditions that influence crime rates and the decisions reflected in crime-control policies in smaller jurisdictions, which may vary widely. State and local studies are needed to analyze the conditions and policies that affect local crime trends.

The current study examines the effects of a small set of factors on violent crime and property crime rates in Chicago.[2] We found that a statistical model based on the state imprisonment rate and a measure of the cost of living (inflation divided by median household income) explained past variation in crime rates with minimal error. Different models were not needed to explain the year-to-year variation in violent and property crime: the results are robust not only within crime types, but also between them.

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1 James Austin and Richard Rosenfeld, 2023. ***Forecasting US Crime Rates and the Impact of Reductions in Imprisonment: 1960–2025***. New York, NY: The Harry Frank Guggenheim Foundation.

2 The violent crime rate is the sum of the homicide, aggravated assault, rape, and robbery rates. The property crime rate is the sum of the burglary, larceny, and motor vehicle theft rates.

We then used the model to forecast crime rates through 2025. We also conducted a hypothetical policy experiment to estimate the impact on the forecasted crime rates of a sizable reduction in the Illinois state prison population. We found negligible effects on Chicago crime rates of decreasing the incarceration rate.

Modeling Crime Rates

A statistical model that would guide policymaking must meet two requirements: (1) it must include factors that not only explain the outcome but also are modifiable by policy, and (2) it must be accurate. Our forecasting model of Chicago crime rates stands up well against both of these criteria. It incorporates policy variables with robust effects on violent and property crime rates, and it produces estimates that are generally very close to the observed values of the crime rates.

With just sixty annual observations, the effects of a large number of variables cannot be reliably estimated in a forecasting model. With a longer time series, we could have included in our model several additional variables known to affect crime trends. These include the age composition of the population, lagged and contemporaneous birth rates, numerous economic indicators, such as poverty and economic growth rates, and several criminal justice indicators. We experimented with a large number of models containing a varying mix of demographic, socioeconomic, and criminal justice variables before settling on a model that contains only the past year's imprisonment rate and the current year's inflation rate, adjusted by median household income. Prior research has shown that each of these variables is associated with changes in crime rates over time, and the logic for including them in our model is fairly straightforward. Increases in the imprisonment rate are expected to reduce crime on the assumption that punishment incapacitates offenders and deters criminal behavior. The magnitude of the effect of imprisonment on crime varies widely across studies, however, and some studies indicate that it weakens at high levels of imprisonment (National Research Council 2014).

Prior research indicates that inflation has strong and consistent effects on crime committed for monetary gain: as retail prices increase, so does the demand for cheaper stolen goods (Rosenfeld and Levin 2016). Inflation is also expected to contribute to both violent and property crime by reducing confidence in government and other institutions (LaFree 1999). Crime rates, especially the property rate, should vary with purchasing power, which is the rationale for adjusting the inflation rate by median income (inflation/median household income). The imprisonment rate and income-adjusted inflation rate are incorporated in the multivariate forecasting models described below.

The Near Future of Crime in Chicago

Forecasting the future of crime is always risky because such predictions are based on crime-related factors whose future values are unknown. Projecting changes in crime rates, even in the near term, is especially difficult in the current period. The social response to the COVID-19 pandemic and the widespread unrest surrounding violent police actions influenced crime rates in ways that were difficult to foresee (Rosenfeld, Boxerman, and Lopez 2023). If the study of crime trends is to have policy relevance, however, it will come mainly from forecasting. Policymakers have an interest in past crime rates mainly insofar as they portend future rates. The planning horizon for criminal justice policy rarely extends beyond a few years, and forecasting models should be calibrated accordingly.

Forecasting models will always contain error. They may be *inaccurate* (the crime rate falls outside the forecast range) or *imprecise* (the crime rate is within the forecast range, but the range is so broad it has little practical utility). Useful and reliable forecasting always involves a tradeoff between precision and accuracy.

Finally, crime forecasting is the most exacting way to test hypotheses about changes in crime rates. To avoid overfitting the data used to develop it, an empirical model should always be evaluated with "out-of-sample" observations. The typical way of testing a statistical model of the change over time in crime rates is to determine how it fits the data used to generate the model—in other words, data on *past* crime rates. This is a necessary but not sufficient method of theory testing. An adequate test will assess how well the model predicts values that were not used in its construction. This test does not require waiting until the future arrives. It simply requires reserving some data from the sample used to generate the model and measuring how well the model predicts these out-of-sample observations. We perform such a validation exercise in forecasts of Chicago's violent and property crime rates through 2025.

Forecasting Method

We derive our forecasts of Chicago crime rates from sample data spanning the period 1960 to 2010. Two out-of-sample forecast periods are examined. The first is the period between 2011 and 2020. This ten-year out-of-sample period, for which the violent and property crime rates are known, is used to validate the forecasts derived from a model based on the 1960–2010 data. We chose a ten-year validation period to minimize "continuity bias" (i.e., the disproportionate influence of very recent values of the crime rates) in our forecasts. The violent and property crime rates for 2021 to 2025 are then forecasted. Although the start of this period precedes the time of publication, the crime rates for these years are not yet known. The forecasting exercise is summarized in the text, and technical details can be found in the Appendix.

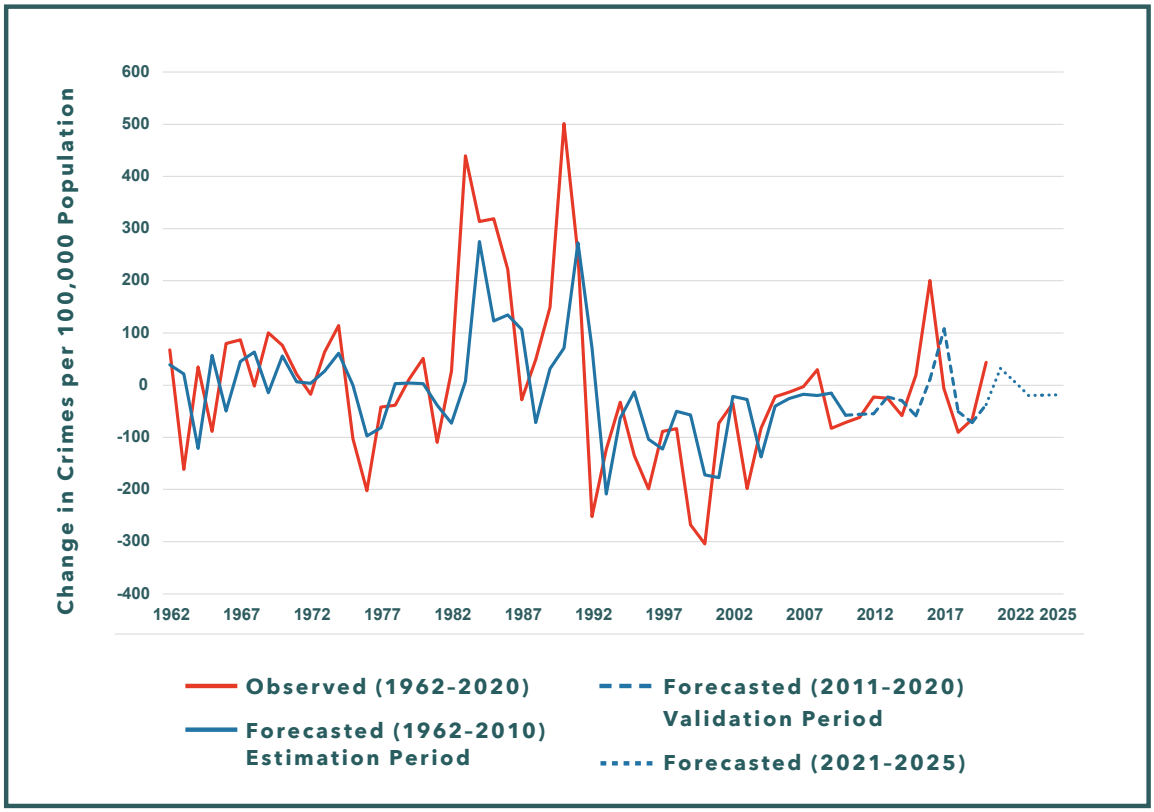
A first step in forecasting the values of a time series is to evaluate the series for "stationarity." A stationary series is one in which the mean and variance of the series are constant or nearly so over time. Forecasts of a stationary time series are more reliable than those of a nonstationary series. Statistical tests showed that Chicago's property crime rate between 1960 and 2010 is stationary but that the violent crime rate is nonstationary.

A common approach to transforming a nonstationary time series to a stationary series is to first-difference the series. First-differencing transforms a series measured in levels (in this case, crime rates) to one in which each data point is the difference between the variable's current and previous level (i.e., Yt-Yt-1). Second- and higher-order-differencing can be applied if first-differencing does not produce stationarity. First-differencing was sufficient to produce stationarity in the violent crime series and, as mentioned, was not necessary for the property crime rate (see Appendix).

Autoregressive integrated moving average (ARIMA) models were used to forecast the first-differenced violent and property crime rates. ARIMA models are commonly used in forecasting because they offer a thorough assessment of the key properties of a time series. A parsimonious multivariate ARIMA model was created that contains the two variables with the most robust effects on crime rates in the Rosenfeld and Levin (2016) study: the inflation rate (adjusted

by median household income) and the imprisonment rate.[3] The imprisonment rate is lagged one year behind the crime rate. Lagging the imprisonment rate helps to mitigate, but does not fully eliminate, the estimation error associated with the "endogeneity" of imprisonment, i.e., the fact that the imprisonment rate is, in part, a function of the crime rate, so that this year's imprisonment rate may be partially caused by this year's crime rate. Lagging the imprisonment rate removes some of this reverse causality.

FIGURE 1. OBSERVED AND FORECASTED YEAR-OVER-YEAR CHANGE IN CHICAGO VIOLENT CRIME RATE, 1962-2025



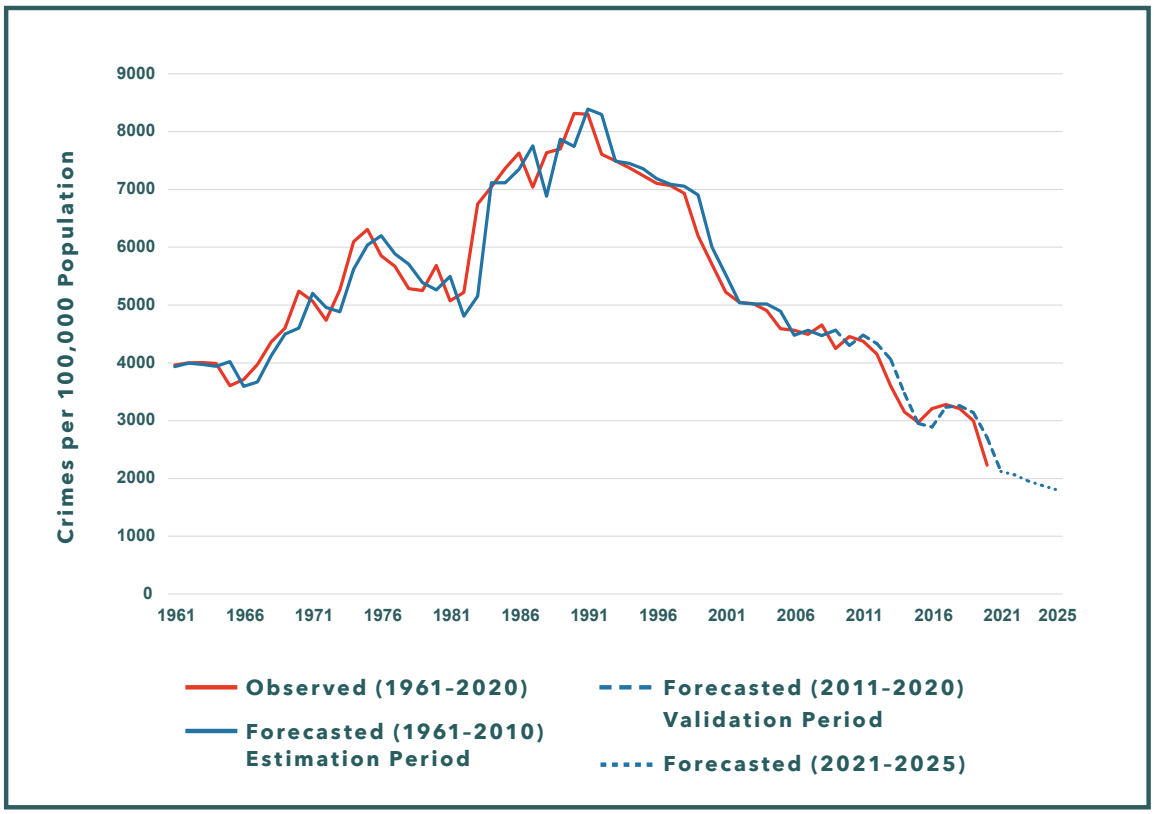
Source: FBI's Uniform Crime Reports.

3 The inflation data are from the Bureau of Labor Statistics (https://www.bls.gov), and the imprisonment data are from the Bureau of Justice Statistics (https://bjs.ojp.gov). The inflation rates for 2023 to 2025 and the income and imprisonment rates for 2022 to 2025 were unknown at the time of this writing. The 2023–2025 inflation rates were assumed to be equal to national inflation forecasts from the Congressional Budget Office (https://www.cbo.gov/data/budget-economic-data#4). The forecasted 2022–2025 income and imprisonment values are based on the average yearly rate of change in these measures between 2017 and 2021 (2.7% and -5.4%, respectively). For example, the median household income forecast for 2022 is assumed to be 2.7% greater than median household income in 2021, the forecast for 2023 is 2.7% greater than the 2022 forecast, and so on.

The forecast models were fit to the first-differenced violent crime rate and to the property crime rates between 1960 and 2010. The years 2011 to 2020 were "held back" from the models so they could be used to validate the forecasts from the 1960–2010 baseline period. The closer the forecasted crime rates are to the observed rates during the validation period, the greater our confidence in the forecasts for 2021 to 2025, when the crime rates are unknown. The forecast results are presented in Figures 1 and 2.

Figure 1 displays the observed and forecasted annual changes in the violent crime rate. The observed changes, denoted by the red line, extend from 1962 (See Appendix) to 2020. The in-sample forecasted changes through 2010 are denoted by the solid blue line, and the dashed blue line represents the forecasted changes during the 2011–2020 out-of-sample validation period. The dotted blue line represents the forecasted changes in the violent crime rate between 2021 and 2025.

FIGURE 2. OBSERVED AND FORECASTED CHICAGO PROPERTY CRIME RATE, 1961-2025



Source: FBI's Uniform Crime Reports.

The forecasted yearly changes in violent crime correspond closely to the observed changes during the 2011–2020 validation period, with a single exception: the difference between the observed and forecasted change in violent crime in 2016 (discussed below). The results suggest that Chicago's violent crime rate will increase in 2021 and 2022 and then fall through 2025. The observed and forecasted property crime rates, shown in Figure 2, are also very similar. The results suggest that the property crime rate will decrease through 2025.

Forecasts of an unknowable future will always contain error. This means that the policymaker will have to decide how much forecast error is tolerable, which is a substantive and not a statistical decision. We will assume for current purposes that forecasted crime rates that diverge from the observed rates by no more than 10% are sufficiently accurate and precise for both policy and theory evaluation. A forecasted annual rate that fell outside of these limits would be uninformative and suggest that the forecast model needed to be revised.

Appendix Table A displays the observed and forecasted crime rates during the validation period. Averaged over the ten years of the validation period, the forecast error for violent crime—the difference between the observed and forecasted rates in either direction—is within the 10% tolerance limits. The mean absolute error during the validation period is 5.7%. There is an exception in 2016, when the forecast error is -17.2%, although the 10.5% error in 2017 falls just outside the acceptable range, and the forecast for that year should be viewed with caution. The error rate in 2016 would be viewed as unacceptably large. The observed violent crime rate rose by 22.2% between 2015 and 2016, from 905 to 1106 violent crimes per 100,000 population. By contrast, the forecasted rate increased by 10.8% from the forecasted rate in 2015 and by 1.2% from the observed rate that year.

An unanticipated 22% rise in the violent crime rate would have caught policymakers and law enforcement officials off guard had they relied for planning purposes on a crime forecasting model such as the one used here. The increase in Chicago's violent crime rate could well have resulted from the killing of Michael Brown by a Ferguson, Missouri, police officer in late 2014 and ensuing protest demonstrations around the country. These circumstances reduced nationwide trust in the police.[4] When police legitimacy declines, acceptance of private violence to settle disputes grows (Tyler, Goff, and MacCoun 2015). Such unexpected "exogenous shocks" to crime rates would be difficult for any forecast model to capture.

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4 https://news.gallup.com/poll/183704/confidence-police-lowest-years.aspx

The average forecast error for property crime during the 2011–2020 validation period is 7%, but the error exceeds the 10% acceptable range in 2013 and 2020 with errors of 12.9% and 21.2%, respectively. A 10.1% error in 2014 suggests that caution should be exercised in viewing the property crime forecast for that year. The other two errors warrant concern, especially the 21% difference between the observed and forecasted property crime rates in 2020. Chicago's observed property crime rate dropped by 25.5% between 2019 and 2020, whereas the forecasted rate decreased by 13.9% from the 2019 forecasted rate and by 9.7% from the 2019 observed rate. With the exception of motor vehicle theft, property crime rates fell in cities across the country at the height of the pandemic in 2020 (Rosenfeld, Boxerman, and Lopez 2023). The reasons are clear enough. There is little or no shoplifting when the shops are closed. Residential burglaries decrease when residents are quarantined at home because burglars tend to avoid occupied households. Here again, an unanticipated exogenous shock, this time a major disease outbreak, could have thrown off our forecast.

In summary, our models forecast a small rise in Chicago's violent crime rate in 2021 and 2022, followed by a decline over the next three years, and a decrease in the property crime rate over the entire 2021–2025 period. With the exceptions we have noted, the generally small forecast errors during the validation period inspire confidence in the violent and property crime forecasts for 2021 to 2025.

We cannot be certain, of course, that our forecasts will be sufficiently accurate and precise to serve as reliable policy guides, and policymakers may choose to set more restrictive tolerance limits around the forecast errors than the illustrative 10% limits we have used. Our results suggest, however, that Chicago is unlikely to experience large and sustained crime increases during the next several years. As of this writing, the disruptive consequences of the pandemic have wound down, and social unrest of the intensity and scale seen in 2020 and 2021 has not returned. But the last few years serve as a reminder that crime rates are subject to unanticipated jolts that can throw off even the most reliable predictions of the future.

The Impact on Chicago Crime Rates of Reducing the Prison Population

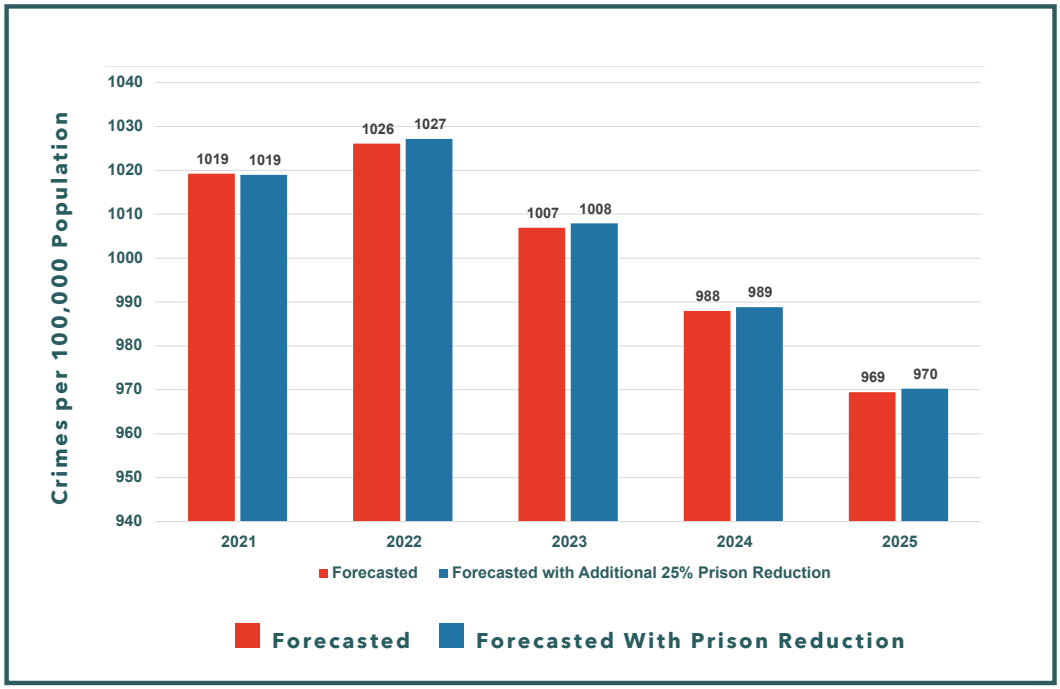
We have suggested that the policy relevance of any statistical model depends on whether the elements of the model are, in fact, modifiable by policy. The size of the prison population is clearly a modifiable policy outcome. It can be reduced by altering the policies that determine prison admissions and the sentencing and parole policies that regulate length of stay and releases. Such proposals, however, invariably run up against concerns that reducing the incarcerated population will increase crime. These concerns are not unreasonable. We would not have included imprisonment rates in our forecasting model if we believed they had no impact on crime rates. But the size of this impact is an empirical question that continues to occupy researchers.

Suppose that in 2020, state policymakers had decided to reduce the Illinois state imprisonment rate, which has been declining for nearly a decade, by an *additional* 25%. What impact would such a reduction have on Chicago crime rates? We assume that a reduction in imprisonment of this magnitude would not occur in a single year but would unfold in a five-year planned decline. This time frame is realistic, and it has the added benefit of providing ample time for policymakers and criminal justice officials to make mid-course corrections as needed.

Figure 3 compares two forecasts of Chicago's violent crime rate between 2021 and 2025: the original forecast, as shown in Appendix Table A, and the forecast assuming an additional 25% reduction in the imprisonment rate over the five years. The other variables in the model remained at their forecasted values. The imprisonment rate is not statistically significant in the property crime model, so we do not carry out this exercise for property crime.

5 We do not present comparable results for property crime because the imprisonment rate is not statistically significant in the property crime model and has no discernible impact on the property crime rate, with or without the additional reduction in imprisonment.

FIGURE 3. CHICAGO VIOLENT CRIME RATE FORECASTS, WITH AND WITHOUT ADDITIONAL 25% PRISON REDUCTION



The reduction in the state imprisonment rate would have a negligible effect on Chicago's violent crime rate between 2021 and 2025. But there are reasons to believe that even these very small forecasted increases are overestimates. First, this exercise assumes that the *total* prison population is reduced by 25%. The policy change, however, would almost certainly be more selective, for example by limiting early release from prison to older inmates and others at relatively low risk of reoffending.

Second, the exercise assumes that no more provision would be made than in past practice to monitor or assist those who would be released from prison, which seems unlikely. Conscientious reform proposals should call for additional community supervision as an alternative to incarceration as well as increases in vocational training, job placement, and mental health and substance abuse treatment for releasees. A responsible approach to decarceration would employ evidence-based forms of supervision and support at the same time.

Conclusion

The hazards of predicting the future of crime are obvious, even when the predictions are based on a reliable statistical model of past crime trends. Some conditions affecting crime rates, such as the aging of the population, can be forecasted with reasonable accuracy. But many others cannot. No one to our knowledge predicted the coronavirus pandemic, George Floyd's murder and the ensuing period of widespread social unrest, or the momentous recent increase in inflation. While we have assumed that the effects of the COVID-19 pandemic on crime rates were temporary, lingering or even permanent effects are possible in the form of educational deficits resulting from school closures and online instruction and changes in population mobility as more people choose to work from home. It would be a mistake to discount the possibility of another inflammatory episode of police violence and social unrest. And, despite optimistic forecasts, the pace at which the current spike in inflation will subside remains uncertain. The lesson is to proceed cautiously, acknowledge the error that accompanies all forecasts, and decide how much error is acceptable for policy planning and evaluation. Most important, predicting the future of crime should be based on models that are continuously recalibrated to take account of new information and of the variation in local conditions to which crime policy must respond.

Appendix: Forecast Methods and Models

Testing the Crime Series for Stationarity

Two formal tests were conducted to determine whether the violent and property crime time series contain a unit root (i.e., are nonstationary). Both the augmented Dickey–Fuller (ADF) test and the Phillips–Perron (PP) test failed to reject the null hypothesis of a unit root for violent crime. Chicago's violent crime rates between 1960 and 2010 are nonstationary and conform to a random walk. The violent crime series was therefore converted to first differences and the same tests were conducted. The tests revealed that violent crime is stationary in first differences. The same tests revealed that Chicago's property crime rate between 1960 and 2010 is stationary, so it was not necessary to convert the property crime series to first differences to induce stationarity.

ARIMA Models and Forecasting Results

ARIMA models estimate the autoregressive (denoted p), differencing (denoted d), and moving average (denoted q) properties of a time series. Several multivariate ARIMA(p,d,q) models containing the income-adjusted inflation rate and the imprisonment rate were estimated on the violent and property crime rates. The models that minimized the mean-squared errors and mean absolute errors of the estimates for both the estimation (1960-2010) and validation (2011–2020) periods of the time series were retained. These models were then used to forecast Chicago's violent and property crime rates for 2021 to 2025.

In Table A, the year-to-year forecasted changes in Chicago's violent crime rate are added to the previous year's rates to generate forecasts of the current year's rates during the validation period. The best-fitting forecast model for violent crime is an ARIMA(2,0,0) model, which contains first- and second-order autoregressive terms in addition to the substantive covariates. Given the inclusion of the autoregressive terms and first-differencing, the violent crime time series shown in Figure 1 begins in 1962. The model forecasts violent crime rates during the 2011–2020 validation period that diverge in either direction from the observed rates by an average of 5.66%. The largest divergence is in 2016. The forecasted violent crime rate is over 17% lower than the observed rate in that year. The forecasts through 2025 suggest that violent crime rates will increase in 2021 and 2022 and then fall through 2025.

TABLE A. ARIMA FORECASTS OF CHICAGO VIOLENT AND PROPERTY CRIME RATES, 2011–2025

	Violent Crime ($ARIMA_{(2,0,0)}$)			Property Crime ($ARIMA_{(2,0,0)}$)		
	Observed Rate	Forecasted Rate	Percentage Error	Observed Rate	Forecasted Rate	Percentage Error
	Validation Period					
2011	992	998	-.60%	4373	4479	2.42%
2012	969	937	-3.30%	4152	4334	4.37%
2013	944	947	.32%	3598	4062	12.90%
2014	886	915	3.27%	3150	3470	10.14%
2015	905	827	-8.62%	2970	2953	.57%
2016	1106	916	-17.18%	3213	2892	-9.98%
2017	1099	1214	10.46%	3283	3231	-1.57%
2018	1008	1048	3.97%	3209	3260	1.60%
2019	943	937	-.64%	2998	3143	4.83%
2020	987	906	-8.21%	2234	2707	21.17%
MAPE[1]			5.66%			6.96%
2021		1019			2123	
2022		1026			2064	
2023		1007			1956	
2024		988			1879	
2025		969			1809	

MAPE[1] = Mean absolute percentage error

The best-fitting forecast model for property crime is an ARIMA(2,0,0) model that contains first- and second-order autoregressive terms in addition to the substantive covariates. For this reason, the property crime time series shown in Figure 2 begins in 1961. On average, the forecasted property crime rates diverge from the observed rates by 6.96% during the validation period. The largest divergence is in 2020, when the forecasted property crime rate is over 21% higher than the observed rate. The forecasts indicate steadily falling property crime rates through 2025.

References

LaFree, Gary. 1999. *Losing Legitimacy: Street Crime and the Decline of Social Institutions in America*. New York: Routledge.

National Research Council. 2014. "The Growth of Incarceration in the United States: Exploring Causes and Consequences." Washington, DC: The National Academies Press. https://doi.org/10.17226/18613.

Rosenfeld, Richard. 2011. "Changing crime rates." In *Crime and Public Policy*, edited by James Q. Wilson and Joan Petersilia. New York: Oxford University Press.

Rosenfeld, Richard, and Aaron Levin. 2016. "Acquisitive crime and inflation in the United States: 1960–2012. *Journal of Quantitative Criminology* 32: 427–447.

Rosenfeld, Richard, Bobby Boxerman, and Ernesto Lopez. 2023. "Pandemic, Social Unrest, and Crime in U.S. Cities: Year-End 2022 Update." Washington, D.C.: Council on Criminal Justice.

Tyler, Tom R., Phillip Atiba Goff, and Robert J. MacCoun. 2015. The impact of psychological science on policing in the United States: Procedural justice, legitimacy, and effective law enforcement. *Psychological Science in the Public Interest* 16: 75-109.

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