The Effect of Prison Populations on Crime Rates

Revisiting Steven Levitt's Conclusions

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Abstract: To examine the impact of changes in prisoner populations on crime rates, studies must control for simultaneity between the two variables. Steven Levitt's 1995 paper "The Effect of Prison Population Size on Crime Rates: Evidence From Prison Overcrowding Litigation" controls for simultaneity by using prison overcrowding litigation as an instrument for changes in the prison population. Using Levitt's data, this paper first replicates his findings from the years 1971-1993. This paper then examines the results from his specified model using the years 2000-2013. No significant relationship between the prison population and crime rates is found using Levitt's model, suggesting an entirely different dynamic in the more recent time period.

I. Introduction and Literature Review

Since the 1970s, the United States prison population has risen 700%, and contains 25% of the world's prison population[1]. Between 2002 and 2010, total state correction expenditures rose to levels above $50 billion annually[2]. With this growth in both incarceration and costs, crime rates in the United States fell over 20% between 2001 and 2012[3]. An important question then arises: does increased incarceration reduce crime, and to what extent.

The majority of literature suggests increased incarceration leads to lower crime rates. Imprisonment may lower crime in two ways: incapacitation and deterrence. Deterrence can be thought of as the threat of punishment deterring people from engaging in illegal acts. Incapacitation refers to a prisoner's inability to commit crimes while imprisoned.

Levitt (1998) attempts to distinguish between deterrence and incapacitation effects by looking at the response of crime to changes in expected punishment. An increase in expected punishment for a certain type of crime should lead criminals to commit more of an alternative crime, if there is evidence of deterrence. An increase in the arrest rate for a certain crime should lead to a reduction in that type of crime, evidence of incapacitation. Levitt finds an equal effect of incapacitation and deterrence for violent crime, and a 75% reduction in property crime as a result of deterrence. Levitt notes that these results may not hold due to endogeneity.

Marvell and Moody (1994) regress crime rates on prison population over a 19-year period. They find the size of the state prison population had a negative short term impact on crime. To analyze causal ordering, Marvel and Moody use a Granger causality test, concluding that prison populations are well specified for determining causal relationships. This study lacks state economic and social characteristics as controls and fails to consider auxiliary variables in the Granger causality test.

[1] American Civil Liberties Union
[2] Bureau of Justice Statistics
[3] Hamilton Project

Levitt (1996) attempts to obtain estimates of the effect of prison populations on crime rates that are not affected by the presence of simultaneity. Simultaneity bias is a critical concern in estimating any model relating incarceration and crime rates. Increases in crime will translate into larger prison populations, and increased incarceration will likely reduce the amount of crime. To control for this, Levitt utilizes an instrumental variable (IV) that is correlated with changes in the size of the prison population, but otherwise unrelated to crimes. Levitt uses prison overcrowding litigation status as an IV in his paper. His data range from 1970 to 1993, including twelve states in which the state prison system underwent litigation change resulting in the early release of prisoners. Levitt's results show a larger impact of prison population on crime than previous estimates imply. Levitt finds elasticities of crime with respect to prisoner populations of -.4 for violent crime, and -.3 for property crime when instrumenting prison populations, as compared to -.1 in OLS estimates. This implies each prisoner released from overcrowding litigation is associated with an increase of fifteen crimes per year.

The current increase in prison population is primarily the result of harsher sentencing, including mandatory minimums for nonviolent drug offenses that grew in the 1980's and "three strikes" laws that began in the 1990's[4]. When offenders committed a third serious offense, they are incarcerated for 25 years to life. As a result of such policies, state prisons have faced enormous expansion and overcrowding. To deal with such issues, states have enacted initiatives to reduce their prison population. These policies often result in the early release of prisoners, typically nonviolent offenders with shorter sentences. In recent years, there are examples of 15 states where such practices have occurred.

This paper attempts to (1) replicate the results of Steven Levitt from the preliminary data he has provided and (2) test his model on a more current time period. The preliminary data are from an earlier version of his 1995 paper, with some minor changes between the final publication and the initial dataset. Replicating his results will confirm he made no mistakes in transforming, calculating, and regressing the variables used in his specified model. It will also assure that the model used in this paper is exactly as done by Levitt.

[4] New York Times

There is one limitation when testing Levitt's model on a more current time period. Levitt uses a specific time period in which lawsuits were brought onto twelve different states regarding prison overcrowding. He obtained the litigation status in a particular year based on information reported in the ACLU National Prison Project Journal. From his data, Levitt notes that a scaled-down set of instruments yields similar results to those in his paper. In particular, he uses a single instrument: the three years immediately following a court decision. This paper will have to use a similar instrument, corresponding to the years following a litigation change.

II. Data

This paper uses panel data with annual observations differing by state. Levitt uses data from the period 1971-1993. This paper will use data from 2000-2013, as identifying litigation changes for state prisons in the 90's is obscure and difficult to find. The list of litigation changes used appears in Table I. All states and their respective prison populations in a given year are provided by the Bureau of Justice Statistics. The Bureau of Labor Statistics posts unemployment rates, the Bureau of Economic Analysis provides per capita income by state, and the Survey of Epidemiology and End Results provides US race and age data by state. The FBI's Uniform Crime Reports data lists annual crime rates, separated by type of crime (violent, nonviolent) and state. Summary statistics and all variables included in the model can be seen in Table II.

III. Model Specification

The dependent variable of interest is the percent change in crime for a given state and year. The independent variable of interest is the percent change in the number of prisoners for a given state and year. Controls include the percent change of income per capita, black population, police population, population living in metropolitan areas, age groups, and the change in unemployment rate.

Data are from 1971-1993 for testing Levitt's findings. Data are then used from 2000-2013 to test the same specification under a different time period. Crime and prison are per capita crime and incarceration rates. Percent changes are calculated as the change in natural log of variables. Year fixed effects are also included in the model.

The prison litigation status variable represents five dummy variables corresponding to the change in prison overcrowding litigation status. These indicators include: Pre-filing, filed, preliminary decision, final decision, and further action. These are the stages that Levitt uses as instruments, where each stage corresponds to a specific year. A two-stage least squares model is used to account for the endogenous prison population in the initial regression.

The paper first tests the use of a single instrument with Levitt's data to compare with the five instruments he uses for the prison population. Specifically, this instrument is a single dummy variable that includes the year of litigation change and the following two years. If the results are similar, it is concluded that a single instrument is valid to use. With the time period of 2000-2013, this paper uses the same single instrument to examine the effect of the prison population on crime rates.

IV. Analysis

a. Replicating Levitt's model

The data provided by Steven Levitt are "from an earlier version of [his] paper. [He] has not tried hard to replicate the findings printed in the tables of the QJE article…it is not impossible that some very minor changes to the data set were made between this data set and the QJE data set. Others have worked with this data set and have said that they could get very close to the QJE numbers, but never quite matched them[5]." The data are also untransformed and just show the raw counts for each variable.

Table III reveals the results replicating Steven Levitt's regressions for violent crime and property crime as the dependent variables. Levitt's findings as reported in his 1995 paper are highlighted in grey. This paper's results are shown in white. The comparative coefficients and standard errors are very similar for each regression, indicating the model and transformations have been specified correctly. Year and age controls are included in each regression, but not reported in the table. At the end of each table, a "single IV" column is reported, which is my proposed method for using Levitt's method on a more current time period. This column only uses a single instrumental variable, which includes the year of litigation change and the

[5] Email from Levitt

following two years. It is seen that the results are similar to what was previously obtained, suggesting this single IV can be used as a valid estimator.

b. Comparing the two time periods

Before utilizing the specified model in a new regression for the years 2000-2013, it is necessary to examine the overall trends in crime and prison population. This will help reveal any fundamental differences between the period Levitt examines and a more current time frame. The relationship between prison population and violent or property crime may substantially differ from the 1970s and 1980s as compared to now. In order to examine this relationship, it is easiest to look at the national trends obtained by summing the values from each state, in a given year. So for violent crime, a sum of each individual state's crime count will reveal the national count of violent crime for each year.

From Figure I, it can be seen that the relationship between prison population and crime trends substantially differs in the two different time periods. Property crime count tends to significantly outnumber violent crime, so although the scale of the prison population looks flat in the graphs of property crime, it is actually the same as shown in the violent crime graphs. From the 1970's to 1993, the prison population steadily rises over time. Both property crimes and violent crimes tend to rise in this time period. In the 2000's and on, there is a more complicated relationship. Both property crimes and violent crimes fall significantly, while the prison population initially rises, then falls back down. From 2008 and on, the prison population actually outnumbers total violent crime. It is difficult to discern any relationship from the two graphs in the current time period. This suggests Levitt's model may longer obtain significance, as there seems to be a different dynamic between crime rates and prison population. It is important to remember, however, that the graphs depict the national level of these variables, while this paper examines a state by state relationship. Therefore, although they are helpful to visualize, the graphs at the national level may not necessarily represent what is going on in each state, which has its own set of litigation and prison populations.

c. Testing the model in the current time period

The relationship between the prison population and crime rates may no longer hold, as discussed in the previous section. To test Levitt's model, a two-stage least squares regression is run with recent litigation changes used as an IV for the prison population. Results are displayed in table IV.

The first stage in the two-stage least squares model is shown in Table V. In both time periods, the litigation change dummy is found significant for a reduction in prison population. This indicator variable equals 1 for the year of a litigation change and the following two years. All other values receive a zero. This suggests the instrument indeed corresponds to a release of prisoners, as specified by the litigation changes listed previously.

The variable of most importance in this paper, the percent change in prison population, fails to achieve significance for the years 2000-2013 (Table IV). The IV regression coefficients on the percent change in prison population are similar in magnitude for both time periods. The standard errors, however, are more than twice those obtained by Levitt. Figure II visually depicts the confidence intervals obtained on the percent change in prison population variable. For both violent and property crime in the current time period, the coefficient estimates are statistically non-different from zero.

Together, these findings suggest a model that is no longer applicable in the current time period. The changes in prison population have no significant effect on crime rates for both violent and property crime, using the technique implemented by Levitt. The lack of significance on other control variables supports this interpretation.

d. Additional test of endogeneity

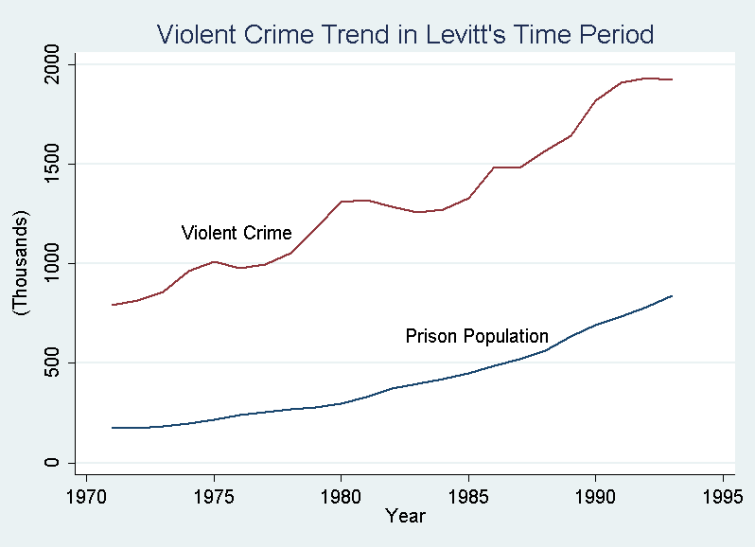
Due to significant differences in results by using the same model in two different time periods, it is necessary to examine why such differences may occur. One question to ask is if the variable instrumented, the prison population, is indeed endogenous. If this endogenous regressor is in fact exogenous, then using an OLS estimator will be more efficient. The prison population

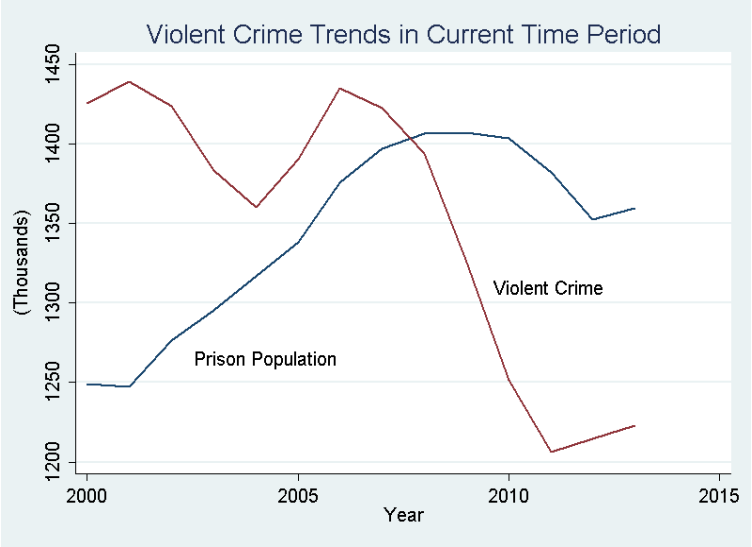
is tested for endogeneity in the two time periods using the Wu-Hausman test. This test compares OLS estimates to IV estimates, with the null hypothesis that the variable instrumented for is actually exogenous. For this paper, the variable instrumented for is the prison population. As shown in Table V, Levitt's time period receives a large F-statistic under the null. This suggests the prison population is indeed endogenous as he claims, and needs an instrument to account for this bias. However, a very small F-statistic is found for the current time period. These findings fail to reject the possibility that the prison population is exogenous. This suggests an IV regression may not be the most efficient estimator, and an OLS regression can instead be used. This also points towards the limitations of using Levitt's model in the current time period, as it seems the prison population is no longer an endogenous regressor.

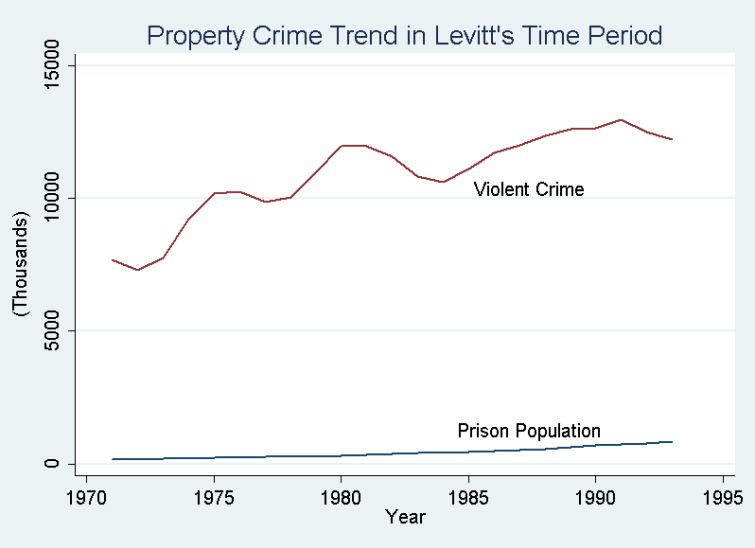
V. Conclusion

Using Steven Levitt's model with prison overcrowding litigation as an instrument for changes in the prison population, this paper finds no statistically significant impact between crime rates and the number of prisoners for the years 2000 to 2013. Levitt's findings of each additional prisoner reducing the number of crimes by 15 per year no longer retain significance. The vastly different relationships between total prisoners and total crime rates in the two time periods implicate these findings. There are then important policy implications to consider following these results. Crime has followed a downward trend over the past decade. However, the United States' practice of mass incarceration may not be the reason behind these falling crime rates. Correlation between growing prison populations and reduced crime does not mean causation. Rising incarceration rates may tend towards diminishing returns, where incarceration produces less and less of a reduction on crime. The possibilities for this trend are numerable, including better social programs, increased technology, and structural change. It is likely a variety of these factors that lead to a reduction in crime. Increasing incarceration is no longer a simple remedy towards addressing issues of crime.

Figure 1. Crime and Prison Trends in the Different Time Periods







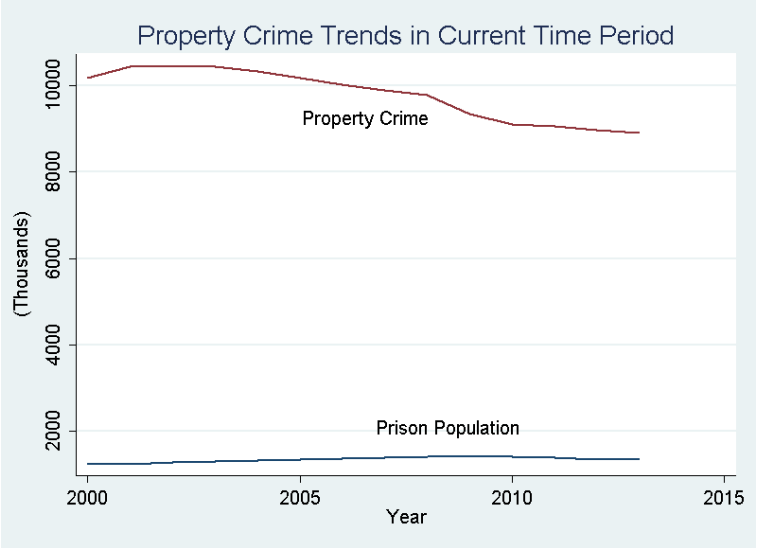


Figure 2. Comparing Coefficient Confidence Intervals

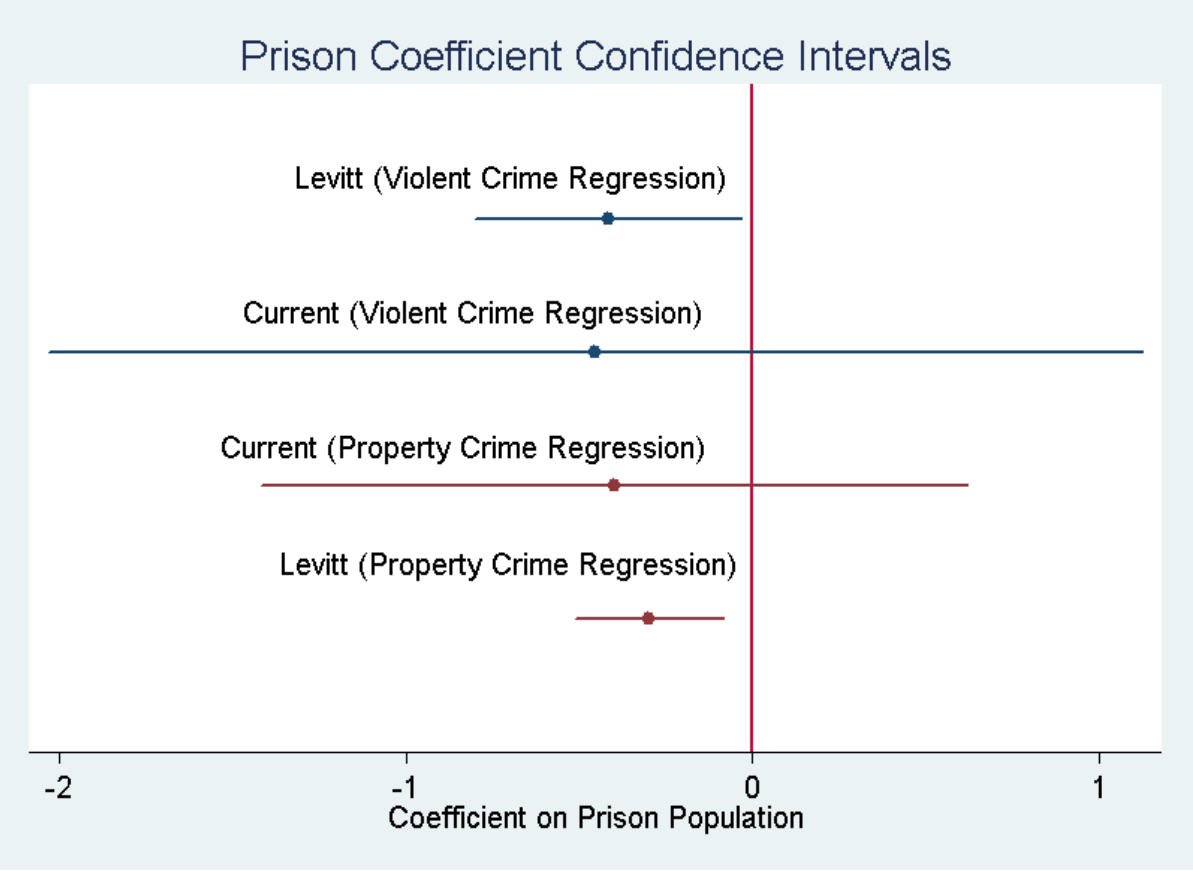


Table I. List of Litigation Changes[6]

State	Year	Description
New Jersey	2002	Mandatory release laws resulting in thousands of prisoners released without supervision
Ohio	2002	Senate Bill 2 implementation, increase of thousands of prisoners returning to their communities
Arkansas	2003	"Emergency Powers Act" allows release of nonviolent offenders
Washington	2003	Senate Bill allowing early release for certain offenders
Michigan	2003	Prisoner Reentry Initiative closes 20 prisons to reduce prison population
Texas, Kansas	2007	Investment of treatment programs as alternative to prison
Arizona	2008	"Safe Communities Act" passed, enforces probationers to help them stay out of prison
Vermont	2008	"War on Recidivism Act" grants parole early for certain prisoners to reduce overcrowding
Pennsylvania	2008	Legislation allowing early release from prison to reduce spending
Kentucky	2008	House Bill 683, allows parole board to review more cases for early prisoner release
Mississippi	2008	Senate Bill 2136, grants parole to certain nonviolent offenders
Illinois	2009	Release of 1,700 prisoners in effort to reduce spending
Wisconsin	2009	Modify sentencing laws to release prisoners early for good behavior
California	2011	Supreme Court order to release 30,000 prisoners
North Carolina	2011	Revision of sentencing laws under Justice Reinvestment Act

[6] Many listings obtained from McCord (2013)

Table II. Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
Percent Black	11.4%	9.7%	1.1%	38.3%
Unemployment Rate	5.1%	2.3%	2.4%	14.2%
Percent Urban	72.5%	14.6%	38.2%	95.2%
Per Capita Income	36,495	7,156	21,564	60,658
Police Population	19,342	23,108	1,299	123,506
Total Population	5,980,407	6,584,630	494,300	38,400,000
Total Property Crime	195,197	219,785	12,010	1,227,194
Total Violent Crime	26,827	35,002	496	212,867
Total Prison Population	26,855	33,860	1,076	175,512
Ages 0 to 4	396,400	453,668	29,646	2,561,061
Ages 5 to 14	817,306	924,951	67,703	5,346,739
Ages 15 to 17	426,469	477,370	37,003	2,834,241
Ages 18 to 24	421,197	476,194	33,627	2,981,456
Ages 25 to 34	804,201	933,473	58,619	5,559,698
Ages 35 to 44	853,380	961,943	66,545	5,516,317
Ages 45 to 54	850,838	913,125	74,557	5,256,172
Ages 55 to 65	643,579	682,930	44,801	4,386,907

Table III. Replication Regressions

%Δ Violent Crime

Variable	Replication OLS	Levitt OLS	Replication IV	Levitt IV	Single IV
	(1)	(1)	(2)	(2)	(3)
%Δ Prison Population	-0.089***	-0.099	-0.414**	-0.424	-0.389**
	(0.033)	(0.033)	(0.196)	(0.201)	(0.210)
%Δ Income per capita	0.483***	0.485	0.493***	0.384	0.492***
	(0.117)	(0.117)	(0.118)	(0.127)	(0.118)
Δ Unemployment Rate	0.505	0.564	0.503	0.411	0.508
	(0.326)	(.333)	(0.329)	(0.301)	(0.330)
%Δ Police	0.075	0.026	0.076	0.054	0.078
	(0.051)	(0.059)	(0.051)	(0.048)	(0.051)
Δ % Black	-0.023	-0.015	-0.021	-0.018	-0.021
	(0.028)	(0.029)	(0.029)	(0.025)	(0.029)
Δ % Metro	0.006	0.013	0.003	0.006	0.004
	(0.010)	(0.011)	(0.010)	(0.012)	(0.010)
Observations	1,063				

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

%Δ Property Crime

Variable	Replication OLS	Levitt OLS	Replication IV	Levitt IV	Single IV
	(1)	(1)	(2)	(2)	(3)
%Δ Prison Population	-0.058***	-0.071	-0.297***	-0.321	-0.315***
	(0.018)	(0.019)	(0.109)	(0.138)	(0.117)
%Δ Income per capita	0.013	0.014	-0.003	0.076	-0.003
	(0.066)	(0.66)	(0.066)	(0.072)	(0.066)
Δ Unemployment Rate	0.862***	1.032	0.853***	1.138	0.861***
	(0.183)	(0.186)	(0.184)	(0.188)	(0.184)
%Δ Police	0.019	-0.004	0.016	0.012	0.016
	(0.029)	(0.033)	(0.029)	(0.030)	(0.029)
Δ % Black	-0.044***	-.043	-0.044***	-0.038	-0.044***
	(0.016)	(0.016)	(0.016)	(0.16)	(0.016)
Δ % Metro	0.002	.006	-0.000	-0.000	-0.000
	(0.006)	(.006)	(0.006)	(.006)	(0.006)
Observations					

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table IV. Testing the Model in the Current Time Period

%Δ Violent Crime

Variable	OLS	Levitt OLS	IV	Levitt IV
	(1)	(1)	(2)	(2)
%Δ Prison Population	-0.007	-0.099	-0.452	-0.424
	(0.073)	(0.033)	(0.805)	(0.201)
%Δ Income per capita	-0.273*	0.485	-0.170	0.384
	(0.157)	(0.117)	(0.167)	(0.127)
Δ Unemployment Rate	0.718	0.564	0.636	0.411
	(0.515)	(0.333)	(0.543)	(0.301)
%Δ Police	0.027	0.026	0.031	0.054
	(0.062)	(0.059)	(0.071)	(0.048)
Δ % Black	0.005	-0.015	0.022	-0.018
	(0.030)	(0.029)	(0.034)	(0.025)
Δ % Metro	0.041	0.013	0.043	0.006
	(0.018)	(0.011)	(0.021)	(0.012)
Observations	700			

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

%Δ Property Crime

Variable	OLS	Levitt OLS	IV	Levitt IV
	(1)	(1)	(2)	(2)
%Δ Prison Population	-0.076	-0.071	-0.398	-0.321
	(0.049)	(0.019)	(.521)	(0.138)
%Δ Income per capita	-0.208*	0.014	-0.226**	0.076
	(0.106)	(0.66)	(0.108)	(0.072)
Δ Unemployment Rate	0.740**	1.032	0.785**	1.138
	(0.349)	(0.186)	(0.359)	(0.188)
%Δ Police	-0.001	-0.004	-0.010	0.012
	(0.042)	(0.033)	(0.046)	(0.030)
Δ % Black	0.018	-.043	0.012	-0.038
	(0.021)	(0.016)	(0.022)	(0.16)
Δ % Metro	0.014	.006	0.012	-0.000
	(0.012)	(.006)	(0.013)	(.006)
Observations	700			

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table V. Additional Test for Endogeneity, First Stage Least Squares Regression

Test of endogeneity
H_0: Prison population is exogenous
Levitt's Time Period
Wu-Hausman F(1,1074) = 4.33975 (p = 0.0375)
Current Time Period
Wu-Hausman F(1,622) = .22283 (p = 0.6371)

	%Δ Prison Population	
Variable	**Current**	**Levitt**
	(1)	(1)
Litigation change indicator	-0.013**	-0.055**
	(0.005)	(0.025)
%Δ Income per capita	0.005	-0.477
	(0.085)	(0.107)
Δ Unemployment Rate	-0.086	0.001
	(0.283)	(0.299)
%Δ Police	-0.034	0.072
	(0.034)	(0.046)
Δ % Black	0.013	-0.004
	(0.016)	(0.025)
Δ % Metro	0.015	-0.011
	(0.008)	(0.009)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

References

Bhati, Avinash. "An Information Theoretic Model For Estimating the Number of Crimes Averted by Incapacitation." *The Urban Institute*. N.p., July 2007. Web.

"End Mass Incarceration Now." *The New York Times*. Editorial Board, 24 May 2014. Web.

Kearney, Melissa, and Benjamin Harris. "Economic Facts about Crime and Incarceration in the United States." *The Hamilton Project*. N.p., May 2014. Web.

Levitt, Steven D. "The Effect of Prison Population Size on Crime Rates: Evidence from Prison Overcrowding Litigation." *National Bureau of Economic Research*. N.p., May 1995. Web.

Levitt, Steven D. "Why Do Increased Arrest Rates Appear to Reduce Crime: Deterrence, Incapacitation, Or Measurement Error?" *University of Chicago*. N.p., July 1998. Web.

Marvell, Thomas B., and Carlisle E. Moody. "Prison Population Growth and Crime Reduction." *Journal of Quantitative Criminology*. N.p., June 1994. Web.

"Mass Incarceration Problems." *American Civil Liberties Union*. N.p., June 2014. Web.

McCord, Roisin. "The Effect of Legislated Reductions in the Prison Population on Crime Rates." *Notre Dame*, 28 Mar. 2013. Web.