

# Factors of Crime and Incarceration: A Cross-Section Study

Shukrit Guha

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## Abstract

This paper investigates potential correlates of state level incarceration and crime rates using cross-sectional data on 50 U.S. states in 2014. Despite including several variables that have been traditionally argued to influence both crime and incarceration, we find only public health to be the most significant variable in determining state-level incarceration. Under the suspicion of possible endogeneity, the effects of both violent crime and health are further examined using an instrumental variable approach. The results of our 2SLS regressions infer that violent crime rates do not significantly explain incarceration, but may do so through the effect of the quality of public health. In order to develop a comprehensive idea of the factors affecting crime, we also examine which factors show strong association with property crime rates. We conclude with policy recommendations that aim to better inform forward-looking state policies in reducing both crime and incarceration.

## 1 Introduction

Over the past decade, the topic of incarceration in the U.S. has received a great deal of attention, as it has criticism. Today, the incarcerated population is 4.5 times larger than in 1980, with approximately 2.2 million people in the United States behind bars, including individuals in Federal and State prisons as well as local jails. Adjusting for population, the incarceration rate grew by more than 220 percent between 1980 and 2014. The U.S. incarceration rate is higher than any other country in the OECD, and is more than four times the world average<sup>1</sup>. The unprecedented surge in incarceration since 1980 has stimulated a national debate between those who claim that locking up over 2 million people is necessitated by public safety concerns, and those who say the human and financial burden of imprisoning so many of our citizens is intolerable<sup>2</sup>. The total social and economic cost of U.S.'s massive incarceration rates is of hot debate, especially when compared to other developed countries. Around \$182 billion in financial resources are invested into this institution every year in the form of infrastructural maintenance, public employee compensation, administrative, judicial and legal fees, policing, healthcare, and other related costs (Wagner & Rabuy, 2016).

Between 1980 and 2014, violent crime rates fell by almost 39% while property crime rates fell by 52%. However, this pattern was neither gradual nor uniform. Further examination revealed that while a large drop in crime rates between 1990 and 2000 did coincide with a large increase in the prison population, this inverse association was not witnessed between 1980 and 1990, when both crime rates and incarceration experienced dramatic increases, or after 2000, when crime rates remained relatively static but incarceration continued to rise. This suggests that factors apart from crime rates alone may be systematically contributing to the rising imprisonment of offenders. This paper aims to provide some insight into this hypothesis, though only from a cross-sectional study perspective, and focuses on determining economic, social, political and institutional dimensions of state populations that could be significant in explaining rising state incarceration rates.

Most research on the topic has resulted in mixed conclusions. Studies that have focused on the effect of unemployment on incarceration rates have yielded inconsistent results. Poverty has been consistently found to be a predictor of imprisonment rates. Arvanites and Asher (1995) find that economic inequality is a significant predictor of imprisonment rates after controlling for arrest rates. A 1998 study by the same authors explores the relation between incarceration, race, and income inequality after controlling for crime rates. This research

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<sup>1</sup>*Economic Perspectives on Incarceration and the Criminal Justice System* (April 2016), Executive Office of the President of the United States

<sup>2</sup>Cook, P.J. & Ludwig, J., *More Prisoners Versus More Crime is the Wrong Question*, Brookings Institute Policy Brief #185 (December 2011)

concludes that crime rates were the most significant determinant of incarceration, but the effect of crime rate while controlling race and income inequality was substantially smaller. Lofstrom and Raphael (2016) present evidence that crime rates are higher in neighborhoods and cities with higher poverty and larger populations of non-Asian minorities. The study also considers the effect of drug arrests on incarceration rates, concluding that, despite an overall decline in arrests over the past decade, drug arrests have increased and persisted since the 1980s. Efforts to estimate the effect of high-school attendance and completion on crime and incarceration also suggest that ‘coercive social policies’ such as compulsory schooling age have significant impacts in reducing crime involvement among younger individuals<sup>2</sup>.

Aside from these generally ‘tried and tested’ economic variables, our study delves deeper into the possible determinants of higher imprisonment rates in different states. We incorporate variables to control for drug and gun control policies, access and availability of quality health care, political and economic participation of state citizens, social inequalities through the use of gender wage gaps, differences in the extent of religiosity and conservatism among people within different states. Given that our analysis is cross-sectional, it provides a snapshot view of those variables that are most significant in explaining state-wise incarceration rates in 2014. Using a much larger set of explanatory variables, our examination of these factors is more comprehensive though our sample size is admittedly small.

## 2 Data

This research utilizes a composite dataset across 50 observations corresponding to the 50 states of the U.S in 2014. Incarceration rate, as measured by the total number of people incarcerated by the state (Bureau of Justice Statistics) per hundred thousand U.S. residents, is the dependent variable of interest. Potential explanatory regressors are listed in Table 1. For our analysis of the factors affecting violent and property crime rates, we measure the number of violent or property crimes reported (Uniform Crime Reporting Statistics) per hundred thousand U.S. residents as our dependent variables.

The independent variable we use for representing the general health of state residents is an index that takes into consideration a wide variety of factors<sup>3</sup>. The problem with this approach is that we are unable to attribute any specific component(s) of the index as having particular influence on incarceration rate. Consequently, apart from a general recommendation that measures be taken to improve average health care access for state citizens, our conclusions regarding health are nonspecific.

The gun control dummy variable is a coarse assignment based on grades given to states by The Law Center to Prevent Gun Violence. We used these grades to divide the states into those with more regulated gun control policies (i.e. states that received a grade of C or better) and those with more relaxed gun control policies (i.e. states that received a grade of D or worse). Although this is a reasonable simplification, the grading scores in the data actually provide more nuanced information than we use in our analysis. As a result, our regression may not have accurately reflected the true impact good or bad gun policies may have on incarceration rates.

The third limitation is that incarceration rates are shown for state prisons only (including private facilities). Federal prisons and local jails are omitted. The omission of federal facilities is intentional, as this would tell us little about state-level offenses, particularly when offenders are incarcerated outside of the state in which they actually committed the crime for which they were convicted. The omission of imprisonment data for city and county jails may cause an underestimate of the true levels of imprisonment when compared with statewide data on our independent variables.

In addition, it is important to mention that corruption index data for individual states was difficult to obtain, and therefore, we resorted to a paper (mentioned in Table 1) that was published at a previous date (2003) to proxy for this institutional dimension of state economies. Acknowledging the potential problems associated with making this addition, we tested the results of our analysis without it to arrive at the same conclusions.

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<sup>3</sup>These include four core measures of determining health outcomes in the US. Behaviours such as smoking, binge drinking, drug deaths, obesity, physical inactivity and high-school graduation. Community and Environmental factors such as violent crime, occupational fatalities, children in poverty, air pollution and exposure to infectious diseases. Policy factors include lack of health insurance, public health funding and immunizations (children and adolescents). Finally, clinical care include low birth weights, availability of primary care physicians and dentists, and preventable hospitalizations.

Table 1: Data Summary

Regressor	What is being measured	Source	Mean	Standard Deviation
Corruption Index	Measure of Stat Government Corruption	State Politics and Policy Quarterly	0.002	0.708
Crime Rate	Violent Crime: Number of crimes reported per 100,000 U.S. residents	Uniform Crime Reporting Statistics, DOJ	346.8	128.8
Drug Control	Legality in the possession of Cannabis	ProCon.org	0.60*	-
GDPPC	Income per capita	United States Census Bureau	\$47,399	\$8,754
Gini Index	Income Inequality	United States Census Bureau	0.462	0.020
Gun Control	Restricted gun control policies vs. Relaxed gun control policies in states	Law center to prevent gun violence	0.66 <sup>+</sup>	-
Health	Comprehensive score on overall health-care accessibility	United Health Foundation	0.081	0.499
High School Degree	Percentage of Population with High School Diploma or higher education	United States Census Bureau	0.876	0.030
Poverty	Percentage of Population below the Poverty Line	United States Census Bureau	0.148	0.031
Unemployment Rate	Number of people unemployed as a percentage of labor force	Bureau of Labor Statistics	0.057	0.013
Voter Participation	Percentage of state citizens that are politically active	United States Election Project	0.401	0.080
Wage Gap	Median wage of women as a percentage of median wage of men	American Association of University Women	0.812	0.047
Conservative Advantage	Percentage of state citizens that identify as Conservative less Percentage of state citizens that identify as Liberal	Gallup News	0.156	0.097
Religion	Percentage of state citizens that are religiously active	Gallup News	0.326	0.075
Labor Force Participation	Labor Force as a percentage of total state population above 15 years	Bureau of Labor Statistics	0.603	0.041

\* denotes percentage of states with restrictive Cannabis possession laws

<sup>+</sup> denotes percentage of states with relaxed guns laws

### 3 Identification Methodology

This dataset is admittedly small, and future expansions of this research would benefit from panel data. Acknowledging the variance-imposed limitations of small sample sizes, our analysis seeks to identify the subset of potential regressors that have the most significant relationships with incarcerations rates.

Model identification began by regressing incarceration rate on all 15 explanatory variables. Natural logarithm transformations were used for all variables except dummy variables, which were drug and gun control, and variables with negative values, which were health, corruption, and conservatism.

In an application of the general to specific identification methodology, we used backward stepwise regression using AIC<sup>4</sup> as the objective criterion, as described by James Et Al. (2015), to specify a model with minimal estimated mean squared error. This procedure produced the following linear models,

$$\log(y_{ir}) = \beta_0 + \beta_1 x_h + \beta_2 x_{cv} + \beta_3 \log(x_{vc}) \quad (1)$$

$$\log(x_{vc}) = \beta_0 + \beta_1 x_h + \beta_2 x_{cv} + \beta_3 \log(x_r) \quad (2)$$

$$\log(x_{pc}) = \beta_0 + \beta_1 x_{lfp} + \beta_2 x_{cp} + \beta_3 d_g + \beta_4 \log(x_r) \quad (3)$$

where,

- $y_{ir}$  is the state incarceration rate
- $x_h$  is the state health index value
- $x_{vc}$  is the violent crime rate
- $x_{pc}$  is the property crime rate
- $x_{cv}$  is the state's conservative advantage
- $x_r$  is the percentage of state citizens considered 'very religious'
- $x_{lfp}$  is the state labor force participation
- $x_{cp}$  is the corruption index value
- $d_g$  is the dummy for relaxed gun control legislation

By step-wise selection of features that maximized the AIC, equation (1) was obtained by regressing  $y_{ir}$  on all the variables. Equation (2) and equation (3) were obtained by regressing  $x_{vc}$  and  $x_{pc}$  respectively, on all the variables. The subset of features selected by this procedure were used to fit the final models as well.

Though auto-correlation in the residuals was not found to be a concern, we detected the presence of heteroskedasticity at the 10% level in most of our models. Therefore, to preserve consistency of the estimators, we employed heteroskedastic-consistent estimates of the covariance matrix for all our fitted models. Moreover, because many of our explanatory variables are correlated with one another, we calculated the Variance Inflation Factor for each model to determine if multicollinearity would pose potential problems. Our tests concluded the absence of any serious multicollinearity<sup>5</sup>.

In equation (1) and equation (2), health is included as a significant explanatory variable for both incarceration and violent crime, respectively. Given that violent crime is a significant variable in equation (1), we suspected that either violent crime or health may exhibit endogeneity to some degree, in explaining incarceration. We investigate both possibilities in Section 5, by reformulating our models to exclude them in separate regressions.

In the first case, we investigate the endogeneity of violent crime using health as an instrument. Since health is significant in explaining violent crime and the latter in incarceration, we need to replace health from the original equation to use to as an instrument for violent crime. To choose the replacement, we employ the step-wise selection procedure as before without health as an explanatory variable. The resulting equation is described below

$$\log(y_{ir}) = \beta_0 + \beta_1 \log(x_{lfp}) + \beta_2 x_{cv} + \beta_3 \log(x_{vc}) \quad (4)$$

We employ 2SLS method by first regressing violent crime on health, and then using the fitted values from that model as the regressors in equation (4). The results are discussed in section 5.

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<sup>4</sup>The Akaike Information Criterion

<sup>5</sup>The standard rule of thumb is that values more than 10 are too multicollinear to ignore, with some literature suggesting even higher values may be tolerable (O'Brien, 2007). For any of our models, the highest recorded VIF was 2.26.

For our second case, we investigate whether health itself may be endogenous to some degree in explaining incarceration. The motivation being that if prisoners' health were included as part of the state-wise health index estimates, their strong association may have been hiding the effect of other state variables. To test for endogeneity, we regressed health on all the variables to determine the best set of instruments. The stepwise selection procedure was used again, and the resulting specification was described as

$$\log(x_h) = \beta_0 + \beta_1 \log(x_p) + \beta_2 x_{ur} + \beta_3 \log(x_{cv}) \quad (5)$$

where  $x_p$  is the percentage of state population below the poverty line and  $x_{ur}$  is the unemployment rate. Thus, using poverty and unemployment as instruments for health, we applied a 2SLS model as before. The results are discussed in Section 5.

## 4 Initial Results

Table 2 summarizes our regression results from all the specifications described in Section 3. In specification (1) and specification (2), notice that health is highly significant in explaining both incarceration and violent crime (respectively). Conservatism is highly significant in explaining violent crime(1%), but less so for incarcerations (10%). Without correcting for heteroscedasticity, violent crime was observed as a significant predictor of incarceration through the step-wise selection procedure. In specification (3), property crime was regressed on all other variables. Labor force participation rate, Corruption and the percentage of state citizens classified as 'Very Religious' were revealed to be the most significant variables. Though these relationships appear incongruous at first, possible explanations are discussed in section 6.

The last two specifications were evaluated only for the purposes of our instrumental variable investigations. In specification (4), the exclusion of health as an explanatory variable in regression (1) is replaced by the labor force participation rate, shown to be significant at the 1% level. Interestingly, the p-values for both conservatism and violent crime decrease substantially, with violent crime now significant at the 5% level. This large change in the significance of violent crime in explaining incarceration by the simple exclusion of health as a control variable, led us to suspect that it may be endogenous. The results of this investigation in discussed in section 6. To confirm that health itself is not an endogenous variable, we regressed it on all the other variables to obtain our results for specification (5). Here, we see that poverty, unemployment rate and the state conservative advantage are all highly significant in explaining health (1% level).

## 5 Instrumental Variable Investigation

First, to investigate whether violent crime was endogenous in explaining incarceration, we performed a 2SLS regression of equation (4), after removing health as an explanatory variable from specification (1), using it as an instrument for violent crime instead. Then, to test whether health itself was endogenous in explaining incarceration in specification (1), we performed a 2SLS regression of equation (1), instrumenting for health using state poverty and unemployment rates. The results are summarized in Table 3.

From specification (1), we see that the state labor force participation is no longer significant, but conservative advantage and the violent crime rate are highly significant (at the 1% level). The diagnostic table displayed at the bottom confirm health as a good instrument for violent crime, but more importantly, the Wu-Hausman test is significant at the 5% level, meaning that the IV estimator for violent crime is more consistent than the OLS estimator. Thus, to that extent the coefficient estimate of the effect of violent crime on incarceration in Table 2: specification (4) is inconsistent relative to that of Table 3: specification (1). The relationship inferred is that on average, a 1% increase in a state's violent crime rate is associated with a 0.76% increase the state's incarceration rate. However, given that it tests positive as an endogenous variable, one must be careful to associate violent crime rate as the sole determinant of the incarceration rate.

Moving ahead, we now concern ourselves with the effect of health on incarceration. We suspected that health may also exhibit some endogeneity with respect to incarceration since there may exist other unobserved factors that influence both directly or indirectly. To resolve our doubts, we performed a 2SLS regression re-estimating equation (1) using the poverty and unemployment rates as instruments for health, the results of which are displayed in specification (2). Notice that the violent crime rate and conservative advantage are no longer significant, even at the 10% level.

Table 2: OLS Regression Results

	<i>Dependent variable:</i>				
	log(Incarc_rate)	log(Violent.Crime.Rate)	log(Property.Crime.Rate)	log(Incarc_rate)	Health
	(1)	(2)	(3)	(4)	(5)
Health	−0.373*** (0.099)	−0.400*** (0.120)			
log(Poverty)					−0.979*** (0.204)
log(Unemp)					−0.768*** (0.140)
Conserv	0.795* (0.482)	−1.722*** (0.518)		1.633*** (0.381)	−2.692*** (0.380)
log(Violent.Crime.Rate)	0.203 (0.126)			0.289** (0.114)	
log(LFP)			−1.037** (0.503)	−1.809*** (0.550)	
Corrup			0.059* (0.032)		
G_cont			0.079 (0.058)		
log(Religion)		0.639 (0.396)	0.251** (0.111)		
Constant	4.627*** (0.776)	6.797*** (0.476)	7.528*** (0.321)	3.064*** (0.655)	−3.639*** (0.350)
Observations	50	50	50	50	50
R <sup>2</sup>	0.610	0.370	0.428	0.581	0.806
Adjusted R <sup>2</sup>	0.585	0.329	0.377	0.553	0.793
Residual Std. Error	0.241 (df = 46)	0.323 (df = 46)	0.181 (df = 45)	0.250 (df = 46)	0.234 (df = 46)
F Statistic	24.008*** (df = 3; 46)	9.015*** (df = 3; 46)	8.421*** (df = 4; 45)	21.224*** (df = 3; 46)	63.698*** (df = 3; 46)

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Note:

The poverty and unemployment rate qualify as good instruments. The Wu-Hausmann test however, is insignificant for this specification, concluding that health is not endogenous in explaining incarceration. Moreover, the OLS estimates of the effect of health on incarceration in Table 2: specification (1) are consistent relative to that of Table 3: specification (2). From our results, evidence of a strong inverse relationship between health and incarceration can be inferred.

Table 3: IV Regression Results

	<i>Dependent variable:</i>	
	log(Incarc.rate)	
	(1)	(2)
log(LFP)	−0.668 (0.844)	
Conserv	1.496*** (0.531)	0.649 (0.572)
log(Violent.Crime.Rate)	0.767*** (0.269)	0.174 (0.141)
Health		−0.424*** (0.136)
Constant	0.901 (1.295)	4.821*** (0.885)
Weak instruments	0	0
Wu-Hausman	0.03	0.54
Observations	50	50
R <sup>2</sup>	0.376	0.608
Adjusted R <sup>2</sup>	0.335	0.582
Residual Std. Error (df = 46)	0.306	0.242
<i>Note:</i> *p<0.1; **p<0.05; ***p<0.01		

## 6 Conclusion and Discussion

The results discussed in Sections 4 and 5 provide a comprehensive view of the various factors that influence both crime and incarceration. From Table 2, health is evidently the most significant factor in influencing incarceration, followed by the state’s conservative advantage (albeit, at the 10% level). The same is true for violent crime, as is evident from specification (2). Interestingly, the effect of the state’s conservative advantage on incarceration is positive while its relationship with violent crime is negative. Violent crime is insignificant in explaining incarceration in specification (1), with the inclusion of health as a control variable. However, it becomes significant in specification (4), where health was replaced with the state labor force participation rate as an explanatory variable. In addition to these findings, specification (3) displays the results of regressing property crime, rather than violent crime, on all other variables. We see the state labor force participation rate is the most significant variable in explaining property crime, followed by the percentage of state population considered ‘Very Religious’, and the level of corruption, as measured by the corruption index.

Our instrumental variable investigation in Section 5 concluded that violent crime was endogenous in explaining incarceration, using health as its instrument. Omitting health from equation (1) firstly increases the significance of violent crime, and when instrumented for through health, also increases its estimated effect on incarceration. This is a consistent estimate when compared to the simple OLS regression specified by equation

(1). In addition, we anticipated that incarceration rates could directly impact state health outcomes (presumably negatively), in which case health would also be endogenous. Alternatively, incarceration and health outcomes may be indirectly associated through the effect of poverty and unemployment. To test the former, we performed a reverse regression and found incarceration rates to be insignificant in explaining state health outcomes, while our second IV regression confirms the rejection of the latter. These results are generally consistent with Lofstrom & Raphael's (2015) conclusion that, when controlling for other indirect factors, crime rates are insignificantly correlated with incarceration rates. Though their study also inferred that income inequality, poverty, education and race were important factors associated with changes in incarceration, our cross-sectional examination of these factors fail to capture these relationships.

Health is negatively related to incarceration rates, which is somewhat anticipated as public health is widely believed to be a measure of social prosperity and peace. Wilper et. al. (2009) studied the relationship between mental health, substance abuse and the prevalence of select chronic diseases among U.S. prisoners pre and post-incarceration. They found that in most cases, several inmates already had these conditions prior to their arrest, often being either directly or indirectly the motivation behind their crimes. Bondurant et. al. (2016) found that increasing health care access to substance-users had significant impact on reducing violent and financially motivated crimes, with particularly pronounced effects on the number of homicides. Further studies such as those by Wen et. al. (2017) and Wogler (2017) examine the effect of Medicaid expansion on violent crime and conclude that access to health insurance had a significant impact on reducing violent as well as property crime after controlling for other independent factors. These studies in conjunction with several others in the literature support our inference that the quality of public health on average, is inversely related to the rate of incarceration in a state. Most of the literature emphasize the direct and indirect benefits and spillovers of treatment facilities, health insurance and access to mental health care in providing individuals and vulnerable social groups with resources and financial stability, effectively reducing their motivation or likelihood in participating in crime.

The state conservative advantage is significant and appears to be positively associated with state incarceration rates. It is also negatively related with violent crime rates. Thus, the larger the difference between the number of people who identify themselves as conservatives as opposed to liberals, the higher the incarceration rate in that state, and the lower the violent crime rate, on average. While this variable is not representative of any particular party, conservatives have been traditionally associated with the Right. Given the history of criminal justice and legal reform movements since the 1960s, this relationship is perhaps more of a lingering effect of the "tough on crime" policies implemented during the later half of the 20<sup>th</sup> century, rather than a product of the present times. However, assuming that policies produce their intended effects, it still suggests that conservative sentiment within state populations perhaps provide greater support for a more aggressive stance on crime - explaining not only its positive relationship with state-level incarceration rates, but also being inversely related to violent crime. With the recent decrease in violent crime rates and coincidental escalation of incarceration rates, there has been greater nuance added to the discussion of criminal justice and how to reform the system.

To conclude, our study provides strong evidence in favor of the quality public health being a significant factor in determining state incarceration rates, as well as violent crime. The relationship between crime and public health has been studied in its various forms and conclusions attribute the impact of high medical care and health care costs being a possible reason for financially motivated crimes. Moreover, the relationship is strengthened when mental health issues, substance-abuse, drug addictions and exclusion from economic participation due to physical inactivity and exposure to diseases is concentrated among low-income, less-educated minority groups. Violent crime in itself is insignificant in explaining incarceration, and should be viewed through the lens of public health outcomes. State governments should invest more resources in the provision of better health care services, targeted programs for more disadvantaged social groups and increase awareness of the implications of bad health on society as a whole. In addition to these, state governments may also do well to acknowledge the conservative sentiment behind the "war on crime" stance that has culminated into the status quo of country-wide incarceration levels. Perhaps, taking a more moderate and well-thought out approach, without any imminent pressure from political action or social groups can help state governments formulate smarter ways of dealing with crime, incapacitation and rehabilitation of criminals within the current system. Such as efforts already being made, conservative policies on crime could benefit from being receptive to the additional scrutiny from opposing views, continually improving themselves with constructive feedback.



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