Crime and Economic Growth: Evidence from India

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Abstract

This paper empirically examines the causality between crime rates and economic growth using state level data in India. A reduced form equation has been estimated using instrumental variable approach to correct for joint endogeneity between crime and economic growth. Higher crimes may reduce level of per capita income and its growth rate. Controlling intentional homicide and robbery rates in each of the states to the minimum level they observed during 1991-2011 period, the predicted annual growth in per capita income could have been higher by 1.57 and 1.2 percentage points, respectively. The average annual gain in growth rate by bringing down the homicide rate at a level of national minimum could be 0.62 percentage points. Note that the loss in growth rate is lower or negative in the states that have higher per capita income.

JEL Classification: C23, O40, R10
Key Words: Crime, economic growth, panel data, India.

1. Introduction

It is well recognized in public policy debates that crime is detrimental to economic growth. Crime undermines the rule of law, and reduces perceived security of property rights and deters new investments, and thereby causes a fall in economic growth. Economic effects of crime, especially of violent crimes, are more pronounced in developing countries since the people in these countries are ill equipped to bear (UN, 2005). Several theoretical and empirical studies have tried to measure the direct and indirect cost of crime to the society.[1] However, the empirical studies have not yet produced a definite conclusion about the magnitude of the impact of crime on the economic growth. This paper aims to quantify the impact of crime on economic growth using state level data in India for the period 1991-2011.

The Global Peace Index Report 2013 ranks India in the category of 25 most violent countries and shows that India loses about 4 percent of its gross domestic product (GDP) due to crime in 2012.[2] Figure 1 presents the evolution of intentional homicide and robbery rates in India since 1991. It shows that though over the period both, intentional homicide (committed and attempted murders) and robbery rates have declined, most of this decline happened in the first 15 years and since 2006 intentional homicide rate is almost stagnant, and robbery rate has even been increasing. Note also that in recent years the growth story of India has slowed down;[3] and controlling crime may contribute to reviving the growth story again.

India experienced, on an average, a growth rate of about 5 percent per annum in the per capita income since 1991 as a result of economic liberalization. The unexpected gain of the liberalization was a steady decline in crime measured in terms of murder rate in the country (Prasad, 2012). Note that though the economic controls were removed as a process of liberalization, the criminal justice system in the country was not reformed. The basic criminal laws, the Indian Penal Code (IPC), the Criminal Procedure Code and the Indian Evidence Act, that define criminal behavior, prescribe police procedures and guide evidence presentation in the courts are maintained. It is the Indian Police Act of 1861 that still govern the constitution and organization of police forces in all the Indian states.[4] Per capita availability of police and judiciary is low in the country and the police and judiciary system is not fully modernized.[5]

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[1]Economic and social costs of crime have been estimated by many studies, for example, Mayhew (2003), Palle and Godefroy (2000), Brand and Price (2000), Roper and Thompson (2006), Miller et al. (1996), Detotto and Pulina (2013), United Nations (2007), Cotte Poveda (2012) etc.

[2]GPI report ranks India at 141 in the list of 162 countries (http://www.visionofhumanity.org/pdf/gpi/2013_Global_Peace_Index_Report.pdf as accessed on June 16, 2013)

[3]Per capita growth rate of income in the last two years has come down which was about 7 percent in 2010 (Figure 1).

[4] The states have also enacted laws on several local and special subjects and some states have also their own police acts.

[5]Police per 100,000 people in India is 137.8 as against the minimum UN norm of 220, police density per 100 square kilometer is 52, vehicles per 100 policemen is about 9, wireless equipments per 100 policemen is 22. About 350 police stations did not have telephone facility; 107 police stations were without wireless sets; and 38 police stations were having neither (http://bprd.nic.in/writereaddata/linkimages/1027356060-Chapter%20%207%20Police%20Communications.pdf as accessed on June 26, 2013). Moreover, there are only 13 judges per million people in India and the total number of pending cases in the High Court and subordinate courts was around 32 million as on 31 December 2010 of which around 8.5 million cases were more than five year old. (http://www.prsindia.org/administrator/uploads/general/1310014291~~Vital%20Stats%20-

Estimating empirically the magnitude of negative impacts of crime on economic growth will provide incentive for reforming and modernizing the criminal justice system.

We take state as unit of analysis since India is not only a socio-economically and geographically diversified country; there is huge variability in crime rates also among the states (Dreze and Khera, 2000). One striking fact of the post-1991 growth of India is that there has been significant increase in regional disparities of growth and poverty reduction across states (Rao, 2008). About 72 percent of India's poor and half of the population are located in the following six states: Uttar Pradesh (including Uttaranchal), Bihar (including Jharkhand), Madhya Pradesh (including Chhattisgarh), Maharashtra, West Bengal and Orissa (Kumar and Managi, 2012). Increasing economic inequality and poverty enhance crime in a country, as is evident from various studies (e.g., Fajnzylber et al. 2002a 2002b, Sharma 2011, Pridemore 2011). Note that law and order is a state subject in India; any major initiative to deter crime has to take place within the resources and domain of the concerned state government.

The purpose of this paper is to provide empirical evidence concerning the impacts of crime rate on the growth rate of per capita income for the Indian states during the liberalization era. Though crime can affect economic growth through various channels such as deterring investment, this paper takes a reduced form equation approach well-grounded in the growth literature. It examines a relationship between the proclaimed indicators of crime such as intentional homicide and robbery rates and economic performance without relying on *a-priori* assumptions about what mechanisms to include and how they might operate, interact, and aggregate. By using a panel data set of 26 states over the period 1991-2011, we isolate the effect of intentional homicide and robbery rates from time-invariant state characteristics such as geographic and cultural factors. We estimate panel lag structure specification of the model that provides information not only on the magnitude and locus of crime effect on the economic growth, but also on whether it impacts state growth rates or the level of income or both.

Crime can influence economic activities in two possible ways: affecting the level of output, for example, loss due to lost working days/lives or property damages; or by affecting the growth rate of per capita income which can happen due to foregone investments and institutional changes that influence productivity growth. In the initial period both affect the growth potential of the economy. Negative effects of crime on the level of output may be transitory effects and may reverse to its *prior* state, but the growth effects are not reversed and leave the economy permanently behind. The lag structure estimation procedure help in examine whether an incident of crime has temporary or persistent impact on economic activities, and thus whether crime has level or growth impacts or both. Our results suggest that higher crime rates reduce growth rate in Indian states, not simply the level of output. Since even small growth effects have large consequences over time, growth effects indicate large impacts of intentional homicide and robbery rates.

%20Pendency%20of%20Cases%20in%20Indian%20Courts%2004Jul11%20v5%20-%20Revised.pdf as accessed on June 26, 2013). Kumar and Kumar (2013) shows modernization of police improves its efficiency. Note also that various commissions including the National Police Commission of 1977 and the Supreme Court has directed at certain occasions for modernization of Indian police, but 'so far the history of police reform in India is that of a series of dreams few effective changes.' (Banerjee et al., 2011)

The paper is organized as follows: Section 2 provides a sketch of the related literature and describes empirical strategy followed in the paper. Data and stylized facts on economic growth and crime rates in various Indian states are discussed in Section 3. Section 4 illustrates the model specification and estimation framework. Discussion on the results has been provided in Section 5. Concluding remarks are given in the final section of the paper.

2. Related Literature and Empirical Strategy

Theoretically various channels can be considered through which crime can affect economic performance, especially the growth potential of an economy. Criminal activities increase risks and effectively impose a tax of the returns to investment as some resources are diverted to protective activities from the productivity enhancing activities, and thereby negatively influence capital accumulation. That is, crime lowers both domestic and foreign private investment (Sandler and Enders 2008); crowds out public expenditure from productive assets such as infrastructure and education to protective activities. It erodes faith in the rule of law and public institutions and damages social relations and disrupts local learning interactions and knowledge spillovers between firms which are essentials of good business environment. Moreover, as high crime environment increases returns to criminal activities relative to returns to legal productive activities, it discourages incentives for human capital accumulation.

It is the influential Backer's (1968) paradigm that formally provides economic rational to criminal activities. Criminals respond to economic incentives in the same way as the law-abiding citizens do. This model predicts that law enforcement depends on the probability of detection of a crime and severity of the punishment. Similarly, Ehrlich (1973) models the participation of individuals in non-market, legal and illegal activities, and predicts an unspecified effect of crime on economic development. Moreover, it finds that inequalities increase the level of crime and the probability of trepidation discourages the crime. A number of studies have been conducted to understand the determinants of crime (e.g., Dreze and Khera 2000, Chaudhary et al 2013, Sharma 2011 in Indian context; and Fajnzylber et al. 2002a 2002b, Pridemore 2011 in cross country context). Most of the published literature focused on the determinants of crime, and crime as one of the determinants of economic growth largely remains neglected in macro-economic framework (Detotto and Otranto 2010).

Some contributions have theoretically tried to establish a relationship between crime, growth and development (e.g., Bourguignon, 2000, 2001; Fajnzylber et al., 2002a, Mauro and Carmeci 2007) and some studies quantify economic and social cost of crime for different countries [Australia (Mayhew 2003), France (Palle and Godefroy 2000), the United Kingdom (Brand and Price 2000), New Zealand (Roper and Thompson 2006), the United States (Miller et al. 1996), Italy (Detotto and Pulina 2012), for some Latin America States (United Nations 2007) and Colombia (Cotte Poveda 2012)]. The econometric results show that crime leads to a negative effect on real per capita output and employment. For example, Peri (2004) using panel data of Italian provinces for 1951-1999 observes crime has a statistically significant negative effect on economic output and employment, indicating the possibility of nonlinearities in the crime-growth relationship. In particular, while she finds a statistically significant adverse violent-crime effect on growth, the impact of property crime is weak and in some specifications perverse. A World Bank study

(World Bank, 2006), using a sample of 43 countries for the period of 1975-2000, shows a strong negative relationship between crime and growth even after controlling for human-capital accumulation and income inequality. Similarly, Càrdenas (2007) finds a significantly negative association between crime and per-capita output growth in a panel of 65 countries using homicides data for 1971-1999. Time-series studies (e.g., Dettoto and Pulina 2009, Dettoto and Otranto 2010) using single country data also find a negative association between crime and income levels. However, Chatterjee and Ray (2009) based on a large cross-country sample for the period 1991-2005 and controlling for human capital and institutional quality, find no strong evidence of a uniformly negative association between crime and growth. Burnham et al. (2004) using US county level data are not able to establish a clear connection between central city crime and per capita income growth.

Note that most of the above cited studies are in the context of developed countries and measure the effects of crime on economic performance in terms of level of income. Following the above cited line of reasoning, we investigate the effects of crime on economic performance measured in terms of level and growth of per capita income at the state level in India, which is a developing country. We adopt a reduced form approach to examine the aggregate outcomes directly rather than relying on *a-priori* assumptions about the potential channels and determinants of the relationship between growth and crime. The reduced form approach has its root in the Ramsey-Solow growth literature. We estimate a more general econometric model for identifying growth effects of crime rates in the context of a dynamic panel growth regression, following the derivation in Bond et al. (2010).

We investigate the robustness and causality of the link between crime rates measured in terms of intentional homicide and robbery rates and economic growth from an empirical perspective. We present the stylized facts starting from the simplest statistical exercises and moving gradually to a dynamic econometric model of the determinants of crime rates. First, we study the correlation between the crime rates, separately, homicide and robbery rates and growth rate of per capita income along different dimensions of the data, namely, between states, within states, and pooled cross-state and time-series data. Second, along the same data dimensions, we examine the link between homicide and robbery rates and economic growth by controlling for the state specific time-invariant characteristics. In this formulation also we specify a lag-structure estimation procedure to get the estimates of the effects of intentional homicide and robbery rates on the level of per capita income and its growth rate. Third, we control for the likely joint endogeneity. Controlling for joint endogeneity is essential to obtain consistent estimates of the effect of crime rate variables on growth rates. For instance, in assessing the impact of crime rates on growth rate, we must control for the possibility that higher growth rate lowers down crime rates (Fajnzylber et al. 2002a 2002b). Fourth, we control for the measurement error in economic performance and crime rates by modeling them as both an unobserved state-specific effect and random noise. We correct for joint endogeneity and measurement error by applying an instrumental variable estimator for panel data. We use the generalized method of moments (GMM) estimator applied to dynamic models of panel data to quantify the effect of crime rates on economic growth (Arellano and Bond, 1991; Arellano and Bover, 1995).

3. Data and Stylized Facts

To investigate the impact of crime on economic growth in India, we rely on a balanced panel dataset on the Indian states over the 1991-2011 period. We take information of 25 states and the union territory of Delhi. We consider the position of before-2001 for the states of Bihar, Madhya Pradesh and Uttar Pradesh from which three states namely Jharkhand, Chhattisgarh and Uttarakhand have been carved out in 2001, i.e. we consider all the states. We do not consider the union territories of A&N Islands, Chandigarh, D&N Haveli, Daman & Diu, Lakshadweep and Pondicherry, since these union territories are very small in size, and insignificant in terms of population, crime, and economic variables as compared to the states and union territory of Delhi. The selected 25 states and the union territory of Delhi account for more than 95 percent of the crime and gross domestic product in the country, and are, therefore, representative.

The selection of period is based on two factors: (i) in the year 1991 India embarked on the path of economic liberalization and it is supposed that the liberalization leads to economic growth and reduces crime rates. However, it needs to be investigated the role of reduction in crime rates in stimulating economic growth; and (ii) on the availability of all the required data for the selected states and union territory. Crime data is available in the country at the district level since 1953, but the data on annual time-series of economic covariates, other than income, is non-existent even at the state level.

We focus on real per capita net state domestic product and, measure state level criminal activities using data on intentional homicide (committed and attempted murders) and robbery rates. These rates are taken with respect to the state's population; specifically, they are the number of homicides or robberies per 100,000 people. Homicide rates are commonly deemed to provide a good proxy for the incidence of criminal activity, since they are usually highly correlated with other violent crime rates and, more importantly, contrary to other types of crime they are not plagued by underreporting (e.g., Dreze and Khera 2000, Chaudhary et al 2013). To complement the impact of homicide rate on growth, we consider the robbery rate as a second proxy for the incidence of crime. Although data on robberies are less reliable than homicide data, they are likely to be more reliable than data on lesser property crimes such as theft. This is so because robberies are property crimes perpetrated with the use or threat of violence; consequently, their victims have a double incentive to report the crime, namely, the physical and psychological trauma caused by the use of violence and the loss of property (Fajnzylber et al., 2002a). The data on crime have been taken from the '*Crime in India'* (various volumes), National Crime Records Bureau, Ministry of Home Affairs, New Delhi. The data on per capita income measured as real per capita net state domestic product on 2004-05 prices comes from the Reserve Bank of India (www.rbi.org.in). The descriptive statistics of pooled sample variables is presented in Table 1.

Figure 1 illustrates some features of the data at all India level. It shows the evolution of the mean values for per capita income growth, and the intentional homicide and robbery rates. While the former displays a rather pronounced upward trend, growing from 2.24 in 1991 to about 7 percent in 2010, but declined to 5.13 percent in 2011. Both the crime rates are characterized by a negative trend particularly till 2005. Intentional homicides per 100,000 people in 1991 were 8.1 and it declined to 5.51 in 2005. Since 2006, there is almost stagnancy in the intentional homicide rate, in 2011 it was 5.48. On the other hand, robbery rates declined from 3.1 in 1991 to 1.6 in 2005, but increased to 2.1 in 2011.

Figure 2 shows that there is a remarkable variability in regional intentional homicide and robbery rates in India, the mean values of intentional homicide rate in the period (1991-2011) ranging from about 2.76 in the case of Kerala to 17.13 for Manipur. It should be noted that most of the Northern and North-Eastern states observe high rate of intentional homicides relative to their counterpart states in Southern and Western regions. Out of 26 states and union territories 11 has observed higher mean values of homicide rate than the national average (6.91). Similarly in the case of robbery rate the states having higher than the national average (2.44) are Nagaland, Arunachal Pradesh, Delhi, Meghalaya, Tripura, Maharashtra, Assam, Odissa, Bihar, Madhya Pradesh and Goa. The lowest robbery rate was observed in the states of Himachal Pradesh, Punjab, West Bengal and Manipur; these states had robbery rate less than one. It should be noted that the states of Manipur and Jammu & Kashmir which had highest homicide rate were among the states that observed lower robbery rate. In the case of Manipur it was 0.97 and for J&K, it was 1.26. Appendix Figure A1 provides the picture of growth rate and crime rates cross the states.

Figures 3a and 3b display scatter plots of per capita income growth and the log of the intentional homicide and robbery rates for a panel of cross-state and time-series observations. To account for likely nonlinearities in the relation between growth rate and homicide and robbery rates, we use the homicide and robbery rates expressed in natural logs. In both cases, the correlation is negative, we go behind this correlation to assess issues of robustness and causality as the objective of the paper is to quantify the negative relationship between crime rates and growth.

Table 2 presents the bivariate correlations between growth rate and both the crime rates for three dimensions of the data, namely, pooled levels, pooled first differences, and state averages. The first row presents the correlation for the pooled samples in levels for the panel variables. The correlation coefficient between the growth rate and intentional homicide rate is -0.58 and statistically significant but for the robbery rate though it is negative but not statistically significant. To control for state specific characteristics which are time invariant such as geographic and cultural factor, we take correlations between the first differences of growth rate and both the crime rates. We find both the correlation coefficients are negative, but not statistically significant. To control for the factors that vary over the time, we measure correlation between the growth rate and the crime rates, based on the state averages for the whole period. Here again we find both the correlation coefficients are negative, but statistically significant for the case of homicide rates only. Note that the magnitude of correlation coefficients is smallest when the correlations were taken in first differences of the concerned variables implying that the negative correlations between the growth rate and crime rates are governed by the state specific characteristics that persist over time.

Within states and within time periods bivariate correlations between growth rate and crime rates are presented in Table 3. It contains the mean and the median of the correlations obtained using within states and within time-periods observations. We also report the percentage of the states and time periods for which we obtain negative correlations between the growth rate and the crime rates. All the estimated mean and median correlations are negative, except for the case of within period for robbery rate. In the case of homicide rates, 88 percent of within state correlations are negative, and for within periods this number is 85 percent. Only three states, namely Haryana, West Bengal and Punjab observe a positive correlation between the growth rate and homicide rate. However in the case of robbery rates the numbers are 69 and 40 percent for within state and within period negative correlations, respectively. Seven states observe a positive correlation between the growth rate and robbery rate.[6] Note that for the case of within states homicide rates the mean correlation is higher than the median correlation implying that for some of the states the negative correlation between growth rate and homicide rate is very high. However, for robbery rates, the median correlation is higher than the mean correlation indicating that there are some outliers having positive correlations that depress the average. For within time-periods correlations mean and median are almost same.

The bivariate correlations showing apparently the negative association between the growth rate of per capita income and crime rates fail to recognize the fact that these negative correlations might be driven by the other variables that are correlated with both of them and/or their own lagged values. To take care of this concern, the following section specifies the relationship between the variables of interest using exogenous growth theories and estimates using lag structure of the reduced form equation.

4. Model Specification and Estimation

Criminal activities can impact economic performance of a state through various channels. To investigate this hypothesis, our empirical framework follows the derivations in Bond et al. (2010). We start by considering the following simple panel production function model with crime effects in per capita terms:

$$Y_{it} = exp^{\beta C_{it}} A_{it} \qquad (1)$$

Where Y stands for per capita net state domestic product, A and C measure total factor productivity (TFP) and crime rate (in logarithmic terms) respectively in a state in year t. β measures the impact of crime on the level of per capita income. Taking log on both the sides of equation (1), the log of per capita net state domestic product (y_{it}) can be represented by the autoregressive distributed lag (ADL) model:

$$y_{it} = a_{it} + \alpha_1 y_{i,t-1} + \alpha_2 y_{i,t-2} + \cdots + \alpha_p y_{i,t-p} + \beta_0 C_{it} + \beta_1 C_{i,t-1} + \cdots + \beta_p C_{i,t-p} + \mu_i + \varepsilon_{it} \qquad (2)$$

Where a_{it} is the logarithm of A_{it}, and μ_i and ε_{it} are time-invariant state specific unobserved characteristics that affect the per capita income levels and error term, respectively. a_{it} is assumed to be non-stationary process that determines the behavior of the growth rate of per capita income in the long run and which is consistent with transitional growth in Solow model (Mankiw et al., 1992). Following exogenous growth theories, the long run growth rate of per capita income (growth in TFP) is assumed to follow;

$$\Delta a_{it} = \theta_0 + \theta_1 C_{it} + d_i + e_t + v_{it} \qquad (3)$$

[6]The seven states are: Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odissa and Punjab.

Where d_i is the time invariant state specific unobserved characteristics, and e_t and v_{it} respectively represent common permanent and state specific shocks to y_{it}. Moreover, Bond et al (2010) assume that v_{it} is independent across states, conditional on e_t. Taking first difference in equation (2) and substituting for Δa_{it}, we obtain:

$$\Delta y_{it} = \theta_0 + \theta_1 C_{it} + \alpha_1 \Delta y_{i,t-1} + \alpha_2 \Delta y_{i,t-2} + \cdots + \alpha_p \Delta y_{i,t-p} + \beta_0 \Delta C_{it} + \cdots + \beta_p \Delta C_{i,t-p} + d_i + e_t + v_{it} + \Delta\varepsilon_{it} \qquad (4)$$

This is a dynamic model of the level of per capita income with state and time effects and log of crime rate (C_{it}), provided $\sum_{i=1}^{p} \alpha_i \neq 1$. The lags of Δy_{it} and ΔC_{it} are included to control for cyclical fluctuations. Note that though the state specific time invariant variables get eliminated while taking the first difference. We have included d_i to account for state specific unobserved characteristics such as institutions that may affect both steady state growth rates and crime rates. The impact of the change in crime rate (in logarithmic terms) on the log level of per capita income can be measured as: $\sum_{i=0}^{p} \beta_i / (1 - \sum_{i=1}^{p} \alpha_i)$. In a steady state with C_{it}=C_i and no shocks, state specific steady state per capita income growth rate (g_i) is:

$$g_i = \frac{\theta_0 + \theta_1 + d_i}{1 - \sum_{i=1}^{p} \alpha_i} \qquad (5)$$

If $\theta_1 = 0$, the growth in a_{it}, and hence in steady state per capita income is common to all states. If $\theta_1 < 0$, the growth in a_{it} varies across states with their (log) crime rates.

The test of whether crime rate affects the growth rate of per capita income in the long run is equivalent to testing whether equation (5) is less than zero. Evidence that equation (5) is not equals to zero would be consistent with both, exogenous models in which the steady state growth rate of per capita income is given by purely exogenous factors such as crime rate and endogenous growth theories. The advantage of the panel approach is that it allows us to address the endogeneity issues that naturally arise when investigating the impact of crime on growth, and that cannot be addressed satisfactorily in a single cross-section (Bond et al, 2007).

To estimate the effects of crime rates on the level and growth rate of per capita income we need to estimate the parameters of equation (4) which requires that all the variables in the equation, including the log level of crime rate should be stationary.[7] Note that if the error in equation (2) is not serially correlated, the error term in equation (4) has a MA(1) structure which correlate it with the lagged values first difference of log of per capita income. As a result the parameter estimates obtained using OLS will be biased and inconsistent (Bond et al. 2010). Instrumental variable estimation can provide consistent estimates, if the error term in equation (2) is serially uncorrelated, using lagged values of endogenous variables from period *t-1* and earlier as instruments. We use GMM system estimator, developed by Arellano and Bond (1991) and Arellano and Bover (1995) for estimating equation (4), which uses the dynamic properties of the data to generate proper instruments. Sargan-type test and serial correlation test are used to judge the correct specification of the estimated equation.

[7]Time series properties of the variables are discussed in Section 5.

5. Results and Discussion

We start with the time series properties of the variables used in the study. Simple ADF tests are not able to reject the null hypothesis of unit root, both with and without trend, for individual states for all the variables.[8] Univariate unit root tests lack power for distinguishing highly persistent, yet stationary processes from unit root processes. Panel unit root tests are able to substantially increase power over univariate tests if the panel data is cross-sectionally independent. In the presence of cross-section dependence, this needs to be accounted for in order to retain the high power properties of these tests. Panel unit root tests of the second generation such as Pesaran's CIPS accounts for this dependence. To test whether the variables used are stationary we use a battery of panel unit root tests. For robustness reasons, we use Maddala and Wu (1999), Im et al (2003) and Pesaran (2007) panel unit root tests.

Results of panel unit root tests are provided in Table 3. For the log level of per capita state domestic product, we are not able to reject the null hypothesis of non-stationarity, but are able to reject the null for the growth rate for all the three tests under without and with trend scenarios. For log level of both the crime rates, homicide and robbery rates, we reject the null hypothesis of unit root for all the three tests in with trend scenario, but not able to reject the null for the IPS (Im – Pesaran – Shin) test in without trend. Thus we assume that all the three series and their lag values are stationary. Moreover note that the Arellano-Bovver approach has better small sample properties and is better at modelling non-stationary data which we use for estimating the parameters of equation (4).

We estimate three variant of equation (4) using OLS with state dummies[9] and GMM system estimator: only homicide rate, only robbery rate, and both homicide and robbery rates. Regression results are given in Tables 4 and 5. We find negative and significant effect of crime rates on growth rate, for all three variant of the OLS estimates. These estimates may be biased due to neglecting the serial correlation in the error term and joint causality between economic growth and crime rates.[10] Failure to correct for the joint endogeneity of the explanatory variables leads to inconsistent coefficients, which depending on the sign of the reverse causality would render an over- or underestimation of their effects on growth rate. We address the problem of joint endogeneity through using an instrumental variable procedure applied to dynamic models of panel data. The GMM estimator uses the dynamic properties of the data to generate proper instrumental variables (Fajnzylber et al, 2002a). In the GMM system estimator, we use lagged observations dated from *t-1* to *t-3* on the growth rate and log crime rates and growth rate of crime rates as instruments. We are not able to reject the validity of these instruments by the Sargan – Hansen test of over-identifying restrictions. We observe negative first-order autocorrelation in the residuals when we estimate these different variants of equation (4) using GMM system estimator. We are not able to reject the null hypothesis of second order no serial correlation of

[8] Results concerning ADF test can be had from the author on request.

[9] This is equivalent to fixed effect model. We estimate the equation using random effect panel model also, but based on Hausman test of specification we select fixed effect model.

[10] Sharma (2011) and Fajnzylber et al. (2002a 2002b) find that higher growth rates of per capita income depress crime rates.

the differenced residuals which again validates the choice of appropriate instruments. Therefore, we focus on the GMM system results.

In the first variant which considers only the homicide rates, we find that the lagged value of the growth rate, log of homicide rate and its first difference and the lag of first difference have significant coefficients with the expected signs. Growth rates show a sizeable degree of inertia implying some kind of divergence in the growth rates among the states. Second variant of the model uses only the robbery rates as the determinant of growth rate. We find that the lagged value of growth rate and the log of robbery rate are statistically significant. Robbery rates affect the growth negatively. The first difference of robbery rates and its first and second lags of the first difference though have negative values, are not statistically significant. In the third variant, we consider both, homicide and robbery rates. The regression results of third variant show that the lagged value of growth rate, log of homicide rates, lag of first difference of log homicide rates, and log of robbery rates are statistically significant and have expected signs. Note that the magnitudes of the coefficients, that are statistically significant and have expected signs, in the third variant are smaller than the magnitude of the corresponding coefficients obtained either first or second variants of the model. This may be due to high correlation between the homicide and robbery rates in India.[11]

By using the coefficients related to log crime rates and their correspondences we can evaluate the impact of decline in crime rates on the growth rate and the level of per capita net state domestic product. Estimates of the general dynamic models suggest significant, negative long-run effects of homicides rates on both the slope and the level of long-run growth paths, but the level effects are not statistically significant in second and third variants of the model.[12] By using the model reported in first column of Table 5, we find that a decrease in homicide rate from 5.93 (first quartile of the sample distribution) to 4.59 (the sample median) is predicted to increase the annual growth rate of per capita net state domestic product by about 11 percentage points. Similarly, reducing the robbery rate from 2.09 (first quartile of the sample distribution) to 1.1 (the sample median) increases per capita income by 3.72 percentage points. Note that the level effect though statistically significant for the homicide rates, but its magnitude is very small.

The empirical results show that crime has had a significant and negative effect on economic performance of Indian states. As crime rates, especially the homicide rates, are higher in most of the northern and north-eastern states relative to their counterpart western and southern states, this may explain to some extend persistent regional economic inequalities. Therefore, it would be useful to compare the existing growth rate to a hypothetical scenario in which the crime rate, for each year over the 1991-2011 period, is fixed at some level. We hypothesise two scenarios, first, each of the state has a fixed crime rates in each of the year which is equal to the minimum it observed during the study period, and second, which is equal to the national minimum observed during the period of 1991-2001. The national minimum homicide and robbery rates were 5.27 in 2007 and 1.6 in 2005, respectively. Figures 3a and 3b plot the average annual values of loss in growth rate over the period under analysis under these two scenarios.

[11] The correlation coefficient between intentional homicides and robberies is 0.83.
[12] Standard errors for the growth effect and level effect are computed using the delta method.

Figure 3a shows that if each of the states has controlled the crime rates to the level of minimum they observed, the predicted annual growth in per capita income could have been higher by 1.57 and 1.2 percentage points due to homicide and robbery rates, respectively. By controlling the homicide rates to their minimum, the biggest gainer states could have been Jammu and Kashmir, Manipur, Nagaland, Uttar Pradesh and Sikkim. Note that some of the north-eastern states and the state of Jammu and Kashmir are prone to the problem of insurgency, implying that addressing insurgency in these states may contribute, to a large extent, reviving growth in these states. Similarly in the case of robbery rates, the most gainer states could be Odissa, Manipur and Mizoram. In all these states the predicted growth in per capita income could be higher more than 2 percentage points.

Figure 3b illustrates that most of the states having the crime rate below the national minimum are economically better off relative to the states that are performing below national minimum in terms of crimes. The average annual gain in growth rate by bringing down the crime rate at national minimum could be 0.62 and 0.17 percentage points for homicide and robbery rates, respectively. This Figure also shows that the loss in growth rate is lower or negative in the states that have higher per capita income; correlation coefficient between these two figures is positive and statistically significant. State-wise yearly gains in growth rate for controlling crime under these two scenarios are presented in Appendix Figures A2 and A3. Note that, the changes in crime rates are unlikely to take place in isolation and affect economic and institutional factors; therefore, the results in Figures 3a and 3b should not be taken at face value and be considered with caution. However, they do indicate that reducing homicide and robbery rates in high-crime states may significantly contribute to their economic growth.

6. Conclusions

To establish the relationship between crime and economic growth in India we apply bivariate and multivariate methods. We take a reduced form approach to estimate the effects of crime, especially intentional homicide and robbery rates. To account for reverse causality between crime and economic growth and inertia in growth rates and crime rates, we use instrumental variable dynamic penal data approach. To test for the stationarity properties of the data we apply first and second generation panel unit root tests. To test the robustness of estimated parameters and validity of chosen instruments we use Sargan-type and serial correlation tests.

We find a negative and statistically significant relationship between the violent crimes and growth rate of per capita income. Intentional homicide rates affect both the level of per capita income and its growth rate in Indian states. However, the robbery rates affect only the growth rate. Reducing homicide rate from 5.93 (first quartile) to 4.59 (median) is supposed to enhance the annual growth rate of per capita net state domestic product by about 11 percentage points, and a reduction in robbery rate to 1.1 from 2.09 increases growth by 3.72 percentage points. If the states keep controlled the rates of homicide and robbery rates at the minimum level they observed during the liberalization era, the corresponding gain in the growth rate could be about 1.57 and 1.2 percentage points, respectively. It is worth to note that the states prone to the problem of insurgency are most affected due to violent crimes.

The evidence shows that the estimated effects are large in magnitude; these large and persistent effects suggest further investigation of the crime-growth relationship. Note that these analyses are reduced form, and therefore do not identify the possible complex structural relationships between crime and economic activities. For example, crime may deter investments in physical and human capital accumulation by effectively taxing the returns on productive investments. Testing structural relationships involve identifying a number of ad-hoc assumptions and lies far beyond the scope of this study. It focuses rather on net effects.

The results show that crime per se has an important effect on economic performance. It does not rule out that many other factors such as the quality of economic, legal and political institutions and the nature of both macroeconomic and microeconomic government policies, including those related to social sectors may play important roles in determining both the level of crime and economic development. The evidence presented here induces to take steps that help in curbing crime in the country. The criminal justice institutions should be modernized and reformed, given the magnitude of foregone economic benefits due to high crime rates. Deterrence could be an effective measure which requires increasing police density and per capita availability of police (Kumar and Kumar, 2013) and judiciary in an area. Moreover, note that socially and economically inclusive development prevents crimes in a society. For example, Kerala observes lowest homicide rates in the country and it has highest female to male ratio. A robust research study is required to understand the factors that contributed in reducing crime rate in the country after liberalization.

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Table 1: Pooled Descriptive Statistics of the Variables Used in the Study

Variable	Obs	Mean	Std. Dev.	Min	Max
Per Capita Income (INR 2004)	546	27205	16398.67	7943.00	116493.00
Homicide Rate (per 100000 persons)	546	6.91	3.98	2.12	25.77
Robbery Rate (per 100000 persons)	546	2.44	2.03	0.07	15.94
Annual Growth Rate of Per Capita Income (%)	520	4.61	4.07	-8.68	15.66

Table 2a: Pairwise Correlations between the Growth Rate of Per Capita Income and Homicide and Robbery Rates (in logs)

	Homicides	Robberies	Obs
Pooled levels	-0.27**	-0.07	546
Pooled first differences	-0.08	-0.04	520
State averages	-0.58***	-0.08	26

Note: ***, ** indicates 1% and 5% or above level of statistical significance respectively.

Table 2b: Within-State and Within-Period Pairwise Correlations between the Per Capita Growth Rate and Homicide and Robbery Rates (in logs)

	Homicides		Robberies	
	Within State	Within Period	Within State	Within Period
Mean correlation	-0.26**	-0.22**	-0.14**	0.02
Median correlation	-0.20**	-0.23**	-0.21*	0.02
Negative correlations (%)	88	85	69	40
Obs	26	20	26	20

Note: ** indicates 5% and * indicates 10% level of statistical significance

Table 3: Panel Unit Root Tests

Variable	Without Trend	With Trend
Im – Pesaran - Shin (2003)Test for Unit Roots in Panels		
Log(Per Capita Income)	13.5177	3.8862
Growth Rate of Per Capita Income	-2.0167**	-2.2129**
Log(Homicide Rate)	-0.4768	-1.9906**
Log(Robbery Rate)	-0.1267	-1.898**
(A) Maddala and Wu (1999) Panel Unit Root test (MW)		
Log(Per Capita Income)	0.638	35.262
Growth Rate of Per Capita Income	76.997**	73.387**
Log(Homicide Rate)	75.127**	77.866**
Log(Robbery Rate)	59.537	86.151***
(B) Pesaran (2007) Panel Unit Root test (CIPS)		
Log(Per Capita Income)	1.944	-2.681***
Growth Rate of Per Capita Income	-2.195**	-4.748***
Log(Homicide Rate)	-2.067**	-3.255***
Log(Robbery Rate)	-2.565***	-1.838**

Note: Reported figures are the W statistics in Im et al. (2003). Under the null hypothesis of a unit root (where the alternative is one sided), the test statistics is asymptotically distributed as a standard normal. Null for MW and CIPS tests: series is I(1). MW test assumes cross-section independence. CIPS test assumes cross-section dependence is in form of a single unobserved common factor. The number of lags used in the test is two. Number of states is 26 and sample period is 1991-2011.**, ***: 5 and 1% level of significance.

Table 4: Basic Economic Model in First Difference: Fixed Effect Models

	Homicide Rate	Robbery Rate	Homicide and Robbery Rate, both
Δy_{it-1}	0.2050171***	0.214793***	0.1946754***
	(4.45)	(4.6)	(4.18)
H_{it}	-0.0311745***		-0.0287079***
	(-3.95)		(-3.32)
ΔH_{it}	0.0000563		0.0000581
	(0.52)		(0.53)
ΔH_{it-1}	-0.0000587		-0.0000508
	(-0.54)		(-0.46)
R_{it}		-0.01257**	-0.0050763
		(-2.57)	(-0.95)
ΔR_{it}		0.017223	0.0135251**
		(1.62)	(2.05)
ΔR_{it-1}		0.00569	0.0036293
		(0.89)	(0.56)
ΔR_{it-2}		0.00201	0.0024879
		(0.34)	(0.42)
Intercept	0.1658003***	0.073956***	0.1710179***
	(5.05)	(5.08)	(5.18)
Growth Effect	-0.0392141***	-0.01601**	-0.041951***
	(15.93)	(6.7)	(17.68)
Level Effect	-3.09E-06	0.03174	0.02439954
	(0)	(1.52)	(1.92)
Hausman Specification Test	-31.81	-43.7	-35.13
(p-values)	0	0	0
Number of States	26	26	26
Number of Observations	468	468	468

Note: y: log per capita net state domestic product, H: log homicide rate, R: log robbery rate. Values in parentheses are t-statistics. *,**, ***: 10, 5 and 1% level of significance.

Table 5: Dynamic Panel Economic Model

	Homicide Rate	Robbery Rate	Homicide and Robbery Rate, both
Δy_{it-1}	0.2005237***	0.340627***	0.2229158***
	(8.57)	(7.43)	(4.05)
H_{it}	-0.0342086***		-0.0258538***
	(-8.18)		(-6.27)
ΔH_{it}	-0.0000845***		-0.0000637

	(-3.62)		(-1.59)
ΔH_{it-1}	-0.0001061***		-0.0000693**
	(-6.81)		(-2.23)
R_{it}		-0.0107	-0.0073946
		(-1.75) *	(-4.96) ***
ΔR_{it}		0.00809	0.0186103
		(1.39)	(1.56)
ΔR_{it-1}		-0.00403	-0.0010567
		(-0.49)	(-0.24)
ΔR_{it-2}		-0.00444	0.0052598
		(-0.49)	(1.16)
Intercept	0.1762764	0.061662	0.1632891
	(9.47) ***	(3.14) ***	(10.46) ***
Growth Effect	-0.0427887	-0.01622	-0.0427862
	(72.32)***	(3.29) *	(56.08)***
Level Effect	-0.0002384***	-0.00058	0.02918662
	(45.52)	(0)	(1.92)
Test of First Order Serial Correlation	-2.7396	-3.2766	-2.439
(p-value)	0.0062	0.0011	0.0147
Test of Second Order Serial Correlation	0.31624	1.1755	0.58295
(p-value)	0.7518	0.2398	0.5599
Test of Over Identified Restrictions	21.62361	20.56844	19.55152
(p-value)	1	1	1
Number of States	26	26	26
Number of Observations	468	468	468

Note: y: log per capita net state domestic product, H: log homicide rate, R: log robbery rate. Values in parentheses are t-statistics. *,**, ***: 10, 5 and 1% level of significance.

Figure 1: Evolution of Crime Rate (per 100000 persons) and Growth Rate of Per Capita Income (%) in India

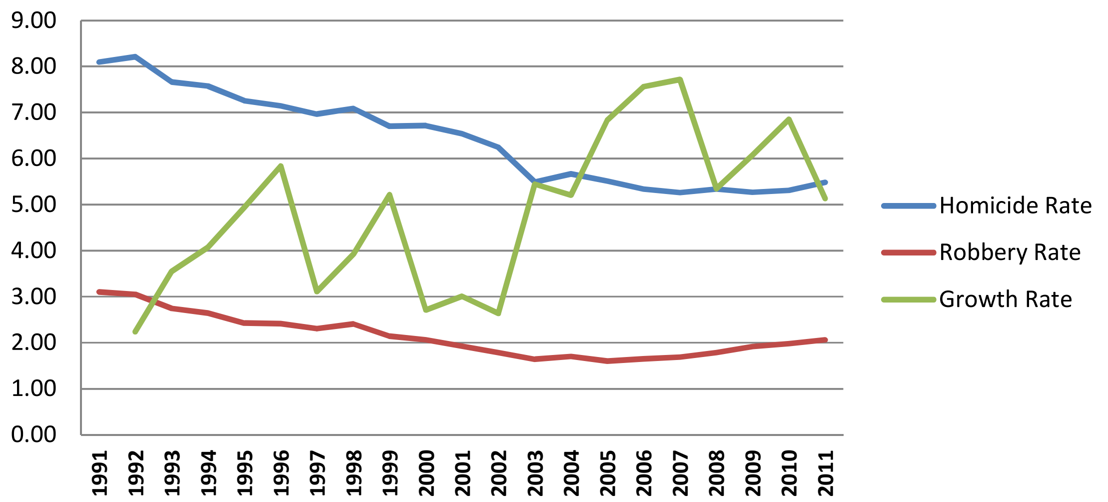


Figure 2: Mean State Level Crime Rates in India (1991-2011)

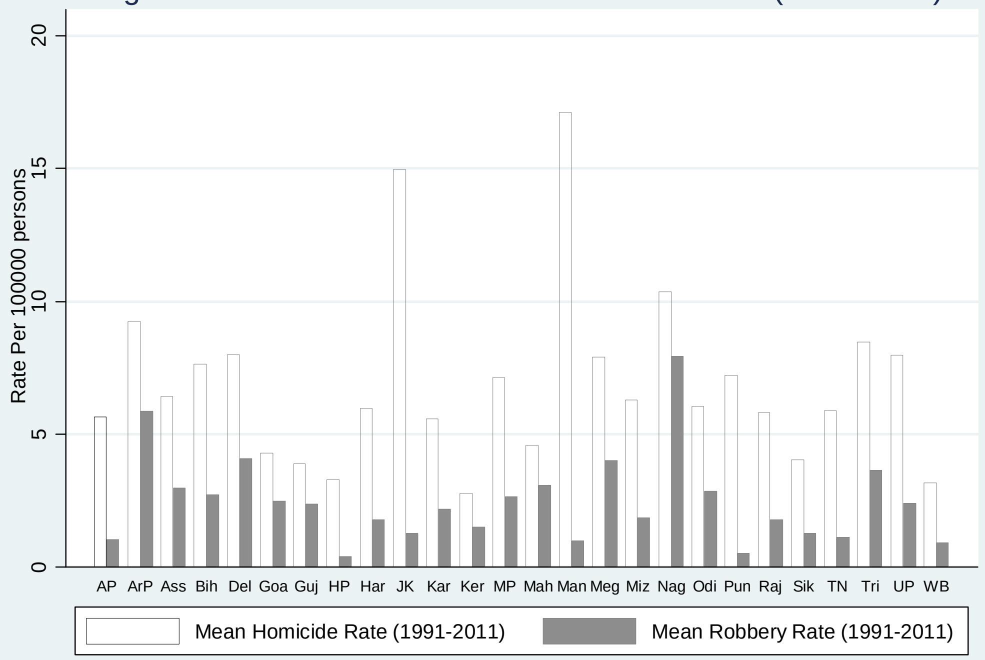


Figure 3a: Relationship between Log(Homicide Rate) and Growth Rate of Per Capita Income (%)

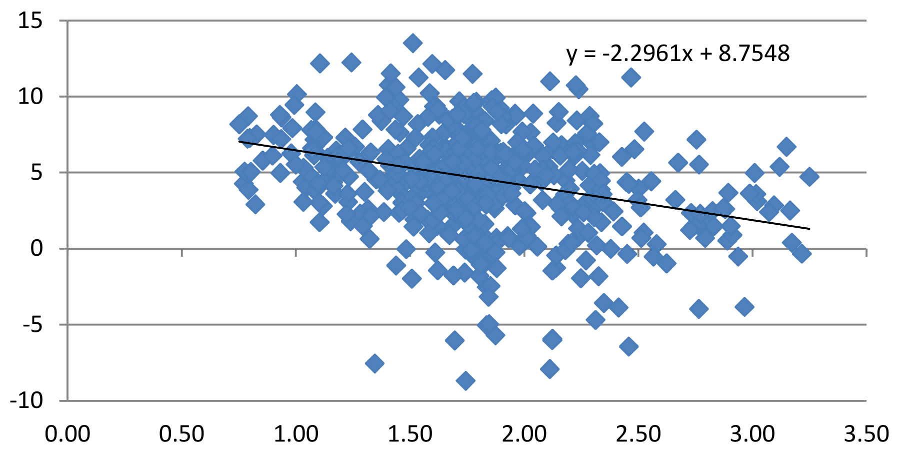
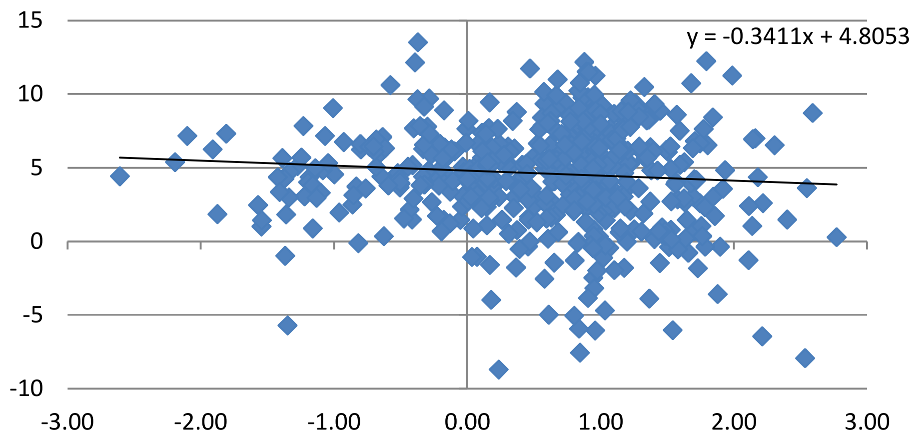


Figure 3b: Relationship between log(Robbery Rate) and Growth Rate of Per Capita Income (%)



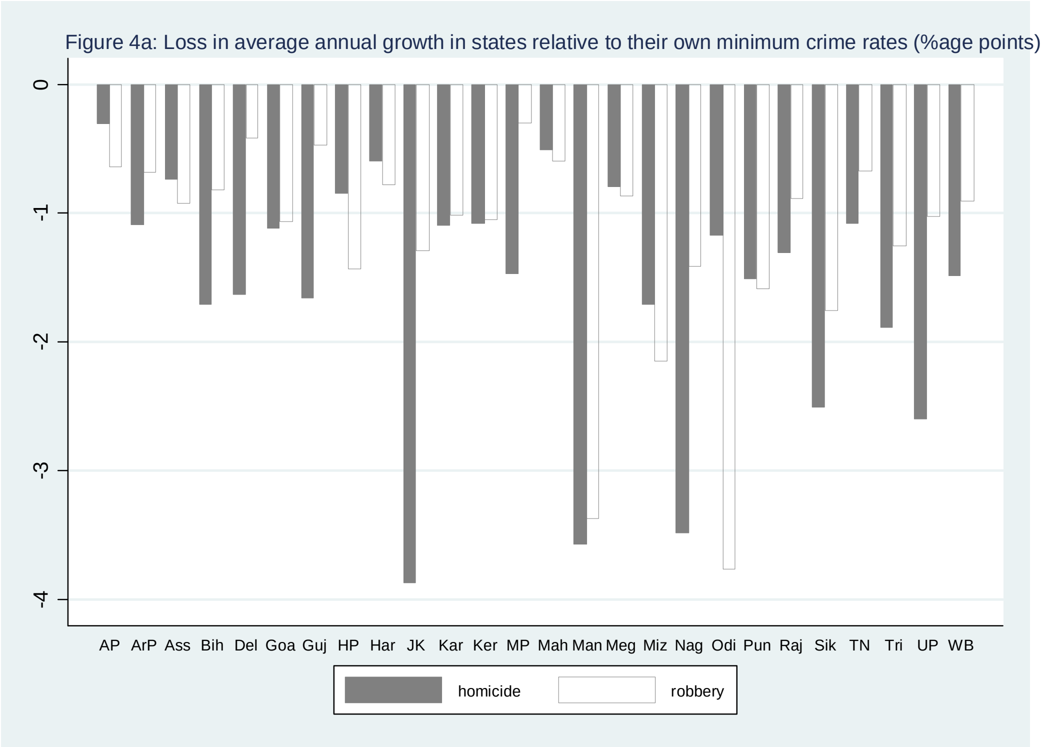


Figure 4a: Loss in average annual growth in states relative to their own minimum crime rates (%age points)
0
-1
-2
-3
-4
AP ArP Ass Bih Del Goa Guj HP Har JK Kar Ker MP Mah Man Meg Miz Nag Odi Pun Raj Sik TN Tri UP WB
homicide
robbery

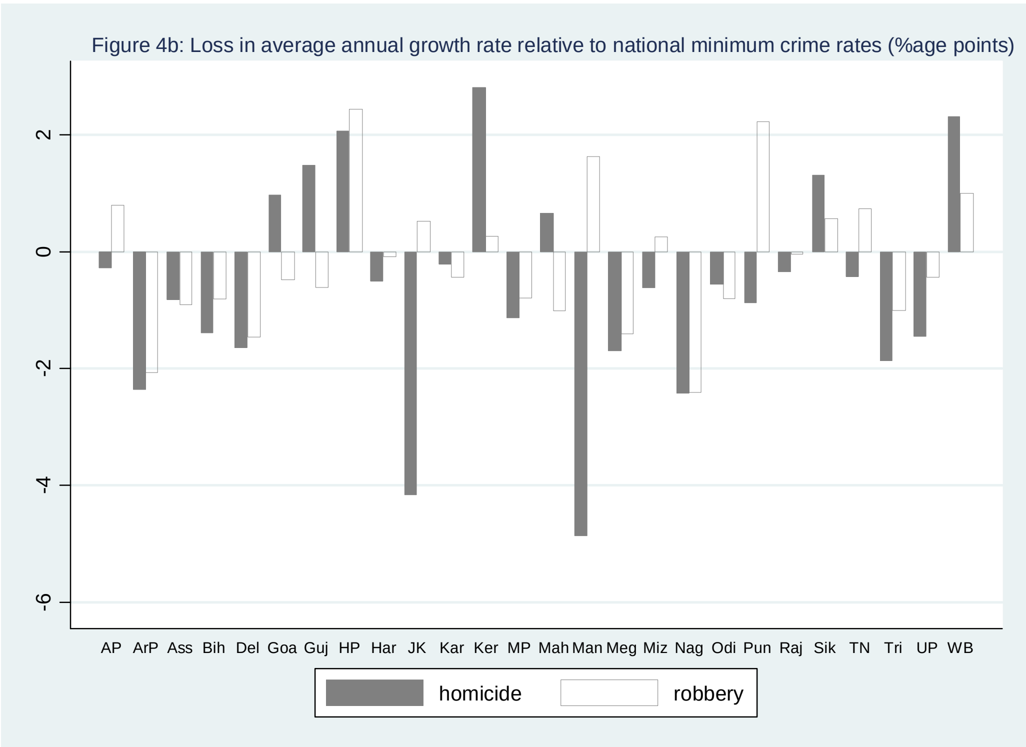
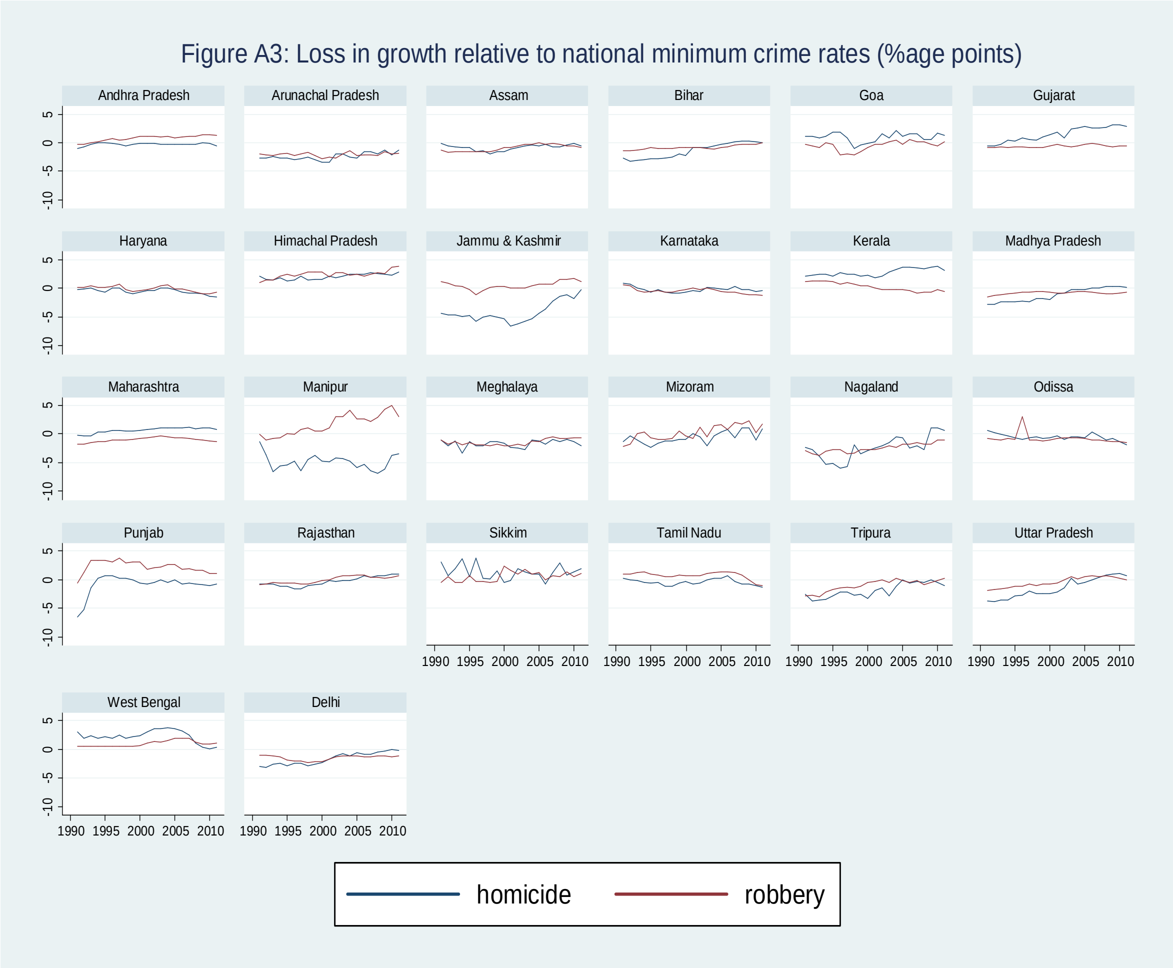


Figure 4b: Loss in average annual growth rate relative to national minimum crime rates (%age points)
2
0
-2
-4
-6
AP ArP Ass Bih Del Goa Guj HP Har JK Kar Ker MP Mah Man Meg Miz Nag Odi Pun Raj Sik TN Tri UP WB
homicide
robbery

Appendix

Figure A1: Evolution of Crime and Growth Rates across States in India since 1991

Figure A2: Loss in growth in states relative to their own minimum crime rates (%age points)



Note: positive values indicate that the state is operating below the national minimum crime rates.