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Abstract

This paper addresses the performance of Indian states in controlling sexual assault or rapeon the basis of the data published bythe National Crime Record Bureau in Indiaon the rape or sexual assault control performances of 28 major Indian states. The relative efficiencies of the states are evaluated by applying stochastic frontier analysis on two decadal periods, ending in 2001 and 2011. Among the Indian states, although Kerala is recognised as the region where women are very progressive, our findings suggest that, unfortunately, the performance of the state in controlling sexual assault is not impressive. On the contrary, Gujaratseems to be the most efficient state in controlling rape. The results also show that not all states with better rape control instruments have efficient control over sexual assault. The study concludes that investment only to improvelaw and order would not result in better control of sexual assault. Efficient management of the investments in the crime-control instruments along with improvement in social indicators, viz. female education, a favourable sex ratio, etc., are required for efficient control of sexual assault.

Keywords: Rape or Sexual Assault, Decadal Panel Data, Efficiency, Stochastic Production Frontier, Female Education, Sex Ratio, India

Introduction

> "*If there is humanity in this country, this case has to be seen with such eyes. It's not just me that has lost a daughter. Hindustan kibetibhithiwoh (She was a daughter of India).*"[2]Muhammad Yusuf Pujwala, father of the eight-year-old girl AsifaBano.

AsifaBano was an eight-year-old girl of Rasana village near Kathua in the Indian state of Jammu and Kashmirwhen she was gang-raped and then murdered by the culprits. This horrible incidentoccurredbetween the10thand 12thof January 2018. The "Nirbhaya" rape incident on16December,2012 was an eye-opener forthe government of India, which then assured its citizens that it would be the last case of that type. The "brutal" "Nirbhaya" rapists were hanged todeath with theintentionofstopping crimes of this intensity. But unfortunately, for millions of Indian women, "Nirbhaya" was not the last example of brutality. India saw a new chapter of brutality referred to as "AsifaBano." Unfortunately, these are not the only two serious cases of crimes against women and girls in India.

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[2]Times of India, 15/04/2018.

The new Indian Constitution, established after independence, passed several acts to protect the dignity of Indian women. But even in the twenty-first century, India witnesses gender-selective abortions based on the preference for a baby boy. As a consequence of this gender discrimination, the current sex ratio for India is 940 women per thousand men (Census, 2011). Gender discrimination is itself a form of violence against women. In fact, an overly simplistic view of gender inequality as rooted in statistics of violence against women overlooks the pervasiveness of discrimination rooted in Indian society, which is based on strong patriarchal norms. In fact, "patriarchal values and practices manifest themselves both in high levels of violence and in a strong preference of male children" (Dreze and Khere, 2000). The existence of the dowry system reduces the status of women in Indian society as one manifestation of gender discrimination, which gives birth to different forms of violence against Indian women, including sexual assault. While women may be victims of multiple crimes that are rooted in gender inequality, the "Crime in India" Report (2015) has defined crimes against women as: "…only the crimes which are directed specifically against women i.e. gender specific crimes, characterised as crimes against women. This characterization overlooks the gender dynamics of crimes such as murder and robbery for which men are also victims. However, various new pieces of legislation have been introduced, and amendments have been made to existing laws with a view to handle these crimes effectively. These are broadly classified under two categories:

1. Crime Heads under the Indian Penal Code (IPC)
   a) Rape (Sec. 376 IPC)[3]
   b) Attempt to commit Rape (Sec 376/511 IPC)
   c) Kidnapping & Abduction of Women (Section 363, 364, 364A, 365, 366 to 369 IPC)
   d) Dowry Deaths (Section 304B IPC)
   e) Assault on Woman with Intent to Outrage Her Modesty (Sec. 354 IPC)
   f) Insult to the Modesty of women (Sec. 509 IPC)
   g) Cruelty by husband or his relatives (Sec. 498A IPC)
   h) Importation of Girl from Foreign Country (up to 21 years of age) (Sec. 366 B IPC)
   i) Abetment of Suicide of Women (Sec. 306 IPC)
2. Crime Heads under the Special & Local Laws (SLL)
   Special Acts enacted for protection and safety of women have been clubbed under SLL. These gender specific laws in which criminal cases recorded by police throughout the country are:
   (i) The Dowry Prohibition Act, 1961
   (ii) The Indecent Representation of Women (Prohibition) Act, 1986
   (iii)The Commission of Sati Prevention Act, 1987
   (iv)The Protection of women from Domestic Violence Act, 2005
   (v) The Immoral Traffic (Prevention) Act, 1956" "Crime in India" Report (2015).

As pointed out by "Crime in India" (2015), rape alone covers 1.2 percent of the total cognizable IPC crimes in 2015. Considering the Indian population size as well as the severity of this crime, we can identify the seriousness of "rape or more broadly, sexual assault" in India. Thusthis paper involvesa detailed discussion of "rape or sexual assault" in India and includes the

[3]Excludes child rapes registered under the section 4 & 6 of Protection of Children from Sexual Offence Act 2012 which published separately in Chapter-6.

following sections: pertinent literature in the field, methodology, data and specification of variables, estimation and empirical results, and finally, discussion and conclusions.

Early Literature

Violence against women has been recognised as a significant social issue at the global level and has received considerable attention. This is because violence against women has involved both social and economic costs. Economic costs include the value of goods and services for treating and preventing violence, whereassuch violence imparts emotional costs from the social point of view (Kazi, 2012). Between 2008-2012 in India, crimes against women finally became a serious concerndue to the continuous increase in the rate of total cognizable crimes against women. As reported by NCRB, the rate of "total cognizable crimes against women"in 2008 was 17.0 percent, while the figure rose to 41.7 percent in 2012. In spite of these horrific numbers, the reported figures do not reflect the actual reality (Gupta, 2014). Krishnaraj (2007) has classified violence as both visible and invisible, or camouflaged, in moral terms and it is always a coercive instrument to uphold or enforce cultural codes of honour. At present, the most significant problems faced by Indian society are domestic violence and sexual assault against women (Bhattacharyya, 2015).

Gender-based violence, especially violent crimes like rape, is a multifaceted problem. To address this, it is essential to tackle various other concurrent issues that act as contributing factors and thus play an equally important role (Himabindu et al., 2014). The stringent laws and strict punishments are important to deter people from committing rape, perhaps the most violent crime against women, but the actual solution to this problem is much more than just promulgation (Himabindu et al., 2014). After the "Nirbhaya" rape case of 16 December 2012, the definition of rape was reframed in the "Criminal Law (Amendment) Act, 2013." In the "Criminal Law (Amendment) Act, 2013" under IPC section 375, the crime "rape or more broadly, sexual assault" is redefined and the punishment for such a crime is stated under IPC section 376. But unfortunately, the situation didn't change so much. There is no doubt that the "Nirbhaya" rape case marked a turning point in the discourse about crimes against women in India (Verma et al., 2017). Unfortunately, this is not the first and only serious case of crime against women in India. Rape or sexual assault is a crime that has long been fraught with the accumulated cultural baggage of socially defined gender norms and how sexuality ought to be expressed or withheld in given situations (Lodhia, 2015). In fact, Taslitz (1999) notesthatrape and sexual assault have strong socio-cultural roots that will condition how social institutions, including police stations, courtrooms and correctional facilities and their personnel, respond to these crimes, even extreme ones. The "Nirbhaya" situation led to modifications to the Indian criminal justicesystem and became an example of "how extreme events help drive changes to the system in a large democracy, yet an economically developing one" (Kadyan and Unnithan, 2017).

In addition to rape, another common form of violence against women is sexual victimization in public spaces. Madan and Nalla (2016) have urged the government to display visible signs in public spaces stating a ''Zero-Tolerance Policy on Sexual Harassment'' at bus stopsand on buses, the metro and roadsides; print media are also encouraged to produce poster campaigns about the punishment of such offences mentioning the relevant IPC section (Madan and Nalla, 2016).

Earlier statistical analysis of Indian crime data had concentrated mainly on ratesof crimes against women and/or any particular form of crimes against women. Driver (1961) has found that caste is an important determinant of crimes against women. In fact, the author found that in 84

percent of cases, victims and offenders belonged to the same caste. Nayar (1975) interestingly found that "police strength" had a positive correlation with lower crime rates. But this finding has to be interpreted with caution, as the study was based only on 18 observations and given the possibility of reverse causation. Chaudhuri et al. (2015) identified a positive association between crime and urbanization and a negative association between crimes against women and opportunities for employment and higher literacy rates. Thus, according to the authors, faster rates of urbanization, lower work participation rates for females and lower female literacy ratesare the major causes of crime against women in India. Again, Dreze and Khera (2000) on the basis ofthe Census district level data concluded that an adverse sexratio is highly and significantly correlated with the murder rate of women. However, the authors found no significant relationship between murder rates and urbanisation and/or poverty. They have also mentioned that female education exercised a moderating influence on criminal violence.

In aggregates, a number of studies have been carried out to understand the patterns and causes of violence against women in India. However, the specific issue of comparative efficiency analysis across states in terms of reducing "rape or sexual assault" has not gotten significant attention in India. Moreover, the Indian states to date have notundertaken any specific policiesto control "rape or sexual assault." Given this research gap, the aim of this study is twofold:(a) finding which of the states is the most efficient with respect to rape control performance and (b) looking into rape control instruments and social indicator parameters that have resulted in better performance of one state over the other. The female literacy rate, sex ratio, the percentage of scheduled-tribe persons in the population, and the percentage of the population below the poverty line, etc., are the social indicator variables which are supposed to induce the state to provide better rape control services. Thus, this paper is an attempt to fill the existing research gap in the field of women studies.

Concept and Methodology

An efficient rape control service is one that achieves its objective at the least cost. The idea of an "efficient" rape control facility is derived from the neoclassical production model in which agents choose inputs to minimise costs. However, rape control efficiency is conceptualised as the "improvement"in the efficiency so that better rape control outcomes can be achieved with given resources. One way to do this is to identify those systems that are performing better than others and looking into the factors that have induced these systems to perform better.

The performance of the rape control systems of various states of India can be evaluated by estimating the relative efficiency of these states in controlling rape. Two methods can be employed to estimate what is achievable: (a) Non-parametric- Data Envelopment Analysis (DEA) and (b) Parametric- Stochastic Frontier Analysis (SFA). Both methods have their merits and demerits. The major problems with the DEA approach are:

1. The range of the firm's inefficiency levels cannot be identified properly.
2. The SFA approach uses more information than the DEA approach.

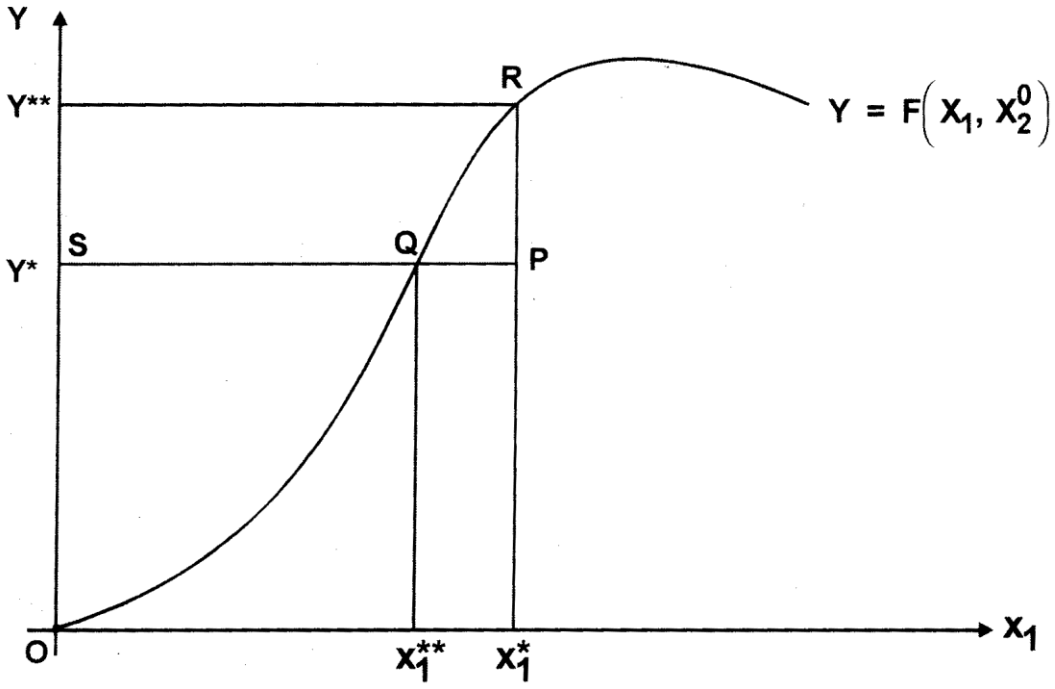
This approach misleads the investigators to level the "statistical noise" by assuming that the "statistical noise" is absent, but this is actually present as the level of inefficiency.

These prompt us to use the second method to calculate the relative efficiency of the states in controlling rape.

Farell's (1957) definition of technical efficiency, that is, the ability to produce the maximum possible output from a given set of inputs and state of technology, is similar to the definition of rape control system performance. This is because both tend to measure the relationship between observed output and the maximum attainable output for the observed inputs, that is, what the system achieves compared with its potential. Given the obvious relationship between the definition of technical efficiency and the definition of the performance of controlling rape, efficiency has been referred to as the system performance in the paper.

Farell's (1957) output-based measure sheds light on the differences in output between firms when inputs are standardised. Let us assume a generalised non-homogeneous production technology and set $X_2 = X_2^0$.

Figure-1: Farell's Output Based Measure of Technical Efficiency



Then, with reference to figure-1, $Y = F\left(X_1, X_2^0\right)$ exhibits the best practice production function. Now, if the firm is observed to produce output OY^* at point P by using OX_1^* input, the firm is said to be inefficient. It is clear from the same amount of output OY^* can be produced by utilising lesser units of input OX_1^{**}. Hence, the input saving measure of technical efficiency is defined by $\frac{SQ}{SP}$ or $\frac{OX_1^{**}}{OX_1^*}$ and thus, we can identify the corresponding measure of technical inefficiency as follows:

$$TIE = 1 - \frac{SQ}{SP} = \frac{SP - SQ}{SP} = \frac{PQ}{SP} \qquad or, TIE = 1 - \frac{OX_1^{**}}{OX_1^*} = \frac{OX_1^* - OX_1^{**}}{OX_1^*} = \frac{X_1^* X_1^{**}}{OX_1^*}$$

From figure-1 it is also clear that by using the input level, the firm is in a position to produce a greateramount of output, that is, the output level OX_1^*. Thus, $\left(\frac{TP}{TR}\right)$ or $\left(\frac{OY^*}{OY^{**}}\right)$ can be defined as the output increasing measure of technical efficiency. Hence,

$$1-\frac{TP}{TR}=\frac{TR-TP}{TR}=\frac{PR}{TR} \qquad or, TIE=1-\frac{OY^*}{OY^{**}}=\frac{OY^{**}-OY^*}{OY}=\frac{Y^*Y^{**}}{OY^{**}}$$

is the corresponding measure of technical inefficiency. So, if we consider a non-homogeneous production function, we then obtain two separate measures of technical efficiency; but if we consider linear homogeneous production function, then these two measures coincide (Fare and Lovell, 1978).

Model Specification

We start with a simple production function, where rape control outcome *Y* of the *ith (it is correct. It should be ith state.)* state is a function of access and availability of rape control infrastructure and some social inputs (*k*), denoted by X_k s:

$Y_{it}=A_iF(X_{kit})$ (1) Where A_i is the level of productivity, which is assumed to vary across states as each state is a distinct identity and utilises infrastructure differently even in similar conditions. The empirical model can be written as:

$$\left.\begin{array}{l}\ln Y_{it}=X_{kit}\beta+\varepsilon_{it}\\ or\ y_{it}=X_{kit}\beta+\varepsilon_{it}\end{array}\right\}\forall i=1....N\ and\ t=1....T$$

(2a)

Here *i*indexes states and *t*indexes time periods. Following Aigner et al. (1977) and Meeusen and van den Broeck (1977), the disturbance is assumed to be of the form:

$$\varepsilon_{it}=V_{it}-U_{it} \qquad (2b)$$

Thus, the stochastic production function for the panel data becomes

$$y_{it}=X_{kit}\beta+(V_{it}-U_{it}) \qquad (3)$$

where y_{it} is the logarithm of the output of the $i-th$ state in the $t-th$ time period. X_{kit} is a (*1*x*k*) vector of values of known functions of inputs of production and other explanatory variables associated with the $i-th$ firm at the $t-th$ observation. β is a (*k*x*1*) vector of unknown parameters to be estimated.

V_{it} is distributed as $N\left(0,\sigma_V^2\right)$ and captures random variation in output due to factors outside the control of the state (acts of God, etc.) and independently distributed of the U_{it} s . On the other hand, U_{it} s are non-negative random variables associated with the technical inefficiency of production, which are assumed to be independently distributed, such that U_{it} is obtained by

truncation (at zero) of the normal distribution with mean μ and variance σ_u^2 and independent of the V_{it} , that is, $U_{it} \sim N(\mu, \sigma_u^2)$ol output of a state is the reciprocal of the rape rate recorded and the *k* inputs are infrastructures as denoted by numbers of jails, number of policemen (per 100 square km of area), total police expenditures (in Rs. Lakhs[4]), Net State Domestic Product in Rs. Crore[5] at 2004-05 prices (for details check Table 1), etc., and some social indicators variables for the state, like the percentage of the population below the poverty line, the female literacy rate, the sex ratio, the percentage of scheduled-tribe persons in the population, the female work participation rate, urbanization, etc.

The technical efficiency U_{it} indicates that the rape control performance of a state must lie on or below the frontier $y_{it} = X_{kit}\beta + V_{it}$.

Although U_{it} is unobserved by the econometrician, its permanency implies that the states tend to observe U_{it} and take the level of U_{it} into account while demanding for infrastructure inputs in the future. For example, if this is interpreted as administrative inefficiency, it is quite apt to assume that the realisation of these will be known to the state rape controlling administrators and would affect their choice of infrastructural inputs. This violates the assumption of a linear model of uncorrelatedness of regressors with the error term rendering the estimation inconsistent.

Most studies on frontier estimation have been cross-sectional, which have their own limitations (Schmidt and Sickles, 1984). Availability of panel data, that is, repeated observations for states or individuals over time, obviates the need for strong distributional assumptions about the error term, as is common in cross-sectional studies. This facilitates the estimation of state-specific technical efficiency. Additionally, the assumption that technical efficiency is independent of factor inputs does not have to be imposed. Pitt and Lee (1981) and Schmidt and Sickles (1984) were the first to employ panel data to estimate the efficiency frontier.

The maximum-likelihood estimation (MLE) of equation (3) has been obtained by using the FRONTIER-4.1 programme (Coelli, 1996). The FRONTIER programme gives the estimate of the vector β, as well as the scalar $\gamma\left(=\frac{\sigma_u}{\sigma} \text{ where } \sigma^2 = \sigma_u^2 + \sigma_v^2\right)$, where γ lies between 0 and 1 depending on the dominance of σ and σ_u, respectively. One deficiency of this programme, however, is that estimates of technical efficiency for different states for each period are given by applying the same exponential trend function on the efficiency estimate for the last period; thus, only the trend values are observed, and the state ranking is invariant.

Data and Variables

This section deals with adetailed discussion of the data sources and specifications of the variables used for the estimation of the SPF regression.

Data

This study is entirely based on secondary data. The data for the two decadal periods ending in 2001 and 2011, are used for the purpose of this study. The relevant data are compiled from various sources, viz.the National Crime Record Bureau, the Census of Indiaand the Handbook of

[4]A *lakh* is a unit in the Indian numbering system equal to one hundred thousand.
[5]A *crore* is a unit in the Indian numbering system denotes ten million.

Statistics on Indian States. Data are selected for the two decadal time points, 2001 and 2011, and are scaled if required. The data of the total rate of rape, the number of jails, the number of policemen (per 100 square km of the area), persons arrested under custodial rape and their disposal by police and courts during 2001 and 2011and total police expenditure (TPE) in Rs. Lakhs are collected from "Crime in India," published by the National Crime Records Bureau. On the other hand, data on the percentage of the population below the poverty line, the female literacy rate, the percentage of scheduled-caste persons in the population, the percentageof scheduled-tribe persons in the population, the female work participation rate, the sex ratio and the proportion of the population living in urban areas, are compiled from the Census of India. Finally, Net State Domestic Product in Rs. million at 2004-05 prices is compiled from the Handbook of Statistics on Indian States, published by the Reserve Bank of India.

Variables

In order to measure the efficiency of the Indian states in controlling rape using the production function approach, three types of variables are essential. First, it is necessary to identify an appropriate outcome indicator that represents the output of the rape control performance of the state. Second, it is imperative to measure the rape control system instrument inputs that contribute to producing that output; and third, it is necessary to include some non-crime control-system-instruments (social indicators) determinants of controlling rape. The following sub-section explains how the output and input variables are constructed.

Output Variables: When the objective is to examine the relative performance of the Indian states in controlling rape, it will be prudent to consider the total recorded rape rate as the output indicator. However, it is assumed that a greater number of recorded rapes is linked with a lower level of law and order for the protection of women. Thus, the reciprocal of the total rape rate is considered as the output variable for this study.

Input variables: Regarding input variables, we have considered rape control instruments as well as social variables. The input variables can be broadly divided into three categories: rape control instruments, socioeconomic indicator variables and social indicator variables. The detail specifications, descriptions and the discussion of the variables are presented in Table-1.

Table-1: Definition of the Regression Variables

Variable name	Definition	Discussion
Output Variable		
Rape	Rate of crimes against women in the form of rape, recorded under Sec. 376 IPC. "Crime rate" for crimes committed against women has been calculated using only the female population based on mid-year projected female population.	---
$\ln(Rape)$	Natural logarithm of rate of rape committed against women (Sec. 376 IPC)	---
$\ln\left(\frac{1}{Rape}\right)$	Natural logarithm of the reciprocal of the rate of rape committed against women (Sec. 376 IPC).	It is assumed that a greater number of recorded rapes is linked with a lower

		level of law and order for the protection of women. Thus, the reciprocal of the total rape rate is considered as the output variable for this study
Input Variables		
Jails	Total number of jails in the state.	This is a crime control instrument. Thus, an increase in the number of jails means an improvement in controlling crime, resulting inlower rates of crime including rape.
Poverty	Rate of poverty of the state: the percentage of the population below the poverty line.	Economic variable: poor women are expected to be more prone to being victims of crime particularly rape,because of their voicelessness.
NSDP	Net State Domestic Product in Rs. Crore at 2004-05 prices (base period). NSDP for the year 2001 in available Rs. Crore at 1999-2000 prices (base period). But for the purpose of this study we have converted the base period to 2004-05 for NSDP figures of 2001. Hence the NSDP figures used for the purpose of the study are available in Rs. Crore at 2004-05 prices (base period) for both 2001 and 2011. It is to be noted here that a ***crore*** is a unit in the Indian numbering system denotes ten million.	Higher NSDP means the state is in a position to spend more resources to maintain law and order and thus results in less crime, including rape.
FLR	Female Literacy Rate, defined as the total percentage of the female population of an area at a particular time aged seven years or above who can read and write with understanding. Here the denominator is the female population aged seven years or more.	Social variable: higher literacy will enable women to protest against any crime committed against themand thus helps in reducing crime, like rape.
Police	The number of policepersons (per 100 square km of the area).	Crime control instrument: helps to

		reduce any form of crime.
TPE	Total Police Expenditure in Rs. Lakhs. It is to be noted here that a lakh is a unit in the Indian numbering system equal to one hundred thousand.	Crime control instrument: helps to reduce any form of crime.
SR	Sex Ratio: number of women per 1000 men.	Social variable: afavourable sex ratio helps in reducing rape.
SC	Percentageof scheduled-caste persons in the population.	Social variable: included with the intention to check whether SC women are more vulnerable to crime or not.
ST	Percentage of scheduled-tribe persons in the population.	Social variable: included with the intention to check whether ST women are more vulnerable to crime or not.
FWPR	Female work participation rate refers to the number of people who are either employed or are actively looking for work.	Thisvariable is included with the intention to check its influence oncrime.
Persons Arrested	Persons arrested under custodial rape and their disposal by police and courts during 2011 and 2001.	Crime control instrument: thehigher the number of persons arrested means greater rape control outcome and at the same time sends amessage to society that rapists should be punished strictly.
Urban	Percentageof the population living in urban areas, 2001 and 2011	Urbanisation is expected to influence rape positively. Faster urbanisation causesmigrations of labourers, including unskilled women labourers, from rural and suburban areas to

		urban areas in search of jobs, which makes them more vulnerable to crime.

Source: Author's specification from NCBR and Census.

$$\ln\left(\frac{1}{Rape}\right)=\alpha_0+\alpha_{Jails}\ln\left(Jails\right)+\alpha_{Poverty}\ln\left(Poverty\right)+\alpha_{NSDP}\ln(NSDP)+\alpha_{FLR}\ln\left(FLR\right)+$$

$$\alpha_{Police}\ln\left(Police\right)+\alpha_{TPE}\ln\left(TPE\right)+\alpha_{SR}\ln\left(SR\right)+\alpha_{SC}\ln(SC)+\alpha_{ST}\ln(ST)+\alpha_{FWPR}\ln(FWPR)+$$

$$\alpha_{Persons\ Arrested}\ln(Persons\ Arrested)+\alpha_{Urban}\ln(Urban)+\left(V_{it}-U_{it}\right) \quad (4)$$

where, *ln* isthe natural logarithm (i.e., to the base *e*).

For the purpose of estimation of the model, we used FRONTIER 4.1, developed by Coelli (1996) and STATA-11.

Table-A.1 in the appendices presents the descriptive statistics of the dependent variables across Indian states considering two decadal periods and table-A.2 presents the same for the dependent and independent variables used in the estimation of SPF regression.

Results

We begin this section with estimates of the random effects GLS and fixed effects (within) regression results of equation (4), followed by a discussion of the estimates of efficiencies.

Random-effects GLS and Fixed-effects (within) Regressions

As we are dealing with panel data, it is customary to specify the nature of the panel data and also the type of the effects model which will be applicable for the purpose of regression. Here we have utilisedstate-level data from28 states over two decadal periods 2001 and 2011. For each cross-section, we have the relevant data covering the two decadal periods2001 and 2011. Thus, we have strongly balanced panel data.

It can be observed from Table 2 that the estimates of fixed effects within and random effects GLS regression results are almost similar. The existence of the multicollinearity problems among the explanatory variables is checked and the result is presented in table-A.3 in appendices. The result suggests that the regression model is not suffering from multicollinearity problem. For the purpose of the regression, we consider $\ln\left(\frac{1}{Rape}\right)$ as the dependent variable. In the random effects GLS regression model we find that the estimated coefficients of the crime controlling instruments like the number of policepersons (per 100 square km of the area), total police expenditure inRs. Lakhs and social variables like female literacy rate, sex ratio, the percentage of scheduled-tribe population and percentage of people below the poverty line have not only the correct sign but are also statistically significant. The estimated coefficient of the economic variable Net State Domestic Product in Rs. Crore at 2004-05 prices is also appropriate in the sign and also statistically significant. For this analysis we have considered two socioeconomic variables, viz. female work

participation rate and urbanization. The sign of the estimated coefficients of the first socioeconomic variable is positive whereas the second is negative; both estimators are statistically significant. The results reveal that a lower female work participation rate and faster urbanization cause an increase in rape incidents. The regression result also reveals that there exists an inverse relationship between the number of persons arrested for committing rape and rape incidents, but unfortunately the result is statistically insignificant. For the fixed effects within regression model, we find that although the estimated coefficients are appropriate in sign, only the number of policepersons (per 100 square km of the area), total police expenditure in Rs. Lakhs, sex ratio and female work participation rate turn out statistically significant.

Table-2: Random-effects GLS and Fixed-effects (within) Regression Coefficients of Production Function of the Performance to Control Rape of Different States (No. of Observations: 56)

Dependent variable: LDRape (log of 1/Rape)						
Random-effects GLS				**Fixed-effects (within)**		
Variable	**Coefficients**	**S.E**	**t-ratio**	**Coefficients**	**S.E**	**t-ratio**
Constant	24.155	16.873	1.43	48.012	43.364	1.11
ln(Jails)	-0.036	0.125	-0.29	-0.277	0.236	-1.17
ln(Poverty)	-0.298***	0.179	-1.67	-0.445	0.395	-1.13
ln(NSDP)	0.182***	0.110	1.65	0.394	0.432	0.91
ln(FLR)	0.549*	0.189	2.90	0.958***	0.565	1.70
ln(Police)	0.170***	0.096	1.77	0.312*	0.136	2.30
ln(TPE)	0.229*	0.082	2.79	0.090	0.135	0.67
ln(SR)	-4.018***	2.454	-1.64	-7.603***	4.084	-1.86
ln(SC)	-0.086	0.105	-0.82	-0.209	0.220	-0.95
ln(ST)	0.209*	0.085	2.46	0.190	0.049	3.91
ln(FWPR)	0.478*	0.209	2.29	0.661*	0.032	20.83
ln(Persons Arrested)	0.245	0.346	0.71	-0.092	0.458	-0.20
ln(Urban)	-0.225***	0.131	-1.72	-0.519	0.372	-1.39
R^2 *(Within)*	0.532			0.628		
R^2 *(Between)*	0.243			0.179		
R^2 *(Overall)*	0.287			0.071		
Sigma_u	0.563			1.014		
Sigma_e	0.289			0.289		
Rho	0.791			0.925		

*Source: Author's own calculation based on NCRB data. Note: *, **, *** significance at 1%, 5% and 10% respectively*

The estimated results for these two models suggest that the states with better crime control instruments, better execution of the crime control instruments, better social indicators like a high female literacy rate, a favourable sex ratio, a higher Net State Domestic Product and a higher female work participation rate, have a higher chance for better control of rape. The explanations of these results are presented later in the discussion section of this paper after the discussion of the maximum likelihood estimates of the frontier model. The table also confirms that the random

effects GLS results are better than that of fixed effects within results. The Hausman specification test concludes that the Random Effects Model will be appropriate in our case (for details check the Mathematical Appendix).

Analysis of Efficiency Levels in Controlling Rape of Different States of India

This section discusses the results on efficiency obtained from the estimation of the model (Equation-4) given in the methodology section. The result is presented in Table 3.

Table-3: Efficiency Estimates for Different States of India

Year → / State ↓	**Rape Control Efficiency Score**		**Efficiency Rank**	
	2001	**2011**	**2001**	**2011**
Andhra Pradesh	**0.481**	**0.391**	8	8
Arunachal Pradesh	0.385	0.292	15	15
Assam	**0.181**	**0.110**	**28**	**28**
Bihar	**0.533**	**0.444**	7	7
Chhattisgarh	0.308	0.219	22	22
Goa	0.295	0.207	24	24
Gujarat	**0.888**	**0.859**	**1**	**1**
Haryana	0.355	0.263	19	19
Himachal Pradesh	0.314	0.224	20	20
Jammu & Kashmir	**0.479**	0.387	9	9
Jharkhand	**0.242**	**0.160**	**26**	**26**
Karnataka	**0.725**	**0.662**	**2**	**2**
Kerala	0.310	0.221	21	21
Madhya Pradesh	0.286	0.198	26	26
Maharashtra	0.388	0.295	14	14
Manipur	**0.636**	**0.559**	6	6
Meghalaya	0.380	0.287	16	16
Mizoram	**0.182**	**0.111**	**27**	**27**
Nagaland	**0.650**	**0.575**	4	4
Orissa	0.362	0.269	18	18
Punjab	**0.477**	0.385	10	10
Rajasthan	0.377	0.284	17	17
Sikkim	**0.421**	0.328	11	11
Tamil Nadu	**0.645**	**0.569**	5	5
Tripura	0.297	0.209	23	23
Uttar Pradesh	**0.392**	0.299	13	13
Uttaranchal	**0.689**	**0.620**	**3**	**3**
West Bengal	**0.418**	0.325	12	12
Mean Efficiency (Yearly)	**0.432**	**0.348**		
Mean Efficiency (Overall)	**0.390**			

Source: Author's own calculation based on NCRB data

With the help of table-3, we will investigate our main objective: the comparison of the performance of Indian states in controlling rape in two decades. The ranking of the states in terms of their efficiency scores considering rape incidences are also presented in table-3. As described earlier, the relative efficiency scores show how efficiently the states have performed in controlling rape in comparison with the most efficient state. The mean efficiency score in the first decadal period, 2001, for controlling rape is 0.432 while that in the second decadal period, 2011, is 0.348. The panel mean efficiency score considering two decades together is 0.390. This panel mean efficiency score is considered as the benchmark of efficiency for each panel as well as for the entire study period. This means that whenastate has an efficiency score above the panel mean efficiency, we will consider that state as more technically efficient than the others and vice-versa. In the first decadal period, Gujarat (0.888) performed most efficiently followed by Karnataka (0.725) and Uttaranchal (0.689). These states maintained their efficiency ranking even in the second decadal period with efficiency scores 0.859, 0.662 and 0.620, respectively. It is to be noted that the level of efficiency is reducing over time even for the most efficient state with a lower efficiency score in the second decadecompared to the first. The state which becomes the worst achiever on the list is Assam. Assam's scores for 2001 and 2011 are 0.181 and 0.110, respectively. The state is preceded by Mizoram and Jharkhand. The same reducing tends in controlling rape continued for the worst achiever also. In fact, all the states in the second decadal period performed less efficiently with lower efficiency scorescompared to their performance in the first decadal period.

As mentioned earlier, considering the overall mean efficiency score as the benchmark of efficiency, we find in the first decadal period out of twenty-eight states, thirteen states performed efficiently in controlling rape. This means that in 2001 almost 46 percent of the states performed efficiently to control rape. The performances of the states deteriorate in the second decadal period, 2011, and in aggregate only eight states perform efficiently in controlling rape, which means only 28 percent of the states efficiently control rape incidences. Again, the mean efficiency for the first decadal period, 2001, is 0.432 and for 2011 is 0.348. On the basis ofthe overall mean efficiency score, we can conclude that the performances of the states in controlling rape declined in 2011 compared to 2001. It is to be noted here that the ranking of the states remains same in the two decadal periods for controlling rape and the result is obvious because we have usedthe FRONTIER-4.1 programme for getting efficiency scores for the states and it is one deficiency of this programme that the ranking of the states remain invariant.

We infer from table-3 that the performances of the Indian states are declining in controlling rape. The worst achievers in this respect are two northeastern states, Assam and Mizoram. Among the northeastern states of India, Nagaland performs really well to control rape. It needs to be remembered that the efficiency ranks only show the relative performance and do not indicate any hierarchy in actual rape control outcomes. For example, Uttar Pradesh has arelative efficiency scoreof 0.392 and 0.299 inthe first and second decadal time periods, though the mean rape figure for Uttar Pradesh is only 1.1, lower than more efficient states. The relative efficiency scores of the rape control systems indicate that given its rape controlling investment, the state has attained a little more than 39 percent inthe first decadeand 30 percent in the second decadeof its potential in reducing rape. The state could have reduced rapeby more than 30 percent if it was as efficient as the most efficient state. However, it is important to note that even at the most efficient levels, the state could have reduced rape to only 89 percent in the first decadal period and 86 percent in the second decadal period and not to a further lower level attained by other efficient states like Gujarat, Karnataka and Uttaranchal. This is due to the lower rape controlling inputs used in Uttar Pradesh

than in the other above states. Thus, the results should be viewed keeping in mind the fact that states differ in their rape controlling system inputs and rape controlling outcomes. It could be said that lack of real investment in the rape controlling sector (caused by poor demand as represented by literacy and awareness) along with the not-so-efficient performance of rape controlling systems are the reason for low levels of rape control outcomes and achievements. Another point to be noted here is that although among the Indian states Kerala is always recognised as the most progressive region in terms of standard indicators of female position, our findings reveal that the mean rape rate in Kerala is 2.6, which is significantly high. Even in our study we find that Kerala is a poor performer in controlling rape. In fact, the efficiency scoresof Kerala in controlling rape were 0.310 and 0.221 in the first and second decadal period, respectively. It is worth mentioning here that our findingssupport the earlier study conducted by Chacko (2003).

Analysis of Stochastic Frontier Model

The stochastic frontier production function in (4) can be viewed as a linearised version of the logarithm of the Cobb-Douglas production function. Maximum likelihood estimates of the parameters of the model are obtained by using a modification of the computer program, FRONTIER 4.1 (see Coelli, 1996). These estimates, together with the estimated standard errors of the maximumlikelihood estimators, given to three significant digits, considering the entire study period are presented in Table 4.

Table-4: Maximum Likelihood Estimates of the Stochastic Production Frontier Function of Controlling Rape for Different States of India

Dependent variable: LDRape (Log of 1/Rape)				
Variable	**Coefficients**	**Estimates**	**S.E**	**t-ratio**
Constant	β_0	0.250	0.523	0.478
ln(Jails)	β_1	0.119*	0.014	8.376
ln(Poverty)	β_2	-0.210***	0.123	-1.709
ln(NSDP)	β_3	0.189***	0.113	1.682
ln(FLR)	β_4	11.951*	1.007	11.866
ln(Police)	β_5	0.164	0.150	1.090
ln(TPE)	β_6	0.140***	0.082	1.701
ln(SR)	β_7	-2.149*	0.389	-5.529
ln(SC)	β_8	-0.106	0.115	-0.919
ln(ST)	β_9	0.146***	0.081	1.797
ln(FWPR)	β_{10}	0.377***	0.214	1.762
ln(Persons Arrested)	β_{11}	0.308	0.327	0.942
ln(Urban)	β_{12}	-2.171*	0.451	-4.815
$\hat{\sigma}_s^2 = \sigma_u^2 + \sigma_v^2$		0.384*	0.136	2.821
γ		0.847*	0.051	16.530
μ		1.141*	0.328	3.482
η		-0.257***	0.134	-1.923
Log(likelihood)	**-30.146413**			
LR test	**23.563777**			
Observations	**56**			

*Source: Author's own calculation based on NCRB data. Note: *, **, *** significance at 1%, 5% and 10% respectively*

It can be observed from the table that the estimates of within, GLS (table-2) and MLE of stochastic production frontier show almost similar results. The correlation matrix for the independent variables is presented in table-A.3 in the appendices and it confirms that there is no multicollinearity problem. From the estimates one can see that the coefficient of the rape control instruments likethe number of jails, total police expenditure (in Rs. Lakhs) and the social variables like female literacy rate, sex ratio, the percentageof scheduled-tribe persons in the population and percentage of population below the poverty line have not only the correct sign but are also statistically significant. The economic variable Net State Domestic Product in Rs. Crore at 2004-05 prices is also statistically significant with the appropriate sign. The estimated coefficients of the two socioeconomic variables, viz. the female work participation rate and urbanization are not only statistically significant but also appropriate in sign. The sign of the estimated coefficient of the variable persons arrested under custodial rape reveals a negative relation between this variable and rape committed. But unfortunately, it becomes statistically insignificant.

The implication here is that the states with lower poverty rates, favourable sex ratios, higher female literacy rates, higher female work participation rates, higher NSDPs and better infrastructure for controlling rape in terms of number of jails and total police expenditures (in Rs. Lakhs) and higher arrest rates for rape (not statistically significant), have higher chances for better rape control outcomes. However, faster urbanization results in higher rates of rape incidents. This result is similar to that of Chaudhuri et al. (2015). The results also imply that though the crime control instruments like the number of jails and total police expenditure, etc., by themselves ensure somewhat better rape control outcomes, these do not reflect better accessibility in terms of social accessibility and acceptability of the facilities. In this context, the actual social accessibility and acceptability variables like higher female literacy rates, higher female work participation rates and favourable sex ratios become important. If two states have similar crime control infrastructure in terms of the number of jails and total police expenditure (in Rs. Lakhs), the state with a higher female literacy rate, higher female work participation rate and better sex ratio would have the better control over rape incidences. To illustrate this further, consider two states, Karnataka and Rajasthan, whose average figures for the number of jails and total police expenditures (in Rs. Lakhs) are almost identical, but their mean figures for female literacy rate, female work participation rate and sex ratio differ considerably. The performances of these two states in controlling rape in terms of their efficiency score ranking are second and seventeen in two decades, respectively.

All the variance parameters are significant at the different level and the variance parameter (γ) is found to be significantly different from zero for a half-normal distribution. The value of sigma-square ($\hat{\sigma}_s^2$) is 0.384 and is significant, indicating the correctness of the specified assumptions of the distribution of the composite error term. The ratio of state-specific variability to total variability (γ) is positive and significant, implying that state-specific technical efficiency is important in explaining the total variability of rape incidences. In addition, the (γ) estimate associated with the sigma-squared of the technical inefficiency effects is relatively large. The estimate of the (η) parameter is negative, indicatingthat the technical inefficiency effects of the sample states increase over time. The value of η in table-5 suggests that in controlling rape incidences, the efficiency of the states showed quite a decreasing and statistically significant trend.

Discussion, Concluding Remarks and Limitations

First and foremost, it is important to note that this is perhaps the first attempt to measure and comparethe efficiency or performance of the Indian states in controlling rape considering two decadal periods. One of the most important findings here is that the performance of the Indian states in controlling rape is positively related to the availability of crime controlling instruments, such as the number of jails, the number of policemen per 100 square km of an area and total police expenditure (in Rs. Lakhs). However, the efficiency of the rape control systems depends on the extent of female education in the state and we find female literacy rates inversely influencesrape incidences. Other than this, a favourable sex ratio and a lower rate of poverty give voice to the woman to protest against any kind of crime, including rape, committed against her. This study also reveals that the states with better economic conditions, measured in terms of higher NSDP, performed more efficiently to control rape incidences. This maybebecause of the fact that with a higher NSDP, the concerned state is in a position to spend more on the safety and security of women of that state. We can conclude that the women enjoy a better position in scheduled tribal

society compared to others from the inverse relation of ST population and rape incidences. The socio-economic variable of the female work participation rate inversely influences rape incidences by empowering women to protest against any crime committed against them. Finally, another socio-economic variable, urbanization, is positively related to rape. The result is not surprising as the faster rate of urbanization is one of the major causes of migrations of labourers, including unskilled womenlabourers from rural and suburban areas to urban areas in search of a job. These labourers are forced to stay on the outskirts of the urban areas. This act makes women (illiterate or less educated) more vulnerable to crime, particularly those who work on construction sites or as domestic help. In fact, the relationship between rape and the female work participation rate and urbanization, as suggested in this study, is similar to the study by Chaudhuri et al. (2015).

At the outset, it is indeed a negative aspect that India's rape controlling outcomes have declined over time, as revealed in the increase of the total rape and, also revealed in the decreased efficiency scores in the second decade. The increased protection against rape in some special cases is not enough to reduce rape. We need time-bound and prominent justice for any crime, including rape, committed against women.

However, unlike the aggregates, which are often deceptive, the disaggregated figures at the state level show disparities in terms of area coverage as well as population coverage, adding to the inefficient management of the rape control systems. States vary enormously in their levels of crime control outcomes, such asfor total crimes against women and particularly in the levels of rape, kidnapping and domestic violence. States also differ in their levels of rape control efficiencies, which results in varied rape control performances. Differences in female literacy levels (as revealed in the study) account for much of such variations. The rate of poverty used as a proxy for income seems an important explanatory variable in the regressions designed to control rape dispersion. The result is quite obvious. The poor, particularly poor women, are always a soft target for crime, in particular, rape, because of their voicelessness, inferior social status and lack of knowledge about their human rights.

It is important to note that contrary to the belief that all the "Bimaru"[6] states perform poorly, Bihar and Rajasthan are not badly performing states in the efficiency analysis. On the other hand, states like Kerala and Maharashtra, which are believed to have improved their rape control instruments and social indicators, showed poor efficiency in performance.

It is also incorrect to say that the most efficient states do not havethe scope to improve further in controlling rape. The performance of Gujarat in controlling rape is better only in comparison with the other 27 states in the analysis, and though the efficiency/performance of controlling rape of this state is impressive, still there is scope for betterment in terms of improving utilization of the available rape control instruments.

The question of how to improve efficiency then becomes paramount and is the main concern of developed and developing countries. Since resources are limited, it is important that the available resources should be used wisely and efficiently. By reducing waste, inefficiency can be reduced and at the same time, it is very important to choose the appropriate mix of interventions. On the basis of the existing variations across states in rape control performance, we can suggest two critical measures to improve rape control outcomes. The first is to increase the efficiency of controlling rape by moving further to the frontier. The second is to create more rape control infrastructure, like more employment of women in police force, a separate unitin the police force

[6]Bimaru is a term coined for states in northern India which have very poor health and human development indicators. The literal meaning of the term is 'sick'. This category includes Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh. These states are also identified for higher crime and rape committed against women.

to control crimes against women, including rape, and most importantly the judicial system must act openly and reach a verdict quickly not only in cases of rape, but any kind of crime committed against women. It is always true that justice delayed means justice denied. The increases in efficiency as well as providing more prominent and quick action against rape imply that both qualitative and quantitative measures are taken for controlling rape.

Thus, to conclude, this study sought to analyse the performance of 28 major states in India in controlling rape. The study has attempted to go beyond the actual attainment levels of Indian states to understand the potential levels that the states can achieve. In order to measure performance, the study used the stochastic production function method on decadal panel data for the periods 2001 and 2011. It was found that not all states with better crime control instruments have more efficient rape control systems. Relative efficiencies differ across states not only due to differences in the endowments of the rape control instruments, but also due to inefficient utilisation of the available instruments. It shows that states should not only increase their investment in controlling rape, but also manage it efficiently to achieve better rape control outcomes. Emphasis should definitelybe given to improving performance whatever the current level of rape control outcomeis.

It is worth mentioning here that the entire study based on the secondary data on rape rates published by NCRB. Thus, we are considering only the recorded crime, but the fact is that in Indian family structure, the man is the undisputed ruler of the household, and activities within the family are seen as private, which allows violence to occur at home (Niaz, 2003). Moreover, due to some understandable reasons such as the attached social stigma, distrust in legal mechanisms, fear of retaliation and so on, most crimes against women including rape are unreported (Mukherjee et al., 2001). Still, in case of the rape victim, there is hesitation to protest because of the fear of losing social reputation. Thus, the reported figures fail to reflect the actual situation. The actual numbers of incidents are much larger than the reported figure (Gupta, 2014). This is definitely a limitation of this study. Moreover, the ranking of the states remains invariant because the efficiency scores of the states are obtained by using the FRONTIER-4.1 programme.

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Conflict of Interest

The author declared that she has no conflict of interest.

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Appendices

Table-A.1: Summary Statistics of Rape Rate for Different States

State	Mean	SD	CV	Skewness	Maximum	Minimum
Andhra Pradesh	1.45	0.354	24.414	0	1.7	1.2
Arunachal Pradesh	3	0.000	0.000	0	3	3
Assam	4.3	1.697	39.465	4.18E-17	5.5	3.1
Bihar	1	0.141	14.100	-3.90E-17	1.1	0.9
Chhattisgarh	4.35	0.354	8.138	0	4.6	4.1
Goa	1.45	0.778	53.655	3.48E-17	2	0.9
Gujarat	0.65	0.071	10.923	0	0.7	0.6
Haryana	2.4	0.707	29.458	7.19E-17	2.9	1.9
Himachal Pradesh	2.25	0.354	15.733	0	2.5	2
Jammu & Kashmir	1.95	0.354	18.154	-1.42E-16	2.2	1.7
Jharkhand	2.25	0.212	9.422	0	2.4	2.1
Karnataka	0.8	0.283	35.375	-3.47E-17	1	0.6
Kerala	2.6	1.131	43.500	5.29E-18	3.4	1.8
Madhya Pradesh	4.7	0.000	0.000	0	4.7	4.7
Maharashtra	1.4	0.141	10.071	-7.59E-18	1.5	1.3
Manipur	1.35	0.778	57.630	0	1.9	0.8
Meghalaya	2.75	2.333	84.836	-8.48E-17	4.4	1.1
Mizoram	6.45	0.919	14.248	0	7.1	5.8
Nagaland	1.05	0.212	20.190	-2.43E-17	1.2	0.9
Orissa	2.45	0.354	14.449	0	2.7	2.2
Punjab	1.45	0.354	24.414	0	1.7	1.2
Rajasthan	2.25	0.495	22.000	3.58E-18	2.6	1.9
Sikkim	2.05	0.778	37.951	-3.28E-17	2.6	1.5
Tamil Nadu	0.8	0.141	17.625	0	0.9	0.7
Tripura	4.4	1.697	38.568	0	5.6	3.2
Uttar Pradesh	1.1	0.141	12.818	1.03E-16	1.2	1
Uttaranchal	1.1	0.283	25.727	-3.46E-17	1.3	0.9
West Bengal	1.75	1.202	68.686	1.02E-17	2.6	0.9

Source: Author's own calculation based on NCRB data

Table-A.2: Summary Statistics for Output and Input Variables of the Frontier Model for Different States of India

Variable	Mean	Median	S.D	C.V	Maximum	Minimum
Rape	2.268	1.900	1.517	66.910	7.100	0.600
$\ln(Rape)$	0.617	0.642	0.639	103.562	1.960	-0.511
$\ln\left(\frac{1}{Rape}\right)$	-0.617	-0.642	0.639	-103.562	0.511	-1.960
Jails	43.821	25.500	47.226	107.769	215.000	1.000
Poverty	22.505	20.250	11.944	53.070	53.500	5.100
NSDP	1056.562	653.515	1262.992	119.538	6676.254	12.077
FLR	62.971	61.000	13.186	20.939	92.100	33.100
Police	62.079	57.650	42.283	68.113	231.300	6.400
TPE	1074.478	686.580	1246.500	116.010	6997.470	41.680
SR	945.125	944.500	43.283	4.580	1084.000	861.000
SC	12.495	14.009	8.285	66.304	31.936	0.000
ST	22.437	12.154	27.714	123.519	94.500	0.000
FWPR	29.118	29.950	8.728	29.976	47.500	13.900
Persons Arrested	0.393	0.000	1.637	416.649	10.000	0.000
Urban	28.261	26.070	11.981	42.396	62.170	9.800

Source: Author's own calculation based on NCBR and Census data

Table-A.3: Correlation Matrix

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
ln(Jails)(1)	1.00											
ln(Poverty) (2)	0.05	1.00										
ln(NSDP)(3)	0.67	-0.15	1.00									
ln(FLR)(4)	-0.15	-0.56	0.11	1.00								
ln(Police)(5)	-0.22	-0.31	0.10	0.43	1.00							
ln(TPE)(6)	0.57	0.00	0.75	-0.01	0.07	1.00						
ln(SR)(7)	0.16	-0.03	0.09	0.47	0.02	-0.10	1.00					
ln(SC)(8)	0.39	-0.07	0.25	-0.19	0.16	0.36	-0.09	1.00				
ln(ST)(9)	-0.39	0.10	-0.42	0.19	-0.18	-0.36	0.02	-0.69	1.00			
ln(FWPR(10))	-0.03	0.05	-0.26	0.09	-0.55	-0.31	0.11	-0.37	0.56	1.00		
ln(PA)#(11)	0.17	0.11	0.23	-0.12	0.00	0.56	-0.04	0.12	-0.16	-0.17	1.00	
ln(Urban) (12)	0.19	-0.40	0.45	0.54	0.25	0.15	0.18	-0.13	-0.04	-0.08	-0.14	1.00

Source: Author's own calculation based on NCRB data. #Persons Arrested

Mathematical Appendix: Random Effects versus Fixed Effects Model

Regarding the identification of the effects model, we conducted the Hausman specification test. The result of this test is obtained by using STATA-11 and is presented in table-A.4 below.

Table-A.4: Hausman Test to Choose Between Random Effect and Fixed Effect Model

Variables	**Fixed Effect (b)**	**Random Effect(B)**	**Difference (b-B)**	**S.E**	χ_{12}^{2}	**Prob** $> \chi^2$
ln(Jails)	-0.264	-0.044	-0.220	0.205	6.99	0.8581*
ln(Poverty)	0.412	0.275	0.137	0.349		
ln(NSDP)	-0.236	0.225	-0.461	0.472		
ln(FLR)	0.861	0.314	0.547	0.689		
ln(Police)	0.111	0.109	0.003	0.269		
ln(TPE)	-0.112	-0.239	0.126	0.113		
ln(SR)	-6.417	-4.261	-2.156	6.151		
ln(SC)	-0.196	-0.120	-0.077	0.195		
ln(ST)	0.031	-0.216	0.247	0.174		
ln(FWPR)	0.229	0.565	-0.336	0.591		
ln(Persons Arrested)	-0.126	0.218	-0.344	0.314		
ln(Urban)	-0.372	-0.252	-0.120	0.449		

*Source: Author's own calculation based on NCRB data. *Evidence shows Random Effect model is appropriate*

The null hypothesis related to Hausman test is that the Random Effects Model is appropriate. Table-3 shows that the values of the χ_{12}^{2} are 6.99 with degrees of freedom 12 and the corresponding Prob $> \chi^2$ value is 0.8581. Thus, we accept null hypothesis which indicates Random Effects Model will be appropriate in our case.