THE ECONOMIC COSTS OF NAXALITE VIOLENCE AND THE ECONOMIC BENEFITS OF A UNIQUE ROBUST SECURITY RESPONSE

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Abstract

Using the synthetic control method of analysis, we provide the first measurements of the macroeconomic costs of Naxalite violence in India, as well as exploit a natural experiment in one of the Naxalite affected states to measure the direct economic benefits of a unique robust security response. Compared to a synthetic control region constructed from states not affected by Naxalite violence, we find that states affected by Naxalite violence lost on average 12.48% of their per capita NSDP over the period 1980 to 2000. Of the states affected by Naxalite violence, only one state i.e. Andhra Pradesh raised a specially trained and equipped police force in 1989 known as the Greyhounds, dedicated mainly to combating the Naxalite menace. Compared to a synthetic control region constructed from states affected by Naxalite violence that did not raise a specially trained anti-Naxalite police force, we find that Andhra Pradesh gained on average 17.23% of its per capita NSDP over the period 1989 to 2000. Placebo tests indicate that both results are significant. (JEL D74, F52, H56)

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I. Introduction

Since its independence in 1947, India has faced numerous insurgencies within its borders at various points in time. One of the longest running insurgencies in India is the Naxalite insurgency. Using the synthetic control method of analysis developed by Abadie and Gardeazabal (2003), we present the first estimates of the economic cost in terms of lost income per capita due to the Naxalite insurgency in the affected states, as well as the gains in terms of recaptured income per capita of a unique, robust security response to the Naxalite insurgency in one of the affected states i.e. Andhra Pradesh.

With the ultimate objective of “seizing political power i.e. state power” (Subramanian, 1990 as quoted in Ramana, 2009), the Naxalite movement started in Naxalbari, a small village in West Bengal in 1967, and then spread steadily across the country during the rest of the 20th century. The rate of spread of the movement has become alarming in the recent past. By the Indian Government’s own estimate, Naxalite activity has increased from 76 districts in 9 states in 2005 (Government of India, 2006) to 182 districts in 16 states in 2007 (Ramana, 2009), prompting Prime Minister Manmohan Singh to observe that the Naxalite insurgency is the single biggest internal security threat facing the country.

Although there is a large literature measuring the economic costs of terrorism in different regions across the world, little research has been done to assess the economic costs of Naxalite violence. This paper attempts to fill this gap. Further, several states in India are affected by Naxalite violence, yet only one state raised a unique, specially trained police force dedicated to combating the Naxalite insurgency. This natural experiment gives us a unique opportunity to measure the direct economic benefits of a robust localized security response to the Naxalite insurgency.

We find that as a group, states affected by Naxalite violence (Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Uttar Pradesh and West
Bengal) lost on average 12.48% of their per capita NSDP\textsuperscript{3} per year over the period 1980 to 2000. The average pcNSDP of these states was Rs.10,200/- per year during this period, and the average loss of pc NSDP due to Naxalite violence was of the order of Rs.1,273/- per year. Despite the magnitude of the Naxalite problem, none of the affected states save Andhra Pradesh instituted a specialized police force, dedicated to combating the Naxalite menace. The introduction of such a force known as the Greyhounds in 1989 by Andhra Pradesh yielded a “security dividend” equal on average to 17.23% of its pcNSDP over the period 1990 to 2000. The average pcNSDP of Andhra Pradesh was Rs.12,884/- per year during this period, and the average gain of pcNSDP due to the Greyhounds force was of the order of Rs.2,221/- per year. Placebo tests indicate that our results are significant. To the best of our knowledge, this is the first study that directly estimates the economic benefits of a unique security response undertaken by a state to an extremist threat.

The rest of the paper is organized as follows. Section 2 briefly summarizes the literature on the economic costs of terrorism, as well as the likely impacts of Naxalite violence on the affected states in India. Section 3 provides a brief history of the Naxalite movement in India. Section 4 provides a brief overview of the synthetic control method of analysis. Section 5 describes the data, Section 6 describes the results of the analysis, and Section 7 concludes.

2. Literature Review

Sandler and Enders (2008) report several avenues through which terrorism can impose economic costs on a state. Specifically, terrorism may “... divert foreign direct investment, destroy infrastructure, redirect public investment funds to security, or limit trade”. Naxalite violence appears to have imposed economic costs on Indian states

\textsuperscript{3} Per capita net state domestic product, Referred to as pcNSDP hereafter.
through all of these avenues. For example, the blog Naxal Terror Watch\textsuperscript{4} documents incidents of Naxalites destroying pipelines transporting iron ore slurry in Chattisgarh, destroying road construction machinery in Bihar, forcing the closure of bank branches in Jharkhand, disrupting power supply by damaging hydroelectric power stations in Orissa, impeding interstate commerce by routinely preventing the repair of national highways and damaging railway infrastructure in Jharkhand and Orissa, degrading telecom service by destroying mobile phone towers, and discouraging the free flow of labor across regions by administering a “kidnap and extortion empire” in their area of operation, among other things (Naxal Terror Watch, 2010). Joshi (2010) reports that investments of the order of Rs.130bn (approximately $2.83bn at 2010 exchange rates) were tied up in just the power and steel industries in projects that could not be completed in the state of Chattisgarh on account of Naxalite violence.

In their excellent surveys, Blattman and Miguel (2010), Frey, Luechinger and Stutzer (2007), Llusa and Tavares (2008) and Sandler and Enders (2008) cite several papers that capture the wide range of macroeconomic (economy wide) and microeconomic (sector or industry specific) effects that armed conflict in general and terrorism in particular may have. We summarize some of these effects below. Macroeconomic effects may include reduced per capita GDP\textsuperscript{5} growth e.g. Blomberg, Hess and Orphanides (2004), higher inflation, lower tax revenues, lower domestic investment, and higher expenditure on defense at the cost of lower expenditure on education and health e.g. Gupta et al (2004), depressed exports and nondurable consumption e.g. Eckstein and Tsiddon (2004), reduced bilateral trade flows e.g. Nitsch and Schumacher (2004), reduced foreign direct investment inflows e.g. Enders and Sandler (1996), depressed aggregate savings e.g. Fielding (2003), significant negative

\textsuperscript{4} This blog, available at naxalwatch.blogspot.com aggregates reports of Naxalite activity from popular Indian newspapers.

\textsuperscript{5} Gross Domestic Product
abnormal stock returns both domestically and internationally e.g. Chen and Siems (2004), etc.

Microeconomic effects may include lower tourist inflows e.g. Enders and Sandler (1991), lower tourism receipts e.g. Enders, Sandler and Parise (1992) and Sloboda (2003), lower regional tourism market share e.g. Drakos and Kutan (2003), depressed demand for domestic airline travel services e.g. Ito and Lee (2005), depressed demand for hotel room stays e.g. Fleischer and Buccola (2002), reduced visits to coffee shops, restaurants and pubs, and reduced usage of public transport e.g. Becker and Rubinstein (2010), reduced long term investments in agriculture e.g. Singh (2010), reduced enrolment in school e.g. Shemyakina (2010), reduced height for age z-scores e.g. Bundervoet et al (2009) etc. Although there is a large and growing literature on the economic consequences of terrorism, to the best of our knowledge, there is none in the Indian context save Singh (2010). This India sized hole in the literature needs to be addressed on a war footing since “… no nation has suffered more from terrorism than India” (Senator John Kerry, quoted in IBN Live, 2009).

In the Indian context, since not all districts of the Naxalite affected states are affected by Naxalite activity, it is possible that Naxalite violence redistributes economic activity and income from affected districts to non-affected districts, but without depressing the overall level of economic activity in the state. In that case, we would expect to find effects on GDP at the district level, but not at the state level. For example, Abadie and Gardeazabal (2003) find that the per capita GDP of a sub national region i.e. the Basque country in Spain declined by over 10 percentage points after the outbreak of terrorism. However, this paper does not use district level GDP data to investigate district level effects of Naxalite violence. We are concerned with the macroeconomic consequences of Naxalite violence at the state level, as measured by the loss in pcNSDP.

In any study of the economic costs of terrorism, there are always endogeneity concerns in that while terrorist violence may depress GDP growth, reduced GDP growth
may in turn spur terrorism. In the Indian context, Borooah (2008) finds that high incidence of poverty, low levels of literacy, and large amounts of forest cover (which camouflage the movement of extremists) are the main correlates of Naxalite activity at the district level in India. Borooah however does not control for possible endogeneity, and notes that while poverty may lead to Naxalite activity, Naxalite activity by discouraging investment may contribute to poverty. However, Subramanian (1990) argues that “the real aim of Naxalites is neither the domain of economics nor state welfare. It is a political movement having its goal as the seizure of political power i.e. state power” (quoted in Ramana, 2009). If this is indeed the case, then the causation would tend to flow from Naxalite violence to low levels of GDP, and not vice versa. In Section 6, we argue that endogeneity issues are unlikely to be a serious concern for this study.

3. **A Brief History of the Naxalite Movement**

This section draws heavily from Kujur (2008) and Hindustan Times (2003). The Naxalite movement traces its roots to Naxalbari, a small village in West Bengal. In March 1967, a tribal farmer was attacked by local landlords over a land dispute. A peasant uprising followed, led by revolutionaries of the Communist Party of India (Marxist) i.e. CPI(M) in several states of India, namely Andhra Pradesh, Bihar, Jammu and Kashmir, Karnataka, Kerala, Orissa, Tamil Nadu, Uttar Pradesh, and West Bengal. The West Bengal government, despite being led by CPI(M), crushed the rebellion within West Bengal. However, the revolutionaries within the CPI(M) split to form the All India Coordination Committee of Communist Revolutionaries (AICCCR) in 1968. The AICCCR rejected parliamentary elections and called for an armed uprising against the state. Due to internal conflicts, the AICCCR split, and a new organization called the Communist Party of India (Marxist-Leninist) i.e. CPI(ML) was formed in 1969. At the same time, another organization, later known as the Maoist Communist Center (MCC) was formed in Bihar.
under the name Dakshin Desh. Although, the CPI(ML) continued armed struggle against the Indian state throughout the 1970s, the movement was riven by internal conflicts, suffered from further splits, and soon disintegrated.

Of the various factions to emerge from the CPI(ML), the two most prominent ones were the Communist Party of India (Marxist-Leninist) Liberation i.e. CPI(ML) Liberation in 1974 and the Communist Party of India – Marxist Leninist (People’s War), also known as the People’s War Group (PWG) in 1980. While the CPI(ML) Liberation did not rule out the possibility of armed revolution against the state, it did participate in the electoral process, even winning an election in Bihar in 1989. The PWG and the MCC on the other hand, completely rejected the democratic system and continuously waged a “people’s war for the “people’s government”’. Consequently, all the major violent organizations of the Naxalite movement were in place by 1980. Kujur (2008, pg.7) notes that in the following years, “intra-organizational conflict and rivalry among different (Naxalite) groups touched several high points, resulting in the loss of a considerable number of cadres of rival groups”.

With regard to the states’ response to the Naxalite problem, Kujur (2008, pg.7) observes that “... while the Naxal movement has mostly been characterized by fragmented groups and innumerable splits, successive governments at the national and state levels were never able to follow a uniform approach to deal with the problem of Naxalism ...”. In addition to a lack of uniform or even unified response, no Naxalite affected state except Andhra Pradesh created a dedicated security force tasked mainly with countering the Naxalite menace. All other Naxalite affected states relied on some combination of their regular state police forces as well as reinforcements from central police organizations, which were not specially trained in either counter insurgency or jungle warfare operations, resulting in an inability to check the spread of the Naxalite movement. Only the Andhra Pradesh Government raised a specially trained state police force known as the Greyhounds in 1989, whose main purpose was to combat the
Naxalite insurgency. Recruited from the state police force, the Greyhounds are well-equipped and specially trained in counter-insurgency methods (Priyadershi, 2009 and Jha, 2009) and in the recent years have been widely accredited with bringing the Naxalite violence in Andhra Pradesh under control (The Hindu, 2010).

Given the evolution of the Naxalite movement in India and the states’ responses to the same, this paper asks two main questions. First: what is the economic cost of Naxalite violence in the Naxalite affected states, as measured by lost pcNSDP? This question assumes importance because there is no study in the Indian context measuring the economic costs of extremist violence. Second: to what extent did the creation of the dedicated anti-Naxalite police force known as the Greyhounds mitigate the loss of pcNSDP due to Naxalite violence in Andhra Pradesh? This question assumes importance for two reasons. First: the creation of the Greyhounds is a natural experiment that gives us an opportunity to directly measure the economic benefits of a unique targeted security response to a violent insurgency. Other papers (some of which were cited earlier) have measured the economic costs of violence, usually in a regression framework, but no paper has exploited an explicit change in the Government’s approach to handling extremist violence as a natural experiment to measure the economic benefits of a unique security response.

Second: in the recent past, motivated by the Andhra Pradesh example, several Naxalite affected states namely Chhattisgarh, Jharkhand, Orissa, Madhya Pradesh, Bihar and Maharashtra are in the process of creating dedicated security forces along the lines of the Greyhounds to tackle the Naxalite menace (Times of India, 2009). This is being done even though there is no study that establishes whether the Greyhounds have either (1) reduced Naxalite violence levels, or (2) mitigated the economic costs of Naxalite violence. We investigate the latter aspect.
4. Research Methodology

In order to answer the two main research questions, we use the synthetic control method developed by Abadie and Gardeazabal\(^6\) (2003) and Abadie, Diamond and Hainmueller\(^7\) (2010) in a comparative case study approach. As ADH (pg. 493) observe, the comparative case study approach involves “... estimating the evolution of aggregate outcomes for the unit affected by a particular occurrence of the event or intervention of interest (the treated unit), and comparing it to the evolution of the same aggregates estimated for some control group of unaffected units (the control units)”. This approach is useful when the event or intervention of interest takes place at an aggregate level, and affects aggregate entities. In such situations, a regression approach is usually ruled out due to the lack of a sufficient number of treated and control units for robust inference. In the present study, our two events of interest i.e. (1) the establishment of all major Naxalite groups in India by 1980, and (2) the creation of the Greyhounds in 1989, occurred at an aggregate i.e. state level, and affected aggregate entities i.e. states of India. The regression approach is ruled out due to the lack of a sufficient number of treated and control states, since India had around 25 states during the period under consideration.

Within comparative case studies, ADH observe that the synthetic control method is advantageous because it uses a data driven approach (as opposed to an ad-hoc approach) to selecting suitable control units, and constructs a weighted average of such units that most closely resembles the treated unit in the relevant characteristics i.e. pre-treatment outcomes and pre-treatment values of the predictors of treatment outcomes. Further, by restricting the weights assigned to control units to be positive and sum to one, the problem of extrapolation can be avoided. ADH motivate the synthetic control approach as a generalization of the linear panel difference-in-differences model where

\(^6\) AG hereafter

\(^7\) ADH hereafter
the effects of unobserved confounders on the outcome are allowed to vary with time, and provide methods to perform “... informative inference regardless of the number of available comparison units and the level of aggregation of the data” (ADH, pg.494).

We now summarize the synthetic control methodology of ADH (notation and equations are those of ADH). Suppose we have J+1 regions with the first region exposed to the treatment and the remaining J regions being the potential controls. There are T time periods and \( T_0 \) pre-intervention time periods such that \( 1 < T_0 < T \). Let \( Y_{it}^N \) be the outcome observed for region \( i \in (1, ..., J + 1) \) if it is not exposed to the treatment and \( Y_{it}^I \) be the outcome observed for the the ith region if it is exposed to the treatment in time periods \( T_0 + 1 \) to \( T \). Let \( D_{it} \) be a dummy variable that takes the value of 1 if region \( i \) is exposed to the treatment at time period \( t \) and 0 otherwise, i.e.

\[
D_{it} = \begin{cases} 
1, & \text{if } i = 1 \text{ and } t > T_0 \\
0, & \text{otherwise} 
\end{cases} \quad (1)
\]

The observed outcome for region \( i \) at time \( t \) is then

\[
Y_{it} = Y_{it}^N + \alpha_{it} D_{it} \quad (2)
\]

where \( \alpha_{it} = Y_{it}^I - Y_{it}^N \) is the effect of the treatment on region \( i \) at time \( t \). We are interested in estimating \( (\alpha_{1, T_0 + 1}, ..., \alpha_{1, T}) \). Since we observe \( Y_{it}^I \), in order to estimate \( \alpha_{it} \) we just need to estimate \( Y_{it}^N \). Let \( Y_{it}^W \) to be given by a generalized difference-in-difference (fixed effects) model, where the unobserved individual specific effect is allowed to vary with time

\[
Y_{it}^W = \delta_t + \theta_t Z_i + \lambda_t \mu_i + \varepsilon_{it} \quad (3)
\]

Here, \( Z_i \) is a vector of observed covariates (which may contain time varying covariates), \( \mu_i \) are individual specific unobserved confounders, and \( \varepsilon_{it} \) are mean 0 shocks. Let \( W = \{w_j\}_{j=2}^{J+1} \) be a set of non-negative weights that sum up to one. Each such set of weights represents a particular weighted average of controls i.e. a particular synthetic control. Hence for a given \( W \) the outcome for the synthetic control will be
Let there be weights \((\omega^*_2, \ldots, \omega^*_{J+1})\) such that
\[
Z_1 = \sum_{j=2}^{J+1} \omega^*_j Z_j \quad \text{and} \quad Y_{1t} = \sum_{j=2}^{J+1} \omega^*_j Y_{jt} \quad \text{for all} \ t \in \{1, \ldots, T_0\}
\]
i.e. (1) the weighted average of the covariates of the controls perfectly replicates the covariates of the treated unit, and (2) the weighted average of the pre-treatment outcomes of the controls perfectly matches the pre-treatment outcomes of the treated unit. Then, ADH show that if \(\sum_{t=1}^{T_0} \lambda'_t \lambda_t\) is non-singular, we have
\[
Y^N_{1t} - \sum_{j=2}^{J+1} \omega^*_j Y_{jt} = \sum_{j=2}^{J+1} \omega^*_j \sum_{s=1}^{T_0} \lambda'_t \left( \sum_{n=1}^{T_0} \lambda'_n \lambda_n \right)^{-1} \lambda'_s (\varepsilon_{js} - \varepsilon_{1s}) - \sum_{j=2}^{J+1} \omega^*_j (\varepsilon_{jt} - \varepsilon_{1t})
\]
Further, they show that the mean of the right hand side of equation (6) is close to zero "... if the number of pre-intervention periods is large relative to the scale of the transitory shocks" (pg. 495). We can therefore estimate the impact of the treatment as
\[
\hat{\alpha}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} \omega^*_j Y^N_{jt} \quad \text{for} \ t \in \{T_0 + 1, \ldots, T\}
\]
Usually we are unable to get a perfect synthetic control as weights do not exist such that the equations in (5) hold exactly. The weights are then selected such that the equations in (5) hold approximately.

Let \(X_1\) be the vector of \(Z_1\) and pre-treatment outcomes for the treated state and \(X_0\) be the matrix of \(Z_j\) and pre-treatment outcomes for the \(J\) control states. The vector of weights \(W^*\) is chosen to minimize \((X_1 - X_0 W)'V(X_1 - X_0 W)\) subject to the weights \(\{\omega_j\}_{j=2}^{J+1}\) being non-negative and summing up to 1. The weighting matrix \(V\) can be any
positive definite matrix. Following AG, we allow the choice of V to be data driven, by choosing V such that the mean square error of the outcome variable is minimized for the pre-treatment period. All calculations in this paper were performed using the software SYNTH for STATA, developed by ADH\(^8\).

Given the small number of control units, large sample inferential techniques cannot be applied to comparative case studies (ADH). To estimate the significance of the results in this study, we conduct placebo tests similar to those in AG and ADH. A placebo test is one where the entire analysis is performed for a control state as if the control state was treated. Since the control state was not treated, we should not expect to find any treatment effect. If the placebo studies using control states iteratively assigned to treatment status create treatment effects of magnitude similar to the ones estimated for the actually treated state, then the conclusion is that the analysis does not provide significant evidence of a treatment effect for the actually treated state.

5. Data
The first objective of this study is to estimate the economic costs of Naxalite violence in Naxalite affected states, as measured by lost pcNSDP; while the second objective is to measure the extent to which the creation of the dedicated anti-Naxalite police force known as the Greyhounds mitigated the loss of pcNSDP due to Naxalite violence in Andhra Pradesh. The outcome variable of interest for both objectives is real pcNSDP at 1999 prices. The variables used to predict growth of pcNSDP are the same for both objectives, and include proxies for human capital (HDI and population density) and infrastructure indicators (percentage of urban households with access to safe drinking water, road density, and per capita consumption of electricity). The list of variables used in the analysis and the data sources are displayed in Table 2.

\(^8\) The software is available for download at http://www.mit.edu/~jhainm/software.htm
Table 2: Description of Variables

<table>
<thead>
<tr>
<th></th>
<th>Variables</th>
<th>Notes</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Real Net State Domestic Product Per capita, NSDP</td>
<td>See Note 1</td>
<td>Central Statistical Office, Ministry of Statistics and Program Implementation, Government of India</td>
</tr>
<tr>
<td>3</td>
<td>Human Development Index (HDI)</td>
<td>1981 value</td>
<td>10th Five-Year Plan, Vol. III, Planning Commission</td>
</tr>
<tr>
<td>4</td>
<td>Road Density (Kilometers per 1000 Sq. Km. Area)</td>
<td>Average of 1971 and 1981</td>
<td>10th Five-Year Plan, Vol. III, Planning Commission</td>
</tr>
<tr>
<td>5</td>
<td>Per capita electricity consumption</td>
<td>Average of 1974 and 1980</td>
<td>10th Five-Year Plan, Vol. III, Planning Commission</td>
</tr>
</tbody>
</table>

Note 1: Data on NSDP at current prices were downloaded from INDIASTAT\(^9\). The data were available in four separate series, each corresponding to a different base year i.e. 1970-71, 1980-81, 1993-94, and 1999-00. The data was first deflated by the Nationmaster\(^10\) GDP deflator series for India using 1999 as the base year, thus converting the data into NSDP at constant 1999 prices, although corresponding to different base years. The NSDP data for each base year series was calculated using slightly different methodology, thus rendering them non-comparable across base years unless suitably linked. The Directorates of Economics and Statistics of the respective state governments are responsible for transforming back series of NSDP data so that it is compatible with the latest base year series. However, in the absence of data from the Directorates, we were compelled to link the various base year series using the following ad hoc method. Data on overlapping years for the different base year series were used to link the series, using different “linking coefficients” for each state. For example, if data on a number of years for a state was available for both the 1993-94 series and the 1999-00 series, then the linking coefficient for that state was calculated as the ratio of the average value of NSDP at constant 1999 prices for that state for the overlapping years in the 1999-00 series to that of the 1993-94 series. Then, data for the 1993-94 series was converted into data for the 1999-00 series by multiplying all observations for that state for the 1993-94 series by the linking coefficient. This procedure was performed for each state, thus converting all 1993-94 series data into 1999-00 data. A similar procedure was then performed for each state in order to convert 1980-81 series data into 1999-00 data by linking with the converted 1993-94 series. In this manner, all data were suitably linked so that they were expressed in terms of their 1999-00 equivalents both for deflation as well as for linking purposes.

For the first objective, we take 1980 as the first year of the treatment period. This is because 1980 is the first year by which all the major violent Naxalite organizations had come into existence. The pre-treatment period is therefore 1970-1979 and the treatment period is 1980-2000. The treated unit (called Naxal States) is constructed by taking a simple average of the variables for Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Karnataka, Orissa, Uttar Pradesh and West Bengal, these being the states most severely affected by Naxalite violence during the treatment period. An alternate

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\(^9\) www.indiastat.com
\(^10\) www.nationmaster.com
way of determining the treatment period could have been to use data on the state-wise levels of Naxalite violence to determine the period after which the Naxalite violence escalated in the Naxalite affected states as a group. Unfortunately, except for Andhra Pradesh, this data is not available for the other Naxalite affected states.

Note that some of the variables from Table 2 that were used for the analysis were measured in 1981, even though the treatment period for the first objective begins in 1980. At the cost of some bias in the estimates, we treat such variables as being measured in 1979 i.e. as being measured prior to the treatment for the first objective. Since these variables (population density, HDI, road density, per capita electricity consumption and percentage of urban population with access to safe drinking water) are unlikely to change much over the course of two years, we feel confident that the bias in our estimates on account of treating the post treatment values of these variables as pre-treatment values will not be too severe.

While choosing the potential controls we drop (1) states that had missing data for the period 1970-2000 (Chhattisgarh, Chandigarh, Uttarakhand and Jharkhand), (2) states that faced some other significant form of violence during this period (the North-Eastern States\textsuperscript{11}, Sikkim, Punjab and Jammu and Kashmir), and (3) states\textsuperscript{12} that are too small (Lakshadweep Islands, Andaman and Nicobar Islands, Daman and Diu, Dadra and Nagar Haveli). After dropping these states, the sample of potential controls consists of nine states: Tamil Nadu, Rajasthan, Kerala, Gujarat, Himachal Pradesh, Haryana, Goa, Delhi and Pondicherry.

For the second objective, we take 1989 as the first year of the treatment period. This is the year in which the Greyhounds police force was raised by the Andhra Pradesh government. This gives us 1970-1988 as the pre-treatment period and 1989-2000 as the

\textsuperscript{11} Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura

\textsuperscript{12} These particular states are known as Union Territories. The main difference between States and Union Territories is that Union Territories are administered by the Federal Government, not by locally elected Governments.
treatment period. The treated unit is Andhra Pradesh, and the potential control units are the other Naxalite affected states i.e. Bihar, Madhya Pradesh, Maharashtra, Karnataka, Orissa, Uttar Pradesh and West Bengal. Since our objective is to measure the extent to which the operations of the Greyhounds force mitigated the extent of loss of pcNSDP in Andhra Pradesh due to Naxalite violence, it is necessary to retain as potential controls only those states that suffered from Naxalite violence but which did not constitute a Greyhounds type dedicated anti-Naxalite force.

6. Results
6.1 First objective
Consider the results for the first objective i.e. measuring the loss of pcNSDP in Naxalite affected states due to Naxalite violence. Figure 1 plots the trajectory of pcNSDP of the Naxal States and that of a simple average of all control states (called Rest of India). The average pcNSDP for the Rest of India lies well above that of the Naxal States in both pre and post treatment periods, indicating that simply using the Rest of India as a comparison group for the Naxal States would not be appropriate. Even before the formation of the major violent Naxalite groups, the Naxal States were consistent underperformers relative to the Rest of India.
Even though the Naxal States were consistent underperformers relative to the Rest of India, we argue that endogeneity between low income levels and Naxalite violence is unlikely to be a serious problem for the study. Between 1970 and 1979 i.e. during the pre-treatment period, Maharashtra (one of the states that subsequently became Naxalite affected) had on average higher income levels than Gujarat, Himachal Pradesh, Kerala, Rajasthan and Tamil Nadu (all control states). Similarly, during the pre-treatment period, West Bengal (one of the states that subsequently became Naxalite affected) had on average higher income levels than Rajasthan and Tamil Nadu (both control states). Despite having higher income levels than some of the control states, both Maharashtra and West Bengal went on to become Naxalite affected, while none of those control states with lower income levels went on to become Naxalite affected. Although this is by no means definitive evidence, it tends to support the argument that causation flows from Naxalite violence to low levels of GDP, and not vice versa.

The synthetic Naxal States i.e. the synthetic control unit, is constructed as a weighted average of the states in the potential control group that most closely resembles the Naxal States in terms of (1) pre-treatment values of pcNSDP and (2) pre-
treatment values of pcNSDP growth predictors. Table 3 compares the pre-treatment characteristics of the Naxal States to those of the synthetic control (appropriately weighted average of control states) and also to the Rest of India (simple average of control states). As can be seen from the table, the synthetic control does a fairly good job of mimicking the real Naxal States both in terms of (1) pre-treatment values of pcNSDP, and (2) pre-treatment values of pcNSDP growth predictors. On the other hand, the Rest of India is quite different from the Naxal States. Table 4 shows the weights given to each state in the control group when constructing the synthetic Naxal States. The optimal weights are positive for only two states – Tamil Nadu, Rajasthan; and zero for all the other states.

Table 3: pcNSDP Predictor Means

<table>
<thead>
<tr>
<th>Variables</th>
<th>Naxal States</th>
<th>Synthetic Control</th>
<th>Avg of Control States</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDI</td>
<td>0.34</td>
<td>0.30</td>
<td>0.39</td>
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<tr>
<td>Population density (persons / sq.km.)</td>
<td>202.97</td>
<td>226.28</td>
<td>702.61</td>
</tr>
<tr>
<td>Road density (km / 1000 sq.km. area)</td>
<td>557.94</td>
<td>550.52</td>
<td>2222.50</td>
</tr>
<tr>
<td>Per capita electricity consumption (Kwh)</td>
<td>91.96</td>
<td>120.07</td>
<td>172.34</td>
</tr>
<tr>
<td>Urban hh with safe drinking water (%age)</td>
<td>68.62</td>
<td>73.68</td>
<td>76.25</td>
</tr>
<tr>
<td>1972 NSDP per capita (1999 Rupees)</td>
<td>7211.36</td>
<td>7274.64</td>
<td>10196.18</td>
</tr>
<tr>
<td>1973 NSDP per capita (1999 Rupees)</td>
<td>7645.42</td>
<td>7881.29</td>
<td>10755.26</td>
</tr>
<tr>
<td>1977 NSDP per capita (1999 Rupees)</td>
<td>7805.32</td>
<td>7808.02</td>
<td>11718.78</td>
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<tr>
<td>1978 NSDP per capita (1999 Rupees)</td>
<td>7878.49</td>
<td>7958.49</td>
<td>12234.85</td>
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All variables unless otherwise mentioned are averaged over 1970-1979
Table 4: State Weights

<table>
<thead>
<tr>
<th>State</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goa</td>
<td>0.00</td>
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<tr>
<td>Gujarat</td>
<td>0.00</td>
</tr>
<tr>
<td>Haryana</td>
<td>0.00</td>
</tr>
<tr>
<td>Himachal Pradesh</td>
<td>0.00</td>
</tr>
<tr>
<td>Kerala</td>
<td>0.00</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>0.46</td>
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<tr>
<td>Tamil Nadu</td>
<td>0.54</td>
</tr>
<tr>
<td>Delhi</td>
<td>0.00</td>
</tr>
<tr>
<td>Pondicherry</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Figure 3 plots the trajectory of pcNSDP of the Naxal States and the synthetic control for the period 1970-2000. In the pre-treatment period 1970-1979, the pcNSDP of the synthetic control behaves very similarly to that of the actual Naxal States. In the treatment period, the pcNSDP of the synthetic control continues to track the movement of pcNSDP of the Naxal States till 1984, after which it begins to diverge from the Naxal States, with the gap increasing rapidly over time and peaking towards the end of the 1990s.

Fig 3: Trends in pcNSDP: Naxal States vs. Synthetic Control
What does this divergence mean for the actual and potential evolution of pcNSDP for the Naxal states? Recall that the evolution of pcNSDP for the synthetic control is what the evolution of pcNSDP would have been for the Naxal States if they had not been subjected to Naxalite violence. The main implication of Figure 3 is that Naxalite violence resulted in a loss of pcNSDP for the Naxal States from 1984 onwards, with the loss becoming more severe over time, and peaking towards the end of the 1990s.

We can quantify the loss of pcNSDP for the Naxal States in two ways: (1) percentage average loss, and (2) average percentage loss. The former is the average yearly gap between pcNSDP of the Naxal States and that of the synthetic control expressed as a percentage of the average yearly pcNSDP of the Naxal States over the treatment period i.e. 1980-2000. The latter is the average of the yearly percentage gap between pcNSDP of the Naxal States and that of the synthetic control over the treatment period.

The average yearly gap between pcNSDP of the Naxal States and that of the synthetic control was Rs.1,273/-, and the average yearly pc NSDP of the Naxal States was Rs.10,200/- over the treatment period. Naxal States consequently experienced a percentage average loss of 12.48% of their pcNSDP over this period\(^\text{13}\). The loss at the end of the period was Rs.3,114/-, and the maximum loss observed\(^\text{14}\) was Rs.3,340/- in 1998. Naxalite violence has therefore had a large negative impact on the pcNSDP of the affected states.

Implicit in the calculation of the economic costs of Naxalite violence is the assumption of no spillover between units i.e. outcomes of control units are not affected by the treatment administered to the treated unit. This assumption may be violated in the following ways in the present context. For example, it is possible that Naxalite violence may have driven away investment from non Naxalite affected states by

\[^{13}\text{The average percentage loss during this period was 10.77%}.
^{14}\text{Yearly losses are available on request.}\]
tarnishing the image of India as a whole as an investment destination. This would artificially lower our estimates of the treatment effect by lowering the pcNSDP of the synthetic control. There is no evidence however that such an effect exists for India. Another possibility could be that investment is driven away from the Naxalite affected states to the non Naxalite affected states within India. To the extent that the investment went to the non Naxalite affected states that comprise the synthetic control, this would artificially raise our estimates of the treatment effect by increasing the pcNSDP of the synthetic control. Our estimate of the treatment effect would then constitute an upper bound on the true treatment effect. As AG argue, the bias in the estimate due to this effect would be smaller the larger is the size of the control units with respect to the treated unit. Since the control states had on average 1.47 times greater pcNSDP than the treated states during the pre-treatment period, it is unlikely that the extent of such bias is high in the present context.

Following ADH, we assess the robustness of our results by using different combinations of predictors of pcNSDP when constructing the synthetic control. We find that our results remained robust to the use of measures of state level credit utilization from scheduled commercial banks, percentage share of NSDP from agriculture, the percentage of population below the poverty line, and area under cultivation of food-grains.

Following AG and ADH, we assess the significance of our results by conducting a series of placebo tests that involve iteratively applying the synthetic control method to each of the nine control states. In each iteration of the placebo test, we treat a different control state as the treated state (as if it experienced Naxalite violence), and assign the actually treated state (the Naxal States) to control state status (as if the Naxal States did not experience Naxalite violence). Each placebo test yields a measure of the treatment effect (average pcNSDP gap) for a control state, and the tests as whole (one for each control state) yield a distribution of treatment effects for the control states. If the
placebo tests yield pcNSDP gaps for the control states similar in magnitude to the pcNSDP gap estimated for the Naxal States, then we conclude that there is no significant effect of Naxalite violence on the pcNSDP of the Naxal States. If however the placebo tests yield pcNSDP gaps smaller in magnitude to the pcNSDP gap estimated for the Naxal States, then we conclude that there is a significant effect of Naxalite violence on the pcNSDP of the affected States.

**Fig 4:** pcNSDP Gap in Naxal States and Placebo Gaps in all Control States

![Graph showing pcNSDP Gap in Naxal States and Placebo Gaps in all Control States](image)

Figure 4 shows pcNSDP Gap in Naxal States and the placebo gaps for all the control states. The estimated pcNSDP gap between each control state and its synthetic counterpart is represented by the grey lines. The black line represents the estimated pcNSDP gap between the Naxal States and its synthetic counterpart. It is clear from Figure 4 that the estimated pcNSDP gap for the Naxal States is large (negative) in comparison to the distribution of pcNSDP gaps for the control states, with the exception of one control state i.e. Pondicherry. Also, the synthetic control method provides a good fit for pcNSDP both in the Naxal States and in the control states in the pre-treatment
period, with the exception of Pondicherry. The pre-treatment MSPE\textsuperscript{15} for the Naxal States is just 323.74, while the median pre-treatment MSPE for control states in the placebo runs is just 583.26, indicating relatively good pre-treatment fits. The pre-treatment MSPE for the Pondicherry placebo run is however relatively large at 1591.65, while that for Delhi is the largest at 4727.46.

The poor pre-treatment fits in the placebo runs for Pondicherry and Delhi cast doubt on the reliability of the post treatment fits for Pondicherry and Delhi. As ADH (pg.502) observe, “… placebo runs with poor pre-treatment fit do not provide information to measure the relative rarity of estimating a large post treatment gap for a state that was well fitted prior to treatment.” Therefore, we also display Figure 5, where we drop placebo runs for states that give pre-treatment MSPEs that are at least three times higher than the pre-treatment MSPE for the Naxal States i.e. we drop the placebo runs for Delhi, Haryana, and Pondicherry. The pc NSDP gap for the Naxal States is now the largest (negative) of all the pcNSDP gaps.

**Fig 5:** pcNSDP Gap in Naxal States and Placebo Gaps in all Control States (Discards States with Pre-Treatment MSPE Three Times Higher than Naxal States)

\textsuperscript{15} MSPE stands for mean square prediction error, where prediction error is the difference between the actual and estimated pc NSDP.
6.2 Second Objective

Next we measure to what extent – if any – the creation of the Greyhounds, a dedicated anti-Naxalite police force, mitigated the loss of pcNSDP due to Naxalite violence in Andhra Pradesh. Figure 6 plots the trajectory of pcNSDP of Andhra Pradesh and that of a simple average of the control states (called Control States). Recall that the control states are the other states that are affected by Naxalite violence but which did not set up a dedicated anti-Naxalite police force. The treatment year is 1989, being the year in which the Greyhounds police force was raised. The pre-treatment period is then 1970-1988, and the treatment period is 1989-2000. The average pcNSDP for the Control States lies well above that of Andhra Pradesh in both the pre-treatment and treatment periods, indicating that simply using the rest of the Naxalite affected states as a comparison group for Andhra Pradesh would not be appropriate. Even before the formation of the Greyhounds force, Andhra Pradesh was a consistent underperformer relative to the rest of the Naxalite violence affected states.

**Fig 6: Trends in pcNSDP: Andhra Pradesh vs. control States**
The synthetic Andhra Pradesh i.e. the synthetic control unit is constructed as a weighted average of the states in the potential control group that most closely resemble Andhra Pradesh in terms of (1) pre-treatment values of pcNSDP and (2) pre-treatment values of pcNSDP growth predictors. Table 5 compares the pre-treatment characteristics of Andhra Pradesh to those of the synthetic control (appropriately weighted average of controls) and also to the simple average of controls. As can be seen from the table, the synthetic control does a fairly good job of tracking the real Naxal States both in terms of (1) pre-treatment values of pcNSDP, and (2) pre-treatment values of pcNSDP growth predictors. On the other hand, the simple average of control states is quite different from Andhra Pradesh. Table 6 shows the weights given to each state in the control group when constructing the synthetic Andhra Pradesh. The optimal weights are positive for Bihar, Karnataka, Madhya Pradesh and Orissa; and zero for the other states.

**Table 5: pcNSDP Predictor Means**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Andhra Pradesh</th>
<th>Synthetic Control</th>
<th>Avg of Control States</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDI</td>
<td>0.30</td>
<td>0.28</td>
<td>0.29</td>
</tr>
<tr>
<td>Population density (persons / sq.km.)</td>
<td>176.50</td>
<td>176.84</td>
<td>303.86</td>
</tr>
<tr>
<td>Road density (km / 1000 sq.km. area)</td>
<td>366.00</td>
<td>396.36</td>
<td>487.14</td>
</tr>
<tr>
<td>Per capita electricity consumption (KwH)</td>
<td>78.60</td>
<td>94.86</td>
<td>107.54</td>
</tr>
<tr>
<td>Urban hh with safe drinking water (%age)</td>
<td>63.27</td>
<td>68.36</td>
<td>70.90</td>
</tr>
<tr>
<td>1970 NSDP per capita (1999 Rupees)</td>
<td>7159.79</td>
<td>7178.38</td>
<td>7485.08</td>
</tr>
<tr>
<td>1972 NSDP per capita (1999 Rupees)</td>
<td>6888.87</td>
<td>6941.35</td>
<td>7257.43</td>
</tr>
<tr>
<td>1973 NSDP per capita (1999 Rupees)</td>
<td>7625.09</td>
<td>7626.81</td>
<td>7648.33</td>
</tr>
<tr>
<td>1983 NSDP per capita (1999 Rupees)</td>
<td>7911.37</td>
<td>7847.85</td>
<td>8383.47</td>
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<tr>
<td>1984 NSDP per capita (1999 Rupees)</td>
<td>7722.79</td>
<td>7686.90</td>
<td>8328.26</td>
</tr>
</tbody>
</table>

All variables unless otherwise mentioned are averaged over 1970-1988
Figure 7 plots the trajectory of pcNSDP of Andhra Pradesh and the synthetic control for the period 1970-2000. In the pre-treatment period 1970-1988, the pcNSDP of the synthetic control behaves very similarly to that of Andhra Pradesh till 1987. In the treatment period, the pcNSDP of the synthetic control diverges sharply from that of Andhra Pradesh, with the gap increasing rapidly over time all the way till the end of the study period.

**Fig 7: Trends in pcNSDP: Andhra Pradesh vs. Synthetic Control**

What does this divergence mean for the actual and potential evolution of pcNSDP for Andhra Pradesh? Recall that the evolution of pcNSDP for the synthetic control is what the evolution of pcNSDP would have been for Andhra Pradesh if it had not raised
the Greyhounds force. The main implication of Figure 7 is that the establishment of the Greyhounds force paid immediate and rich dividends to Andhra Pradesh in terms of raising its pcNSDP to levels higher than could have been achieved in the absence of a dedicated anti-Naxalite force. The pcNSDP “dividend” seems to be increasing steadily from year to year all the way till the end of the study period.

The average yearly gap between pcNSDP of Andhra Pradesh and that of the synthetic control was Rs.2,221/-, and the average yearly pc NSDP of Andhra Pradesh was Rs.12,884/- during the treatment period. Andhra Pradesh consequently experienced a percentage average gain of 17.23% of its pcNSDP during this period\textsuperscript{16}. The maximum gain observed\textsuperscript{17} was Rs.4,409/- at the end of the period. The Greyhounds force has therefore had a large positive impact on the pcNSDP of Andhra Pradesh.

The assumption of no spillover between units may be violated in the present context in the following ways. Anti-Naxalite operations by the Greyhounds in Andhra Pradesh may have resulted in the movement of Naxalites from Andhra Pradesh to the surrounding Naxalite affected states, where the absence of specially trained and equipped security forces would have meant a less threatening security environment for Naxalites. An example of such an instance occurred in 2007 when Naxalites from North Telangana and Nallamala regions in Andhra Pradesh state retreated to Dantewada (in Chattisgarh state) in response to the increased tempo of Greyhounds operations in Andhra Pradesh (Tata, 2010). Although this incident occurred after the study period ended, such instances may have occurred during the study period as well. To the extent that such displaced Naxalites indulged in insurgency activity in their temporary refuge across state borders, the pcNSDP of the other Naxalite affected states would have decreased (the decrease being a direct consequence of the activities of the Greyhounds force in Andhra Pradesh). This would result in an over estimate of the Greyhounds

\textsuperscript{16} The average percentage gain during this period was 16.45%.
\textsuperscript{17} Yearly gains are available on request.
treatment effect. Unfortunately, there is no publicly available data on the extent of Naxalite activity in any state except Andhra Pradesh during the treatment period. As a result, there is no way to know the extent of such bias in the calculated treatment effect. The calculated treatment effect must therefore be interpreted as an upper bound on the true treatment effect.

Another source of violation of the assumption of no spillover between units could have been if the Greyhounds offered support to the police forces of other states to tackle the Naxalite insurgency. Such support could be in the form of training, joint operations, material supply, deputing officers to other state police forces etc. To the extent that the Greyhounds offered such support, the effect of the Greyhounds on pcNSDP would not have been confined to Andhra Pradesh, but would have extended to all other states whose police forces were supported by the Greyhounds. This would have artificially raised the pcNSDP of the other Naxalite affected states and thus biased the estimate of the treatment effect downwards. Priyadershi (2009) notes that the Greyhounds started offering training to the police forces of other Naxalite affected states from 2000. To avoid this source of bias, we terminate the analysis at the year 2000.

As before, we assess the robustness of our results by using different combinations of predictors of pcNSDP when constructing the synthetic control. We find that our results remained robust to the use of measures of state level credit utilization from scheduled commercial banks, the percentage share of NSDP from agriculture, the percentage of population below the poverty line, and area under cultivation of food-grains.

As before, we assess the significance of our results by conducting a series of placebo tests that involve iteratively applying the synthetic control method to each of the nine control states. Figure 8 shows pc NSDP Gap in Andhra Pradesh and the placebo gaps for all the control states. The estimated pc NSDP gap between each control state
and its synthetic counterpart is represented by the grey lines. The black line represents the estimated pc NSDP gap between the Andhra Pradesh and its synthetic counterpart. It is clear from Figure 8 that the estimated pc NSDP gap for Andhra Pradesh States is large (positive) in comparison to the distribution of pc NSDP gaps for the control states, with the exception of one control state i.e. Maharashtra.

Fig 8: pcNSDP Gap in Andhra Pradesh and Placebo Gaps in all Control States

From Figure 8, it is clear that the synthetic control method provides a good fit for pc NSDP both in Andhra Pradesh and in control states prior to the treatment period, with the exception of Maharashtra. The pre-treatment MSPE for Andhra Pradesh is just 279.10, while the median pre-treatment MSPE for control states in the placebo runs is just 514.54, indicating relatively good pre-treatment fits. The pre-treatment MSPE for the Maharashtra placebo run is largest at 2112.54, while that for Bihar is also relatively large at 1633.12.

The poor pre-treatment fits in the placebo runs for Maharashtra and Bihar cast doubt on the reliability of the post treatment fits for Maharashtra and Bihar. Therefore, we also show Figure 9, where we drop placebo runs for states that give pre-treatment MSPEs that are at least five times higher than the pre-treatment MSPE for Andhra Pradesh.
Pradesh i.e., we drop the placebo runs for Bihar and Maharashtra. The pc NSDP gap for Andhra Pradesh is now the largest (positive) of all the pc NSDP gaps.

**Fig 9:** pcNSDP Gap in Andhra Pradesh and Placebo Gaps in all Control States (Discards States with Pre-Treatment MSPE Five Times Higher than Andhra Pradesh)

7. **Summary and Conclusion**

Using the synthetic control method approach to comparative case studies first developed by AG and ADH, we provide the first estimates of (1) the economic cost in terms of lost pc NSDP of Naxalite violence in Naxalite affected states, as well as (2) the extent to which the creation of the dedicated specialized anti-Naxalite police force known as the Greyhounds mitigated the loss of pcNSDP due to Naxalite violence in Andhra Pradesh.

We find that as a group, states affected by Naxalite violence (Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Uttar Pradesh and West Bengal) lost on average 12.48% of their pcNSDP over the period 1980 to 2000. The average yearly pc NSDP of these states was Rs.10,200/- during this period, and the average yearly loss of pc NSDP due to Naxalite violence was Rs.1,273/-. Placebo tests indicate that these results are significant. Naxalite violence has therefore had a large negative impact on the pc NSDP of the Naxalite affected states. To the best of our
knowledge, this is the first estimate of the economic costs of Naxalite violence in India. Prime Minister Manmohan Singh has observed that the Naxalite problem is the gravest threat to India’s internal security. This analysis shows that the Naxalite problem may well be the gravest threat to India’s remarkable growth story.

Despite the magnitude of the Naxalite problem, none of the affected states save Andhra Pradesh instituted a specially trained and equipped police force, dedicated solely to combating the Naxalite menace. The introduction of such a force known as the Greyhounds in 1989 by Andhra Pradesh yielded a “security dividend” equal on average to 17.23% of its pcNSDP over the period 1989 to 2000. The average yearly pcNSDP of Andhra Pradesh was Rs.12,884/- during this period, and the average yearly gain of pc NSDP due to the Greyhounds force was Rs.2,221/-. Placebo tests indicate that these results are significant. The Greyhounds force has therefore had a large positive impact on the pc NSDP of Andhra Pradesh. To the best of our knowledge, this is the first study that directly estimates the economic benefits of a unique robust security response undertaken by a state to an extremist threat.
References


Naxal Terror Watch (2010), blog available at http://naxalwatch.blogspot.com/ as on May 10, 2010


