Do Educated Leaders Affect Economic Growth? Evidence from India

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Abstract

We study the impact of electing an educated politician to state legislative assemblies on economic growth in the politician's constituency. Intensity of night lights is used to proxy for constituency-level economic activity and data on all politicians contesting state elections between 2008 and 2013 is used. Our identification strategy is based on a regression discontinuity design that exploits quasi-experimental election outcomes of close elections between educated and less-educated politicians. We find that having a graduate state representative increases the growth rate of night lights by about 2 percentage points in the constituency. Though statistically significant, the impact on economic activity of having an educated leader is substantially lower than that of having a woman or non-criminally accused leader. Further, the effect of educated leaders is heterogeneous depending on the initial level of development of the state. Our findings have implications for recent policy changes mandating minimum education requirements of leaders in some states of India.

Keywords: Educated leaders; Night-lights; Close Elections; India

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1 Introduction

In the area of new political economy, the role of identity of politicians in determining policy outcomes has been widely acknowledged (Besley, 2007). The identity of a politician is comprised of multiple dimensions including background and individual characteristics. In this paper, we focus on one such dimension – educational attainment – to investigate whether politicians with higher levels of education lead to better economic outcomes. The broad agenda of this paper is to explore whether educational attainment reflects the quality of a politician. Specifically, we examine whether there is a causal effect of formal education level of leaders in the state legislature on regional economic growth in India.

This study is motivated by a recent policy that was implemented in two states of India. These states, Haryana and Rajasthan, enacted ballot access restriction on candidates who would contest in local body elections in 2015-16. Individuals who did not possess a minimum level of formal education were disqualified from contesting elections.[1] There are opposing views about this policy. On one hand it has been considered as undemocratic, elitist and discriminatory. On the other hand, the government justified its implementation arguing that educated politicians are more competent and will lead to better outcomes. A few other states have recently expressed similar views and are planning to promulgate minimum education mandate on candidates in local and state level elections.[2]

There is a large body of evidence linking educational attainment to an individual's achievement in the economic sphere. Human capital theory suggests that education may increase the productivity of an individual by enhancing his/her personal skill-set (Ben-Porath, 1967). Signalling or screening hypothesis postulates that education reflects the innate ability of an individual; hence educated individuals are likely to have higher level of competency (Spence, 1973; Stiglitz, 1975). In the empirical literature, private returns to education is extensively tested and a positive relationship is well founded. However, it is not straightforward to extend this relationship and imply that educated politicians will deliver their duties better and propagate higher development in their constituency. There are at least two potential reasons why this may not hold. Firstly, the nature of training obtained through school/college education may be more in line with the labour market requirements rather than building leadership capabilities relevant for a political leader. Secondly, even if educated leaders have higher ability, they may

[1]The requirements were 10 years of education for general caste candidates, 8 years of education for women or from backward caste candidates. This disqualified a significant proportion of the population from contesting election as they did not meet the education requirements (Bhaskar, 2016; Lahoti and Sahoo, 2016).

[2]These states include Assam from the north-eastern part and Maharashtra from the western part of India. This has been reported in recent news: https://goo.gl/9MXWj2 and https://goo.gl/vRnac6.

use their competency for own private benefit instead of the benefit of constituents. Therefore, the link between education level of political leader and policy outcomes is ambiguous.

Our paper contributes to the literature that seeks to analyze the effectiveness of educated leaders for improving economic outcomes in the regions from where they are elected. There exists only a few studies in this area and they offer somewhat inconclusive evidence. In a cross-country setting, Besley et al. (2011) use random leadership transitions to find that highly educated leaders have a positive effect on economic growth. However, using data from US and Brazil, Carnes and Lupu (2016) find that educated leaders perform the same as compared to less-educated leaders on various economic outcomes including governance and corruption. In the context of India, there are a number of studies investigating the effect of gender, caste, religion, and criminality of political leaders on various outcomes such as economic growth and provision of public goods (Clots-Figueras, 2011; Clots-Figuerasa, 2012; Bhalotra and Clots-Figueras, 2014; Bhalotra, Clots-Figueras, Cassan, and Iyer, 2014; Baskaran, Bhalotra, Min, and Uppal, 2015; Prakash, Rockmore, and Uppal, 2015). Evidence on the effect of education level of politicians in India is rather scarce. In a recent study, Lahoti and Sahoo (2016) look into the effect of educated leaders at the state legislature on education outcomes using district level panel data covering all states of India. This is the closest to our current study. In this paper, we concentrate on economic growth as the main outcome.

We analyze data on all the members of the state legislative assemblies (MLA) for the period spanning 2008-2013. We have information on the electoral performance and individual characteristics of all candidates who contested state level elections during this period. Our objective is to evaluate the causal effect of educated versus less-educated leaders on economic growth in their respective constituency. To measure economic growth at the constituency level, we utilize satellite data on night time luminosity (or night lights). In the recent literature, night lights have been extensively used to proxy for regional gross domestic product and economic growth. In absence of data on economic growth at such a disaggregated level, average night lights in the constituency have been used by Prakash et al. (2015) and Baskaran et al. (2015) to evaluate how economic growth is affected by leaders' criminality and gender, respectively. We exploit the quasi-experimental set-up of close-elections between educated and less-educated leaders to identify the causal effect of educated leaders on the growth of night lights in their respective constituencies in the subsequent period. Using a sharp regression discontinuity design (RDD) framework, we find that a college graduate leader, as compared to a leader who is not college graduate, has a statistically significant and positive effect on the growth rate of night lights. Using elasticity of GDP with respect to night lights in India, we convert the estimate and find that having a college graduate leader results in 0.2 to 0.6 percentage points higher growth rate in GDP in the constituency. We further delve into exploring heterogeneity in the effect of educated leaders. We find that the effects are larger in less developed regions of India.

We compare the magnitude of the effect of educated leaders with that of female leaders and leaders without any criminal accusation – the two other characteristics explored in the current literature that considers economic growth captured by night lights as an outcome (Prakash et al., 2015; Baskaran et al., 2015). This comparison reveals that despite being statistically significant, the effect size of educated leaders is comparatively smaller. Thus, our results are more or less consistent with Lahoti and Sahoo (2016) who find no discernible difference in the performance between educated and less-educated leaders for improving education outcomes.

2 Data

The empirical analysis investigates the casual effect on economic growth in the constituency of being represented by a more educated politician as compared to a less educated politician. In the following sub-sections, we describe the data used to measure the outcome and the main explanatory variables in our analysis.

2.1 Night Lights Data

We proxy the level of economic activity at the assembly constituency level by the intensity of night lights. We chose to use night lights as proxy for economic acticity because there is no other reliable data to estimate the level of economic activity or output at the assembly constituency level. Data from the existing sample surveys in India can be used to generate estimates at the district level only; but even that is not available on an annual basis. The night lights data on the other hand is available on an annual basis and can be used to construct time series data for the intensity of night lights at a sub-regional level as well. Accordingly, the outcome of interest in the paper is the annual growth rate in the intensity of night lights in an assembly constituency and we define the same as below:

$$y_{it} = log(l_{it}) - log(l_{it-1}) \tag{1}$$

i herein identifies an assembly constituency while t identifies the time period; l_{it} measures the average intensity of night lights in assembly constituency i in time period t. The outcome variable y_{it}, thus, captures the change in the log of the average intensity of night lights in assembly constituency i in between the period t and $t-1$. For each assembly constituency i we generate an annual time series of night lights for the period 2008-2013, the time series data has been generated using the annual cloud free composites for stable night lights over the same period of time[3].

These composites have been procured from National Oceanic and Atmospheric Administration (NOAA)[4]. Since the 1970s, the United States Government has been using satellites to record daily night light imagery under the Defence Meteorological Satellite Program (DMSP), these satellites record concentrations of outdoor lights, fires and gas flares. The images collected under the DMSP has been processed and released as annual composites by the NOAA, these annual composites are scaled onto a geo referenced 30 arc-second grid such that each pixel is roughly around 1 km^2 . For each pixel, the intensity of the observed night lights is reported using Digital Number (DN) and the reported Digital Number ranges from 0 to 63, wherein a higher number represents a higher intensity of light. Figure 1 presents the observed night lights for the case of India as during the year 2008 while figure 2 combines the same with assembly constituency boundaries. Similarly, figure 3 presents the observed night lights in and around the National Capital Region (Delhi-NCR), note that the brighter areas in the same represents well lit areas in the region.

Various studies in the past have used night lights as a proxy for economic activity in the region (Michalopoulos and Papaioannou, 2013a,0; Hodler and Raschky, 2014; Storeygard, 2016; Alesina, Michalopoulos, and Papaioannou, 2016).[5] In order to assess the reliability of night lights as a proxy for economic performance, various studies such as Chen and Nordhaus (2010), Henderson et al. (2012) and Doll et al. (2006) have analysed the relationship between the intensity of night lights and GDP (or GRP) in the region. Henderson et al. (2012), for instance, notes that night lights serves as a useful proxy for economic growth as well as for measuring the short run fluctuations in the same. Recent studies, in this regard, have focussed on analysing the relationship between night lights and various developmental outcomes at a local or sub-regional level. Chen (2015), for instance, has analysed the correlation between night lights and infant mortality at a sub national level. Similarly, using data from the Demographic and Health Survey (DHS) Weidmann and Schutte (2017) has examined the relationship between night lights and wealth at a local level while Bruederle and Hodler (2017) has analysed the

[3] In order to extract the assembly level data we overlay these annual composites with assembly constituency boundaries for India. The shape files used for this purpose have been sourced from Susewind (2014); they can be accessed from: `https://pub.uni-bielefeld.de/data/2674065`

[4] The annual composites for night lights are available in the public domain and can be downloaded as .tiff files from the NOAA's website. The NOAA provides these cloud free composites for stable night lights for the period 1992-2013.

[5] Further, Donaldson and Storeygard (2016) provides a complete list of studies that have used night lights in different contexts in economics.

same relationship for the case of health and education related outcomes. Both Bruederle and Hodler (2017) and Weidmann and Schutte (2017) notes that a higher intensity of night lights is associated with better development outcomes at the local level. Within the Indian context as well, Bhandari and Roychowdhury (2011) has examined the association between night lights and district level GDP, the same reports that there exists a significant correlation between the two.

2.2 Political Data

We use the information provided by the Election Commission of India and Association of Democratic Reforms (ADR) in order to construct political data for each state assembly election that was conducted following the delimitation order in the year 2008. Table 1 provides a list of all such state assembly elections that were conducted following the delimitation order and the number of assembly constituencies contested for within the same. For each of these state assembly elections, the information on the number of candidates contesting the election across various assembly constituencies and the number of votes polled for each of the candidate has been procured from the ECI. On the other hand, the data regarding the education qualifications, criminal status and assets of each candidate contesting in these state assembly elections has been procured from the ADR. Following a Supreme Court judgement in 2003, any individual contesting a state assembly election is required to file an affidavit, with the election commission, detailing his/her educational qualification, assets, criminal charges and other details, the same information from these affidavits is available in usable form from ADR [6]. Thus, for each individual candidate contesting a state assembly election we combine information on the number of votes polled for the candidate in the election with his/her education qualifications and other relevant details that available.

3 Empirical Strategy

We aim to estimate the effect of electing an educated leader at the constituency level on economic activity. The election of an educated leader, however, is not random and constituencies that elect an educated leader might systematically differ from those that do not. Hence, estimates using ordinary least squares might be biased and inconsistent. In order to identify the causal effect, we rely on the Regression Discontinuity Design (RDD) framework. RDD is a quasi experimental design that identifies the causal effect of a treatment by exploiting the

[6] ADR has processed these affidavits from different state elections overtime. The same are also available on the ECI website as well but in a scanned format

discontinuity in the treatment assignment. Treatment, in the present context, refers to the election of a college educated leader at the constituency level. In order to implement the RDD framework we limit our analytical sample to those constituencies wherein one of the top two contestants (i.e. the winner and the runner-up) is a college graduate, while the other is not. Our analytical sample, thus, excludes all those constituencies in which either both the elected and runner-up candidates are college educated or both are not college educated. Accordingly, for each constituency j in our analytical sample, we define a variable $Margin_{js}$ that equals the difference between the percentage of votes received by the college educated and non-college educated candidate in the legislative assembly election in state s.

$$Margin_{js} = [Vote\_Share \mid College\_Educated = 1] - [Vote\_Share \mid College\_Educated = 0] \quad (2)$$

$Margin_j > 0$, thus, implies that the elected leader in constituency j is college educated and vice-a-versa. The probability of having a college educated leader, thus, changes discontinuously at the cut-off where $Margin_{js} = 0$. We exploit this discontinuity in treatment assignment to identify the causal effect of electing a college educated leader to the state legislative assembly on economic activity in constituency j. Given this, we estimate the following specification using constituencies that lie in the close neighbourhood (h) around the cut-off ($Margin_{js} = 0$). The identification of the casual effect relies on the assumption that those constituencies that elected a non-college educated candidate in a close election are a valid counter-factual for those that elected a college educated candidate in a close election.

$$Y_{jst+1} = \alpha + \beta_s + \gamma_{t+1} + \delta\, College\_Educated_{jst} + f(Margin_{jst}) + \epsilon_{jst+1}, \quad \forall\, Margin_{jst} \in (-h, h) \quad (3)$$

t, herein, identifies the time period while j and s identifies a constituency and state respectively. The dependent variable (Y_{jst+1}) measures the growth rate of average luminosity in constituency j between time periods t and $t+1$.[7] In the set of explanatory variables, we include state fixed effects (β_s) to control for various time invariant factors at the state level. Year fixed effects (γ_{t+1}) are included to capture any secular change in the growth rate of night lights over time. $Margin_{jst}$ identifies the forcing variable and $f(Margin_{jst})$ denotes a polynomial function of the same. Our interest lies in the estimated coefficient of the variable $College\_Educated_{jst}$ and the same (δ) captures the marginal effect of electing a college educated leader in constituency j during time period t on the growth in the average luminosity in the same during time period $t+1$.

[7] $Y_{jst+1} = Log(Avg.\ Luminosity)_{jst+1} - Log(Avg.\ Luminosity)_{jst}$

4 Validity of RD Design

Before discussing the results from the empirical specification outlined above, in this section, we test whether the regression discontinuity specification is valid or not in the present context. Firstly, we test whether the observed characteristics of the graduate leaders who won in a close election are any different from the observed characteristics of non-graduate leaders who also won in a close election; the intuitive idea behind this test is to check whether there exist any significant differences in the observed characteristics (other than education) of the graduate and non graduate leaders around the cut off of the forcing variable. If there does exist significant differences in these characteristics, then the regression discontinuity estimate for the effect of graduate leader might end up picking up the effect of such differences. Figure 4 and 5 provide a check for whether the observed characteristics of the leaders are continuous or not around the cut off in the vote margin. We find that other factors such as the leader's age, gender and criminal status do not change significantly around the cut-off. Hence this exercise indicates that only the education status of the politician changes discontinuously at the zero margin of victory, implying that our analysis identifies the causal effect of graduate versus non-graduate leaders on the outcomes of interest.

Secondly, we test whether the distribution of the forcing variable, that is the vote margin, is continuous or not around the cut off zero. We implement a test suggested by McCrary (2008) which identifies whether there exists any discontinuity in the density of the forcing variable around the cut off. A significant jump or a discontinuity in this case would imply the possibility of manipulation of the outcome of a close election, violating the assumption that the treatment is random around the cut off (Figure 6). However, we find that there is no such concern in our analysis because the estimated difference in the density function around the cut-off is very low at 0.0003 which is also statistically insignificant.

5 Estimation Results

Before discussing the estimation results, we present a descriptive analysis for our outcome variable, which measures the annual growth in the intensity of night lights across different constituencies in the country. Figure 7 presents a scatter plot for the average of the night lights in an interval of 0.5 percent of the running variable *Margin*. In addition, figure 7 also presents a local polynomial fit of the outcome variable on the running variable to the left and right of the cut-off (that is, $Margin$=0). In figure 7 we do see a jump in the value of the outcome variable at the cut-off. However, in addition to the jump in the outcome variable at the margin we notice that there is some overlap in the confidence intervals, indicating that the effect may not be statistically significant. We delve deeper in the RDD to figure out whether the effect of educated leaders is statistically significant.

Here we present the estimation results for equation 3 where the dependent variable measures the annual growth rate in the intensity of night lights in the constituency. As already described above, we use the intensity of night lights as a proxy for the level of economic activity in the region and our interest lies in estimating the effect of an educated leader on this outcome. Accordingly, we have estimated equation 3 using a local linear regression for the optimal bandwidth calculated using the Imbens and Kalyanaraman (2012) (IK) algorithm, the results for the same are presented in columns 1 and 2 of table 3. In addition, columns 3 and 4 present similar results for the case where the optimal bandwidth has been calculated using the Calonico et al. (2014) (CCT) algorithm. Further, column 1 and 3 of table 3 present the estimation results for the case where we have estimate equation 3 without any additional controls (other than $Margin$ and $Educated\_Leader$) whereas for the results presented in column 2 and 3 of table 3 we additionally control for the state and year fixed effects as well. Results presented in table 3 suggest that there exists a positive effect of electing an educated leader on the annual growth rate of nightlights in the corresponding assembly constituency. The estimated coefficient for $Educated\_Leader$ in column 1 is both positive and statistically significant at 5 percent level of significance and the magnitude of the same is around 3.104. From column 2 as well we find that the estimated coefficient is both positive and statistically significant when we control for the state and year fixed effects. The magnitude of the effect in this augmented specification reduces to be around 1.942. This estimate implies that the annual growth rate in the night lights is around 1.9 percentage points higher in constituencies that elected a graduate leader in a close election in comparison to those that elected a non graduate leader in a close election. Further, from column 3 and 4, we find that the magnitude of the estimated coefficient is similar when equation 3 is estimated for the optimal bandwidth calculated using the CCT algorithm. Our results are thus robust to the choice of algorithm used for calculating the optimal bandwidth.

6 Heterogeneity Analysis

Given the above results, in this section we examine whether the estimated effect of a graduate leader varies with any district or state specific characteristics. In order to analyse the same we create various sub samples based on the level of development in the state and on the basis of the literacy rates in the district and for all such sub samples we again estimate equation 3 with state and year fixed effects, the results for the same are discussed below —

6.1 Heterogeneity Based on the Level of Development

We start by examining the heterogeneity in the estimated effect of a graduate leader on the basis of the level of development in the state; we use three different criteria in order to classify states into developed and less developed. Firstly, we consider those states as less developed that have been identified as the least developed states by the Expert Committee constituted towards developing a composite development index for various states in the country[8], the estimation results for the sub sample of the less developed states are presented in column 1 and 3 of table 4 while column 2 and 4 of table 4 presents similar results for the remaining states in the country. Results presented in table 4 suggests that the estimated coefficient for *Educated Leader* varies significantly across the developed and less developed states in the country. For the case of the less developed states the estimated coefficient is both positive and statistically significant at 10 percent level of significance, and the same is around 3.529. Whereas for the case of the remaining states in the country, the estimated coefficient is positive but the same is not statistically significant. Besides, the magnitude of the estimated coefficient is larger for the less developed states in comparison to that for the remaining states in country, this implies that the effect of having a graduate leader on the growth rate in the night lights is much larger and stronger for the less developed states in the country.

Secondly, we classified states into the BIMAROU and Non-BIMAROU states, wherein the BIMAROU states[9] constitutes the less developed states in the country; the estimation results for the sub-sample of BIMAROU and Non-BIMAROU states are presented in table 5, column 1 and 3 in 5 presents the estimation results for the sub-sample of BIMAROU states while column 2 and 4 presents the same for the sub sample of Non-BIMAROU states. Again we find that the magnitude and statistical significance of the estimated coefficient varies across the BIMAROU and Non BIMAROU states; for the sub sample of the BIMAROU states the estimated coefficient is both positive and statistically significantly and the magnitude of the same is around 6.019 while the estimated coefficient for the case of the Non-BIMAROU is not

[8] In the year 2013, Government of India constituted a seven member Expert Committee for developing a composite development index for various states in the country and within its report the committee categorized the following 10 states as the least developed states in the country - Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Meghalaya, Odisha, Rajasthan and Uttar Pradesh. The complete report of the Expert Committee can be accessed at - $http://finmin.nic.in/sites/default/files/Report_CompDevState.pdf$

[9] BIMAROU states is an acronym used for the following less developed states in India – Bihar, Madhya Pradesh, Rajasthan, Orissa and Uttar Pradesh

statistically significant.

Finally, we classify states on the basis of the average intensity of night lights; states wherein the average intensity of night lights in the year 2008 was lower than the national average have been classified as less developed states while the rest have been classified as developed states, column 1 and 3 of table 6 presents the estimation results for the less developed states while column 2 and 4 presents the estimation results for the remaining states in the country. Results presented in table 6 are more or less similar to those presented in table 4, again we find that the estimated coefficient is statistically significant only for the less developed states. The reason that the results in table 4 and 6 are similar is due to the fact that there is a considerable overlap between the least developed states and states that had less than the average night lights during the year 2008. Out of a total of twelve states that are considered as less developed based on the third criteria, ten are identified as the least developed states by the Expert Committee.

6.2 Heterogeneity Based on District Level Literacy Rates

Similar as above, we further estimate equation 3 for the sub-sample of districts wherein the literacy rate was lower than the national average as per the Census 2001 data; the estimation results for the same are presented in column 1 and 3 of table 7; column 2 and 4 presents similar results for the remaining districts in the country. From table 7 we find that the results presented in the same are qualitatively similar to those discussed above; again, from table 7 we find that the estimated coefficient varies significantly across the two group of districts considered herein. Although the estimated coefficient is positive across the two group of districts but it is statistically significant only for those districts wherein the literacy rate is lower than the national average, for the sub sample of these districts the estimated coefficient is around 4.16 while the same is around 0.80 for sub sample of the remaining districts.

7 Sensitivity Analysis

7.1 Sensitivity to Alternate Bandwidths

Further, to check for the sensitivity of the estimates to alternate bandwidths, we again estimate equation 3 for the half and double of the optimal bandwidth calculated using the IK algorithm. Column 1 and 3 of table 8 presents the estimation results using half the optimal bandwidth ($h/2$) while column 2 and 4 of table 8 presents the results using double the optimal bandwidth ($2h$). Column 3 and 4 additionally controls for the state and year fixed effects as well while column 1 and 2 does not. Results presented in table 8 suggests that our main results indeed change when equation 3 is estimated for the half and double of the optimal bandwidth (h). Except for the case of column 2, the estimated coefficients are not statistically significant. In addition, the estimated coefficient is indeed negative for the case of half of the optimal bandwidth, although the same is not statistically significant.

7.2 Sensitivity to Higher Order Polynomial

For the results presented in table 3, we controlled for the first order polynomial of the running variable. In order to check for the sensitivity of our results, to the order of the polynomial of the running variable, we again estimate equation 3 wherein we additionally control for the second and third order polynomial of the running variable as well. Column 1 and 3 of table 9 presents the results for equation 3 with additional control for the second order polynomial while column 2 and 4 of table 9 presents the same for the case wherein we control for both the second and third order polynomial. Results presented in table 9 suggests that our results are indeed sensitive to a higher order polynomial of the running variable, except for the case of column 1 in table 9, the estimated coefficients across the various specifications presented in table 7 are indeed negative, although none of the estimated coefficient in table 9 is statistically significant.

8 Conclusion

Recent policy changes, across some Indian states, barring the less educated citizens from contesting elections builds upon the assumption or notion that that an educated leader is good for economic or social outcomes. However, there does not exist much literature with regard to the efficacy of educated leaders. In this paper we test for the validity of this notion that educated leaders promotes economic well-being, accordingly we investigate whether having an educated leader results in a higher level of economic activity or not in the context of India. Based on our estimation results we do find some evidence for the positive effect of having an educated leader on the level of economic activity in a region and in the paper we proxy for the level of economic activity by intensity of night lights in the same. Our results suggests that the annual growth in the night lights is around 1.9 percentage points higher in constituencies that elected a graduate leader in a close election in comparison to those that elected a non graduate leader in a close election. Henderson et al. (2012) estimates the elasticity of the effect of night lights on GDP as 0.3 for the sample of middle and lower income countries; using the same our estimates suggests that the growth in GDP is roughly around 0.57 percentage points higher in constituencies that elected a graduate leader in a close elections. Comparing these estimates to the existing studies in the Indian context; Prakash et al. (2015), for instance, estimates that the growth in GDP is around 7.2 percentage point lower in constituencies that elected a criminally accused politician. Similarly, Baskaran et al. (2015) finds that the growth in the GDP is around 4.6 percentage point higher in constituencies that elected a women legislator in a close election. In comparison to these, the magnitude of our estimate is small but the same is statistically significant, which in some way suggests that the leaders education does matter but the effect of the same, however, is much smaller in comparison to other characteristics such as their gender or criminal background. Further, we find that the above estimate for the effect of educated leader varies considerably with region specific characteristics; based on the heterogeneity analysis we find that the estimated effect is indeed larger for the less developed states in the country and similarly for those districts with lower levels of literacy.

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Figure 1: Intensity of Night Lights in India in 2008

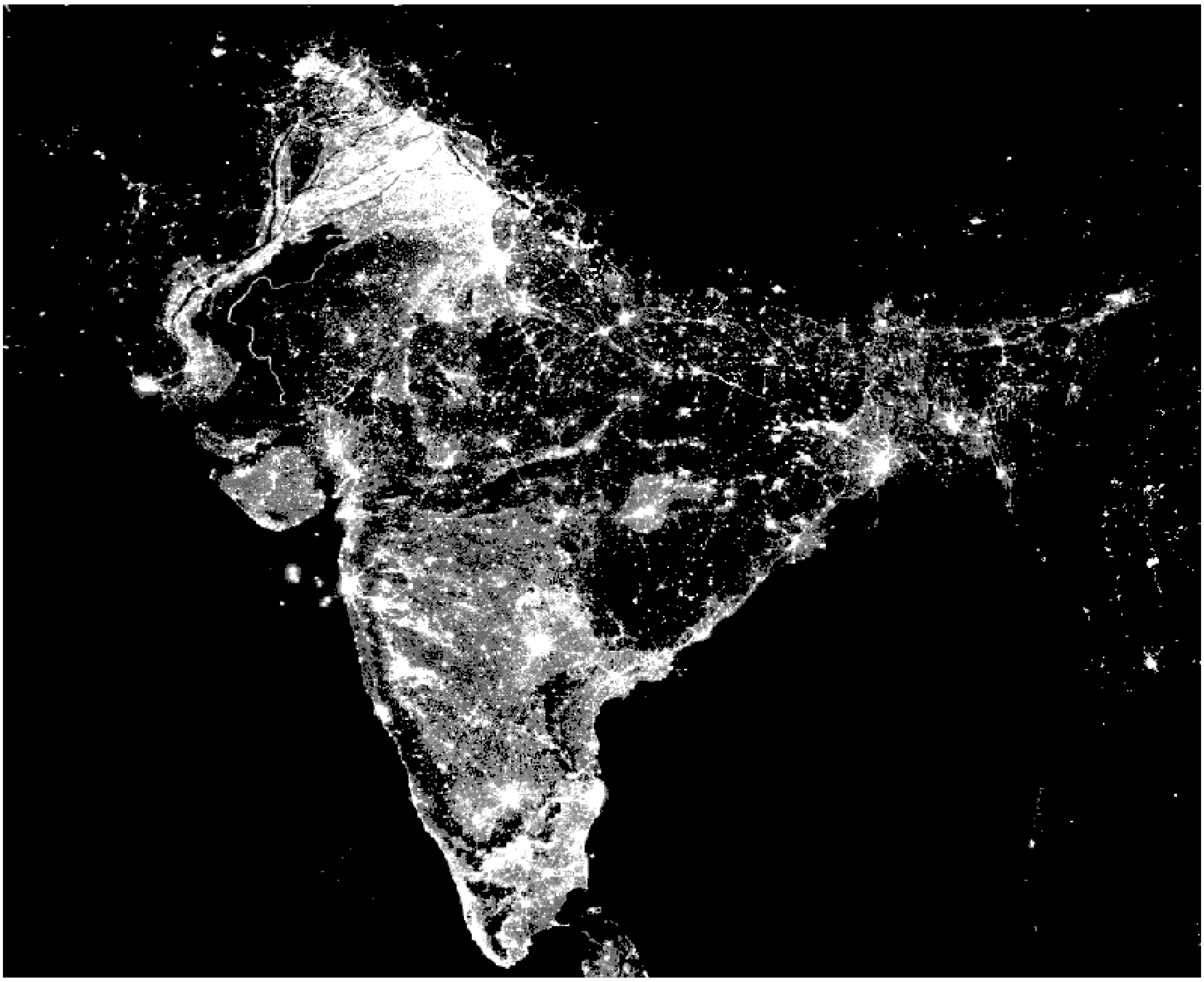

Figure 2: Map for Assembly Constituencies in India

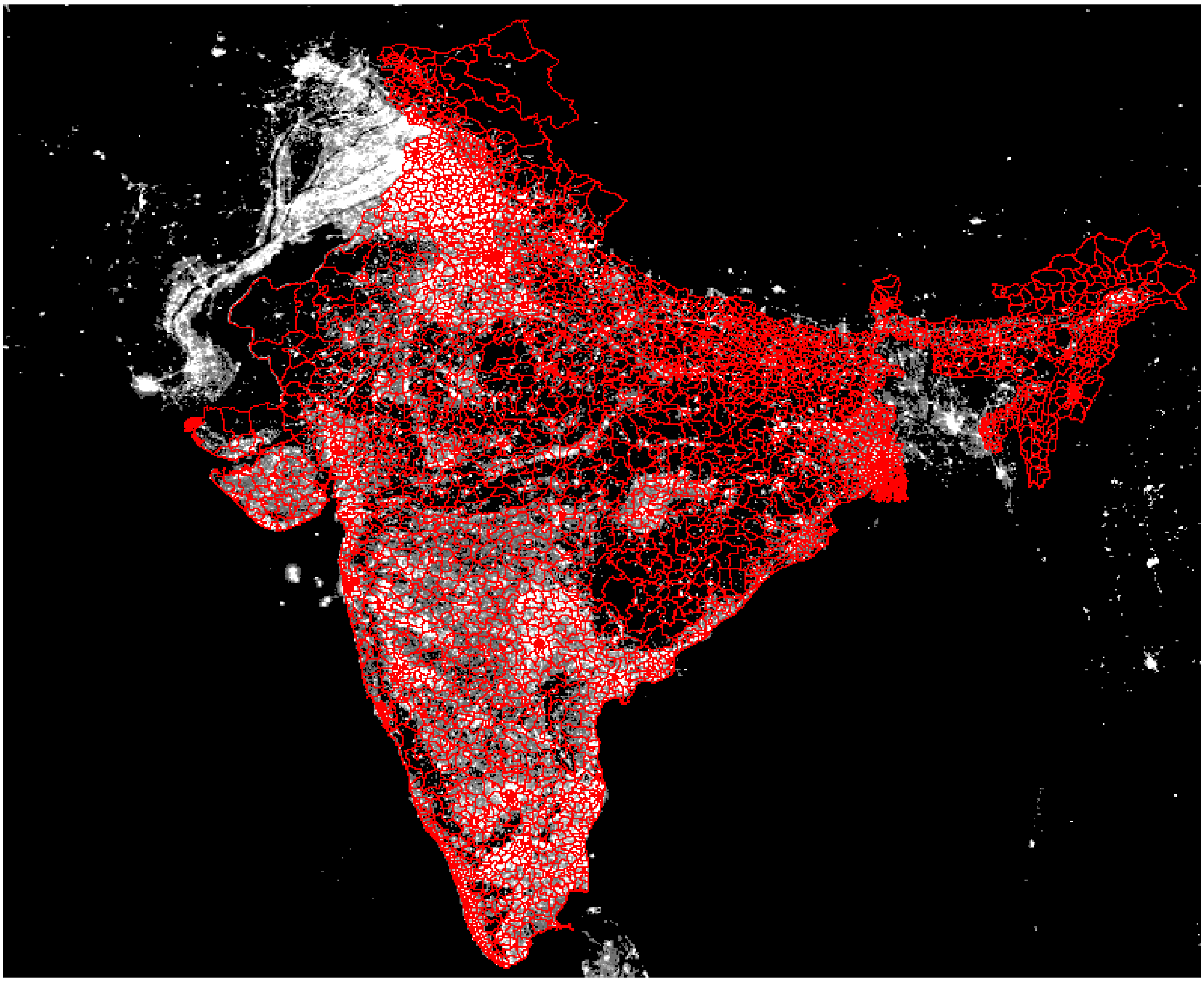

Figure 3: Observed Night Lights in the National Capital Region (Delhi-NCR)

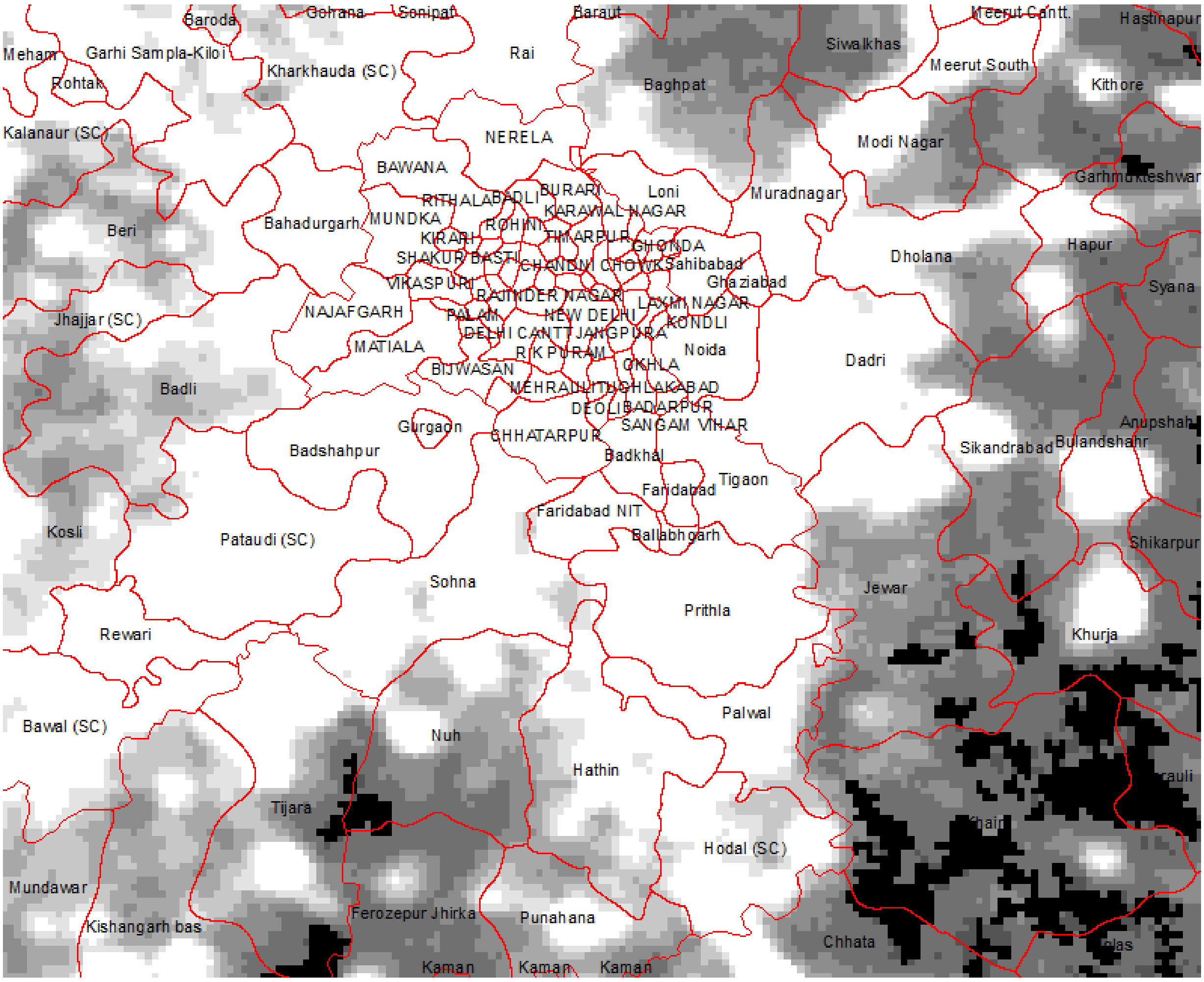

Figure 4: Continuity Graphs

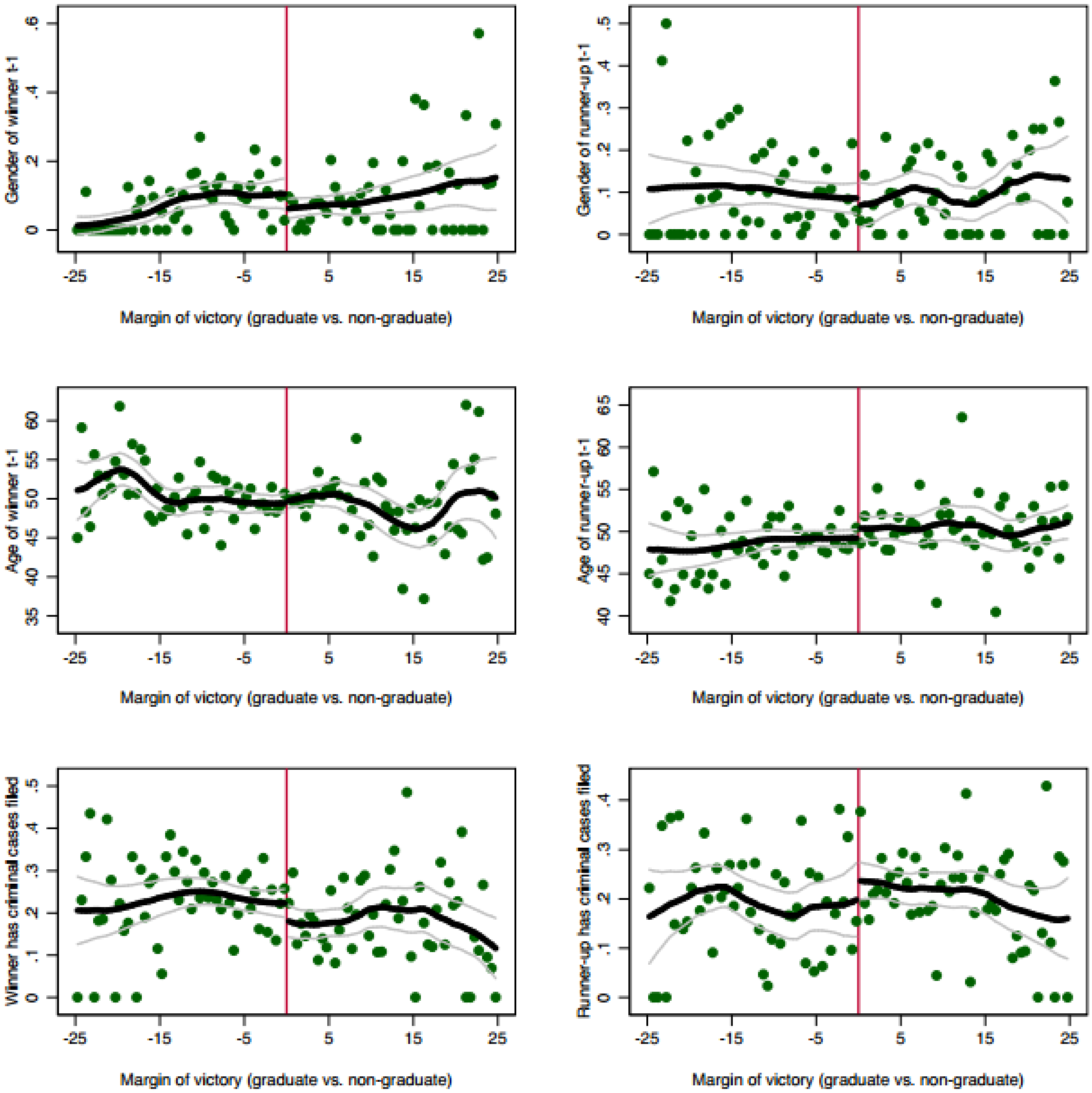

Figure 5: Continuity Graphs

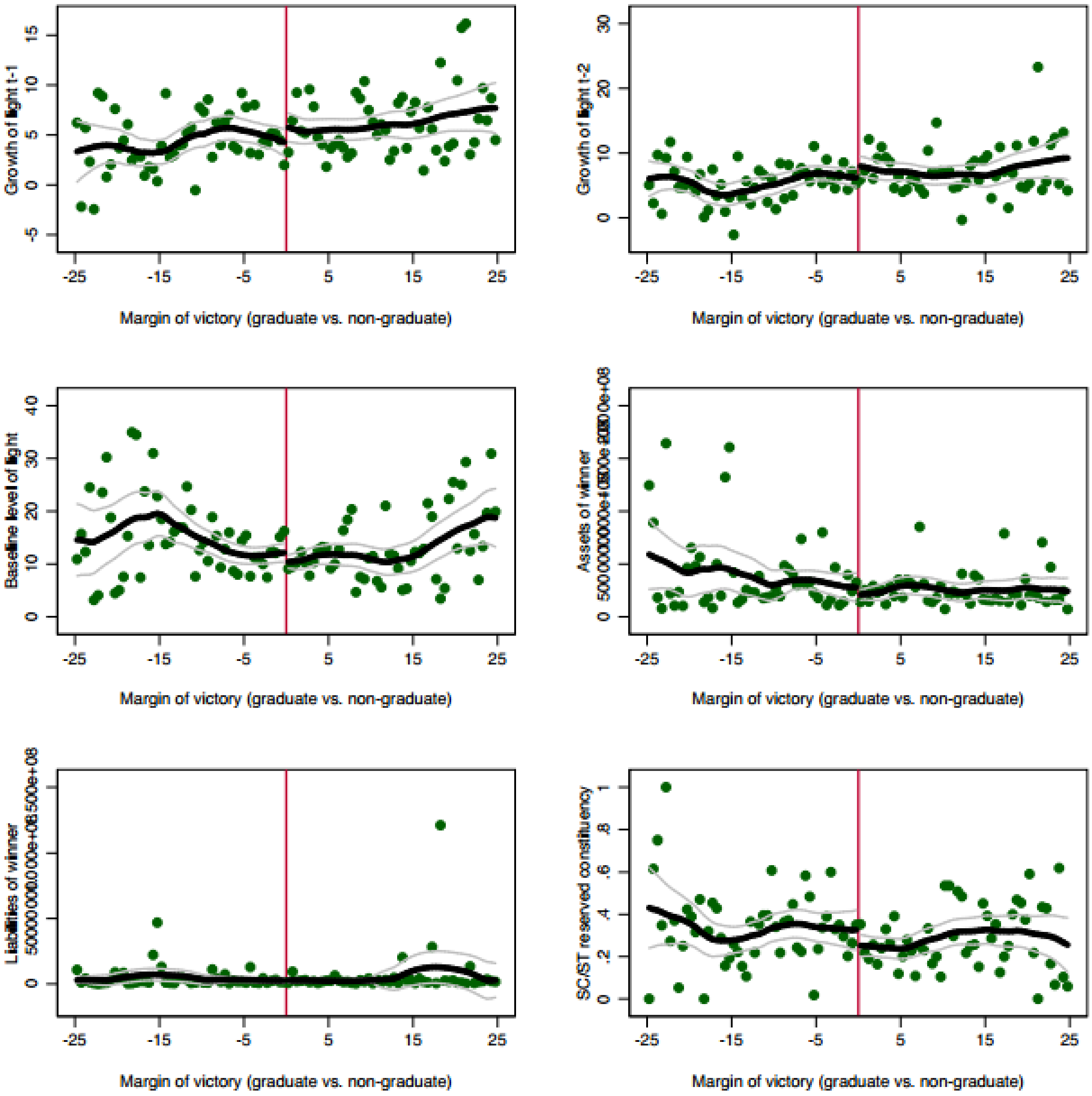

Figure 6: McCrary Test

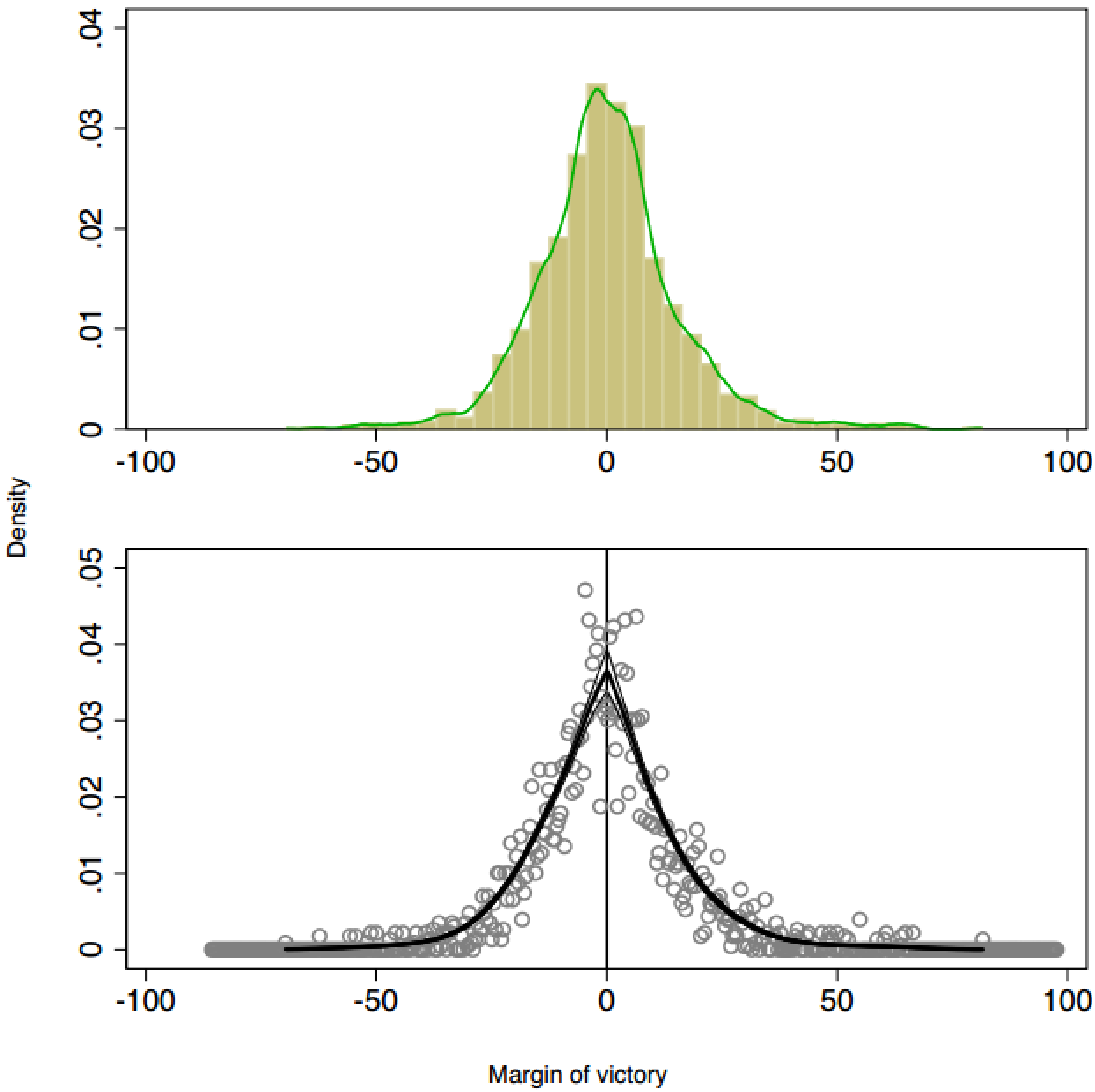

Figure 7: Outcome Variable

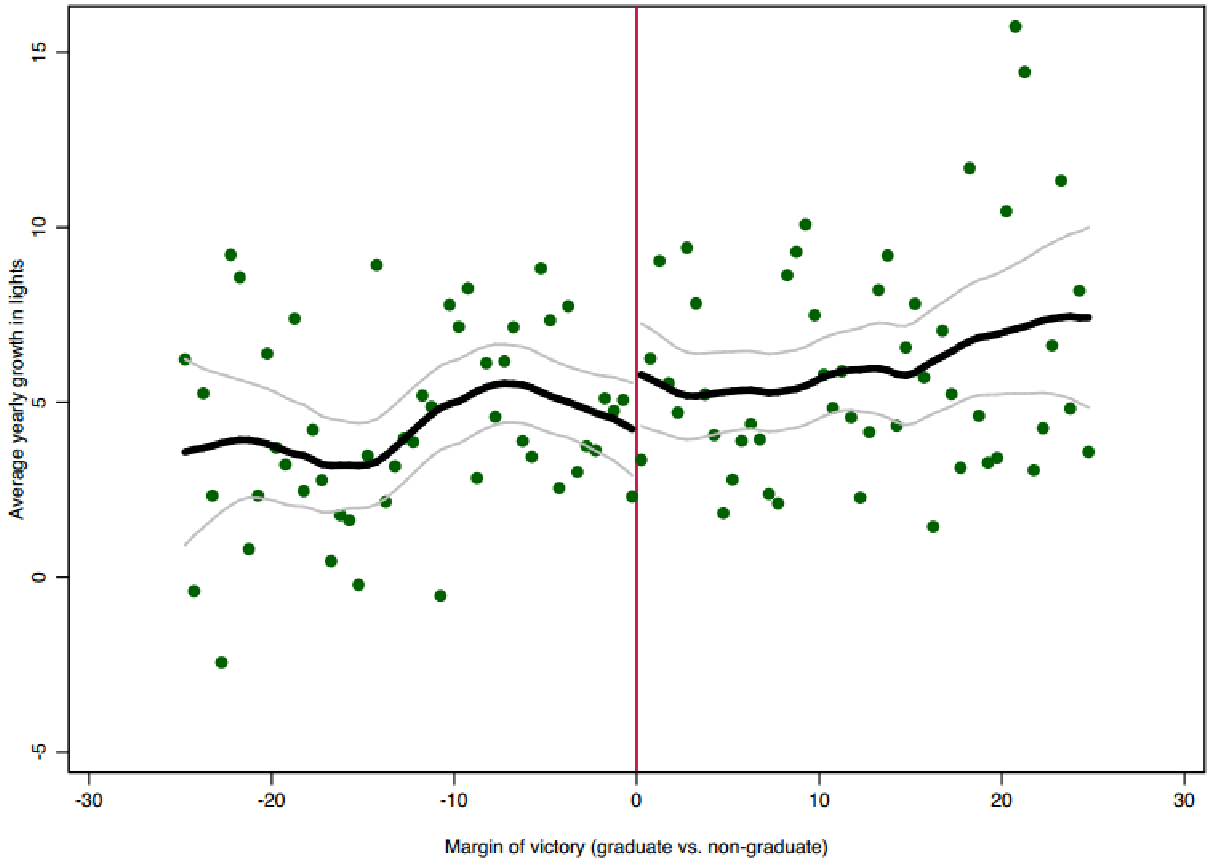

Table 1: State Assembly Elections in India (Post Delimitation Order in 2008)

Year	State
2008	Karnataka, Meghalaya, Nagaland, Tripura
2009	Andhra Pradesh, Chhattishgarh, Delhi, Jammu & Kashmir Madhya Pradesh, Mizoram, Odisha, Rajasthan, Sikkim
2010	Arunachal Pradesh, Haryana, Jharkhand, Maharashtra
2011	Assam, Bihar, Kerala, Puducherry, Tamil Nadu, West Bengal
2012	Goa, Manipur, Punjab, Uttar Pradesh, Uttarakhand
2013	Gujarat, Himachal Pradesh

Table 2: Summary Statistics

	(1)	(2)	(3)	(4)	(5)	(6)
	RD Sample			Close Election Sample		
	Non-Graduates	Graduates	Difference	Non-Graduates	Graduates	Difference
Night Lights Growth Rate	4.67	5.48	-0.80	5.00	5.49	-0.49
Level of Night Lights	13.94	12.31	1.63**	12.10	11.23	0.87
Women Leader	0.09	0.08	0.01	0.10	0.07	0.03*
Criminally Accussed Leader	0.32	0.26	0.06***	0.32	0.25	0.06***
Age	50.11	49.55	0.56	49.68	50.17	-0.49
Incumbent	0.15	0.19	-0.04	0.14	0.17	-0.03
Turnout	117540.12	117292.21	247.91	120290.87	122394.58	-2103.71
Observations	2083	1954	4037	1199	1141	2340

Table 3: Effect of Electing a Graduate Politician on Growth of Night Lights

	(1)	(2)	(3)	(4)
	Growth NL	Growth NL	Growth NL	Growth NL
Educated Leader	3.104**	3.172**	1.942*	2.132*
	(1.420)	(1.377)	(1.126)	(1.092)
Year Fixed Effects			Yes	Yes
State Fixed Effects			Yes	Yes
Observations	1784	1886	1784	1886
Bandwidth	6.792	7.379	6.792	7.379
Bandwidth Type	IK(h)	CCT	IK(h)	CCT
Highest Order Smoothing Function	Linear	Linear	Linear	Linear
Heterogeneity Type	-	-	-	-

Robust standard errors clustered at the constituency level are in parentheses.

* p<0.10, ** p<0.05, *** p<0.01

The dependent variable *Growth NL* measures the growth rate in the intensity of night lights. While the variable *Educated Leader* is a dummy variable and it takes a value 1 if the winning candidate is a graduate while the runner up candidate is a non graduate and 0 otherwise. The above table presents the estimation results for the entire sample and we have estimated equation 3 using a local linear regression for the optimal bandwidth calculated using the IK and CCT algorithm.

Table 4: Effect of Electing a Graduate Politician on Growth of Night Lights (Heterogeneity Based on Development)

	(1)	(2)	(3)	(4)
	Growth NL	Growth NL	Growth NL	Growth NL
Educated Leader	3.529*	1.199	3.483*	1.243
	(1.897)	(1.148)	(1.912)	(1.098)
Year Fixed Effects	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Observations	912	1151	887	1211
Bandwidth	8.498	8.051	8.222	8.679
Bandwidth Type	IK(h)	IK(h)	CCT	CCT
Highest Order Smoothing Function	Linear	Linear	Linear	Linear
Heterogenity Type	leastdev	notleastdev	leastdev	notleastdev

Robust standard errors clustered at the constituency level are in parentheses.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

The dependent variable *Growth NL* measures the growth rate in the intensity of night lights. While the variable *Educated Leader* is a dummy variable and it takes a value 1 if the winning candidate is a graduate while the runner up candidate is a non graduate and 0 otherwise. In the above table 'heterogeneity type' describes the sub-sample used for the estimation and accordingly, 'leastdev' constitutes the sub-sample of those states that have been identified as the least developed states in the country by the Expert Committee constituted towards developing a composite development index for various states in the country; while 'notleastdev' refers to the sub-sample of the remaining states in the country. Note that the specification used for the results presented above is similar to the specification used for the results presented in column 3 and 4 of table 3.

Table 5: Effect of Electing a Graduate Politician on Growth of Night Lights (Heterogeneity Based on BIMAROU States)

	(1) Growth NL	(2) Growth NL	(3) Growth NL	(4) Growth NL
Educated Leader	6.019**	1.044	6.398**	1.164
	(2.606)	(1.213)	(2.633)	(1.128)
Year Fixed Effects	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Observations	472	1464	432	1649
Bandwidth	9.762	7.016	8.524	8.239
Bandwidth Type	IK(h)	IK(h)	CCT	CCT
Highest Order Smoothing Function	Linear	Linear	Linear	Linear
Heterogenity Type	bimarou	nonbimarou	bimarou	nonbimarou

Robust standard errors clustered at the constituency level are in parentheses.

* p<0.10, ** p<0.05, *** p<0.01

The dependent variable *Growth NL* measures the growth rate in the intensity of night lights. While the variable *Educated Leader* is a dummy variable and it takes a value 1 if the winning candidate is a graduate while the runner up candidate is a non graduate and 0 otherwise. In the above table 'heterogeneity type' describes the sub-sample used for the estimation and accordingly, 'BIMAROU', herein constitutes the sub-sample of those states that are collectively referred to as the BIMAROU states; while 'Non-BIMAROU' refers to the sub-sample of the remaining states in the country. Note that the specification used for the results presented above is similar to the specification used for the results presented in column 3 and 4 of table 3.

Table 6: Effect of Electing a Graduate Politician on Growth of Night Lights (Heterogeneity Based on Average Night Lights)

	(1)	(2)	(3)	(4)
	Growth NL	Growth NL	Growth NL	Growth NL
Educated Leader	3.241**	0.328	3.056**	0.407
	(1.432)	(1.447)	(1.480)	(1.312)
Year Fixed Effects	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Observations	1150	907	1059	999
Bandwidth	7.830	8.419	6.993	9.912
Bandwidth Type	IK(h)	IK(h)	CCT	CCT
Highest Order Smoothing Function	Linear	Linear	Linear	Linear
Heterogenity Type	belavglit	abvavglit	belavglit	abvavglit

Robust standard errors clustered at the constituency level are in parentheses.

* p<0.10, ** p<0.05, *** p<0.01

The dependent variable *Growth NL* measures the growth rate in the intensity of night lights. While the variable *Educated Leader* is a dummy variable and it takes a value 1 if the winning candidate is a graduate while the runner up candidate is a non graduate and 0 otherwise. In the above table 'heterogeneity type' describes the sub-sample used for the estimation and accordingly, 'belowavlit', herein constitutes the sub-sample of those states wherein the average intensity of night lights, during the year 2008, was lower than national average for the same; while 'abvavglit' constitutes the sub-sample of the remaining states in the country. Note that the specification used for the results presented above is similar to the specification used for the results presented in column 3 and 4 of table 3.

Table 7: Effect of Electing a Graduate Politician on Growth of Night Lights (Heterogeneity Based on Literacy Rates)

	(1) Growth NL	(2) Growth NL	(3) Growth NL	(4) Growth NL
Educated Leader	4.158**	0.799	4.190**	0.533
	(1.838)	(1.343)	(1.961)	(1.126)
Year Fixed Effects	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Observations	955	1074	845	1325
Bandwidth	8.077	8.047	6.774	11.315
Bandwidth Type	IK(h)	IK(h)	CCT	CCT
Highest Order Smoothing Function	Linear	Linear	Linear	Linear
Heterogeneity Type	distbellit	distabvlit	distbellit	distabvlit

Robust standard errors clustered at the constituency level are in parentheses.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

The dependent variable *Growth NL* measures the growth rate in the intensity of night lights. While the variable *Educated Leader* is a dummy variable and it takes a value 1 if the winning candidate is a graduate while the runner up candidate is a non graduate and 0 otherwise. In the above table 'heterogeneity type' describes the sub-sample used for the estimation and accordingly, 'distbellit', herein constitutes the sub-sample of those district wherein the literacy was lower than national average as per the Census 2001 data; while 'distabvlit' constitutes the sub-sample of the remaining districts in the country. Note that the specification used for the results presented above is similar to the specification used for the results presented in column 3 and 4 of table 3.

Table 8: Sensitivity Results (Alternate Bandwidth)

	(1) Growth NL	(2) Growth NL	(3) Growth NL	(4) Growth NL
Educated Leader	1.156	2.160**	-0.653	1.354
	(1.787)	(1.087)	(1.483)	(0.854)
Year Fixed Effects			Yes	Yes
State Fixed Effects			Yes	Yes
Observations	892	2807	892	2807
Bandwidth	3.396	13.584	3.396	13.584
Bandwidth Type	h/2	2h	h/2	2h
Highest Order Smoothing Function	Linear	Linear	Linear	Linear
Heterogeneity Type	all	all	all	all

Robust standard errors clustered at the constituency level are in parentheses.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

The dependent variable *Growth NL* measures the growth rate in the intensity of night lights. While the variable *Educated Leader* is a dummy variable and it takes a value 1 if the winning candidate is a graduate while the runner up candidate is a non graduate and 0 otherwise.

Table 9: Sensitivity Results (Higher Order Polynomials)

	(1) Growth NL	(2) Growth NL	(3) Growth NL	(4) Growth NL
Educated Leader	1.065	-0.378	-0.854	-2.857
	(1.871)	(2.293)	(1.542)	(2.006)
Year Fixed Effects			Yes	Yes
State Fixed Effects			Yes	Yes
Observations	1784	1784	1784	1784
Bandwidth	6.792	6.792	6.792	6.792
Bandwidth Type	IK(h)	IK(h)	IK(h)	IK(h)
Highest Order Smoothing Function	Quadratic	Cubic	Quadratic	Cubic
Heterogenity Type	all	all	all	all

Robust standard errors clustered at the constituency level are in parentheses.

* p<0.10, ** p<0.05, *** p<0.01

The dependent variable *Growth NL* measures the growth rate in the intensity of night lights. While the variable *Educated Leader* is a dummy variable and it takes a value 1 if the winning candidate is a graduate while the runner up candidate is a non graduate and 0 otherwise.