Female Legislators and Economic Growth: Evidence from State Elections in India

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Abstract

There is growing evidence that women politicians are relatively effective in protecting the interests of women and children. But is this at the cost of economic growth? We investigate this using close elections between men and women in a regression discontinuity design. Using night luminosity as a measure of economic activity, we find significantly higher economic growth rates in constituencies from which women rather than men are elected to state legislative assemblies in India. Amongst mechanisms, we find evidence consistent with women being less corrupt, more effective at attracting state-level resources and more likely to improve access to roads.

Keywords: Political representation, identity, India, women, night lights, luminosity, corruption, roads, close elections

JEL codes: D72, D78, H44, H73
1 Introduction

In this paper, we present what would appear to be the first systematic examination of whether women politicians are good for economic growth. A number of recent studies establish that women politicians are effective in protecting the interests of women and children, for instance (Chattopadhyay and Duflo, 2004; Iyer et al., 2012; Brollo and Troiano, 2014; Bhalotra and Clots-Figueras, 2014; Clots-Figueras, 2012; Miller, 2007; Edlund et al., 2005; Chaney et al., 1998; Thomas, 1991; Svaleryd, 2009). Amongst the findings of these studies are that women in politics have influenced the passage of the equal inheritance rights law in India, the passage of abortion law in the US, spending on child care, education and elderly care in Sweden, the reporting of crime against women in India and the promotion of public health and inputs to child survival in India.\footnote{Yet, there are also several studies suggesting that a politician’s gender is irrelevant for policies. Ferreira and Gyourko (2014), for example, find that policy outcomes under female mayors are not different than under male ones in US cities. Similarly, Rigon and Tanzi (2012) obtain similar evidence for Italian municipalities.} Quotas for women are being introduced across the world (Besley et al., 2013) and the feminization of politics is one of the most exciting political phenomena of our time. Yet, we do not know what it portends for growth, the rising tide that is thought to lift all boats.

There is some evidence that women politicians are less corrupt (Dollar et al., 2001; Swamy et al., 2001) and plenty of evidence that corruption slows economic growth (Mauro, 1995). This suggests that hypothesis that women politicians may promote growth by being less corrupt themselves or by curtailing the corruption of local politicians and bureaucrats. On the first, there is a glaring difference between male and female political candidates in India in the probability that they have pending criminal charges against them (Prakash et al., 2014). This is consistent with experimental evidence that women are more risk-averse and so less likely to engage in risky behavior than men (Eckel and Grossman 2008, Fletschner et al. 2010). On the second, the evidence is ambiguous. In one of the few rig-
orous studies available, Afridi et al. (2014) exploit the randomization of quotas for women as chiefs of village councils in the Indian state of Andhra Pradesh to investigate whether corruption and governance of India’s largest poverty alleviation program varies by the gender of the village head. They find greater program inefficiencies and leakages in village councils reserved for women heads which they attribute to their more limited political and administrative experience making them more vulnerable to bureaucratic capture. Using a panel of official audit reports they find that women leaders in reserved seats catch up over the period of their tenure with male leaders in unreserved seats but there is no evidence that they overtake. In contrast, Brollo and Troiano (2014) find that municipalities ruled by female mayors have better health outcomes, receive more federal discretionary transfers, and have lower corruption. None of these studies analyze consequences for an indicator of economic growth.

Another open question is whether there is a short term growth sacrifice associated with redistribution, given evidence that women favor redistribution and tend to allocate scarce fiscal resources to public goods that have a growth yield but often only over a somewhat longer term (Doepke et al., 2012). In their work, establishing that women legislators in India are more effective in promoting child health and survival, Bhalotra and Clots-Figueras (2014) show that one of the mechanisms involved is that women are more likely to improve the health infrastructure in villages (clinics, pharmacies) but that they are less likely to improve the bank and telecommunications infrastructure. It therefore seems plausible that the improvement in public health comes is achieved at the (short run) cost of economic growth, but the authors do not investigate this.

A reason for the relatively limited evidence on growth is that constituency or sub-regional data on growth are often not available. We use an index of luminosity at the constituency level as a measure of economic activity, following Henderson et al. (2012a) and Chen and Nordhaus (2011). Luminosity is measured by light nights using satellites and there is
increasing faith in interpretation of variation in this variable as indicative of economic growth.

In order to identify mechanisms that may drive any relationship between the gender of legislators and their impact on economic growth, we investigate the relevance of the criminality of the individual politician using affidavit data, the efficacy of women vs male legislators in promoting road building under the PMGSY, and the degree to which the legislator is able to command state level resources.

We use electoral data for about 4000 Indian state assembly constituencies for the period 1992-2012, which spans four elections in most states. In general, preferences for women leaders are likely to be positively correlated with economic growth. For instance, Jayachandran (2014) reports evidence from the World Values Survey that income is positively correlated with the probability that people report that women are suitable for executive positions. So a positive association between women politicians and growth may not indicate that women are good for growth or may be despite women being bad for growth. To address this problem, we use a sample of elections in which women compete against men, using which we identify causal effects of women winning on growth on the premise that the gender of the winner in a close election is quasi-random because a narrow vote margin between the winner and the runner up tends to reflect idiosyncratic factors rather than voter preferences. This strategy has recently been used by Rehavi (2012); Clots-Figueras (2012); Bhalotra and Clots-Figueras (2014); Meyerson (2014); Bhalotra et al. (2015); Brollo and Troiano (2014). It allows for the fact that constituencies that elect women are likely to have systematically different voter preferences than constituencies that elect men and unobservable differences in preferences may have direct effects on economic growth. We establish the internal validity of this regression discontinuity design by testing for sorting at the threshold zero vote margin and by testing for continuity across the vote margin of a range of relevant pre-determined covariates at the candidate and constituency level.
We investigate robustness of our results to alternative ways of controlling for the running variable (the vote margin).

We estimate that the rate of growth of night lights is about 11 percentage points higher in female-led as compared with male-led constituencies, and that this translates to a growth in GDP of between 1.2 and 3.3 percentage points. Women legislators are also significantly more likely to improve growth in constituencies in which they are from a party that is politically aligned with the state government. This suggests that a mechanism by which they achieve higher growth is that they may be able to attract larger state transfers although we do not have direct evidence of this. We also find that the growth-enhancing capacity of women legislators is restricted to women who do not carry a criminal conviction and who have completed secondary education. In 2009, about a third of members of parliament and about xx percent of members of state legislative assemblies carried (self-reported) criminal charges, about half of which are graded as serious (including murder or rape) and, alarmingly, the trend is positive, this share having risen by 25 per cent from that in the 2004 elections. Unconditional tabulations show that candidates with criminal records are significantly more likely to win seats in Parliament than candidates with a clean record and this correlation is almost as strong for women as it is for men\(^2\). This might lead one to expect that criminality is good for growth, for instance, voters may perceive leaders with a criminal record as effective or their crimes may be seen through a Robin Hood lens. Against this, we find that a reason that women legislators are good for growth is that they are less likely to be criminal and our evidence ties in with recent evidence emerging in parallel with this study showing that criminality among Indian politicians is bad for growth - see Prakash et al. (2014); this paper does not discriminate between male and female politicians.

In line with our findings, using observational cross-country panel data, Jayasuriya and Burke (2012) find increasing the share of women in parliament is associated with faster growth. However, the study design makes it hard to rule out competing explanations including that growth or an omitted variable correlated with growth encourages the introduction of quotas for women and/or a shift in electoral preferences in favor of women’s leadership.

There is increasing evidence that women have different preferences from men and different non-cognitive skills so that, conditional upon ability, they often make different choices (Lott and Kenny, 1999; Edlund and Pande, 2002)). In a another literature, there is growing evidence that non-cognitive skills can have large effects on individual education, unemployment and, ultimately, income (Almlund et al., 2011; Kautz et al, 2014). This has generated increased curiosity concerning the effects of psychological or personality traits (differences in which are often evident by gender) on economic outcomes. Our findings are relevant to these emerging streams of research. They also contribute directly to research on political identity and substantive representation (Osborne and Slivinski, 1996; Besley and Coate, 1997). The existing literature has tended to explore specific fiscal policy choices or the provision of specific public goods, while economic growth is a summary statistic of more general interest.

The remainder of this paper is structured as follows. The next section offers some background. Section 3 introduces our empirical strategy. In Section 4, we discuss our data. Section 5 collects the main results. In Section 6, we report some extensions. Section 7 concludes.
2 Politics, female politicians, and economic growth in India

2.1 Politics in India

The Indian Union has currently 29 states. The states are parliamentary democracies where every five years a new legislative assembly is elected. The Members of the Legislative Assembly (MLAs) are chosen according to a first-past-the-post system in single member constituencies. Voters thus vote for individual candidates rather than party lists. Nevertheless, successful candidates are typically appointed and supported by an established party. In fact, parties are crucial arbiters of political careers given the high costs of running for office. In the 2009 federal elections, for example, the average costs of winning a seat were around 2 million US dollars (Tiwari, 2014). Most candidates cannot raise such large sums without the support of sophisticated party organizations.

The nomination process by which the party leadership chooses its candidates is nontransparent, especially given the autocratic nature of Indian parties (Hasan, 2010). The most important characteristic party leaders seem to value in a candidate is her “winnability”. A candidate’s winnability covers various individual aspects, such as her name recognition in the constituency or her caste background (Bhalotra et al., 2015; Tiwari, 2014). However, party leaders also care about broader characteristics besides winnability. Tiwari (2014) finds that parties tend to appoint richer candidates to safe constituencies, not because richer candidates are more likely to win but because they can confer wider benefits to the party leadership, for example, party leaders may be able to redistribute private resources of richer candidates to more competitive races or benefit from the networks of richer candidates. While there are quotas for certain minority scheduled tribes and castes, there are no gender quotas yet for electoral constituencies both at the federal and state levels.
Indian elections are highly competitive. There is a high degree of turnover at the state level with state governments being repeatedly voted out of office. Constituencies themselves are also characterized by significant turnover. In fact, unlike in many other democracies, evidence suggests that there is even a negative incumbency effect for members of Indian state legislative assemblies (Uppal, 2009).

### 2.2 Female politicians

Despite a secular increase in the number of female politicians, women generally remain under-represented in Indian federal and state politics. In the federal and state legislatures, for example, the average share of female representatives continues to oscillate around 10 percent (Beaman et al., 2012). The low number of representatives is arguably due to a low number of female political candidates to begin with. While there is some variation across states – Bhalotra et al. (2015) report that the share of female candidates between 2000-2007 varied between 13% in Andhra Pradesh and 4% in Karnataka – male candidates vastly outnumber female ones in all states.

There is some discussion as to the reasons for the relatively small number of candidates. One possibility is that women dislike competitive environments and thus self-select themselves out of politics. Bhalotra et al. (2015), however, suggest that female candidates run more often in races that are more competitive, such as in constituencies that have more contestants. Another possibility is that party leaders discriminate against women in the nomination process, which leads to both fewer female candidates and eventually fewer female representatives. Given the leverage party leaders have over the nomination process, it is plausible that the low number of female representative is due to discriminatory nomination processes.

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3Indian elections as such are generally believed to be free and fair (i.e. electoral fraud is rare and there is no coercion to vote in a particular way), even if they may still suffer from clientelism and elite capture (Anderson et al., 2014).
While quantitative evidence for outright discrimination is difficult to obtain given that nomination processes take place behind closed doors, Spary (2014) explores whether party leaders are more likely to appoint female candidates in unwinnable constituencies. Focusing on the two largest parties in India, the Indian National Congress (INC) and the Bharatiya Janata Party (BJP), she finds that party leaders in both parties are not more likely to allocate unwinnable seats to female candidates. However, she also finds that party leaders are less likely to field female candidates in marginal constituencies because they perceive them to be high risk. Instead, successful female candidates tend to be either well known in the state or established within their constituencies. Thus, one reason why the number of female candidates is small may be that party leaders are less willing to take a chance on them than on male candidates, which in the competitive political environment of India may prevent many viable female candidates from being appointed.

The extent of female representation is larger at the local than at the state or federal level. In particular, the share of village council heads has increased substantially in the last two decades. While this expansion in local female representation was initially not due to changing voter preferences or different nomination strategies by party leaders but rather due to constitutionally mandated quotas, Beaman et al. (2009) show that the exposure to female politicians has had positive effects on voters' attitudes. Voters exposed to female politicians updated their beliefs about the ability of women to assume leadership positions. Following such experiences at the local level, a historic constitutional amendment that would reserve one third of all federal and state assembly seats for women was passed by the upper house of the federal parliament in 2010. However, this bill still needs to passed by the national Parliament and state assemblies.

The evidence from village councils suggest that female political leaders emphasize different projects than male leaders. Using the introduction of quotes as a natural experiment, there is by now a substantial body of evidence showing that women leaders are more likely
to finance goods preferred by women, that they provide more and better public goods for their villages, and that they are less corrupt (Beaman et al., 2006). Following such evidence from the local level, we ask in this paper whether such differences between female and male politicians can be observed for state legislators as well. Thereby, we provide another pertinent piece of evidence to the current discussion in India about the bill aimed at reserving parliamentary seats for women.

2.3 Politics of economic development

All state governments have substantial leverage over the allocation of public resources across their state. Public goods that are either directly or indirectly allocated by the state government include electricity, public schools, and roads. In addition, the state government can potentially influence the distribution of financial transfers. Even as the allocation of financial transfers is determined by supposedly independent State Finance Commissions, they are believed to be ineffectual (Khemani, 2006), and may thus be subject to political interference. In addition, state government may also distort the allocation of funds related to specific development programs such as the National Rural Employment Guarantee Scheme (NREGS) for political reasons (Gupta and Mukhopadhyay, 2014).

As the state government must have the support of a majority of delegates to rule effectively, delegates have a reasonable degree of influence at the state level. Thus, representatives can play a crucial role for the economic fate of their constituencies. First, given the volume of resources under the state government’s control, a representative can attract large amounts of pork to her constituency by lobbying the state government and exerting appropriate effort to advertise development opportunities in her constituency. Second, representatives can use any personal or political influence they may have with the state leaders to extract additional resources. Finally, representatives could also try to attract private investors to their constituency.
Whether a constituency has a female rather than a male representative may thus have substantial effects for its economic fortunes. First, if there is taste-based discrimination on part of voters, successful female candidates will have to be more competent than male ones. Accordingly, they may be more effective in attracting state resources for their constituency, for example by exerting more effort or by trying harder to build a good relationship with the state government. Second, female representatives may also have different policy preferences and therefore attract different types of state spending. Rather than consumptive expenditures or transfers that only benefit some narrow special interests, they may work hard to acquire productive resources such as electricity or roads.

Third, female politicians may also exhibit innate traits that are conducive for a growth-promoting political climate. Evidence at the local level from India and Brazil suggests, for example, that female politicians are less corrupt (Beaman et al., 2006; Brollo and Troiano, 2013). Such qualities in one of the most important politicians of a constituency may translate to a more efficient allocation of public resources. Representatives with more desirable characteristics may also increase trust in private investors about the investment climate in a particular constituency and dispel fears about arbitrary political interventions in their business activities (Kumar, 2014).

3 Empirical Strategy

We aim to estimate the causal effect of election of a female candidate on economic activity as proxied by growth of night lights. If election of a female to a constituency was randomly determined, constituencies that elected a male MLA will serve as a valid counterfactual for constituencies that elected a female MLA. We could then compare average growth of light in these two sets of constituencies to identify the causal effect of electing a female MLA. We doubt, however, that election of a female MLA is randomly determined. The
main concern is that due to unobserved heterogeneity, constituencies that elect female MLAs may not be comparable to constituencies that elect male MLAs. For instance, female candidates may be more likely to run and win in constituencies that have favorable attitudes towards females. These constituencies may also share other social and cultural characteristics conducive for economic growth.

We therefore exploit the discontinuity that arises in the first-past-the-post electoral system in the state elections in India to construct a credible identification strategy. By the electoral law, only candidates who get the most votes and have a positive margin of victory become elected. We thus compare female MLAs and male MLAs in close elections, where the winner’s margin of victory is arbitrarily small and hypothesize that in such close contests, the election of a female MLA is decided as if it is random. In other words, constituencies that barely elected a male MLA in a close election could serve as a valid counterfactual for constituencies that barely elected a female MLA, allowing us to interpret the difference in outcomes between such constituencies as the causal effect of electing a female MLA.

More formally, we consider the following model:

\[ y_{ist} = \alpha + \tau \times \text{FemaleMLA}_{ist} + f(MARGIN_{ist}) + \epsilon_{ist} \]  

(1)

where \( y_{ist} \) is growth of light in constituency \( i \) in state \( s \) in year \( t \). \( \text{FemaleMLA}_{ist} \) is an indicator variable for treatment and is defined as follows:

\[
\text{FemaleMLA}_{ist} = 1 \text{ if } MARGIN_{ist} > 0 \\
= 0 \text{ if } MARGIN_{ist} \leq 0,
\]  

(2)
where $MARGIN_{ist}$ is the forcing variable. We consider races in which a female candidate won against a male runner-up and male candidate won against a female runner-up. Thus, $MARGIN_{ist}$ is the margin of victory and is defined as the difference between vote shares of a female and male candidates. By construction, it is positive for a female candidate who won against a male runner-up. It is negative for a male candidate who won against a female runner-up. At a margin of zero, gender representation of a constituency changes discontinuously from male to female. The RD design considers a close neighborhood, $\lambda$, of the threshold margin of zero and premises that as $\lambda$ goes to 0 the differences between constituencies that elected a female candidate and that elected a male candidate vanish, allowing us to identify the causal effect of electing a female MLA.

$$\lim_{\lambda \to 0^+} E[y_{ist} | 0 < MARGIN_{ist} \leq \lambda, X] - \lim_{\lambda \to 0^-} E[y_{ist} | -\lambda \leq MARGIN_{ist} < 0, X] = \tau, \quad (3)$$

which is the difference in the average outcomes of constituencies that barely elected a female MLA against a male runner-up and constituencies that barely elected a male MLA against a female runner-up. This setup makes a much weaker assumption that the distribution of the error term, $\varepsilon_{ist}$, is continuous in the forcing variable compared to other selection-on-observable methods.

We estimate the above discontinuity using local linear regressions as suggested in Gelman and Imbens (2014). We also report results for several bandwidth choices including optimal bandwidth procedure suggested in Imbens and Kalyanaraman (2011) and in Calonico and Titiumik (2014).
4 Data

Our sample period is from 1992-2012. We draw on a novel set of satellite imagery of the earth at night. The satellite images come from several satellites orbiting the earth under the U.S. Air Force Defense Meteorological Satellite Program’s Operational Linescan System (DMSP-OLS) and are processed by the National Oceanic and Atmospheric Agency’s (NOAA) National Geophysical Data Center (NGDC). The NGDC processes these images after excluding late-evening sunlight due to longer days in summer months, effect of lunar illuminance, observations with clouds, effects of the auroral lights, and active fires. The images from this satellite were digitalized in 1992 and provide as an end product a series of images of time stable night lights. Images are scaled onto a geo-referenced 30 arc-second grid (approximately 1 km2). Each pixel is encoded with a measure of its annual average brightness on a 6-bit scale from 0 to 63 (Henderson et al., 2012a).

Henderson et al. (2012b) show that nighttime light output correlates strongly with GDP in general. Similar evidence at the regional level is offered by Bickenbach et al. (2013). Although GDP is widely used, it is thought to be fairly unreliable in developing countries where the informal sector is large, making it harder to verify inputs, outputs, incomes and profits (Jerven, 2013; Bhalotra and Umana-Aponte, 2015).

We overlay a map of India’s about 4,000 state Assembly constituencies to identify the state Assembly constituency boundaries. Since our unit of observation is an Assembly constituency, we use boundaries to identify the constituency-level light output, which is the sum of total light emitted by each pixel. Our outcome variable is growth of light, which is the difference in log of light in year $t$ and in year $t-1$.

The source of election data is various editions of the Statistical Reports on General Election to Legislative Assembly of states, published by the Election Commission of India (ECI). These reports provide all the information pertaining to an election: names, vote

\footnote{As some of the light values are zero, we add 1 to each of the light values before taking the logs.}
counts, gender and party affiliation of all contesting candidates, Assembly constituency names and codes, year of the election, size of the electorate, number of votes cast, and number of valid votes. Currently, India has 29 states. Our data spans all states in India except the northern state of Jammu and Kashmir and various union territories. A constitutional amendment fixed the boundaries of constituencies till 2001. However, the first election to use new boundaries was held in 2008 in the state of Karnataka. The post-2008 period in our data includes only elections held before new boundaries took effect.

Our forcing variable is the victory margin between the female candidate and the male candidate in the mixed gender races in which the top-2 candidates have one male and one female. We also check for the sensitivity of our results to an alternative definition of victory margin where we consider all the races in which a female contested, but placed third or lower.

Table 1 summarizes the main outcome variable and the predetermined covariates in our data. In columns (1) and (2) of Panel A we report means and standard deviations of growth of lights and share of incomplete roads, our two outcome variables. The constituencies represented by female MLAs have similar growth of light and a larger share of incomplete roads than those represented by male MLAs. On average, females tend to get elected from constituencies where a female won in the previous election than Males. Also, male MLAs are more likely to have 10 or larger years of education and more likely to be criminally accused than female MLAs. In columns (4)-(5) we compare closer contests in which the outcome was decided by a margin of 5% or less. Most of the differences between male and female MLAs are insignificant, but for the likelihood of being criminally accused. We turn now to formally estimate the causal effect of electing a female candidate.

\[5\text{In 2000, three states, namely Bihar, Madhya Pradesh, and Uttar Pradesh, were partitioned to make three additional states. The newly formed states are Chhattisgarh (from partition of Madhya Pradesh), Jharkhand (from Bihar), and Uttarakhand (from Uttar Pradesh). Chhattisgarh was allocated 90 constituencies from Madhya Pradesh and Jharkhand was allocated 81 constituencies from Bihar. The constituencies themselves remained unchanged. However, Uttarakhand was allocated 22 constituencies from Uttar Pradesh and these constituencies were redrawn in to 70 new constituencies.}\]
5 Empirical Results

5.1 Validity of RD Design

While the RD design makes assumptions, namely continuity of predetermined characteristics, that are weaker than other methods, these assumptions must still hold for identifying the causal effect of electing a female MLA. In this section we test for the continuity assumption using several variables that are determined before the election in $t$. We consider several predetermined variables, such as growth of light in $t-1$ election (averaged over the previous term); Share of incomplete roads in t-1, electorate size, which is the number of registered voters, in $t-1$ election, number of voters, which is the number of people who voted in the election, in $t-1$ election; turnout in $t-1$ election; winner’s gender in $t-1$ election; proportion of seats reserved for Scheduled Caste (SC) candidates; proportion of seats reserved for Scheduled Tribes (ST) candidates, whether the constituency belonged to a ruling party in $t-1$ election, Net worth (difference between assets and liabilities) of the candidate, whether a candidate is criminal or not, and candidate’s education, which is a dummy variable representing if a candidate has 10 or higher years of education.

In Figure 1, we report graphical evidence on the continuity assumption. Panel (a) plots growth of light output in the previous election term against margin of victory in $t$. The scatter plot depicts the local averages of growth of light in each successive interval of 0.5% of margin of victory. The local linear curve is estimated using a triangular kernel and an optimal bandwidth as suggested in Imbens and Kalyanaraman (2011) with the 95% confidence interval plotted along the curve. The results suggests that growth of light in the previous term is a continuous function of the margin of victory. Similarly, predetermined covariates in panels (b)-(j) show no significant discontinuity and vary smoothly with margin of victory. Overall, the continuity of these predetermined variables suggests that only the
gender of an elected member changes discontinuously at margin of victory of zero and that the RD design identifies the causal effect of election of a female on electricity provision. Another concern is that there may be sorting around the cutoff. It is plausible that a certain gender, either male or female, is more likely to win a close election implying a discontinuity in the density of the forcing variable around the cutoff. Any such sorting may point towards manipulation of the margin of victory in close elections. In Figure 2 we depict the density of margin of victory as suggested in McCrary (2008). There is no apparent discontinuity in the density around the cutoff suggesting absence of any sorting. The point estimate of the discontinuity is 0.043 with a standard error of 0.075.

### 5.2 Main Effects

We turn now to estimating the causal effect of female election on economic growth. In Figure 3, we plot the average growth of light against margin of victory using local averages and local linear regression. Since there is not within election term variation in the treatment variable, female MLA, we average the growth of light over an election term. This also provides an estimate of the growth rate over the election term. The RD estimate of the effect of electing a female is the difference in the estimated growth rates at the cutoff margin of victory of zero. The local linear regression curve fits the local averages well. Growth of light output jumps discontinuously at the threshold margin of victory of zero suggesting that light output in a constituency in which a female barely won grows faster than in a constituency in which a female barely lost.

The above is a graphical representation of the RD estimate. We however like to know if the effect of female representation is statistically and economically significant. Table 2 reports the size and significance of the estimated discontinuity in growth of light. Since there is likely correlation in light output over time within a constituency, we cluster standard errors at the constituency level.
In column (1), we estimate the size of discontinuity using a local linear regression of
growth of light on margin of victory. The bandwidth is calculated using the optimal
bandwidth procedure suggested by Imbens and Kalyanaraman (2011) (IK). Growth of
light is about 15 percentage points higher in a constituency in which a female barely got
elected compared to a constituency in which a female barely lost. This effect is significant
at the 5% level. The estimated effect however is not only statistically significant, but
also has economic significance. Henderson et al. (2012b) estimate an elasticity of GDP to
night lights of 0.3, whereas Bickenbach et al. (2013) provide an estimate of the elasticity
of about 0.107. Using these two estimates of elasticity of GDP to night lights, the above
discontinuity in growth of light of about 11 percentage point can be translated in to 1.6-4.6
percentage points growth in GDP.

Further, columns (2) and (3) report the size of the estimated discontinuity using band-
widths that are half and twice as much as the optimal bandwidth given in column (1).
Column (4) estimates the size of the discontinuity using bandwidth suggested by Calonico
and Titiunik (2014) (CCT). Although the estimated size of the discontinuity is smaller
with larger bandwidths, the results are qualitatively consistent with those in column (1).
In column (5), we revert to the IK bandwidth but control for the predetermined covariates
(considered in 1) and constituency and year fixed effects. The results are similar to those
in column (1).

Finally, in columns (6)-(7), we report results with higher order local polynomial smoother.
The estimated treatment effect is slightly larger than, albeit consistent, the estimated ef-
fects with a local linear control function.

5.3 Alternative Definitions of Margin

In the above analysis we focus on mixed gender races in which one of the top-2 candidates
is a female. This definition excludes races in which a female ranks third or lower. In this
subsection we consider such races and define the margin of victory as the difference in the vote shares of the top-ranked female and top-ranked male candidates. It is positive for races in which a female won and is the difference between her vote share and the vote share of the top-placed male (usually the runnerup). The margin of victory is negative for races in which a male won and is the difference between the vote shares of the top-ranked female loser and the male winner. Expanding the definition of victory margin in such a way increases the sample size. However, by definition victory margin in such races is likely to be away from the discontinuity and hence is unlikely to affect our results based on the local estimation.

We use this alternative definition of victory margin as our forcing variable in columns (1)-(8) of Table 3, similar to Table 2. As expected, the results are similar to what we find above. The growth of light is significantly higher in a constituency in which a female barely wins compared to a constituency in which a female barely loses.

6 Transmission Channels

6.1 Heterogeneous Effects

The previous results show that that female representation causes on average higher economic growth. A follow-up question then is how female MLAs affect economic development within their constituencies. While there are many possible mechanisms, plausible ones are that female MLAs are more successful than their male colleagues in attracting resources from the state government and that they have specific personal traits that lead to a political climate in a constituency which is conducive for growth. The first channel is plausible because the state government dispenses large developmental resources. If female MLAs exert more effort in lobbying the state government, their constituencies may witness significant improvements in local infrastructure, such as better roads or more reliable electricity,
which in turn may cause higher economic growth. With respect to the second channel, also as outlined above, it is plausible that certain personal characteristics, notably non-criminality, may help female MLAs to attract higher investments to their constituency, for example by credibly signaling that it follows the rule of law.

To explore these channels, we examine whether treatment effects vary with characteristics of a given female candidate. We consider two characteristics of a female candidate: her criminal status and education level. We measure criminality by whether a female candidate faces any active criminal cases against her. We also consider whether a female candidate has more than 10 years of education or not. These data are only available from 2004 onwards and thus represents a subsample of our overall sample.

Some evidence from India suggests that criminal politicians are detrimental for growth (Prakash et al., 2014). Criminality (or lack thereof) of candidates including females may be a proxy for characteristics that are not conducive for economic development. Similarly, education level may be another proxy for the type of a candidate and hence could reflect his or her ability to serve in the office. To explore whether the criminal status of a female MLA matters for growth, we estimate in Panels A and B of Table 4 separate treatment effects for female candidates that have been criminally accused and for female candidates that have not been criminally accused. Specifically, in columns (1)-(4) of Panel A we compare constituencies with female winners who were not criminally accused. We observe that constituencies with female winners who were not criminally accused experience significantly higher growth compared to constituencies in which a male won. In Panel B, we compare female winners who were criminally accused and find that light output growth in constituencies with criminally accused female winners was at best no different than in con-

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6Starting in 2003, the Supreme Court of India passed a seminal judgment that every candidate who runs for a political office at the national or state level must file an affidavit with the Election Commission of India (ECI) detailing his or her criminal background, amount of assets and liabilities, and other biographical information, such as education. The data from the affidavits was compiled by the Association of Democratic Reforms (ADR) and is publicly available at [www.adrindia.org](http://www.adrindia.org).
constituencies with male winners. Overall, these results indicate that higher growth effect of female representation stems from constituencies where females are not criminally accused and possibly not corrupt.

Next, we explore whether the level of education of a female matters for constituency-level growth in light output. In Panel C, we consider light output growth in constituencies where a more educated female won. The results suggest that a more educated female MLA has a large positive effect on light output growth. In Panel D, the bump in economic growth attributable to female MLAs disappears when we consider less educated females implying that the type of female MLA matters for economic growth.

6.2 Growth of Assets

Fisman et al (forthcoming) find a disproportionate growth in net assets (difference between assets and liabilities) of elected officials and link it to rent seeking activities of the office holders. Following this argument, it is plausible that a disproportionate growth in assets is indicative of corrupt practices while in office and these corrupt practices are less conducive to economic growth. In this subsection, we examine if female MLAs show lower growth in assets compared to male MLAs. We consider MLAs who rerun for office in the second election held after the Supreme Court Judgment and hence have submitted affidavits before the two elections. Based on this sample of rerunning candidates, we estimate the difference in the growth of net assets for female winners and male winners.

We report these results in Table 5. The results suggest that the net assets of a female MLA show significantly lower growth than of a male MLA. In column (1), which uses the optimal bandwidth, the growth in net assets is about 49 percentage points lower for a female MLA than for a male MLA. Although the results are insignificant for larger bandwidths, the growth of net assets is negative when we halve the bandwidth. These results suggest that female MLAs are plausibly less corrupt and less likely to exploit their
office for personal financial gain. The propensity of female MLAs to be less corrupt may mean greater transparency for businesses, which is highly conducive for economic growth.

### 6.3 Effects on local infrastructure

The above discussion suggests that female MLAs possess certain personal characteristics that improve economic growth. They are less likely to face any criminal accusations and show lower growth of assets while in office. This may translate into a more transparent governance that various businesses value. Although no data on transparency or business attractiveness exist at the constituency level, there is nonetheless data on infrastructure activity that can be matched to various Assembly constituencies. We utilize the road construction data available from the Prime Minister Gram Sadak Yojna (PMGSY), which is a scheme to provide all weather road links to various villages in India.

If female MLAs cause higher economic growth in general, we should also find evidence of beneficial effects of female MLAs on road infrastructure. Specifically, any higher effort exhibited by female MLAs in supervising development projects within her constituency may lead to improvements in local infrastructure, leading to higher economic growth. In Table 6, we explore, using the RD setup as above, whether the share of incomplete roads relative to awarded road projects is lower in constituencies with female MLAs compared to constituencies with male MLAs. We find that the share of incomplete roads is about 42% lower in constituencies with female MLAs. The effect is significant across all bandwidth choices except CCT.

### 7 Conclusion

We study whether female representatives are associated with higher or lower economic growth with constituency-level data from Indian States. Implementing a regression dis-
continuity design with close elections as our identification strategy, we find that female MLAs lead to about 11 percentage points higher growth in light output, which translates to an increase in economic growth of about 1.2 to 3.3 percentage points. Consistent with this evidence for light output, we also find that female MLAs improve access to important public infrastructure such as roads. We also find evidence that the growth effects are higher if a female MLA is politically aligned with the ruling party. Moreover, only female MLAs that are not criminally accused and who are educated have positive effects on growth. Overall, our results imply that the gender of a representative has substantial effects for the economic performance of her constituency. That estimated treatment effects vary according to state-level political variables suggests that political skills are one reason why female MLAs may lead to higher growth. However, personal qualities, such as a lower likelihood of criminality – which in turn are reflected by a lower likelihood of pending criminal charges and a lower growth in assets – and higher education, also seem to be a reason why female politicians are good for growth.

References


Kumar, N. (2014). Political interference on firms: effect of elections on bank lending in India. Mimeo (University of Chicago, Booth School of Business).


Table 1: Descriptive Statistics

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<td>Difference</td>
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Table 2: Female MLA and Electricity Provision

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<td>CCT</td>
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<td>IK (h)</td>
<td>IK (h)</td>
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<td>Female MLA_{t}</td>
<td>15.25**</td>
<td>16.97*</td>
<td>8.52**</td>
<td>8.67**</td>
<td>11.83***</td>
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<td>6.68</td>
<td>6.68</td>
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The dependent variable is the growth of light, \((\log(\text{Light}_{t+1}) - \log(\text{Light}_t)) \times 100\), averaged over an election term. Female MLA_{t} is a dummy variable which is 1 for a female legislator and 0 for a male legislator. The forcing variable is margin of victory (\text{margin}_{t}), which is the difference between vote shares of the winning and runnerup candidates. We consider mixed gender races in which a female either won or was a runnerup against a male. Column (1) reports estimates from a local linear regression of Growth of Light_{t+1} on Female MLA_{t}, using a bandwidth determined by Imbens and Kalyanaraman (2012) optimal bandwidth calculator. Columns (2) and (3) half and double the optimal bandwidth. Column (4) considers bandwidth as calculated in Calonico, Cattaneo, and Titiunik (2014). Column (5) additionally controls for the covariates, constituency and year fixed effects. Columns (6)-(7) use higher order smoothing functions. The kernel used is triangular. The standard errors are clustered at the constituency level. The number of observations with in the given bandwidth is denoted by N. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
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<td>IK (h)</td>
<td>h/2</td>
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<td>CCT</td>
<td>IK (h) with Covariates</td>
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<td>IK (h)</td>
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<td>14.70***</td>
<td>17.41**</td>
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<td>12.98***</td>
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<td>0.01</td>
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<td>21.12</td>
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The dependent variable is the growth of light, $(\text{Log(Light}_{t+1})-\text{Log(Light}_t))*100$, averaged over an election term. Female MLA$_t$ is a dummy variable which is 1 for a female legislator and 0 for a male legislator. The forcing variable is margin of victory (margin), which is the difference between vote shares of the top-male and top-female candidates. We consider mixed gender races in which there was at least one male and one female candidate. Column (1) reports estimates from a local linear regression of Growth of Light$_{t+1}$ on Female MLA$_t$ using a bandwidth determined by Imbens and Kalyanaraman (2012) optimal bandwidth calculator. Columns (2) and (3) halve and double the optimal bandwidth. Column (4) considers bandwidth as calculated in Calonico, Cattaneo, and Titiunik (2014). Column (5) additionally controls for the covariates, constituency and year fixed effects. Columns (6)-(7) use higher order smoothing functions. The kernel used is triangular. The standard errors are clustered at the constituency level. The number of observations with in the given bandwidth is denoted by N. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Table 4: Female MLA and Electricity Provision: Heterogeneous Effects

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<th>Herogeneity Effects by Criminal Status</th>
<th>Herogeneity Effects by Education</th>
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<tr>
<td></td>
<td>Panel A: Female Candidate is Not Criminally Accused</td>
<td>Panel C: Female Candidate is Educated</td>
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<td>Female MLAs</td>
<td>(1) h</td>
<td>(2) h/2</td>
</tr>
<tr>
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<td>27.22*</td>
<td>33.79*</td>
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<td>0.01</td>
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<td>N</td>
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<td>373</td>
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<tr>
<td>Bandwidth</td>
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<td>4.31</td>
</tr>
<tr>
<td></td>
<td>Panel B: Female Candidate is Criminally Accused</td>
<td>Panel D: Female Candidate is Not Educated</td>
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<td>Female MLAs</td>
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The dependent variable is the annual growth of light, which is (Log(Light_{t+1})-Log(Light_{t+1}))*100. Female MLA is a dummy variable which is 1 for a female legislator and 0 for a male legislator. The forcing variable is margin of victory (margin), which is the difference between votes shares of the winning and runner up candidates. Panel A reports the effect of electing a female candidate from the set of constituencies where an unaccused female either won or lost against a male. Panel B reports the effect of electing a female candidate from the set of constituencies where an accused female either won or lost against a male. In Panels C and D, a female is considered to be educated if she had 10 or more years of schooling. The method of estimation is local linear regression of Growth of Light on Female MLA, using alternative choices of bandwidths: Imbens and Kalyanaraman (2012) optimal bandwidth (h), half of the optimal bandwidth (h/2), twice of the optimal bandwidth (2h), and bandwidth (CCT) as calculated in Calonico, Cattaneo, and Titiunik (2014). The kernel used is triangular. The standard errors are clustered at the constituency level. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
<table>
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<th>(4)</th>
</tr>
</thead>
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<td><strong>IK (h)</strong></td>
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<tr>
<td><strong>R^2</strong></td>
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<td>0</td>
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The dependent variable is Growth of Net Assets, which is the difference between assets and liability. Female MLA is a dummy variable which is 1 for a female legislator and 0 for a male legislator. The forcing variable is margin of victory (margin), which is the difference between voteshares of the winning and runnerup candidates in columns (1)-(4). Column (1) reports estimates from a local linear regression of Growth of Net Assets on Female MLA, using a bandwidth determined by Imbens and Kalyanaraman (2012) optimal bandwidth calculator. Columns (2) and (3) halve and double the optimal bandwidth. Column (4) considers bandwidth as calculated in Calonico, Cattaneo, and Titiunik (2014). The kernel used is triangular. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Table 6: Female MLA and Share of Incomplete Roads

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<td>Female MLA&lt;sub&gt;i&lt;/sub&gt;</td>
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<td>[0.19]</td>
<td>[0.29]</td>
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<td>1.49</td>
<td>5.96</td>
<td>9.99</td>
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</table>

The dependent variable is the share of incomplete roads projects in total projects awarded. Female MLA<sub>i</sub> is a dummy variable which is 1 for a female legislator and 0 for a male legislator. The forcing variable is margin of victory (margint), which is the difference between votes shares of the winning and runner-up candidates. Column (1) reports estimates from a local linear regression of Share of Incomplete Road Projects<sub>t+1</sub> on Female MLA<sub>i</sub> using a bandwidth determined by Imbens and Kalyanaraman (2012) optimal bandwidth calculator. Columns (2) and (3) halve and double the optimal bandwidth. Column (4) considers bandwidth as calculated in Calonico, Cattaneo, and Titiunik (2014). The kernel used is triangular. The standard errors are clustered at the constituency level. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Figure 1: Continuity Checks

(a) Growth of Light in t-1
(b) Share Incomplete Roads in t-1
(c) Electorate Size in t-1
(d) Turnout t-1
(e) Proportion female in t-1
(f) Proportion SC Seats
(g) Proportion ST Seats
(h) Ruling Party in t-1
(i) Proportion Criminally Accused
(j) Education

Growth of Light and Share of Incomplete Roads are the averages from the election term prior to a female's election. Other variables are from the previous election. Each dot represents a local average in bins of 5 percent margin of victory. The solid lines are the smooth curves estimated using a local linear regression of each variable on margin of victory separately on either side of the cutoff of zero. The black curves around the local linear curve depict a 95 percent confidence interval for each variable.
Figure 2: Density of the Forcing Variable

(a) Density of Victory Margin

(b) McCrary’s Density Test
Figure 3: Effect of Female MLAs on Economic Growth

Each dot represents a local average in bins of 5 percent margin of victory. The solid lines are the smooth curves estimated using a local linear regression of each variable on margin of victory separately on either side of the cutoff of zero. The black curves around the local linear curve depict a 95 percent confidence interval for each variable.
Figure 4: Effect of Female MLAs on Share of Incomplete Roads

Each dot represents a local average in bins of 5 percent margin of victory. The solid lines are the smooth curves estimated using a local linear regression of each variable on margin of victory separately on either side of the cutoff of zero. The black curves around the local linear curve depict a 95 percent confidence interval for each variable.