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Women legislators and economic performance

Thushyanthan Baskaran[1] · **Sonia Bhalotra**[2] · **Brian Min**[3] · **Yogesh Uppal**[4]

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Abstract
There has been a phenomenal global increase in the proportion of women in politics in the last two decades, but there is no evidence of how this has influenced economic performance. We investigate this using data on competitive elections to India's state assemblies, leveraging close elections to isolate causal effects. We find significantly higher growth in economic activity in constituencies that elect women and no evidence of negative spillovers to neighbouring male-led constituencies, consistent with net growth. Probing mechanisms, we find evidence consistent with women legislators being more efficacious, less corrupt and less vulnerable to political opportunism.

Keywords Political representation · Identity · India · Gender · Women legislators · Economic growth · Luminosity · Corruption · Roads · Close elections · Electoral incentives

JEL Classification D72 · D78 · H44 · H73

1 Introduction

More than a hundred countries have introduced quotas for women in parliament or in party lists in the last two decades (Pande & Ford, 2012; Besley et al., 2017; Dahlerup, 2006) and the percentage of women in parliament worldwide has more than doubled, standing at 25.2 percent in October 2020.[1] 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

[1] In contrast, only 12 percent of corporate board members are women.

All errors are our own. UNU-WIDER Helsinki invited this study in connection with Bhalotra's Keynote Address at the 17th Nordic Conference on Development Economics.

✉ Sonia Bhalotra
sonia.bhalotra@warwick.ac.uk

[1] Ruhr University Bochum, Bochum, Germany

[2] University of Warwick, Coventry, UK

[3] University of Michigan, Ann Arbor, USA

[4] Youngstown State University, Youngstown, USA

that is thought to lift all boats. In this paper we present the first systematic examination of whether women politicians are good for economic growth.

The association of women with redistributive policies and a tolerance of higher taxes (Edlund & Pande, 2002; Edlund et al., 2005; Campbell, 2004) makes it plausible that, at least in the short to medium term, women politicians are less effective than men at promoting growth. Women have been shown to favour public goods investments, such as in education and health (Bhalotra & Clots-Figueras, 2014; Clots-Figueras, 2012), which may have only long term returns. However, women legislators might promote growth if women who select into public office have a stronger sense of public mission, are more motivated to meet higher expectations, or are less corrupt (Beaman et al., 2006; Brollo & Troiano, 2016; Dollar et al., 2001; Swamy et al., 2001; Mauro, 1995; Prakash et al., 2019; Non et al., 2022).[2]

We know of no causal estimates linking economic performance to the gender of politicians, but a few recent studies examine impacts on firm performance of women on corporate boards. The results of these studies are ambiguous, with many suggesting negative impacts or no impact (Ahern & Dittmar, 2012; Matsa & Miller, 2013; Gagliarducci & Paserman, 2014; Baltrunaite et al., 2021). However, this evidence base is too small to be conclusive, and the gender composition of decision makers may influence economic performance differently in the political and corporate sectors.

Two factors probably contribute to the scarcity of causal evidence on the relationship between legislator gender and economic performance. The first is that constituency level data on economic activity are not available in most countries. We use satellite imagery of nighttime luminosity as a measure of growth in economic activity. A number of studies examine the validity of this measure, and use it to proxy growth, including studies set in India, see Henderson et al. (2012), Chen and Nordhaus (2011), Costinot et al. (2016), Donaldson and Storeygard (2016), Bruederle and Hodler (2018) and Baragwanath et al. (2019).[3] We also show, using constituency-level data, that women are more effective than men at overseeing road building and at raising the share of non-farm employment, and that women are less prone to corruption. Each of these is an indicator of economic progress in its own right.

A second reason for the paucity of causal research on women legislators and growth is that it poses an identification challenge. Constituencies in which women win elections may be systematically different in ways that are correlated with economic performance. To isolate the role of legislator gender from voter preferences and other potentially omitted variables at the constituency level, we use a regression discontinuity design on close elections between men and women. In first-past-the-post elections in which the winner takes all, there is a sharp discontinuity at the zero vote margin between the top two candidates. In this setting, the identity (and hence gender) of the winner can be considered quasi-random (Lee, 2008; Eggers et al., 2015; Imbens & Lemieux, 2008). Comparing constituencies in which a woman wins against a man by a narrow margin ('treated') with those in which a

[2] See, for instance, http://www.forbes.com/sites/kerryhannon/2010/11/19/top-five-reasons-why-women-flock-to-nonprofit-jobs/).

[3] We demonstrate a positive association of nighttime luminosity growth with GDP growth using available state-level data for India. We discuss three potential sources of measurement error in the use of night time lights to estimate economic activity: saturation, low sensitivity and blooming, and show that our estimates are not sensitive to these issues.

man wins against a woman by a narrow margin ('control') can thus isolate the causal influence of legislator gender.[4]

We examine data for 4265 state assembly constituencies for 1992–2012, during which time most states had four elections. This is a period of strong economic growth in India. It was also a period in which the share of female state legislators increased from about 4.5 percent to close to 8 percent. Moreover, there was vast regional variation in both the gender composition of state legislators and luminosity growth (see Figs. 1 and 2).

We find that women legislators in India raise economic performance in their constituencies by 2.3 percentage points per year more than male legislators. We discuss below the numerous specification checks that this coefficient is robust to. When we condition upon state-specific election-term fixed effects, the coefficient falls to half the size but, in all cases, we can reject that electing women compromises growth relative to electing men.[5]

Now, if women-led constituencies do better on account of winning resources away from male-led constituencies, then overall impacts on economic growth of increasing the share of women legislators would depend upon the size of these negative spillovers. Assessing this by mapping growth in neighbouring constituencies to legislator gender in the index constituency, we reject negative spillovers.[6] Thus, our estimates suggest that increasing the share of women legislators favours economic progress.[7]

In probing mechanisms using the same close election strategy, we find evidence that women legislators are more likely than their male counterparts to achieve completion of road infrastructure projects and that they are less corrupt, by two different indicators of corruption. In a different exercise that compares the male–female gap in performance in close vs. non-close elections, we find evidence consistent with women being less prone to distortions arising from electoral incentives. Each of these potential mechanism variables has been shown in previous work to impact growth. Thus, this sequence of results supports and strengthens our finding that women increase economic growth. Indeed, each of these results, on its own, is a contribution to the literature and, pulled together, they point to likely improvements in economic growth under women's leadership.

We now elaborate the evidence on these intermediate outcomes. Since economic infrastructure is an important input to economic growth, especially in developing countries (Jacoby, 2000), we analysed legislator performance in implementation of a massive federally-funded village road construction program involving state legislators bidding for federal funds and delivering goods at the local level. Using administrative programme data we find that, although male and female politicians are equally likely to negotiate federal projects for road building in their constituencies, women are more likely to oversee completion of these

[4] In Sect. 2 we describe the many powers that state legislators in India have.

[5] We explained above that it is often hard to find a measure of economic growth at the constituency level. However, even at an aggregate level, measurement of growth in developing countries is made difficult by the size of the informal sector and the income volatility that many agrarian and self-employed households face. Classical models of growth associate it with structural change, a marker of which is the share of non-farm employment. We find that the share of non-farm employment is higher under women than under male legislators by 0.84% points per year.

[6] The estimated coefficient, though imprecise, is positive, consistent with yardstick competition between neighbours (Besley & Case, 1995) and with positive externalities of public infrastructure like electricity and roads for neighbours, for instance, infrastructure does not stop abruptly at constituency boundaries. Also our finding- discussed next- that women are less corrupt is consistent with women achieving higher growth without necessarily bringing more resources from the state to their constituencies.

[7] We also test for more diffuse, state-wide spillovers by focusing on state-level growth. We again find no evidence for negative spillovers.

projects. The share of incomplete road projects in woman-led constituencies is 22 percentage points lower than in male-led constituencies, a mechanism that plausibly contributes to the better growth performance of woman-led constituencies. Like George (2019), we interpret the share of projects completed vs. stalled as a measure of politician effort.

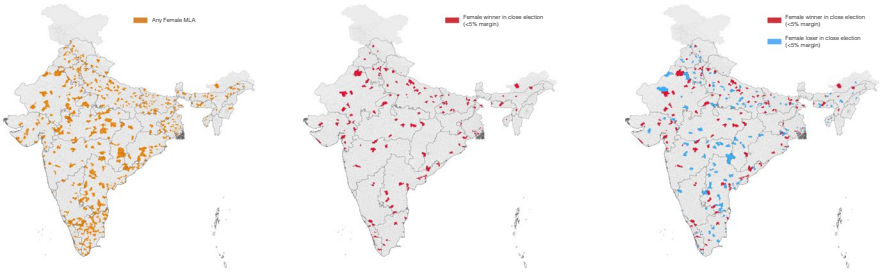
To investigate corruption, we use asset growth in office, a measure devised and validated in Fisman et al. (2014) (who do not look at gender differences). We find that the rate at which women accumulate assets while in office is 12 percentage points lower per annum than for men. We analyse an alternative measure of (potential) corruption that is measured before the legislator enters office, which is an indicator for whether the contestant has pending criminal charges against them. Comparing characteristics of male and female legislators in the close election sample, we find that men are about three times as likely as women to contest with pending charges. Following Prakash et al. (2019), we estimate the growth penalty associated with criminal legislators on our sample. Using this parameter, we estimate that criminal tendencies can explain close to one fourth of the identified difference in growth between male and female-led constituencies.[8]

India is a large country and there is considerable variation across the states in governance or in opportunities for corruption. Using a crude marker of this, we divide the states into two samples which we refer to as more and less developed. We find a larger difference in economic performance in favour of women in the sample of less developed states. This is mirrored in larger gender difference in both criminality and corruption in office in the less developed states. However the legislator gender gap in road completion rates is not significantly different between the more and less developed states. These results suggest that, as economic development progresses, the growth advantage from electing women may narrow but is unlikely to be eliminated.

We also divide the Indian states into groups that are more vs less gender-unequal. We find that women do not perform significantly better than men in the most gender-unequal states (with a population female to male ratio below the 25th percentile). This is consistent with women, including women leaders, having more limited agency in these states.

As regards internal validity, the data satisfy a suite of checks on the RD design. We show that there is no evidence of sorting at the threshold, and that a rich set of constituency-level pre-determined electoral and demographic covariates are balanced around the threshold. This mitigates concerns that the estimates are driven by pre-existing differences in constituency characteristics, in particular the weaker performance of men cannot be attributed to mean reversion or to their being elected in places with weaker growth potential. Luminosity growth (and, similarly, road completion rates and non-farm employment share) in the preceding election term exhibit balance at the threshold. We nevertheless conduct a stricter test to allay the concern that constituencies in which women are narrowly elected against men are different in ways that favour growth. We posit that unobservable imbalance between constituencies with female and male legislators will tend to be smaller among neighbouring constituencies, and re-estimate the main equation limiting the estimation sample to constituencies with female legislators and their neighbours (mostly male-led). The coefficient of interest is almost identical, suggesting balance on unobservables in the original sample. In a further set of specification checks, we show results conditional upon covariates, constituency fixed effects and state-specific election term fixed effects. We further evaluate the RD design by re-estimating the model with a series of placebo

[8] Neither Fisman et al. (2014) nor Prakash et al. (2019) look at legislator gender.



(a) Women legislators / all races (b) Women legislators / close races (c) Women and male legislators / close races

Fig. 1 The geography of women legislators: 1992–2008. Subfigure **a** indicates constituencies in which a female candidate won an assembly constituency seat in state elections between 1992 and 2008. Subfigure **b** indicates constituencies in which the female candidate won in a close mixed-gender election. Subfigure **c** additionally shows constituencies where the female candidate lost in a close mixed-gender election

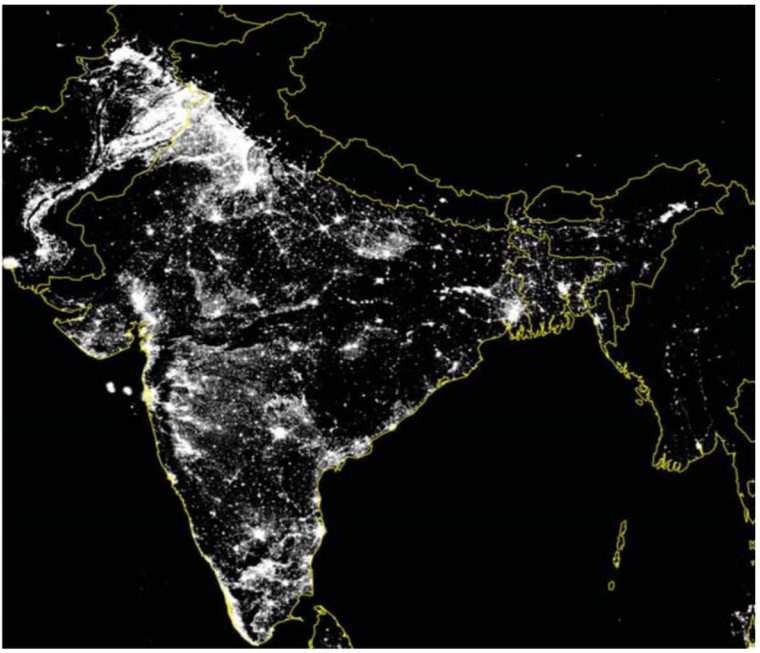
thresholds, demonstrating that the placebo coefficients are smaller than the true coefficient, and not significantly different from zero.

In considering external validity of our results it is important to highlight that a third of all mixed-gender races are won with narrow margins (i.e. are in the close election sample). Indian elections are competitive in general, the share of all elections that is close also being a third. So elections in which women contest against men are neither more nor less competitive. Figure 1 shows that constituencies in which women win are geographically dispersed, so our analysis does not pertain to a specific region. Women are also not significantly more likely to be from any one of the main political parties, though we nevertheless show that our estimates are robust to controlling for legislator party.

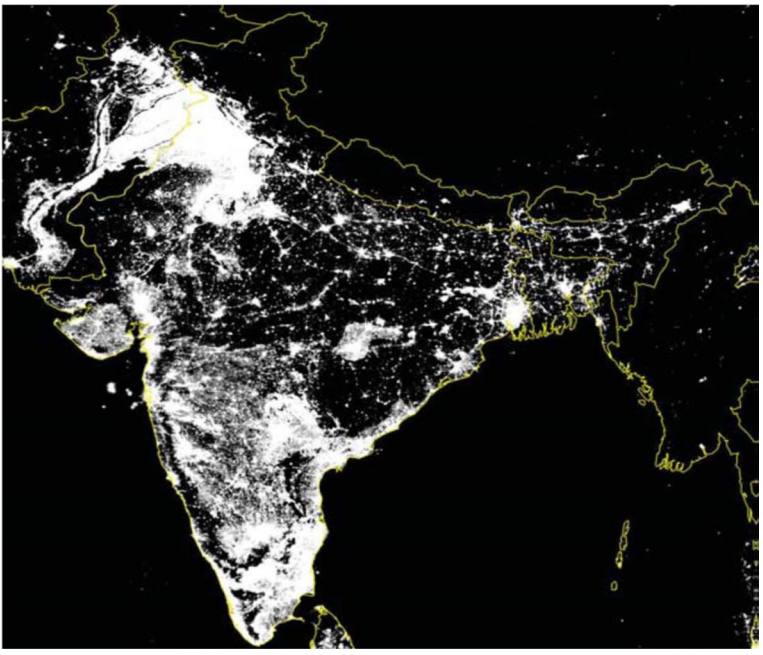
We discuss selection into the close election sample. In particular, we consider whether men who win against women with narrow margins are negatively selected relative to men who win against women with wide margins. We find no significant difference in constituency or candidate characteristics between these two groups of men, except that men winning in close elections are more likely to have dynastic links than men winning with a wider margin. Dynasts are less effective leaders over an election term (George, 2019) but dynastic links cannot explain the better performance of women because, in the close election sample, men and women are equally likely to be dynasts.[9] To investigate whether men who win in close elections are negatively selected on unobservables, we adapt a strategy suggested in George (2019), using swings in the state-level vote share of the candidate's party as a measure of luck. We show that our results are robust to accounting for negative selection among men in close elections. Even if we focus only on higher quality candidates (who won despite a negative party swing), women outperform men.

To explain why women appear to do no better than men (though no worse) in non-close elections while decisively doing better in close elections, we highlight that electoral incentives are sharper in close than in non-close election constituencies, and posit that men and women respond differently to these incentives. In particular, women are less likely than men to distort economic policies to pursue a narrow electoral agenda. We provide

[9] We are grateful to Siddhartha George for sharing his data on dynastic links.



(a) Luminosity in 1992



(b) Luminosity in 2009

Fig. 2 Luminosity in India. Subfigures **a** and **b** show the level of average luminosity in India in 1992 and 2009, respectively. The average growth rate of GDP in India during this period was about 120%. Source for all figures: DMSP-OLS v4 Time Stable Annual Composites from NOAA National Geophysical Data Center

descriptive evidence consistent with this, showing that re-election rates for women vs. men are lower in close elections, while being similar in non-close elections,[10]

Overall, we set out to find out if electing women, while being positive for certain redistribution-related outcomes, compromised economic growth. We find that it does not, indeed, electing women results in improved economic growth. So as to allay any concerns over luminosity growth as a measure of growth, and so as to bolster the result with evidence of plausible mechanisms, we provide estimates for five different outcomes, all of which show significant movements in a consistent direction.

1.1 Relation to existing literature

Recent research by economists on women in politics has been rather dominated by research on India because of the opportunities for identification created by randomisation of local government gender quotas. A constitutional amendment mandating that a random one third of village council positions be reserved for women was passed in India in 1993. A number of studies analyse these reservations, for example, Chattopadhyay and Duflo (2004), Beaman et al. (2009), Iyer et al. (2012); Afridi et al. (2017). The evidence in this study is different for four reasons. First, we analyse the performance of women vs. men who win in competitive elections, which is not comparable to relative performance if women are elected to reserved seats. Second, we analyse state legislatures, which have different powers and functions compared to village councils in India. Third, the village gender quota was implemented jointly for council membership and council leadership, while we isolate the role of membership of the state legislature. Fourth, previous studies of women competitively elected to state legislatures have focused upon the composition of state-provided public goods (Bhalotra & Clots-Figueras, 2014; Clots-Figueras, 2012), while we focus on growth and plausible determinants of growth. This is a step change because while there is considerable evidence that men and women in government have different preferences or priorities, it is unclear how a social planner would determine the trade-offs that arise. Economic growth, on the other hand, shifts the entire possibilities frontier outward.

We contribute new evidence to a literature on political identity and substantive representation (Osborne & Slivinski, 1996; Besley & Coate, 1997) that has tended to focus more narrowly upon differences in priorities and hence on the composition of government spending, rather than on growth. For instance, see Chattopadhyay and Duflo (2004); Iyer et al. (2012); Brollo and Troiano (2016); Bhalotra and Clots-Figueras (2014); Clots-Figueras (2012); Miller (2007); Edlund et al. (2005); Chaney et al. (1998); Thomas (1991); Svaleryd (2009); Bhalotra et al. (2019); Bhalotra et al. (2023).

Amongst the findings of these studies are that women in politics have influenced the passage of abortion laws in the US; equal inheritance rights legislation, the reporting of crime against women, and the promotion of public health inputs to child survival in India;

[10] Our findings cohere with our earlier analysis of mechanisms for behaviour within the close sample, consistent with women having greater intrinsic motivation. Other studies have highlighted the potential for electoral incentives to distort economic choices, e. g. generating electoral cycles (Cole, 2009) vote buying (Mitra et al., 2017), or pork-barrel politics (Arulampalam et al., 2009) but with the exception of Brollo and Troiano (2016), these studies do not distinguish men and women. Recall that it is only the close election analysis that is identified and, in the close election sample, we show balance on election rates of men and women in the preceding election. Different but, broadly related, Sheffer (2021) argue that women are more conservative in policy making.

government spending on childcare, expenditures on education and elderly care in Sweden; and maternal mortality decline in developing countries. A few studies find no significant influence of the gender of local politicians on policy choices (Ferreira & Gyourko, 2014; Rigon & Tanzi, 2012). Since road construction has higher returns for men (Asher & Novosad, 2019) and economic growth, in principle, favours all, our finding indicates that women politicians are not exclusively focused upon serving the interests of women voters, but are also more generally effective in providing public goods.

Our study is relevant as this is a time when women are increasingly participating in government across the globe. In India, a historic constitutional amendment proposing to 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, it was not voted on in the lower house and lapsed in 2014. Our findings are of considerable interest beyond India, given the scarcity of evidence on the question of how legislator gender is associated with economic performance, and in view of the fact that the share of women in government is small but rising in many (rich and poor) countries. In addition to contributing the first causal estimates indicating how election of a female vs. male legislator influences luminosity growth, we also provide new causal evidence on how legislator gender influences road infrastructure, sectoral change and corruption and we present evidence suggesting that men and women respond differently to electoral incentives. We conclude the paper with remarks on how the growth premium associated with women leaders might evolve with economic development.

The remainder of this paper is structured as follows. Section 2 offers contextual information on Indian elections and women's political participation. Section 3 presents our empirical strategy. In Sect. 4, we discuss the electoral, luminosity, road building and candidate characteristics data. Section 5 presents the main results. Section 6 explores geographical spillovers. In Sect. 7, we investigate mechanisms. Sections 8 and 9 present a number of extensions, and Sect. 10 concludes.

2 Context

India is a large federal country with highly competitive multi-party elections monitored by an independent electoral commission. Electoral fraud is uncommon, although some areas suffer from clientelism and elite capture (Anderson et al., 2015). The current 29 states of the Indian Union are parliamentary democracies in which, typically, a new legislative assembly is elected every five years. There is a high degree of turnover at the state level with state governments often voted out of office. In contrast to the case of the USA, but similar to Brazil, incumbents in India are less likely to win than challengers (Uppal, 2009). Members of Legislative Assemblies (legislators) are chosen according to a first-past-the-post system in single member constituencies. Voters vote for individual candidates rather than party lists. Successful candidates are typically fielded by an established party,[11] While there are political quotas for certain minority tribes and castes at the local, state and national level, gender quotas in India are only at the local level (village, town) and only since 1993 (Chattopadhyay & Duflo, 2004).

[11] In fact, parties are crucial arbiters of political careers given the high costs of running for office in India. In the 2009 federal elections, the average cost of winning a seat was around 2 million US dollars (Tiwari, 2014) a sum that most candidates would struggle to raise without the support of sophisticated party organizations.

State legislators shape policy. They influence the flow of federal funds and the financing of village councils and they are responsible, inter alia, for roads, electricity, law and order, health and education. They act to serve their constituents, whether on account of electoral incentives or mission-driven preferences. They are able to implement their preferences because they are each endowed with a development fund that they can spend in their constituencies in the manner they think fit. Political manipulations by state officials can further influence the allocation of federal transfers (Khemani, 2006) and of federally funded development programs (Gupta & Mukhopadhyay, 2016). The state government needs the support of a majority of legislators to rule effectively, which gives them substantial influence at the state level and the power to negotiate for state resources for their constituencies. Legislators can directly influence economic conditions in their constituencies by exerting effort to pursue development opportunities or implementing federal or state government programs more or less effectively (Baskaran et al., 2015; Min, 2015).

In India state legislators are not only active in the state capital, influencing legislation or working in committees. They spend a lot of their time acting as intermediaries between their constituents and state bureaucracies and private firms. Jensenius (2015, p. 197), for example, summarizes their role as follows:

> Members of Legislative Assemblies (MLAs) in India are often thought to matter more as "fixers" in their constituencies than as legislators (Chopra, 1996). At the state level, meeting activity in legislative assemblies is limited (Jensenius & Suryanarayan, 2015), so politicians spend most of their time in their constituencies, where they help people access government schemes, try to influence the bureaucracy to implement projects, or use their networks to attract construction or business projects (Chopra, 1996; Asher & Novosad, 2017; Bussel, 2014).

Evidence emerging from political quotas in village and town councils and analysis of close elections to state assemblies suggest that women politicians have different priorities from men, tending to favor the concerns of women and children (see references in Sect. 1). Despite a secular increase in the share of women legislators, women remain vastly underrepresented in Indian federal and state politics, their share oscillating around 10 percent in recent years (Beaman et al., 2012). This reflects not so much lower chances of winning conditional on standing, but that fewer women come forward as candidates (Bhalotra et al., 2017). This may be because women dislike competitive or corrupt environments or because party leaders discriminate against women in the nomination process (Spary, 2014).

3 Empirical strategy

We aim to estimate the causal effect of election of a woman legislator on economic activity in her constituency. If the election of women was randomly determined, constituencies that elected a man would serve as a valid counterfactual. However, the election of women is unlikely to be random. For instance, one might expect that constituencies with more progressive voters are more likely to elect women. This creates the identification challenge that unobserved differences between constituencies that elect women vs. men are potentially correlated with the outcome (economic activity).

To address this challenge, we exploit the discontinuity in electoral outcomes that arises in first-past-the-post electoral systems by comparing female and male winners in close elections, defined as elections in which the margin of victory between the

winner and the runner-up is arbitrarily small. Previous work shows that, in these circumstances, the identity of the winner is quasi-random (Lee, 2008).

The estimated model is:

$$y_{ist} = \alpha + \tau * femalelegislator_{ist} + f(margin_{ist}) + \varepsilon_{ist} \tag{1}$$

where y_{ist} is average growth of light in constituency i in state s over the election term t. We calculated the growth of light as the difference in the logarithm of light density in years $t+1$ and t. The margin of victory in constituency i in state s for election in t ($margin_{ist}$) is the forcing variable. Since we restrict the sample to elections in which the top two vote winners are a man and a woman, $margin_{ist}$ is defined as the difference between the vote shares of the female and the male candidate. So, by construction, it is positive when a woman wins against a male runner-up and negative when a male wins against a female runner-up. At a (notional) margin of zero, the gender of the constituency leader changes discontinuously from male to female. We can think of the treatment $femalelegislator_{ist}$, as an indicator for the winner being a woman, defined as follows:

$$\begin{aligned} femalelegislator_{ist} &= 1 \; if \; margin_{ist} > 0 \\ &= 0 \; if \; margin_{ist} \leq 0, \end{aligned} \tag{2}$$

The RD design considers a close neighbourhood, λ, around the threshold margin of zero and premises that as λ goes to 0 the differences between constituencies that elected a female candidate and those that elected a male vanish, allowing us to identify the causal effect of electing a woman legislator:

$$\lim_{\lambda \to 0^+} E[y_{ist} \mid 0 < margin_{ist} \leq \lambda] - \lim_{\lambda \to 0^-} E[y_{ist} \mid -\lambda \leq margin_{ist} < 0] = \tau, \tag{3}$$

This is the difference in the average outcomes of constituencies that barely elected a female legislator against a male runner-up and constituencies that barely elected a male legislator against a female runner-up. The RDD assumption that the distribution of the error term, ε_{ist}, is continuous in the forcing variable is weaker than the identifying assumptions that other selection-on-observables methods rely upon. Since there is no within election term variation in our treatment variable ($femalelegislator_{ist}$), we average the growth of light over an election term. Standard errors are clustered at the constituency level to allow for within constituency correlation of the errors over different election terms.

We estimate the discontinuity using local linear regressions as suggested in Gelman and Imbens (2019). We report results for several bandwidth choices including the optimal bandwidth procedure suggested in Imbens and Kalyanaraman (2012). In further robustness checks, we retain only neighbours of female-led constituencies as any unobservable differences are likely to be smaller and we investigate sensitivity of our results to an alternative definition of the victory margin, using the larger sample of all races in which a female contested, irrespective of whether or not she was ranked among the top two in voteshare (Meyerson, 2014). We also show results conditional on party, allowing for measurement error and we show results for the early vs. late years of the electoral term. We then present estimates for spillovers and potential mechanisms before investigating heterogeneity in impact. The empirical specifications for these extensions of the main analysis are presented together with the findings below.

4 Data

Table 8 collects the variable definitions and sample periods. Table 9 provides summary statistics of the main outcome variables (Panel A) and the predetermined covariates (Panel B) in our data. It also provides summary statistics for variables available from the candidate affidavits (Panel C). In this section, we discuss the electoral data and the data on luminosity, road construction and non-farm employment.

4.1 Night lights data

We use nighttime light imagery data gathered by satellites from the U.S. Air Force Defense Meteorological Satellite Program's Operational Linescan System. The data are processed by the National Oceanic and Atmospheric Agency to exclude pixels with low quality data due to clouds, stray light, lunar illuminance, auroral lights, and active fires. Annual composites are produced by averaging across all remaining good quality data from across the calendar year. Each pixel is encoded with a measure of its annual average brightness on a 6-bit scale from 0 to 63, and geo-referenced onto a 30 arc-second grid (approximately 1 km^2 at the equator). Night lights data were first digitized in 1992 and our electoral data run through to 2012.

We overlaid a map of 4265 Indian State Assembly constituencies to create constituency level light density data as the sum of total light emitted by each pixel within constituency boundaries divided by the area of the constituency. Figure 2 shows considerable growth in the intensity and spread of lit areas over time, consistent with the substantial economic growth during this period.

To examine the relationship between growth in nighttime light output and economic growth, we use state-level GDP data, which is the smallest administrative unit for which consistent time series data are available. Figure 3 plots the data, showing a strong correlation. Panel data estimates, conditional on state and year fixed effects, indicate that a 1 percent increase in night lights is associated with a 0.15 percent increase in GDP (see Table 10).[12]

Henderson et al. (2012) argue that although GDP data is widely reported, it is often unreliable in developing countries where accounting biases arise because the informal sector is large, making it harder to verify inputs, outputs, incomes and profit (see also Jerven, 2013, Bhalotra & Umana-Aponte, 2015). Thus GDP and night lights are both error-prone measures of economic activity, and it is unclear which is measured with more error. The compelling advantage of nighttime lights data, exploited here, is that it is available for disaggregated areas and can be measured for state assembly constituencies.

We nevertheless consider three technical limitations of the sensor that may generate measurement error in the use of night time lights to estimate economic activity: saturation, low sensitivity and blooming. Saturation occurs because of the limited dynamic range

[12] Using Indian district level GDP data that is available for a few recent years, Bickenbach et al. (2013) estimate of elasticity of 0.107. Using global data, Henderson et al. (2012) estimate an elasticity of about 0.3. Weidmann and Schutte (2017) show that local level nighttime lights emissions are positively correlated with economic wealth in a cross-section of clusters in the Demographic and Health Survey of 56 countries, the average rank order correlation being 0.73. The last association is higher than in the preceding studies because it is cross-sectional; within-cluster associations over time are smaller. Indeed, conditional on state but not year fixed effects, our estimates of the association in Indian state-level panel data is 0.34.

of the satellite sensor, leading to a limitation in recording high levels of brightness on the ground. This results in data censoring, with the brightest pixels being assigned the highest digital number value of 63 pixels. This is most common in the centers of large cities and will tend to result in an underestimate of growth if growth occurs within city centers where light output is saturated. On the other hand, the limited sensitivity of the sensors implies that dimly lit areas are not detectable, and assigned a value of zero.[13]

In the close mixed-gender election sample, we have 7 cases (also 1% of observations) with a luminosity of zero and also 7 cases of top-coding (1% of observations). In the robustness checks section, we re-estimate the baseline model excluding these cases and, to anticipate those results, they are very similar in magnitude and not statistically significantly different. In the main analysis we have retained the top-coded cases and added 1 to each zero value before taking logs. If instead we use the inverse hyperbolic transformation, we get similar results, available on request.

The third potential source of measurement error is blooming, which refers to light output from a brightly lit area dispersing over neighbouring areas. Blooming is most prominent around the edges of large cities and can increase in the presence of nearby water sources that reflect light into space. This decreases the precision of light output measurement. If blooming occurs within constituencies, there is no problem. However, there is potential for bias in our estimates if substantial increases in light output in bright constituencies spill over into neighbouring constituencies. We will report a specification in which we estimate spillovers to neighbouring constituencies, and discuss there a robustness check in which we drop brightly lit areas to adjust for blooming potentially affecting neighboring constituencies.

Henderson et al. (2012) provide a detailed discussion of the satellite data, and the premise for interpreting light growth as economic activity. As most lights observable from space are from electric illumination, in principle, electricity consumption could be used to predict GDP growth, but electricity data are unavailable at the constituency level both for India and more generally. Among studies documenting an association of night lights and electricity use are Chand et al. (2009), Shi et al. (2016), Xie and Qihao (2016), the first for India and the other two on a global scale.

Electricity is the lifeblood of the modern economy. The quality and quantity of electricity service provision, including hours of supply, are a known constraint on output, see Allcott et al. (2016), Dinkelman (2011), Rud (2006), Lipscomb et al. (2013).[14] Politicians can influence availability of electricity through providing more connections and ensuring higher reliability (fewer power cuts), and electricity often features as one of the top priorities of Indian voters in election surveys (Chhibber et al., 2004). A number of recent studies highlight the relevance of political control over electricity distribution in India, see Burgess et al. (2020), Mahadevan (2019), Dubash (2018), Kale (2014), Baskaran et al. (2015). However, none of these studies is focused on distinguishing the behaviour of male and female politicians.

[13] That said, Min et al. (2013) show that rural villages in Senegal with as few as 20 streetlights are detectable in satellite imagery and, in another field test by Tuttle et al. (2014), light produced by a single 1000 watt high pressure sodium lamp was reliably detected by the satellite.

[14] We note that Burlig and Preonas (2016) show that a rural electrification programme in India that acted on the extensive margin had limited impacts on growth- this was, however, a programme targeting very poor households.

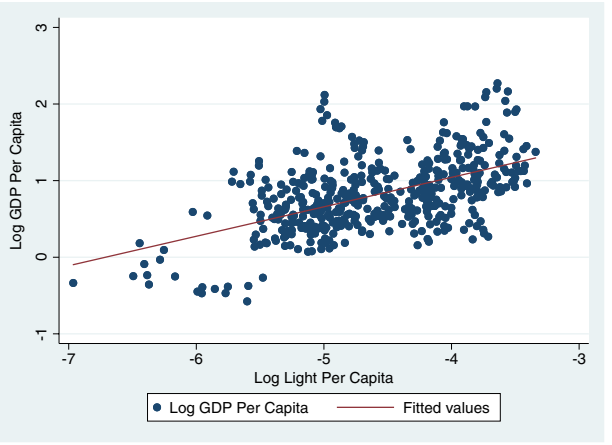


Fig. 3 GDP against luminosity-state data. Scatter of log of night lights per capita and log of GDP per capita, both using the state population in the denominator. The time period is 1992–2009

4.2 Election data

The election data are drawn from successive editions of the Statistical Reports on General Elections to Legislative Assembly of States, published by the Election Commission of India. For each election, the reports contain candidate names, vote counts, gender and party affiliation; assembly constituency names and codes, year of the election, size of the electorate, total number of votes cast, and number of valid votes. India currently has 29 states. Our data, which cover about 99% of the population in India, include all states and the union territory of Delhi, and exclude the disputed northern state of Jammu and Kashmir and smaller union territories.[15]

A constitutional amendment in 1976 fixed the boundaries of constituencies until 2001 to avoid adversely affecting representation of states that implemented population control measures. The fourth Delimitation Commission empowered by the Delimitation Act of 2002 set out to redraw constituency boundaries based on the 2001 census data. However, the Commission's order was only accepted in 2008 and the first election to use new boundaries was held in 2008 in the state of Karnataka. Due to non-comparability of the pre- and the post-delimitation constituencies, we only consider elections held before 2008. However, our data extend until 2012 for states which had not yet held new elections under the newly drawn boundaries.[16]

In the analysis period, 1992–2012, there are 16,857 constituency-election years. Of these, 1709 (10.3%) constituency-election years are in the mixed-gender sample, defined as

[15] 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 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. Uttarakhand was allocated 22 constituencies from Uttar Pradesh which were redrawn into 70 new constituencies.

[16] The data include: Bihar till 2009, Assam, Kerala, Tamilnadu and West Bengal till 2010; Goa, Gujarat, Himachal Pradesh, Manipur, Punjab, Sikkim, Uttar Pradesh, and Uttarakhand till 2011; Meghalaya, Mizoram, Nagaland, and Tripura till 2012. The remaining states appear in our sample till 2008.

a sample in which a woman and a man are the top two vote-winners.[17] Among mixed-gender elections, 471 (27.6%) are close elections, defined as elections with a victory margin of less than 5%. In fact a third of all Indian elections are won with a victory margin of less than 5%, a marker of how competitive Indian elections are in general.

So elections in which women contest against men are, in general, neither more nor less competitive. Figure 1 shows that constituencies in which women win are fairly evenly distributed across the country, so our analysis does not pertain to a specific region.[18]

We utilize data on candidate characteristics drawn from affidavits submitted to the Election Commission of India. The submission of an affidavit became mandatory for all political candidates following a Supreme Court of India order in 2003, the Right to Information Act. The Election Commission of India publishes the affidavits and they contain information on education, assets, liabilities, and pending criminal charges. The Association of Democratic Reforms (ADR), an election watchdog, has compiled the information since 2004.[19] The part of the analysis using candidate characteristics is thus restricted to state elections held between 2004–2008, encompassing one election for each state.

4.3 Road construction data

We investigate acquisition and completion of federally awarded village road building contracts as a proxy for public goods provision at the constituency level. We use administrative data on a centrally sponsored rural roads construction program, Pradhan Mantri Gram Sadak Yojana (PMGSY), launched in 2000 that aims to provide all weather road connectivity in rural areas, and forms an integral part of the Government of India's poverty reduction strategy. This program is unprecedented in its scale and scope (Aggarwal, 2017). We obtained road sanctioning and completion dates. The data are available at the census block level, a sub-district census administrative unit. We matched the roads data to state assembly constituencies.[20]

4.4 Non-farm employment data

In general, it is difficult to find conventional measures of economic activity such as GDP at the constituency level, but luminosity can be mapped to any coordinates. Recently, Asher et al. (2019) have made available constituency level data on non-farm employment. We use this share as a proxy for economic activity. The data are drawn from the Socioeconomic

[17] It is notable that when a woman wins, in 91% of cases, the runner up is a man. However, when a man wins, it is only in 6% of cases that the runner-up is a woman. This is because it is only in 30% of constituency-years that at least one woman contests. The question of what inhibits women's candidacy in India is discussed in Bhalotra et al. (2017).

[18] There is a widespread perception that Indian women suffer discrimination on account of their gender. This is true in many domains and Bhalotra et al. (2017) suggest that Indian women may face party bias in being less likely to be put forward as candidates, as appears to be the case in Spain (Casas-Arce & Saiz, 2015) However, they also show that, conditional upon contesting, women are more likely than men to win, which undermines the possibility of voter bias against women.

[19] www.myneta.info first accessed in March 2014.

[20] The roads data are at http://omms.nic.in/, first accessed in May 2015. While there is significant geographical overlap between a census block and an assembly constituency (sharing on average 80% of villages), a census block can span more than one assembly constituency. We assign block-level road variables to an assembly constituency if the constituency contains at least 50% of villages in the block.

High-resolution Rural-Urban Geographic Data Platform for India (SHRUG), sourced from the 3rd through the 6th rounds of the Economic Census of India, covering the years 1990, 1998, 2005, and 2013. The Economic Census is a complete enumeration of all non-crop producing economic establishments in India including both public and private firms in the formal and non-formal sectors. The SHRUG files are available aggregated at the constituency-year level. Since the data are not annual, we assume that non-farm employment is constant between rounds. This is not ideal but as it is difficult to obtain constituency level economic activity data, we nevertheless use these data to provide a crude check on the luminosity data. As we do not have total employment at the constituency level we normalise on constituency-level population to arrive at the share of non-farm employment.

5 Results

5.1 Validity of RD design

Validity of the RD design requires continuity of predetermined characteristics of constituencies across the threshold of a zero victory margin. We use a rich set of variables determined before the election in t, either variables from the previous election in $(t-1)$, or outcome variables averaged over the previous electoral term. These include the growth of night lights, the share of incomplete road projects, the share of non-farm employment, electorate size (i.e. number of registered voters), number of candidates, turnout, female turnout, whether the legislator was a woman, whether the legislator (in $(t-1)$) was an incumbent, whether the head of the winning party was a woman, as well as whether the constituency was reserved for lower castes (Scheduled Castes or Scheduled Tribes), aligned with the state government, and aligned with the central government.

Figure 4 reports graphical evidence of the validity of the continuity assumption, and Table 11 shows tests of mean differences and the corresponding RD regression results.[21] To elaborate the graphs in Fig. 4, consider Panel (a) which plots average growth of light output in the previous election term against the margin of victory in t. The scatter plot depicts the local averages of growth of light in each successive interval of 0.5% of the margin of victory. The local linear curve is estimated using a triangular kernel and a 5% bandwidth and the 95% confidence interval is shown. The average growth of light in the previous term is a continuous function of the margin of victory. So there is no evidence here that women are more likely to be elected in constituencies that were performing either less well or better on luminosity growth in the electoral term preceding their election. Put differently, the balance test shows us that there is no differential pre-trend in the outcome in the "treated" constituencies (women win) as compared with the "control" constituencies (men win). We also find balance on the many other constituency characteristics listed above. Overall, the evidence suggests that only the gender of the legislator changes abruptly at the zero margin of victory and that, therefore, we can take the RD design as identifying the causal effect of the election of a woman.

Another RD validity check that we did is for sorting around the cutoff. Sorting has been documented in the case of close elections between Republicans and Democrats in

[21] In Table 23, we also show continuity for pre-determined variables in t, i. e. variables determined with the election in t but before the start of the term.

Fig. 4 Continuity checks- RD tests of balance on predetermined covariates. Each variable is plotted against female margin of victory in mixed gender races, which is the difference between vote shares of a female candidate and male candidate in mixed gender races. Mixed gender races are in which a woman either won or was a runnerup against a man. By construction, margin of victory is positive for female legislators and negative for male legislators. Each dot represents a local average in bins of 0.5 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, triangular kernel and a 5 percent bandwidth. The figures also depict a 95 percent confidence interval for each variable around the solid curve

the United States, and associated with manipulation of the margin of victory that renders the close election experiment invalid (Snyder, 2005; Caughey & Sekhon, 2011; Grimmer et al., 2012). To investigate this, Fig. 5 depicts the density of the margin of victory as suggested in McCrary (2008). There is no apparent discontinuity in the density around the cutoff. The point estimate of the discontinuity is 0.043 with a standard error of 0.075. This suggests there is no evidence of sorting in our sample of close mixed-gender races, and female and male candidates are equally likely to win. Observe that Fig. 5 also shows that the distribution of the margin by which women win is broadly similar to the distribution of the margin by which men win in mixed-gender races.

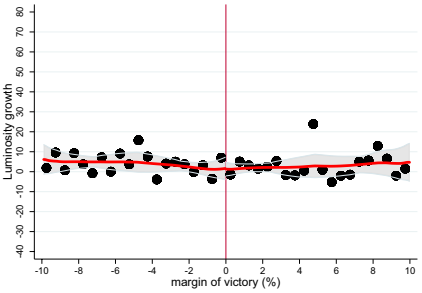
5.2 Results: legislator gender and economic performance

In this section we present estimates of the causal effect of female relative to male legislators on economic activity over the electoral term in the constituency from which they were elected. The RD estimate of the impact of electing a woman rather than a man is the difference in luminosity at the zero margin of victory.

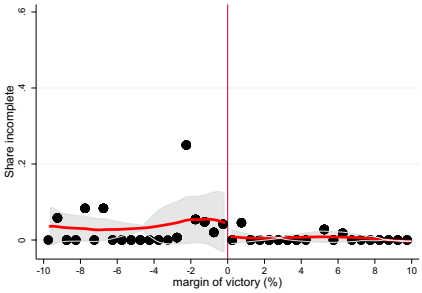
The regression estimates are in Table 1. We estimate a local linear regression of growth of night lights on the margin of victory in the RD framework. The bandwidth is calculated using the optimal bandwidth procedure suggested by Imbens and Kalyanaraman (2012) (IK). We find that annual luminosity growth averaged over the electoral term is 15.25 percentage points higher in constituencies in which a woman won by a small margin than in constituencies in which a man won by a small margin, and this difference is significant at the 5% level (column 1). Using our estimate (from state-year data) of an elasticity of GDP to night lights of 0.15 (see Table 10), a 15.25 percentage point difference in luminosity growth translates into a 2.3 percentage point difference in GDP growth. Given that average growth in India during the period of study was about seven percent per year, our estimates indicate that the growth premium for constituencies stemming from them having a female legislator is about 32 percent.

The RD plot is in Fig. 6, which depicts average growth in luminosity against margin of victory. The data are averaged across bins that each cover 0.5 percentage points in the margin of victory and provide local linear smooths of the underlying data using a bandwidth of 5 percent. We observe a discontinuous jump in light output at the threshold margin of victory of zero, in line with the regression results. The graph plots coefficients for elections with victory margins larger than the optimal RD bandwidth, where we see the difference even out. These estimates are potentially contaminated by selection, which we examine in relation to the external validity of the RD results in the penultimate section of the paper.

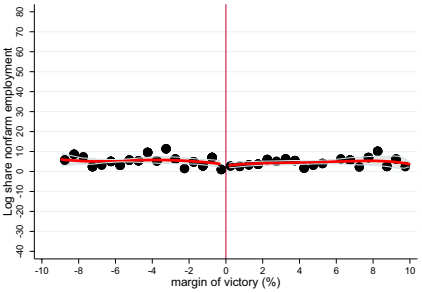
Sensitivity to bandwidth Estimates using bandwidths that are half and twice the size of the optimal bandwidth are in Columns (2)–(3) of Table 1. The estimated coefficient declines as the bandwidth increases, but remains statistically significant.



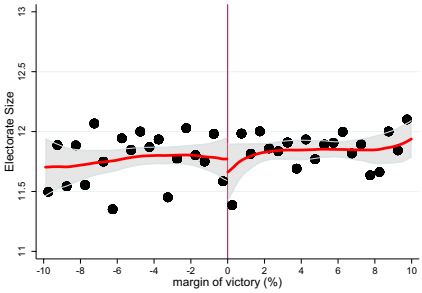
(a) Growth of Light in t-1



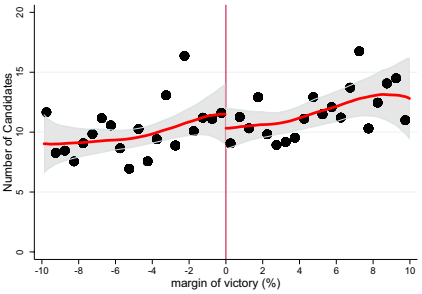
(b) Share Incomplete Roads in t-1



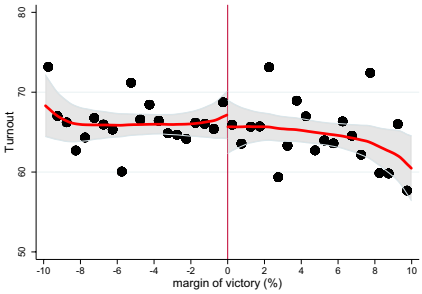
(c) Share of non-farm employment in t-1



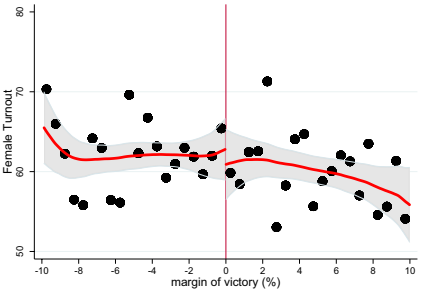
(d) Electorate Size in t-1



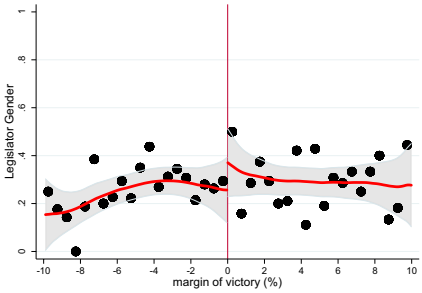
(e) Number of candidates in t-1



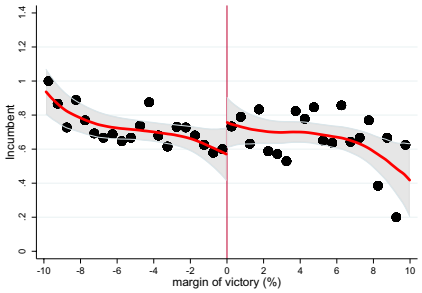
(f) Turnout in t-1



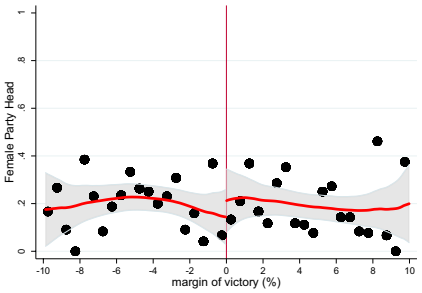
(g) Female Turnout in t-1



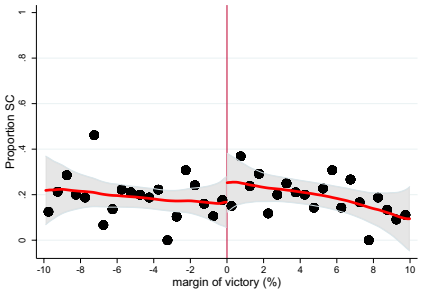
(h) Female legislator in t-1



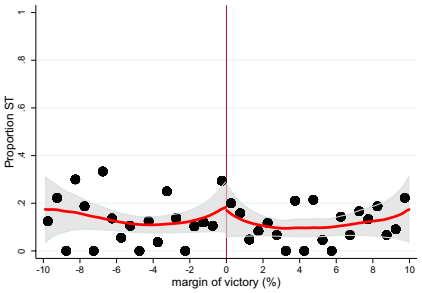
(i) Incumbent in t-1



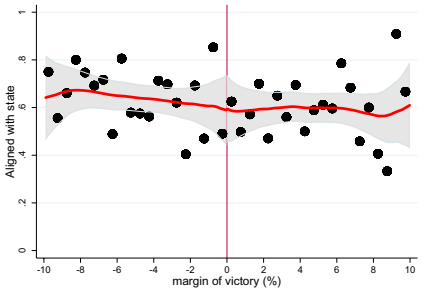
(j) Female party head in t-1



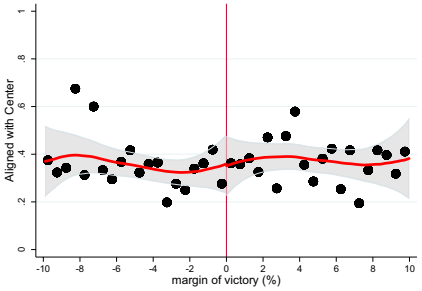
(k) SC-reserved constituency in t-1



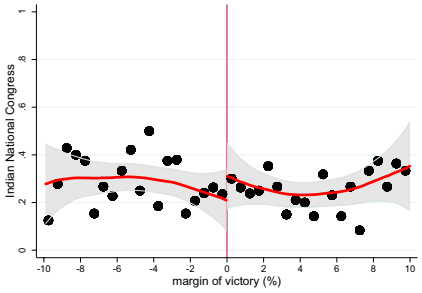
(l) ST-reserved constituency in t-1



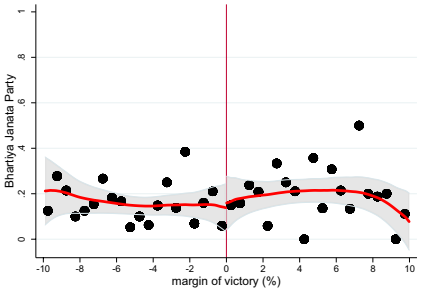
(m) Aligned with state government in t-1



(n) Aligned with central government in t-1

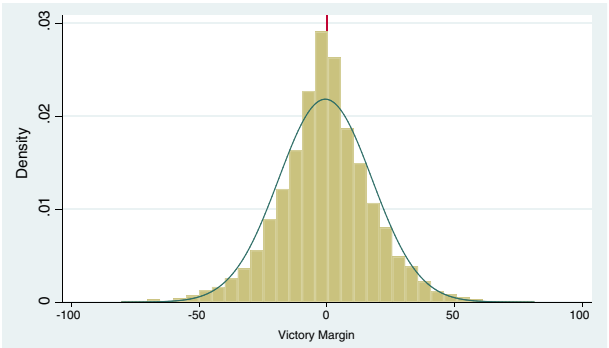


(o) Won by Congress Party t-1

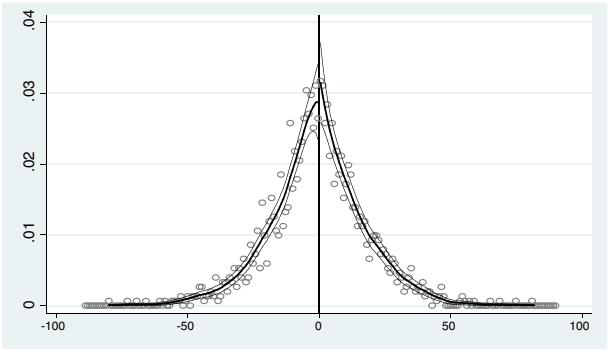


(p) Won by BJP in t-1

Fig. 4 (continued)



(a) DensityofVictoryMargin



(b) McCrary'sDensityTest

Fig. 5 Density of the forcing variable. The figures plot the density of the margin of victory, which is the difference between vote shares of the female and male candidates in mixed gender races. Mixed gender races are defined as those in which a man and a woman rank in the top two. By construction, margin of victory is positive for female legislators and negative for male legislators. The magnitude of the discontinuity (log difference in height) is 0.13 (with a standard error of 0.15)

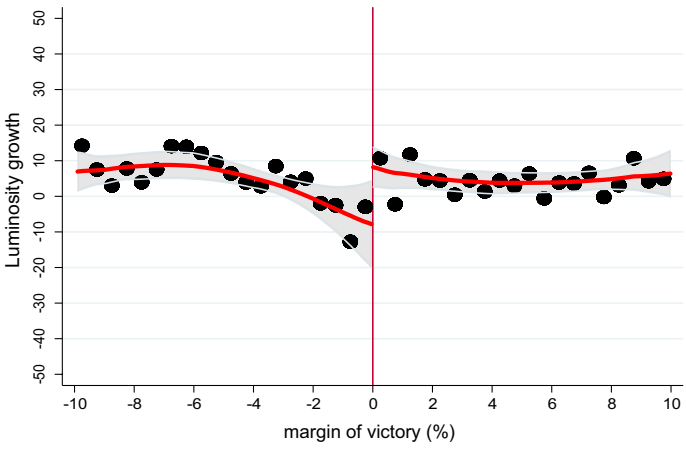


Fig. 6 Legislator gender and luminosity growth. The dependent variable is the growth of light averaged over an election term against female margin of victory in mixed gender races. The victory margin is the difference between the vote shares of the female and male candidate in mixed gender races. These are races in which a man and a woman are the top two vote-winners. By construction, the margin of victory is positive when women win and negative when men win. Each dot represents a local average in bins of 0.5 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, using a triangular kernel and a 5 percent bandwidth. The figures also depict a 95 percent confidence interval for each variable around the solid curve

Table 1 Legislator gender and luminosity growth

	(1)	(2)	(3)	(4)
	Growth of $light_{t+1}$			
	Local linear			Local quadratic
	IK (h)	h/2	2 h	IK (h)
Female legislator	15.25**	16.97*	8.52**	17.11*
	[6.12]	[8.96]	[3.79]	[9.42]
R^2	0.03	0.03	0.02	0.03
N	584	316	980	584
Bandwidth	6.68	3.34	13.36	6.68

The dependent variable is the growth of light, $(Log(Light_{t+1}+1)-Log(Light_t+1))*100$, per year (averaged over an election term). $FemaleLegislator_t$ is a dummy variable which is 1 for a female legislator and 0 for a male legislator in mixed gender races in which a female either won or was a runner-up against a male. The forcing variable is margin of victory in t ($margin_t$), which is the difference between the vote shares of the female and male candidate in mixed gender races. Column (1) reports estimates from a local linear regression of growth of light on $FemaleLegislator_t$, using a bandwidth determined by Imbens and Kalyanaraman (2012) optimal bandwidth calculator. Columns (2) and (3) halve and double the optimal bandwidth. Column (4) uses a local quadratic smoothing function. The following is true for this and all subsequent tables unless noted otherwise. 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

We do not expect coefficient stability as we move outside the optimal bandwidth, but it is useful as a marker of how selection sets in as we move away from the threshold, and we discuss this later. In Panel A Column (5) of Table 2, we show that results using CCT optimal bandwidths are similar to the baseline results.

Sensitivity to functional form Column (4) of Table 1 shows that estimates with a second order local polynomial smoother are similar to those estimated with a local linear control function in Column (1). Gelman and Imbens (2019) argue against the use of polynomials in RD of higher order than the quadratic.

Sensitivity to controls While we have shown that pre-determined covariates are balanced at the RD threshold, a straightforward test for the effect of any imbalances is to directly control for pre-determined covariates. In Panel A Column (3) of Table 2, we thus re-estimate our RD specification for the optimal bandwidth while controlling for the pre-determined covariates discussed in Sect. 5.1 and we also control for constituency fixed effects. The resulting estimate is 18.07 percentage points, which is statistically similar to the baseline estimate. In Panel A Column (2), we show results with the less demanding inclusion of district fixed effects. In Panel A Column (4), we add state specific election term fixed effects. The coefficient is now half the size of the baseline coefficient, albeit not statistically different.[22]

[22] The state-term fixed effects capture the average change in the outcome (growth rate) for all constituencies in the state in a given term. So what we are identifying by including both AC and state-term fixed effects is by how much a women winning in term t increases the difference between the growth rate in the

Table 2 Robustness tests

	(1)	(2)	(3)	(4)	(5)	(6)
	Growth of $light_{t+1}$					
	Panel A					
	Baseline	With district FEs	AC FEs + covariates	AC FEs + State-specific term effects	CCT bandwidth	Weighted regression
Female legislator	15.25**	24.33*	18.07**	8.95*	12.09***	16.07**
	[6.12]	[12.57]	[8.10]	[5.16]	[4.64]	[7.23]
R^2	0.03	0.61	0.55	0.75	0.02	0.03
N	584	499	428	194	783	583
Bandwidth	6.68	6.68	6.68	6.68	9.97	6.68
	Panel B					
	Growth of $light_{t+1}$					Excess rainfall
	With alternative margin	Neighbor sample only	No top-coded ACs	No ACs with 0 light	No top-coded or 0 light ACs	
Female legislator	14.78***	15.52**	15.40**	15.35**	15.51**	0.05
	[5.50]	[6.54]	[6.17]	[6.19]	[6.25]	[0.18]
R^2	0.02	0.03	0.03	0.03	0.03	0.01
N	685	553	579	579	572	352
Bandwidth	7.55	7.40	6.69	6.67	6.68	3.82

The baseline specification is drawn from Column 1 of Table 1. Changes to the specification relative to baseline are indicated in column headers. Column (2) in Panel A controls for district fixed effects (FEs) to our baseline specification. Column (3) in Panel A controls for assembly constituency (AC) FEs and the following predetermined covariates in t-1: Log electors, number of candidates, turnout, female turnout, female legislator, incumbency status, female party head, SC constituency, ST constituency, Aligned with state government, Aligned with central government, INC legislator and BJP legislator. Column (4) in Panel A controls for AC FEs and state-specific term effects. Column (5) in Panel A estimates the effect using the Calonico, Cattaneo and Titiunik (2014) bandwidth. In column (6) in Panel A we weight regression by the inverse of proportion of close mixed gender elections in a state in an election. Column (1) in Panel B defines margin of victory (our forcing variable) as the difference in share of votes between top-placed female and male candidates. Column (2) in Panel B restricts the sample to women-led constituencies and adjacent male-led constituencies. Column (3) in Panel B excludes top-coded (defined as having luminosity value of 63) constituencies from the sample. Column (4) in Panel B excludes ACs with luminosity values of 0. Column (5) in Panel B excludes both top-coded and 0 light values AC from the sample. In Column (6) of Panel B, excess rainfall at the constituency-year level is defined as the deviation in accumulated rainfall from the long-term mean. It is included as a placebo outcome. All robustness checks reported here are discussed in Sect. 5.2 of the paper

Footnote 22 (continued)

AC and the state-wide average growth rate in t, compared to the difference between the AC and the state-wide growth rate when a man was the legislator, for example, in t-1. In contrast the baseline estimates from the standard RD model that excludes these fixed effects use all available variation - within and across constituencies - to compare outcomes when women vs men win. In principle, the fixed effects estimate could be larger or smaller.

Neighbour sample We investigated the validity of the RD design using another strategy as follows. The idea is that any (unobservable) imbalances between constituencies with female and male legislators should be particularly small among neighbouring constituencies. We thus re-estimate the main equation limiting the estimation sample to constituencies with female legislators and their neighbours; see Panel B Column (2) of Table 2. The estimates are similar to those in Table 1, which suggests the absence of significant imbalances.

Alternative margin As a further sensitivity test, we estimated regressions with a larger sample that includes all mixed-gender races in which a woman contested, rather than just races in which a woman ranked among the top two, as in Meyerson (2014). The margin of victory is again defined as the difference in the vote shares of the top-ranked female and the top-ranked male candidate, except that now the top-ranked female may not be one of the top two vote-winners.[23] The results are similar to those in Table 1; see Panel B Column (1) of Table 2. This is because the victory margin in the additional races that are incorporated is likely to be away from the discontinuity and hence unlikely to influence estimates that exploit variation around the threshold of a zero victory margin.[24]

Weighted regression We re-estimated the model weighting each mixed-gender race with the inverse of the proportion of mixed-gender races in the state over the sample period. The baseline (unweighted) model delivers an average coefficient that puts more weight on the relationship in states that have more close elections, and it is plausible that the relationship is heterogeneous across states (indeed we will show later that it is). The estimate is close to the baseline estimate, see Panel A Column (6).[25]

Placebo outcome Luminosity growth is the primary outcome of interest, proxying economic growth, and we find supporting evidence when considering relevant mechanisms. We now model a placebo outcome- an outcome that we expect cannot change on account of legislator gender, which is rainfall. Panel B Column (6) shows a coefficient close to zero for the deviation of rainfall from its long-time trend.

Placebo estimates Yet another strategy to evaluate our RD design is to estimate Eq. (1) with placebo thresholds using subsamples of only male and female winners, respectively. We estimate 62 placebo coefficients (and their confidence intervals) and collect them in Fig. 8 (see the figure notes for further details regarding the placebo regressions). We also include the true coefficient estimate in red. We find that all placebo coefficients are clearly smaller than the true coefficient (and also generally insignificant).

Gender versus constituency and other legislator characteristics We may be concerned that we are capturing the effects of other characteristics of the winning legislator or the constituency in question rather than those of gender per se. Specifically, women legislators

[23] The margin is by construction positive for races in which women win. The runner up is typically the top-ranked man, there being very few races in which the top two vote winners are women (about 0.5% of all the races in our time period) and negative for races in which men win.

[24] If we use the full sample of all elections and obtain OLS estimates conditional on constituency and year fixed effects, we find no significant impact of legislator gender on growth. There is similarly no correlation between parliamentarian gender and GDP growth in cross-country data, see Fig. 7. Thus the causal effect of women on growth is not evident in observational data, and it is important to investigate this relationship using techniques for causal identification in other settings.

[25] The distribution of mixed-gender races being unbalanced across states does not result in bias as long as women and men win about 50% of the races which, in our set-up, is the case. The baseline estimates are, in a sense, the true all-India estimates. The weighted estimates are nevertheless of interest, telling us what the average treatment effect would be if the incidence of mixed-gender elections was similar across states.

could be (i) more or less likely to run in constituencies reserved for scheduled castes or tribes, (ii) more or less likely to be from scheduled castes or tribes, (iii) more or less likely to be Muslim, (iv) more or less likely to be from the BJP or the Congress, (v) more or less likely to be aligned with upper-level governments. Overall, this seems unlikely since we checked for balance in various individual and constituency characteristics (see Tables 11 and 13).

Nevertheless, to investigate this concern, we included indicators for these legislator and constituency characteristics. The estimates are robust to this (see Table 14). It is interesting that there is a positive association of luminosity growth with Congress rather than BJP Party leaders, with the alignment of the party of the legislator with the ruling party at the state and with the legislator being from a scheduled tribe.

Distribution of effects through the electoral term So as to investigate how the growth effects of having a female rather than a male legislator evolve, we re-estimated the model separating the first two years of growth from the last two years of growth in the electoral term. The coefficients are imprecise in these split samples and not significantly different from one another. However, the growth difference (between women and men) is more than twice as large later in the electoral term, consistent with any legislator activity cumulating or taking effect with an administrative lag (Table 15).[26]

Non-farm employment share Non-farm employment share is a proxy for structural change, a process associated with economic growth as productivity in manufacturing and services tends to be higher than in agriculture. Using recently available data on non-farm employment at the constituency level we find that women perform better by 4% points over the electoral term, or 0.84% points p.a., see Table 3. This result is also robust to using different bandwidth choices and a local polynomial. Panel A in Fig. 9 is the corresponding RD plot, which displays a jump in non-farm employment at the threshold. Later we will show that heterogeneity in impacts of legislator gender on luminosity is mirrored in heterogeneity in impacts of legislator gender on non-farm employment share.[27]

Measurement issues We discuss potential issues with the lights data in Sect. 4.1, including saturation, low sensitivity and blooming, explaining how we check that our estimates are not biased by these issues. We dropped all constituencies that are top-coded with respect to their luminosity, all observations with zero luminosity, and both top-coded and zero luminosity constituencies. The estimates are essentially unchanged, see Panel B Columns (3)-(5) of Table 2. We have presented the impact of legislator gender on luminosity growth as an impact on GDP growth using the luminosity-GDP elasticity derived from a state level panel data regression. We checked that this elasticity is not sensitive to the exact sample used. However this conversion is only indicative as, for example, the state-level elasticity may not be the correct elasticity if there are non-linearities in the relationship at the constituency level. We also provide estimates for a range of outcomes so that our results do not rely entirely upon the luminosity estimates. It is also worth reiterating that

[26] Compared with the term-averaged coefficient of 15.25 percentage points, we estimate 8.55 percentage points in the first two years and 20.41 percentage points in the last two years.

[27] Table 16 provides the descriptive association of non-farm employment share with luminosity growth. Our main purpose is to validate the measures by demonstrating a positive association. We do not wish to attach much weight to this estimate as it is not identified but we note that the association shown suggests that the estimated increase in non-farm employment under women legislators can account for about half of the estimated increase in luminosity growth.

the motivation for this work is to test whether having women leaders might compromise economic growth so, strictly, we only require that we can reject this null.

Magnitude of effects To contextualise the magnitude of the effects we highlight two points. In our analysis sample (of mixed gender close elections) the share of constituencies won by a woman is 48% (and in the full unrestricted sample it is 5.4%). Thus the growth gains that we identify refer to a small share of constituencies, not to the country as a whole. As discussed in the section on spillovers, this does not translate into a discernible impact on state (and hence) national growth. Second, India is experiencing rapid growth over the analysis period, and potential growth in some less developed regions is high. Related, we show that the result that women are more growth producing than men emerges largely from the less-developed states of India.

6 Spillovers

We have shown that women are more effective than men at raising growth in their own constituencies. If this comes at the cost of lower growth in other constituencies, then effects of increasing the share of women on total growth are ambiguous. We therefore examine spillovers to contiguous constituencies. Spillovers can, in principle, go in either direction. They may be negative if legislators play a zero-sum game with fixed state resources. Alternatively positive spillovers may arise for the following reasons. First, legislators may build roads or electricity networks that continue across constituency boundaries, or road construction in one constituency may increase access to markets in neighbouring constituencies. Second, the success of women legislators may encourage yardstick competition if voters evaluate politicians in their jurisdiction by comparing outcomes with those in neighbouring jurisdictions (Besley & Case, 1995).

To implement this test, we define the dependent variable as light growth averaged over neighbours of constituency j identified using a constituency map. The mean (s.d.) of number of neighbours of a constituency is 5.8 (1.6).[28] The independent variable of interest is as before: the gender of the legislator in constituency j. The sample is still restricted to mixed gender races for j, and we use the RD approach described for the main analysis. This yields estimates of the difference in light growth in constituencies neighbouring female vs. male led constituencies.

The estimated coefficient is positive, but the difference is not significant (Panel A of Table 4). As discussed in the Data section, blooming in the night lights data could bias estimates of geographic spillovers from highly luminous constituencies. To assess the potential of any such bias to influence the estimates here, we dropped constituencies with top-coded light levels, and the results are robust to this- see Panel B of Table 4. Overall, there is no evidence of negative growth spillovers from female-led to neighbouring constituencies, allowing us to conclude that women legislators have a positive impact on overall growth.[29]

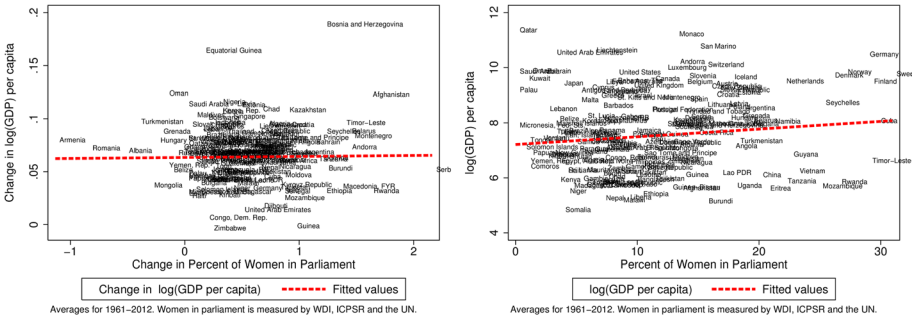
[28] The reported results restrict to within-state neighbours as we analyse state legislators and the concern is around competing demands on state budgets. However, if we relax this restriction, we get the same results, as the mixed-gender ACs within the bandwidth we use are not at state borders.

[29] In principle, spillovers could extend beyond neighbours to other constituencies in the state. Indian states are large, containing on average about 200 constituencies. The share of female-led constituencies in a state ranges between 0 and 9.4%, with the median share being 5.6%. Any state-level spillovers from one constituency to the rest will thus tend to be small and difficult to identify. We nevertheless implement a state level regression (using an IV approach similar to (Bhalotra & Clots-Figueras, 2014)), designed to test for spillo-

Table 3 Legislator gender and non-farm employment

	(1)	(2)	(3)	(4)
	Share of nonfarm employment$_{t+1}$			
	Local linear			Local quadratic
	IK (h)	h/2	2 h	IK (h)
Female legislator	4.19***	4.82***	2.89***	4.28**
	[1.33]	[1.78]	[1.00]	[1.81]
R^2	0.08	0.15	0.04	0.08
N	160	76	263	160
Bandwidth	5.39	2.69	10.78	5.39

The dependent variable is the share of non-farm employment in the constituency population averaged over the election term. *FemaleLegislator*$_t$ is a dummy variable which is 1 for a female legislator and 0 for a male legislator in mixed gender races. Column (1) reports estimates from a local linear regression of share of non-farm employment on *FemaleLegislator*$_t$, using Imbens and Kalyanaraman (2012) optimal bandwidth calculator. The forcing variable is margin of victory in t (*margin*$_t$), which is the difference between vote shares of the female and male candidates in mixed gender races. Columns (2) and (3) halve and double the optimal bandwidth. Column (4) uses a local quadratic smoothing function. See also Notes to Table 1



(a) (b)

Fig. 7 Cross-country scatter–women in parliament and economic growth

Footnote 29 (continued)
vers and we find none (See Table 17). This allows us to reject the concern that a unit increase in female representation, while increasing light growth in female-led constituencies, has a negative spillover on (the larger set of) male-led constituencies.

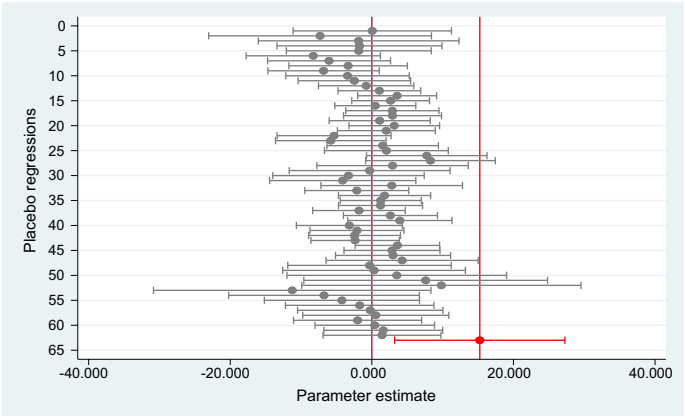


Fig. 8 Legislator gender and luminosity growth: placebo regressions with fake thresholds. This figure displays 62 placebo coefficient estimates for the gender dummy with confidence intervals. We obtain 31 placebo coefficients by estimating Eq. (1) on a subsample of male winners, redefining the margin of victory as *placebo margin of victory* = *true margin of victory* - *x* in steps of 0.5 within the interval { -20,-5}, thus effectively defining 31 placebo thresholds. We repeat this exercise on the subsample of female winners. The true coefficient estimate and confidence intervals are highlighted in red. Most placebo coefficients are not significantly different from zero and smaller than the true coefficient

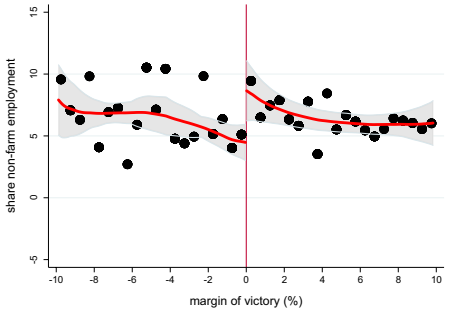
7 Mechanisms

7.1 Road infrastructure

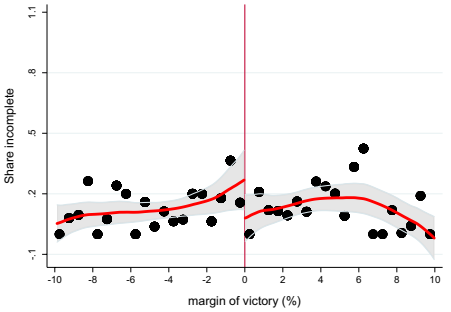
We first investigate a hard outcome that is growth producing. In general and especially in developing countries, road infrastructure is a key ingredient to growth. Rural roads are estimated to have significant positive effects on local economic outcomes including growth and structural transformation, involving the decline of agricultural work in favour of wage work (which we also capture in the share of non-farm employment) (Jacoby, 2000; Shrestha, 2015; Jacoby & Minten, 2009; Casaburi et al., 2013; Asher & Novosad, 2019). In one of the few previous studies that uses luminosity growth to measure changes in economic activity in India, Asher and Novosad (2019) estimate that construction of a village road increases village-level luminosity by 2.5 percent per annum.

We use administrative data from the Prime Minister's Village Road Program (PMGSY) described in Sect. 4.3. The PMGSY is a flagship programme that, between 2000 and 2015, funded the construction of over 400,000 km of roads (in over 100,000 new roads), benefiting almost 200,000 villages at a cost of almost 40 billion US dollars (Asher & Novosad, 2019). It is a program of considerable political and economic significance and effective delivery of this program is a good marker for public goods delivery, involving state legislators bidding for federal funds and delivering goods at the local level. PMGSY is federally funded but responsibility for road construction is delegated to state governments, and the program by definition involves village-level roads.

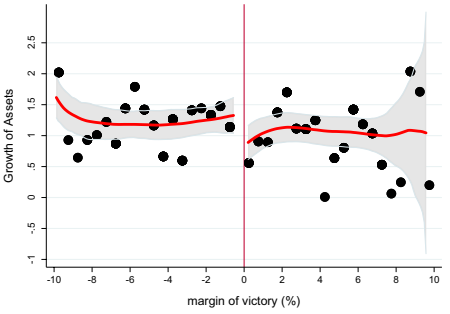
Program eligibility involved the village having a population above 1000 till the year 2003 and above 500 after then. Therefore validity of the RD design we use requires that constituencies won by men vs. women in close elections are not systematically different in population size, in particular around these thresholds. Using the 2001 census files, and using both threshold and average population figures at the village level, we test this premise



(a) Share of Non-farm Employment



(b) Share of Incomplete Roads



(c) Asset Growth

Fig. 9 Legislator gender and other economic outcomes. The dependent variable is the share of non-farm employment in Panel (**a**), the share of incomplete roads in Panel (**b**), and Asset growth in Panel (**c**). In Panel **c** the sample is restricted to candidates who re-contest the next election. Each variable is plotted against female margin of victory in mixed gender races, which is the difference between vote shares of a female candidate and male candidate in mixed gender races. Mixed gender races are in which a woman either won or was a runnerup against a man. By construction, the margin of victory is positive when women win and negative when men win. Each dot represents a local average in bins of 0.5 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, using a triangular kernel and a 5 percent bandwidth. The figures also depict a 95 percent confidence interval for each variable around the solid curve

just like we test for continuity across the zero vote margin threshold for other constituency characteristics. The results are in Table 12 and show no significant differences in population size.

Using data for 2004–2012 and the RD approach used for the main analysis, we investigate whether the share of incomplete roads relative to awarded road projects is a function of legislator gender. Table 5 reports the point estimate of the discontinuity. We find no significant difference in contracts allocated (Panel B of Table 5).[30] However, the share of incomplete roads is 22 percentage points lower in constituencies with female legislators (Panel A of Table 5).[31] This difference is significant across a range of bandwidth choices

[30] Okuyama (2018) finds that, contrary to a widespread concern in Japan that women are less qualified politicians than men, legislator gender does not affect the size of per capita intra-governmental transfers.

[31] On our sample we estimate a descriptive association of road completion rates and luminosity growth (conditional upon number of road contracts awarded) using a fixed effects model-Table 16 confirms that it is positive and statistically significant. Using this association, our back of the envelope estimate is that the

Table 4 Spillovers to neighbouring constituencies

	(1)	(2)	(3)	(4)
	Neighbor average growth of $light_{t+1}$			
	Local linear			Local quadratic
	IK (h)	h/2	2 h	IK (h)
Panel A: All constituencies				
Female legislator	2.83	0.89	1.60	1.46
	[1.76]	[2.39]	[1.26]	[2.54]
R^2	0.01	0.01	0.00	0.01
N	576	309	965	576
Bandwidth	6.63	3.31	13.25	6.63
Panel B: Without top-coded constituencies				
Female legislator	2.81	1.19	1.53	1.82
	[1.75]	[2.37]	[1.26]	[2.53]
R^2	0.01	0.01	0.00	0.01
N	585	314	972	585
Bandwidth	6.87	3.43	13.74	6.87

In Panel A the dependent variable is defined as the average growth of light, $(Log(Light_{t+1} + 1) - Log(Light_t + 1)) * 100$, in neighbouring constituencies, averaged over an election term. Panel B excludes any constituency-year observations that have top-coded light values. See also Notes to Table 1

and robust to replacing the linear with a quadratic smoother.[32] Panel B of Fig. 9 shows the RD plot of the share of incomplete roads against the margin of victory.[33] We observe a discontinuous drop in the share of incomplete roads at the threshold margin of victory of zero, in line with the regression results.[34]

Our findings reject the presumption that men are more effective at delivering growth-producing infrastructure. Since road construction in India has been shown to produce higher returns in terms of job mobility for men than for women (Asher & Novosad, 2019), our findings establish that women deliver public goods beyond those that serve the interests of women. The qualities that lead women to achieve higher completion rates may include efficiency, mission or lower corruption, all of which are related to effective delivery of public goods. In the next section we examine corruption and in the section on external validity

Footnote 31 (continued)
higher road completion rates under women legislators can explain about a third of the increase in luminosity growth under women.

[32] The mean number of road contracts won (by male and female legislators alike) in the close mixed-gender election sample is 3.5. If an additional fifth of these is left incomplete in male-led constituencies, that implies about 0.7 fewer roads on average. We also examined costs associated with a project and found no significant differences in constituencies led by female and male legislators.

[33] The data are averaged across bins that each cover 0.5 percentage points in the margin of victory and provide local linear smooths of the underlying data using a bandwidth of 5 percent.

[34] We re-estimate the impact of legislator gender on luminosity growth using the (smaller) data sample used for analysis of road construction. See Panel A of Table 18 where, in line with the results in Table 5, we find an estimate of the same order of magnitude as in Table 1, albeit it is imprecise in this smaller sample.

Table 5 Legislator gender and road completion

	(1)	(2)	(3)	(4)
	Road projects			
	Local linear			Local quadratic
	IK (h)	h/2	2 h	IK (h)
Panel A: share of incomplete road projects				
Female legislator	− 0.22*	− 0.26*	− 0.17*	− 0.35*
	[0.12]	[0.15]	[0.08]	[0.18]
R^2	0.04	0.11	0.03	0.05
N	122	63	226	122
Bandwidth	3.29	1.64	6.58	3.29
Panel B: number of road projects awarded				
Female legislator	− 1.13	− 1.38	− 0.88	− 1.08
	[0.85]	[1.12]	[0.69]	[1.25]
R^2	0.01	0.03	0.01	0.02
N	255	134	435	255
Bandwidth	6.11	3.05	12.21	6.11

In Panel A, the dependent variable is the share of projects that remain incomplete in total projects awarded, averaged over an election term and in Panel B, the dependent variable is the number of projects awarded. $FemaleLegislator_t$ is a dummy variable which is 1 for a female legislator and 0 for a male legislator in mixed gender races in which a female either won or was a runner-up against a male. Column (1) reports estimates from a local linear regression of share of incomplete road projects on $FemaleLegislator_t$, using Imbens and Kalyanaraman (2012) optimal bandwidth calculator. The forcing variable is margin of victory in t ($margin_t$), which is the difference between vote shares of the female and male candidates in mixed gender races. Columns (2) and (3) halve and double the optimal bandwidth. Column (4) uses a local quadratic smoothing function. See also Notes to Table 1

we discuss evidence consistent with women legislators having greater intrinsic motivation than men.[35]

7.2 Corruption in office

Following Fisman et al. (2014), we use growth in assets during office as a proxy for corruption. Since assets are only recorded in affidavits submitted by candidates when standing

[35] We report results for roads because we have access to unusually good local-level data on a public infrastructure programme of large political and economic significance. We could not find similar data for other infrastructure. In India, electricity is, like roads, an important state provided infrastructural good (Lal, 2005) Refer to discussion of electricity in the subsection on nightlights in the Data section above. When we use night lights data as a proxy for economic activity it is implicit that it is a proxy for electricity demand, as this will tend to scale with economic activity. However, to the extent that women legislators provide electricity better (for the same reasons that they provide roads better), some of the better performance of women leaders may reflect better electricity supply. As this is growth-producing, it does not substantively alter the interpretation of the results.

for election, Fisman et al. (2014), restrict the sample to candidates who contest for two consecutive elections, whether or not they win. They find higher asset growth for winners than for runners-up in close races, estimated as a difference of 3 to 5% p.a. and interpret this as evidence that politicians leverage public office for private benefits by engaging in rent-seeking activities.[36]

Fisman et al. (2014) do not distinguish between male and female legislators. We adopt their sampling and measurement strategy but rather than compare winners with runners up in close races, we compare women who won in a close race with men who won in a close race. Regression estimates are in Table 6. Column (1), using the IK bandwidth, shows that asset growth during an electoral term is about 60 percentage points lower among female legislators. This translates into a 12 percentage point per annum difference in the rate at which male vs. female legislators accumulate rents in office.[37] As a benchmark, note that the mean annual growth rate of assets in the sample (averaging over all legislators) is 23 percentage points.

If we halve the bandwidth, this coefficient is similar but less precisely determined (column 2). If we double the bandwidth, the coefficient falls a bit more but is statistically significant. The result is robust to replacing the linear with a quadratic polynomial (column 4). Across the columns, the coefficients are not significantly different from the coefficient in the first column. Panel C in Fig. 9 plots asset growth between elections t and t+1 against the margin of victory between winners and losers (of opposite gender) in election t, confirming a discontinuity in asset growth at the zero margin of victory.[38]

Overall, this constitutes compelling evidence that women legislators are less likely than men to exploit their office for personal financial gain. It indicates lower corruption as one likely contributor to the economic advantage of women legislators given evidence that lower corruption is conducive to economic growth (Dollar et al., 2001; Swamy et al., 2001; Mauro, 1995; Prakash et al., 2019).[39]

A possible take on our finding of lower corruption among women legislators is that they tend to have less political experience and have not yet learned the ropes (Chaudhuri et al., 2022). If this were the case, gender differences in corruption would disappear as women's political tenure lengthens. We respond to this potential concern in three ways. First, we note evidence that the association of experience in politics with corruption is not necessarily positive.[40] Second, we emphasise that even if tenure rather than gender were driving

[36] In a section labeled External Validity, they acknowledge potential selectivity into the two-contests sample associated with a runner-up not re-contesting because they are hit by a negative wealth shock. They argue that this will tend to create a downward bias, making the estimates conservative. The same applies in the current analysis.

[37] While Fisman et al. (2014) use growth in net assets (total assets minus total liabilities), we use growth in gross assets because liabilities of Indian politicians may not reflect their actual net wealth. For example, with reference to Pakistan, Khwaja and Mian (2005) show that politicians can easily get loans from public sector banks without paying them back. However, if we use net asset growth the results are similar- the coefficient in column 1 is −0.5 instead of −0.6 and significant.

[38] We re-estimate the impact of legislator gender on luminosity growth within the subsample used for establishing the legislator gender on asset growth. See Panel B of Table 18 which shows a large and positive effect of female legislators on luminosity growth. This increases confidence in our suggestion that legislator identity impacts on asset growth contribute to explaining their impacts on luminosity growth.

[39] Using the descriptive association of corruption in office and luminosity growth in Table 16 we estimate that this can explain about 7% of the male–female gap in luminosity growth.

[40] Comparing women appointed to village council headship under quotas with men in unreserved seats in the Indian state of Andhra Pradesh, Afridi et al. (2017) find that they are initially more corrupt and they attribute this to their being inexperienced and therefore subject to elite capture–indeed, by the end of their

Table 6 Legislator gender and asset growth

	(1)	(2)	(3)	(4)
	Growth of assets			
	Local linear			Local quadratic
	IK (h)	h/2	2 h	IK (h)
Female legislator	− 0.60**	− 0.49	− 0.31*	− 0.46
	[0.26]	[0.27]	[0.16]	[0.43]
R^2	0.14	0.31	0.02	0.22
N	59	27	111	59
Bandwidth	3.64	1.82	7.29	3.64

The dependent variable is the growth rate of a legislator's assets over the election term, $(Log(Assets_{t+1}+1) - Log(Assets_t+1))$. The sample only considers legislators who re-contest the next election. $FemaleLegislator_t$ is a dummy variable which is 1 for a female legislator and 0 for a male legislator. The standard errors are clustered at the state level. See also Notes to Table 1

this result, policies the world over that are introducing *new* women into politics will tend to lead to lower corruption. Second, in the following section we investigate a measure of corruption that is available before the candidate takes office. If we were to find gender differences in this measure of criminality that project onto differences in growth once the candidate is elected, this result would indicate a role for corruption that is independent of legislator tenure. If at all, we may expect larger differences in pre-election characteristics if politicians in office face stricter scrutiny and are subject to a re-election constraint which encourages them to act in more accountable ways. Alternatively, they may develop a sense of duty once they attain office if "office ennobles" (Brennan & Pettit, 2002; Benabou & Tirole, 2003).[41]

7.3 Candidate characteristics

In India, following passage of the Right to Information Act, all political candidates are required to file affidavits that include various information including whether or not they are carrying pending criminal charges. Using these data, we compare characteristics of male and female legislators in the analysis sample of mixed-gender close elections, see Appendix Fig. 10 and Table 13. In the close election sample (and also in the full sample of all mixed gender elections), there is no significant difference in education and wealth between

Footnote 40 (continued)
tenure women are neither more nor less corrupt than men. Studying cross-sectional differences in different states, Beaman et al. (2009) find women are less corrupt. These studies are not comparable to ours because we study women competitively elected to state legislative assemblies. First, quotas distort quality, and may lead to 'lower quality' women taking office (Chattopadhyay & Duflo, 2004) Second, state leaders are less vulnerable to elite capture than village leaders (Bardhan et al., 2010). Direct comparison is further invalidated by these studies having looked at particular states, whereas we analyse all-India data.

[41] The two measures are related–although the coefficient is not statistically significant it is sizeable–legislators who enter office carrying criminal charges experience higher asset growth if office.

male and female legislators. However, women legislators are significantly less likely than men to be carrying criminal charges and slightly younger on average.

In the close election sample, about 10% of women legislators face pending charges,[42] in contrast to about 32% of men.[43] It seems plausible that legislators with a criminal record are more likely to practice corruption, to have priorities other than economic development and, to be less likely to provide a stable business environment for growth. Using the RD approach developed in Prakash et al. (2019) on the expanded set of states in our sample, we estimate that luminosity growth is 16.8% points smaller in constituencies led by a legislator carrying pending criminal charges. Scaling this (gender-neutral) estimate by the difference in the propensity for criminality between men and women (a 21.8 percentage points difference in our close election sample—see Table 13) suggests that it can explain about 24% of the estimated growth premium associated with women legislators.

While the validity of a close election design depends on balance in constituency characteristics around the RD threshold (which we demonstrated above), it does not require balance on candidate characteristics. In fact, if men and women were identical, then the question of whether legislator gender influences economic performance would be void.[44] However, if criminality were to predict winning this could be problematic for our identification strategy. We therefore examined this on the mixed-gender sample, and we find no evidence of it (Table 19).

Differences in criminality between men and women legislators are consistent with experimental evidence that women are more risk-averse than men (Eckel & Grossman, 2008) and more patient (Silverman, 2003) since risk taking and high discount factors are positively associated with crime (Mastrobuoni & Rivers, 2016). If experimental evidence captures inherent personality traits, then differences in criminality are unlikely to erode over time, as more women join politics, or as women acquire longer political tenure.

7.4 Discussion

The results for intermediate outcomes serve two purposes. First, they lend plausibility to the main result by identifying mechanisms by which women legislators achieve higher luminosity growth. It is compelling to find that women do better on five different outcomes, drawn from different data sets. Second, they allay potential concerns over what luminosity growth captures. Consider two likely concerns. One is that luminosity growth captures expansion of street lighting, and that women leaders invest more in street lighting to ensure the safety of women in public places. There is some evidence that increasing public safety for women increases women's economic participation which in turn increases economic activity (Borker, 2020; Siddique, 2020). Another natural contention is that our results for luminosity growth demonstrate that electricity provision improves under women legislators. This would be consistent with women legislators improving growth as electricity is the lifeblood of the modern economy and electricity supply is a known constraint on

[42] The criminal charges here refer to cases in which an indictment or a charge sheet has been filed. The judicial process in India is very slow and most are never convicted.

[43] This is a larger difference than in the overall sample that includes elections won by a wide margin. In the overall sample, male legislators are only twice as likely to be carrying charges.

[44] As with most studies of gender differences in outcomes, the design identifies systematic differences in outcomes of men and women in elections in which their assignment as leaders is quasi-random. We additionally confirm that, in close elections, they are balanced on education and wealth.

output in India (and other developing countries) (Allcott et al., 2016; Dinkelman, 2011; Rud, 2006; Lipscomb et al., 2013).[45]

Nevertheless, for the skeptic who is not persuaded by the evidence for India and other countries that luminosity growth proxies economic growth (Sect. 4.1), our findings for road infrastructure, non-farm employment and corruption point to women legislators improving growth prospects. To summarise, if women leaders do improve street lighting and electricity provision (outcomes that we are unable to measure at the constituency level over time), (a) these outcomes are growth-enhancing, and (b) our results for the five outcomes we can analyse show that women leaders achieve more than merely an increase in street lighting and electricity.

Part of the explanation for why women legislators perform better than men is likely to be that they are positively selected. In view of evidence that women face stronger barriers to political candidacy than men, we expect that women candidates are positively selected relative to male candidates. However, even if the ability distribution of men and women was similar, the marginal female entrant would be positively selected because the baseline share of women is small (also see Besley et al. (2017)). The latter tendency will dissipate with an increase in the share of women legislators, but it seems plausible that a performance gap in favour of women will persist if women have stronger intrinsic motivation, or are intrinsically less corrupt (Andreoni and Vesterlund (2001) provide experimental evidence that women are intrinsically more fair). In line with our broad findings, Ashraf et al. (2022) find that female workers are, on average, more productive than male workers and that the gap is larger when the baseline share of women is lower. They attribute this to positive selection, highlighting that this symptomizes a misallocation of talent. Our estimates may be seen as a measure of the potential gain from lowering barriers to entry to women in politics and thus correcting some of this distortion.

8 Heterogeneity

In this section we investigate differences in the relative performance of male and female legislators in sub-samples distinguished, first, by an indicator of human development (a correlate of corruption) and, then by the sex ratio at the state level (Table 7).[46] We also

[45] A number of recent studies highlight the relevance of political control over electricity distribution in India, though no previous work isolates the role of women leaders. We discuss the evidence on these points in Sect. 4.1, where we also explain that there are no constituency-level electrification data with which we could directly test impacts on electrification versus luminosity.

[46] We define different cutoffs for the subsamples in order to highlight the differences in coefficient estimates. Specifically, we define as less developed those states with a Human Development Index (HDI) score below the median as of 1999 (Andhra Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh, Uttarakhand and West Bengal). More developed states are those with a HDI above the median (Arunachal Pradesh, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Punjab, Sikkim, Tamil Nadu, Tripura). Note that according to the HDI measure, some states that are poorer (e. g. north eastern states) are classifed as more developed.

Low sex ratio states are those with a sex ratio that is less than the 25th percentile in the 2001 census (Haryana, Sikkim, Punjab, Arunachal Pradesh, Uttar Pradesh, Nagaland) and high sex ratio states are those where the sex ratio is higher than and equal to the 25th percentile (Madhya Pradesh, Bihar, Gujarat, Rajasthan, Maharashtra, West Bengal, Mizoram, Assam, Jharkhand, Tripura, Goa, Uttarakhand, Karnataka, Himachal Pradesh, Orissa, Meghalaya, Andhra Pradesh, Manipur, Tamil Nadu, Chhattisgarh, and Kerala).

explore heterogeneity by party alignment and gender of the state minister and the education and incumbency status of the legislator (Table 20). The differences in coefficients reported in Table 19 are in general not statistically significant but, in most cases, are of a considerable magnitude.[47]

Institutional environment If clean governance is a reason that women-led constituencies experience higher growth, we may expect that women make a larger difference in institutional environments where (male-dominated) corruption is pervasive. Using the Human Development Index as a proxy for the prevailing quality of government (Sen & Dreze, 2005) and splitting the sample into states with HDI above or below the median value in 1999, we find that women are only significantly better than men at producing growth in the less developed states, where the coefficient is twice as large, see columns 1–2, Table 7.

Indicator of gender progressively at state level We used data from the 2001 census to construct the ratio of females to males at birth, widely used as a measure of progressiveness with regard to the status of women (Sen, 1992). We re-ran the main specification on two groups of states, defined by their sex ratio being below the 25th percentile and above the 25th percentile, see columns 3–4 in Table 7. We see a clear pattern, indicating that women legislators do no better than men (though still no worse) in states with the most male-biased sex ratios. This is consistent with women having more limited agency, their hands may be tied by men. For example, male contractors for road works may not take their cues from them, or their husbands may force them to be corrupt while in office.

Party alignment and gender of state minister State governments may have an incentive to favor aligned politicians in the allocation of public resources (Brollo & Nannicini, 2012; Asher & Novosad, 2017). If aligned legislators have more resources to work with and if the growth results emerge from women legislators making better use of these resources, then we should expect to see larger differences in female vs. male led constituencies in the sample of constituencies that is aligned. This is what we find. The difference between female and male legislators is 50% larger in the aligned sample. Although the difference between the two samples is not statistically significant, it is large. See columns 1–2, Table 20.[48]

On the other hand, if female chief ministers favor female legislators, women may outperform men under female chief ministers not because they use resources better but because they are favoured. To investigate this, we estimate the baseline RD specification on subsamples of states ruled by female vs. male chief ministers (column 3–4, Table 20). We find no evidence of favoritism along the lines of gender. The sample with male chief ministers, which contains 85% of cases (states) exhibits a growth difference in favor of female legislators similar to the full sample results, while the smaller female chief minister sample shows a small and insignificant coefficient.[49]

Education, caste and incumbency of legislator We showed earlier that there is on average no significant difference in the level of education of female and male legislators in the close mixed-gender sample. So education is unlikely to be a mechanism. However, given an interest in the relationship between politician education and policy choices (Besley

[47] In Table 21, we repeat the exercise replacing luminosity with non-farm employment share. It is striking that we find the same pattern of results.

[48] The alignment status of a constituency may change within a term, for instance, if a coalition at the state-level breaks down. To account for this we set the alignment dummy to equal one if the constituencies was aligned throughout the term and to zero if it was either not aligned or aligned for part of the term.

[49] The shares of women and men in the estimation sample who are aligned is 54.8% and 40.7%. The shares of women and men in states with a female chief minister is 8.3% and 11.1%.

Table 7 Heterogeneity by level of development and gender inequality

	(1) More developed	(2) Less developed	(3) High sex ratio	(4) Low sex ratio
	Growth of light			
Female legislator	9.16	20.37*	21.68***	− 2.31
	[5.75]	[10.56]	[8.19]	[6.90]
R^2	0.02	0.03	0.04	0.00
N	322	258	426	187
Bandwidth	8.30	5.45	6.05	12.53
Share of nonfarm employment				
Female legislator	1.64	4.35***	4.02**	3.51
	[1.51]	[1.65]	[1.54]	[2.28]
R^2	0.02	0.08	0.06	0.10
N	70	121	134	49
Bandwidth	8.09	6.29	5.79	7.83
Average HDI	0.5	0.32		
Average sex ratio			949.3	884.2
Share of female legislators	0.053	0.056	0.056	0.05
Share of close elections	0.061	0.072	0.07	0.06

The dependent variable is the growth of light (upper Panel) and the share of non-farm employment (lower panel). The more developed states are states with HDI above the median value in 1999. Low sex ratio states are those with a female to male population ratio below the 25th percentile and high sex ratio states are those where the sex ratio is higher than or equal to the 25th percentile in the 2001 census. All models are estimated using local linear regressions with bandwidth determined by the Imbens and Kalyanaraman (2012) optimal bandwidth calculator. See also Notes to Table 1

et al., 2011), we investigate whether the relative success of women emerges from samples of more or less educated legislators. We separate the sample into constituencies led by legislators with at least ten years of education vs. those with less (column 5–6, Table 20). Growth in luminosity is only higher in women-led constituencies in the sample in which leaders are more educated. The results are similar if we cut at twelve years of education. Examining heterogeneity by caste of the legislator (columns 7–8), we find that the growth premium derived from electing women leaders is driven by high caste women. This is consistent with high caste women being more educated.[50] Finally, dividing the sample into incumbents and non-incumbents, we identify a larger male–female growth difference among incumbents (columns 9–10). Our proposed explanations of these results are speculative but they line up with our earlier results in suggesting that women use available resources with more effect for growth than men, insofar as their education and experience are such resources.

[50] Given long-standing caste segregation in India, and that gender norms are stronger in high caste groups, it may be that personality traits like an aversion to corruption exhibit a larger difference in the high caste group- though this is admittedly no more than one rationalisation of the result.

9 Analysis of behaviour outside the RD sample

Our first result, that luminosity growth is discontinuously lower when a man rather than a woman wins by a narrow margin was displayed in Fig. 6. The RD estimate shows a statistically significant difference. However, Fig. 6 also shows that outside the IK bandwidth (which, as noted in the Tables, is roughly 6%) luminosity growth in constituencies won by men vs. women is similar (note that men do not do better at any victory margin). It is not unusual that the causal RD estimates for close victory margins differ from the descriptive estimates for non-close victory margins as the latter are potentially contaminated by selection. In this section we discuss how representative close elections are likely to be of all elections in India, and then consider selection into the close election sample at constituency and candidate level.

Close mixed-gender elections in India are representative of all mixed-gender elections. In particular, a third of all mixed-gender elections are within the optimal bandwidth and about half have a victory margin of less than 10%. The median victory margin is 10.5% for women and 10.4% for men in the entire sample (the 25th percentile is about 4% and the 75th percentile is about 19% for both female and male winners). This directly diminishes concerns that our results have limited validity. We nevertheless now consider why men who win with narrow margins perform worse than men who win with wider margins to address the possible concern that the poorer performance of men relative to women in close elections stems from their being a bad lot.[51]

Constituency characteristics Constituencies won by men with narrow margins may have been a bad selection compared with constituencies won by men with wider margins. For example, they may have historically struggled with generating growth. However, the balance plots in Fig. 4 and the corresponding data in Panel A of Table 24 show no meaningful differences between these two sets of constituencies.[52]

Candidate characteristics including dynastic links An alternative possibility is that men who win in narrow races are selectively worse than men who win with wide margins. We find no evidence of this using characteristics available in the affidavit data, including education and wealth, see Panel B of Table 24. Using data recently created by George (2019), we compare the dynastic links of candidates, that is, whether a parent or spouse preceded them in political office. We find that men who win in close elections are more likely to have dynastic links (17.4%) than men who win with wide margins (13.6%). Since dynasts are less effective leaders over an election term (George, 2019), this can explain their poorer performance, evident in the dip to the left of the threshold in Fig. 6. However, dynastic links cannot explain the male–female performance gap in close elections. Using our RD design, we show that the probability that the winner is a dynast is invariant to the victory

[51] Table 22 describes characteristics of constituencies and candidates in constituencies where the election involves both genders vs. not. There are clearly differences here, which are not surprising. Our RD design, similar to any close election design in the literature, is conditional on the entities of interest (male vs. female politicians) contesting.

[52] Among constituencies which have at least one mixed-gender election, nearly 60% have had only one or two mixed-gender elections over a period of three decades (Bhalotra et al., 2017) This suggests that the RD estimates do not capture features specific to certain constituencies. Similarly, Fig. 1 showed that constituencies in which women win against men by a narrow margin are not clustered but, rather, fairly evenly distributed across the country.

margin (Fig. 11). In close elections, the share of dynasts is 15.9% among women and 17.4% among men, and the difference is not statistically significant.[53]

Unobservable candidate characteristics/quality We further investigate if men who win in close races are negatively selected on unobservables, adapting to our setting a test proposed in George (2019). The idea is that candidates who win with a narrow margin—relative to candidates who win with a wide margin—are either weaker candidates or unlucky. The trick is to use swings in the state-level vote share of the candidate's party to measure luck, as aggregate party swings constitute a shock to the individual candidate's victory margin.

The party swing of the winning candidate, Swing_i, in a mixed-gender race is defined as follows:

$$\text{Swing}_i = \Delta\text{Party of winning candidate}_t - \Delta\text{Party of losing candidate}_t. \quad (4)$$

Δ_t is the state-level vote share of candidate k's party in the state election in t minus the same share in the preceding state election in *t-1*. Swing_i hence captures the swing experienced by the party of the winning candidate i, relative to the party of the runner-up.[54]

Candidates who win in a close race in a year with a positive net party swing ($\text{Swing}_i > 0$) are a relatively "bad" selection (they won with a narrow margin despite a positive party swing) and those winning during a negative party swing are a relatively "good" selection. We estimate impacts of legislator gender on luminosity growth for candidates winning during positive vs. negative swings. The estimates are similar and statistically indistinguishable, see Table 25. This makes it unlikely that candidate quality drives our results. Our main result is robust to accounting for negative selection among men in close elections. Even if we focus only on good candidates (who won despite a negative party swing), women perform better than men.

Electoral incentives A potential explanation of the difference in outcomes of close vs. non-close elections is that legislators who win in close races face more stringent electoral incentives than those who win with comfortable margins (because their re-election is more uncertain). That politicians pursuing a narrow electoral agenda have an incentive to distort economic policies has been discussed in a literature on distributive politics, which highlights this as a drawback of democratic politics (see e.g., Mani & Mukand, 2007; Cole, 2009; Golden & Min, 2013). Politicians may induce electoral cycles, engage in vote buying, or target resources to key electoral groups for purely electoral reasons; see Cole (2009), Mitra et al. (2017), Arulampalam et al. (2009) for evidence from India. With the exception of Brollo and Troiano (2016), this literature provides limited evidence of whether men are more likely than women to fall prey to electoral incentives.

[53] If the main results showing better performance of women who win close races were related to their dynastic links then we would expect (Fig. 11) to mimic the patterns seen in Fig. 6 with a discontinuity at the threshold and a dip to the left of the threshold.

[54] On average, the winning party has a positive swing of up to 3 percentage points and the losing party a negative swing of the same order of magnitude. We obtain data on state-level party vote shares for all state elections during 1980-2008 from Jensenius and Vernier (2017) available at https://www.francesca.no/data-2. The results are robust to leaving out the index candidate's voteshare when estimating the state-party level swing.

We argue that if men are more opportunistic than women then we may expect the pattern seen in Fig. 6. We find (descriptive) support for this in comparing re-election rates of men and women in the mixed-gender election sample, see Table 26. Men and women elected with wide margins are equally likely to be re-elected, the chances being 30–35%. Among legislators who win in close races, men have a similarly high re-election rate of 27%, but women have a substantially lower re-election rate of about 18%, *despite* their better growth performance.[55] These estimates are consistent with women being less likely to engage in economic distortions even if it costs them electoral defeat. The results generalize in the sense that if a non-close man were to find himself in a close election, he would also behave opportunistically. We note again that close elections are not special cases, a third of all elections being close.

There are other possible explanations of lower growth in competitive constituencies with male legislators. One is that politicians with shorter expected tenure have less influence over the promotion of bureaucrats. In line with this, Nath (2016) shows that the performance of bureaucrats is worse in such constituencies. Women may be able to improve bureaucratic performance even without explicit control over promotions if they are more efficacious or intrinsically motivated. For instance, our result that road completion rates are higher in constituencies with female legislators is consistent with women exerting more effort to monitor bureaucrats effectively.[56]

10 Conclusion

We estimate that women legislators in India raise economic growth (GDP) in their constituencies by 2.3 percentage points per annum more than male legislators. We find no evidence of negative spillovers from female-led constituencies, which suggests considerable overall growth gains. These are, as far as we know, the first causal estimates of the impact of legislator gender on economic activity.

Investigating mechanisms we find that women legislators are more effective at overseeing completion of road infrastructure projects (the share of incomplete projects being 22 percentage points lower) and increasing non-farm employment (by 0.84% points p.a.), they are less likely to rent-seek while in office (personal asset growth is about 12 percentage points p.a. lower), and only about a third as likely as men to be carrying pending criminal charges when they enter office. We also find evidence consistent with women legislators being less likely than men to distort economic policies in order to achieve electoral gains. Thus it seems that economic activity improves under women legislators on account of them being more efficacious, less corrupt and more intrinsically motivated. We note that this array of results makes it unlikely that what we capture is only that street lighting or

[55] These figures refer to the unconditional re-election probability. The results are similar for the probability of re-election conditional on re-contesting. Conditional on re-contesting, comfortably elected men and women have a similar re-election probability of about 50–55%. Barely elected men also have a high re-election probability of 44%, while barely elected women have a re-election probability of 29%. We do not observe any meaningful difference in the likelihood of re-running among barely and comfortably elected men and women.

[56] Anecdotes and media coverage in India often highlight that women in Indian politics are mission oriented, see for instance, https://www.thebetterindia.com/4721/mla-jyoti-how-an-abandoned-musahar-girl-stepped-on-to-the-political-stage/ and https://www.dnaindia.com/ahmedabad/report-once-jobless-phd-woman-slays-5-time-bjp-mla-from-unjha-2569652.

electrification (which manifest in luminosity growth) improve under women leaders, also noting that both are potentially important contributors to growth in developing countries.

A lower initial share of women in government implies that the marginal female entrant will be higher ability than the marginal male entrant, and this may be reinforced by discrimination against women. Against this, as the share of women grows, average female tenure will fall. Our results are consistent with female politicians having higher ability.[57] Our findings are potentially relevant to the many (richer and poorer) countries in the world that have a small but growing share of women in the legislature.

To the extent that opportunities for corruption decline with development, any female-advantage that derives from lower corruption will tend to dissipate with development. In line with this, we find some evidence that the gender gap in legislator performance is smaller in the more developed states of India but, in general, it is unclear that these differences will disappear altogether if lower criminality and corruption are intrinsic to women. Gender differences in intrinsic motivation may persist, and our finding that women achieve higher road completion rates is not significantly different in more vs. less developed states of India. Overall, our analysis suggests that differences in economic performance by legislator gender may narrow but not necessarily close with economic development. Further work in other settings is merited.

Appendix

See Tables 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26 and Figs. 10, 11.

[57] This result is non-trivial because we do not know a priori whether the underlying ability distribution is the same for men and women, and we do not know how unobserved ability vs. tenure translate into growth.

Table 8 Variable definitions and data availability

Variable	Definition (Years of data availability)
Growth of light	Log difference in light density between periods t+1 and t (1992–2012)
Share of non-farm employment	Share of Non-farm employment in total population (1990, 1995, 2005, 2013)
Share of incomplete projects	Share of incomplete projects in total projects awarded (2004–2012)
Growth of assets	Log difference in total assets of legislators who recontest the next election (2004–2012)
Log electors	Natural log of number of registered voters (1992–2008)
Number candidates	Number of candidates contesting (1992–2008)
Turnout (%)	Percentage of registered voter turned out to vote (1992–2008)
Female turnout (%)	Percentage of registered women voter turned out to vote (1992–2008)
Female legislator	Is 1 if a woman won and 0 otherwise. (1992–2008)
Incumbent	Is 1 if a candidate is incumbent and 0 otherwise (1992–2008)
Female party head	Is 1 if a party is headed by a woman and 0 otherwise (1992–2008)
SC-reserved constituency	Is 1 if the constituency is reserved for a scheduled caste (SC) candidate and 0 otherwise (1992–2008)
ST-reserved constituency	Is 1 if the constituency is reserved for a scheduled tribe (ST) candidate and 0 otherwise (1992–2008)
Aligned with state govt	Is 1 if the constituency was aligned with the state ruling party or coalition for the entire election term and 0 otherwise (1992–2008)
Aligned with central govt	Is 1 if the constituency was aligned with the central ruling party or coalition for the entire election term and 0 otherwise (1992–2008)
INC legislator	Is 1 if a candidate belongs to the INDIAN NATIONAL CONGRESS (INC) party and 0 otherwise (1992–2008)
BJP legislator	Is 1 if a candidate belongs to the bhartiya janata party (BJP) party and 0 otherwise (1992–2008)
Educated	Is 1 if a candidate has a 10 or more years of education and 0 otherwise (2004–2008)
Legislator's age	Age of a legislator in years (2004–2008)
SC legislator	Is 1 if a legislator belongs to a scheduled caste and 0 otherwise (2004–2008)
ST legislator	Is 1 if a legislator belongs to a scheduled tribe and 0 otherwise (2004–2008)
Log total assets	Log(Total Assets+1) where total assets are the self-reported assets in the affidavits (2004–2008)
Log total liability	Log(Total Liabilities+1) where total liabilities are the self-reported liabilities in the affidavits (2004–2008)
Criminal	Is 1 if a candidate has a criminal case pending against him or her and 0 otherwise (2004–2008)
Muslim legislator	Is 1 if a legislator is muslim and 0 otherwise (1992–2008)

Table 9 Summary statistics

	Full sample					Mixed gender sample				
	N	Mean	SD	min	max	N	Mean	SD	min	max
Panel A: main outcome variables										
Growth of light density	15520	7.46	39.6	− 829.8	916.3	1623	4.40	31.6	− 829.8	318.2
Share nonfarm employment	4255	5.88	4.94	0	171.9	477	6.53	4.46	0	41.2
Share of incomplete projects	4198	0.11	0.26	0	1	561	0.12	0.26	0	1
Growth of assets	1948	1.06	0.85	− 5.08	5.84	258	1.15	0.81	− 1.01	3.75
Panel B: predetermined constituency characteristics										
Log electors t-1	12402	11.7	0.81	7.93	14.2	1377	11.8	0.61	8.76	13.1
Number candidates t-1	10686	11.5	13.1	1	1033	1252	11.4	29.8	2	1033
Turnout t-1	12402	66.1	12.7	1.07	126.0	1377	65.3	11.7	4.48	96.1
Female turnout t-1	10686	60.7	13.6	0.82	100.0	1252	61.0	13.2	4.32	95.7
Female legislator t-1	12402	0.050	0.22	0	1	1377	0.27	0.44	0	1
Incumbent t-1	10686	0.72	0.45	0	1	1252	0.69	0.46	0	1
Female party head t-1	10686	0.13	0.34	0	1	1252	0.16	0.37	0	1
SC-reserved constituency t-1	12568	0.14	0.35	0	1	1393	0.20	0.40	0	1
ST-reserved constituency t-1	12568	0.14	0.35	0	1	1393	0.13	0.33	0	1
Aligned with state govt t-1	12568	0.61	0.48	0	1	1393	0.64	0.47	0	1
Aligned with central govt t-1	12402	0.33	0.41	0	1	1377	0.34	0.40	0	1
INC legislator t-1	12568	0.29	0.46	0	1	1393	0.28	0.45	0	1
BJP legislator t-1	12568	0.20	0.40	0	1	1393	0.18	0.38	0	1
Panel C: candidate characteristics										
Educated	2927	0.87	0.34	0	1	408	0.84	0.36	0	1
MLA's age	3056	49.3	9.96	25	84	423	48.1	10.1	25	80
Total assets ('000 Rs.)	3106	10771.2	31028.5	0	714083.8	430	9904.5	27855.4	0	330990.9
Total liability ('000 Rs.)	2759	1102.6	6213.9	0	192653.3	375	686.8	3232.3	0	54852.6
Criminal	3615	0.29	0.45	0	1	515	0.22	0.41	0	1

Table 9 (continued)

	Full sample					Mixed gender sample				
	N	Mean	SD	min	max	N	Mean	SD	min	max
SC legislator	2433	0.15	0.36	0	1	329	0.20	0.40	0	1
ST legislator	2433	0.063	0.24	0	1	329	0.055	0.23	0	1
Muslim legislator	14617	0.064	0.24	0	1	1576	0.044	0.20	0	1

Full Sample is the sample of the all races during the period 1992–2008. Mixed Gender sample is the sample of races where a female candidate placed either first or second against a male candidate. The unit of observation is an Assembly constituency. Each data point is a constituency-election year observation. For annual data, we compute election term averages

Table 10 Luminosity elasticity of GDP

	(1)	(2)	(3)
	Log(State GDP per capita)		
Log light per capita	0.38***	0.34***	0.15***
	[0.11]	[0.09]	[0.04]
Method	OLS	FE	FE with year dummies
R^2	0.28	0.82	0.98
N	473	473	473

The above is a panel of 29 Indian states over the period 1992–2009. The standard errors are clustered at the state level and are in the parentheses. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. We have explored whether our estimated elasticity in Column (3) is sensitive to the choice of sample and find that this is not the case. The elasticity estimates we obtain in the following subsamples are: Dropping 8 states with lower population than Himachal Pradesh (pop<5 million): 0.153; Dropping 9 states smaller than Kerala (area<30,000 km2): 0.148; 1995–2008 only: 0.150; 1992–2005 only: 0.147. We also compare GDP and electricity availability for Indian states, using data from India's Central Electricity Authority's annual reports. A 1 percent increase in electricity availability is associated with a 0.24 percent increase in GDP, conditional on state and year fixed effects. If we estimate a panel regression of log lights on the log of electricity availability, we get an elasticity of 0.44, conditional on state and year fixed effects

Table 11 Balance in constituency characteristics–female versus male legislators

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All mixed gender races			Mixed gender races within 5% margin			RD estimate
	Female legislators	Male legislators	Difference	Female legislators	Male legislators	Difference	
Growth of light density t-1	3.505	6.761	− 3.256	3.048	3.511	− 0.464	− 0.0496
	(29.052)	(42.261)	(2.042)	(30.402)	(30.140)	(3.200)	(2.443)
Share incompete projects t-1	0.032	0.032	− 0.000	0.003	0.047	− 0.044	0.00934
	(0.150)	(0.127)	(0.016)	(0.021)	(0.175)	(0.027)	(0.0452)
Share nonfarm employment t-1	4.927	5.390	− 0.463	4.008	5.748	− 1.739*	− 0.934
	(3.302)	(5.816)	(0.725)	(2.493)	(4.175)	(1.027)	(1.123)
Log electors t-1	11.825	11.777	0.047	11.815	11.818	− 0.003	− 0.230
	(0.567)	(0.644)	(0.033)	(0.630)	(0.577)	(0.061)	(0.236)
Number candidates t-1	10.761	11.903	− 1.142	10.573	10.560	0.014	− 1.618
	(7.300)	(40.533)	(1.689)	(6.975)	(7.274)	(0.758)	(1.292)
Turnout t-1	64.993	65.580	− 0.588	65.588	66.104	− 0.516	− 0.635
	(12.104)	(11.326)	(0.632)	(11.542)	(10.427)	(1.119)	(1.812)
Female turnout t-1	60.763	61.258	− 0.494	61.192	62.262	− 1.070	− 0.844
	(13.816)	(12.668)	(0.749)	(13.662)	(12.285)	(1.374)	(2.246)
Female MLA t-1	0.305	0.238	0.066***	0.311	0.301	0.009	0.120
	(0.461)	(0.426)	(0.024)	(0.464)	(0.460)	(0.047)	(0.129)
Incumbent t-1	0.666	0.707	− 0.041	0.713	0.684	0.029	0.222
	(0.472)	(0.455)	(0.026)	(0.454)	(0.466)	(0.049)	(0.142)
Female party head t-1	0.152	0.176	− 0.024	0.201	0.202	− 0.001	0.0400
	(0.359)	(0.381)	(0.021)	(0.402)	(0.403)	(0.043)	(0.109)
SC-reserved constituency t-1	0.216	0.190	0.026	0.223	0.171	0.053	0.0908
	(0.412)	(0.392)	(0.022)	(0.418)	(0.377)	(0.040)	(0.118)
ST-reserved constituency t-1	0.113	0.137	− 0.024	0.112	0.114	− 0.002	− 0.0424
	(0.317)	(0.344)	(0.018)	(0.316)	(0.318)	(0.032)	(0.131)

Table 11 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All mixed gender races			Mixed gender races within 5% margin			RD estimate
	Female legislators	Male legislators	Difference	Female legislators	Male legislators	Difference	
Aligned with state govt t-1	0.627	0.656	− 0.030	0.593	0.619	− 0.026	0.00720
	(0.476)	(0.468)	(0.025)	(0.482)	(0.474)	(0.049)	(0.127)
Aligned with central govt t-1	0.335	0.346	− 0.012	0.390	0.322	0.068	0.001
	(0.395)	(0.411)	(0.022)	(0.408)	(0.410)	(0.042)	(0.116)
INC legislator t-1	0.261	0.291	− 0.030	0.240	0.275	− 0.035	0.0882
	(0.440)	(0.454)	(0.024)	(0.428)	(0.448)	(0.045)	(0.117)
BJP legislator t-1	0.192	0.169	0.023	0.201	0.147	0.054	0.0239
	(0.394)	(0.375)	(0.021)	(0.402)	(0.355)	(0.038)	(0.0962)

Columns (1)–(3) compare unconditional means of predetermined constituency variables between female-led constituencies with male-led constituencies in our mixed gender races sample. Columns (4)–(6) additionally condition the sample to close races that are decided by margin of 5% or less. Column (7) reports the RD estimates of the difference in the constituency characteristics. Note that for constituency-level variables that are determined prior to the gender of the legislator, balance could be explored in either t or t-1. We find that balance holds for these variables in t as well (see Table 23). Standard deviations in parentheses except in columns (3), (6) and (7) which have standard errors in parentheses. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels from tests of no differences, respectively

Table 12 RD check for road completion–constituency population thresholds

	(1) Average village population	(2) Proportion of villages with population> = 500	(3) Proportion of villages with population> = 1000
Female legislator	24.62	− 0.01	0.03
	[491.20]	[0.07]	[0.08]
R^2	0.00	0.01	0.01
N	894	221	253
Bandwidth	12.45	2.52	2.90

The village population data is from 2001 census. $FemaleLegislator_t$ is a dummy variable which is 1 for a female legislator and 0 for a male legislator in mixed gender races. The forcing variable is margin of victory ($margin_t$), which is the difference between vote shares of the winning and runnerup candidates in mixed gender races. Column (1) reports estimates from a local linear regression of average village population on $FemaleLegislator_t$ using a bandwidth determined by Imbens and Kalyanaraman (2012) optimal bandwidth calculator. The dependent variables are proportion of villages with population of 500 or more in Column (2) and proportion of villages with population of 1000 or more in Column (3). See also Notes to Table 1

Table 13 Balance in candidate characteristics-female versus male legislators

	(1)	(2)	(3)	(4)	(5)	(6)
	All mixed gender races			Mixed gender races within 5% margin		
	Female legislators	Male legislators	Difference	Female legislators	Male legislators	Difference
Educated	0.800	0.883	− 0.083**	0.762	0.870	− 0.108
	(0.401)	(0.323)	(0.036)	(0.429)	(0.339)	(0.067)
MLA's age	46.500	49.680	− 3.180***	45.646	48.671	− 3.025*
	(10.344)	(9.676)	(0.973)	(11.341)	(9.939)	(1.811)
Total assets ('000 Rs.)	12588.207	7504.576	5083.631*	7859.415	6061.714	1797.701
	(37190.682)	(14978.659)	(2682.717)	(13907.696)	(9860.372)	(2026.900)
Total liability ('000 Rs.)	777.249	605.144	172.105	741.619	724.553	17.066
	(4362.568)	(1653.743)	(334.589)	(2509.085)	(2337.882)	(443.373)
Criminal	0.135	0.284	− 0.149***	0.103	0.321	− 0.218***
	(0.342)	(0.452)	(0.036)	(0.306)	(0.470)	(0.066)
SC legislator	0.195	0.206	− 0.011	0.231	0.148	0.083
	(0.398)	(0.406)	(0.044)	(0.425)	(0.359)	(0.076)
ST legislator	0.073	0.036	0.037	0.038	0.037	0.001
	(0.261)	(0.188)	(0.025)	(0.194)	(0.191)	(0.037)
Muslim legislator	0.031	0.056	− 0.025**	0.048	0.071	− 0.023
	(0.174)	(0.230)	(0.010)	(0.213)	(0.258)	(0.023)

These candidate characteristics are available for elections held between 2004 and 2008 from the self-reported candidate affidavits. There is only one election per state during the time period considered. Columns (1)–(3) compare unconditional means of candidate characteristics between female-led constituencies with male-led constituencies in our mixed gender races sample. Columns (4)–(6) additionally condition the sample to close races that are decided by margin of 5% or less. Standard deviations in parentheses except in columns (3) and (6) which have standard errors in parentheses. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels from tests of no differences, respectively

Table 14 Controls for constituency and individual characteristics (besides gender)

	(1)	(2)	(3)	(4)	(5)	(6)
	Growth of $light_{t+1}$					
Female legislator	15.35**	32.71**	11.61**	13.52**	13.83**	12.05**
	[6.07]	[16.15]	[5.73]	[5.90]	[5.73]	[5.73]
SC-reserved constituency	− 0.53					
	[2.71]					
ST-reserved constituency	3.41					
	[6.95]					
SC legislator		7.86				
		[5.18]				
ST legislator		19.36***				
		[5.38]				
Muslim legislator			1.48			
			[3.58]			
INC legislator				6.32**		8.34**
				[2.69]		[3.42]
BJP legislator				1.79		1.59
				[3.44]		[3.36]
Aligned with the state					6.30**	5.92**
Government					[2.57]	[2.46]
Aligned with the central					− 2.97	− 6.67
Government					[3.32]	[4.19]
R^2	0.03	0.09	0.02	0.04	0.04	0.05
N	584	145	541	584	584	584
Bandwidth	6.68	6.68	6.68	6.68	6.68	6.68

Column (1) adds dummies to the baseline specification that are one if the constituency is reserved for scheduled castes or tribes, respectively. Column (2) adds dummies that are one if a legislator is from a scheduled tribe or caste, respectively. Column (3) adds a dummy that is 1 if a legislator is Muslim. Column (4) adds dummies that are one if a legislator is from the BJP or the Congress Party, respectively. Column (5) adds dummies that are one if a legislator's party is aligned with the state or central government. Column (6) jointly adds the dummies for parties and alignment. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels from tests of no differences, respectively

Table 15 Legislator gender–impacts over the legislative term

	(1) Local linear	(2)	(3)
	IK (h)	h/2	2 h
Panel A: first two years			
Female legislator	10.75	12.83	2.64
	[7.13]	[11.04]	[5.50]
R^2	0.00	0.01	0.00
N	744	425	1.134
Bandwidth	10.84	5.42	21.69
Panel B: last two years			
Female legislator	23.29	31.74	8.23
	[16.67]	[26.55]	[10.78]
R^2	0.01	0.01	0.01
N	578	327	959
Bandwidth	8.22	4.11	16.45

In Panel A the dependent variable is the average growth rate for first two years of an election term. In Panel B the dependent variable is the average growth rate for the last two years of an election term. Column (1) runs a local linear regression using the optimal bandwidth calculator. Columns (2) and (3) halve and double the optimal bandwidth. See also Notes to Table 1

Table 16 Associations of alternative outcomes with luminosity growth

	(1) Growth of light	(2)
Panel A: roads		
Share of incomplete projects	− 11.15*	− 23.86**
	[6.74]	[11.41]
R^2	0.03	0.32
N	561	561
Method	OLS	FE
Panel B: assets		
Growth of assets	− 3.09**	− 1.64
	[1.45]	[1.19]
R^2	0.01	0.26
N	258	258
Method	OLS	OLS
Panel C: non-farm employment		
Share non-farm employment	1.12***	2.07*
	[0.41]	[1.17]
R^2	0.02	0.50
N	426	426
Method	OLS	FE

FE refers to fixed effects, which are constituency and election term fixed effects. In the regressions for road completion, both columns control for the number of road projects awarded, the regressions for asset growth control for the baseline level of assets. Standard errors are in parentheses and are clustered at the constituency level in Panels A and C, and at the state level in Panel B. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

Table 17 State-level IV regressions

	(1)	(2)	(3)
Panel A: Light output in all constituencies			
Proportion of woman legislators	0.03	0.01	0.01
	[0.78]	[0.79]	[0.66]
R^2	0.71	0.71	0.71
N	430	430	418
Method	IV	IV	IV
Close election	Margin within 5%	Margin within 5%	Margin within 5%
Panel B: Light output in male-led constituencies			
Proportion of woman legislators	− 0.12	− 0.15	− 0.11
	[0.79]	[0.80]	[0.68]
R^2	0.69	0.69	0.69
N	428	428	417
Method	IV	IV	IV
Close election	Margin within 5%	Margin within 5%	Margin within 5%
Panel C: Light output in female-led constituencies			
Proportion of woman legislators	5.69***	5.65***	5.17***
	[2.08]	[2.10]	[1.74]
R^2	0.37	0.37	0.37
N	371	371	360
Method	IV	IV	IV
Close election	Margin within 5%	Margin within 5%	Margin within 5%

Panel A reports regression results from specifications that relate average luminosity growth across all constituencies of a state to the proportion of female legislators in that state. Panel B reports regression results from specifications with average luminosity growth in male-led constituencies in a state to the proportion of female legislators in that state. Panel C reports regression results from specifications with average luminosity growth in female-led constituencies in a state to the proportion of female legislators in that state. All regressions use state-level annual data. Column (1) reports results from models that include state and year fixed effects. Column (2) report results from models that add the share of mixed-gender races in a state as a control. Column (3) report results from models that add further state-level covariates. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels from tests of no differences, respectively

Table 18 Legislator gender and luminosity growth in subsamples

	(1)	(2)	(3)	(4)
	Growth of $light_{t+1}$			
	Local linear			Local quadratic
	IK (h)	h/2	2 h	IK (h)
Panel A: incomplete road projects subsample				
Female legislator	21.75	4.70	18.97	3.91
	[17.20]	[17.08]	[11.67]	[20.44]
R^2	0.04	0.05	0.04	0.05
N	122	63	226	122
Bandwidth	3.29	1.64	6.58	3.29
Panel B: growth of assets subsample				
Female Legislator	55.61*	58.74	32.62*	62.84
	[32.49]	[65.20]	[18.28]	[68.70]
R^2	0.12	0.14	0.09	0.13
N	59	27	111	59
Bandwidth	3.64	1.82	7.29	3.64

This table replicates the results in Table 1 for the subsamples used for the results in Panel A of Table 5 (legislator gender and road completion) and Table 6 (legislator gender and asset growth). See also Notes to Tables 1, 5, Table 6

Table 19 Do candidate criminal records impact winning?

	(1)	(2)
	Probability of winning	
	OLS	IK(h)
Panel A: full sample		
Criminal	0.0356**	− 0.00833
	(0.0164)	(0.0283)
N	4828	1637
Panel B: mixed gender sample		
Criminal	0.0714	0.0531
	(0.0503)	(0.0936)
N	722	238

This table estimates how having pending criminal accusations at the time of contesting an election affects the probability of winning. In Panel A, the sample is races in which a candidate with criminal accusations either won or was the runnerup against a candidate with no accusations. In Panel B, we consider close close races with a victory margin of 5% or less in which a candidate with criminal accusations either won or was the runner-up against a candidate with no accusations. The dependent variables is a dummy variable which is 1 if a candidate wins and 0 otherwise. Criminal is a dummy variable which is 1 if a candidate has any criminal charges against him or her and 0 otherwise

Table 20 Heterogeneity by party, legislator and state characteristics

	(1) Aligned	(2) Non-aligned	(3) Female chief minister	(4) Male chief minister	(5) Educated	(6) Not educated	(7) General	(8) SC/ST	(9) Incumbent	(10) Non-incumbent
Female legislator	15.67***	10.66	− 5.33	17.56***	33.48**	− 0.64	34.11*	10.31***	13.67*	4.48
	[5.07]	[7.71]	[4.75]	[6.77]	[16.16]	[4.97]	[18.68]	[3.70]	[7.53]	[5.27]
R^2	0.04	0.02	0.04	0.03	0.08	0.08	0.09	0.03	0.02	0.02
N	337	332	101	511	151	32	118	44	361	214
Bandwidth	7.92	8.05	11.52	6.48	6.63	8.44	7.72	7.82	7.46	10.58

The dependent variable is the growth of light averaged over an election term against female margin of victory in mixed gender races. Aligned constituencies are constituencies that were aligned with the state government for an entire election term and non-aligned constituencies are those that were either not aligned with the state government or were aligned only for a fraction of an election term. Female Chief Minister is 1 for a constituency which is aligned with a female-headed state government and 0 otherwise. Educated is 1 for a legislator who has completed 10th grade or higher and 0 otherwise. General is one for legislators who do not belong to a scheduled caste or scheduled tribe. Incumbent is a dummy that is 1 if a legislator is also an incumbent and 0 else. All models run local linear regressions using a bandwidth determined by Imbens and Kalyanaraman (2012) optimal bandwidth calculator. See also Notes to Table 1

Table 21 Heterogeneity: impacts of legislator gender on non-farm employment

	(1) Aligned	(2) Non-aligned	(3) Female chief minister	(4) Male chief minister	(5) Educated	(6) Not educated	(7) General	(8) SC/ST	(9) Incumbent	(10) Non-incumbent
Female legislator	5.55***	2.97*	1.38	4.44***	3.74**	− 0.71	2.72	3.74	4.87***	4.31*
	[2.03]	[1.56]	[1.29]	[1.34]	[1.66]	[2.81]	[1.74]	[2.91]	[1.52]	[2.47]
R^2	0.16	0.04	0.42	0.08	0.10	0.08	0.06	0.25	0.09	0.09
N	83	96	20	148	94	29	76	30	110	56
Bandwidth	5.57	7.26	4.80	5.98	7.71	10.13	8.57	9.47	6.30	8.30

The dependent variable is the share of non-farm employment in total constituency population averaged over the election term against female margin of victory in mixed gender races. Aligned constituencies are constituencies that were aligned with the state government for an entire election term and non-aligned constituencies are those that were either not aligned with the state government or were aligned only for a fraction of an election term. Female Chief Minister is 1 for a constituency which is aligned with a female-headed state government and 0 otherwise. Educated is 1 for a legislator who has completed 10th grade or higher and 0 otherwise. Incumbent is a dummy that is 1 if a legislator is also an incumbent and 0 else. All models run local linear regressions using a bandwidth determined by Imbens and Kalyanaraman (2012) optimal bandwidth calculator. See also Notes to Table 1

Table 22 Mixed-gender versus non-mixed gender races

	(1) Mixed gender	(2) Non mixed gender	(3) Diff.
Growth of light density t-1	5.230	7.786	− 2.556**
	(36.670)	(44.545)	(1.292)
Share incompete projects t-1	0.032	0.047	− 0.015
	(0.139)	(0.185)	(0.011)
Lag share nonfarm employment	5.178	4.517	0.661
	(4.823)	(5.594)	(0.433)
Log electors t-1	11.799	11.659	0.141***
	(0.610)	(0.829)	(0.023)
Number candidates t-1	11.362	11.566	− 0.204
	(29.828)	(8.728)	(0.394)
Turnout t-1	65.306	66.241	− 0.936**
	(11.695)	(12.833)	(0.363)
Female turnout t-1	61.024	60.690	0.334
	(13.221)	(13.620)	(0.408)
Female MLA t-1	0.269	0.023	0.246***
	(0.444)	(0.150)	(0.006)
Incumbent t-1	0.688	0.723	− 0.036***
	(0.464)	(0.447)	(0.014)
Female party head t-1	0.165	0.131	0.034***
	(0.371)	(0.337)	(0.010)
SC-reserved constituency t-1	0.202	0.131	0.071***
	(0.402)	(0.337)	(0.010)
ST-reserved constituency t-1	0.126	0.142	− 0.016*
	(0.332)	(0.349)	(0.010)
Aligned with state govt t-1	0.642	0.604	0.039***
	(0.472)	(0.480)	(0.014)
Aligned with central govt t-1	0.341	0.332	0.009
	(0.404)	(0.406)	(0.012)
INC legislator t-1	0.277	0.296	− 0.018
	(0.448)	(0.456)	(0.013)
BJP legislator t-1	0.179	0.197	− 0.018
	(0.384)	(0.398)	(0.011)
10th or higher educated	0.843	0.874	− 0.031*
	(0.364)	(0.332)	(0.018)
MLA's age	48.147	49.483	− 1.337**
	(10.118)	(9.921)	(0.521)
Total assets ('000 Rs.)	9904.523	10910.411	− 1005.888
	(27855.378)	(31511.198)	(1612.232)
Total liability ('000 Rs.)	686.836	1168.046	− 481.209
	(3232.302)	(6558.791)	(345.142)
Criminal	0.216	0.297	− 0.082***
	(0.412)	(0.457)	(0.021)

Table 22 (continued)

	(1) Mixed gender	(2) Non mixed gender	(3) Diff.
SC legislator	0.201	0.148	0.053**
	(0.401)	(0.355)	(0.021)
ST legislator	0.055	0.065	− 0.010
	(0.228)	(0.246)	(0.014)
Muslim legislator	0.044	0.066	− 0.023***
	(0.205)	(0.249)	(0.007)

Columns (1)–(3) compare differences in constituency characteristics between constituencies with mixed-gender races and constituencies without mixed-gender races. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels from tests of no differences, respectively

Table 23 Balance in constituency characteristics in election year (t)–female versus male legislators

	(1)	(2)	(3)	(4)	(5)	(6)
	All mixed gender races			Mixed gender races within 5% margin		
	Female legislators	Male legislators	Difference	Female legislators	Male legislators	Difference
Log electors t	11.860	11.829	0.031	11.824	11.874	− 0.050
	(0.572)	(0.630)	(0.029)	(0.644)	(0.575)	(0.056)
Number candidates t	11.453	9.661	1.792	9.786	10.040	− 0.254
	(39.921)	(5.828)	(1.483)	(6.116)	(5.667)	(0.593)
Turnout t	65.250	65.514	− 0.264	65.972	65.761	0.211
	(12.028)	(12.011)	(0.582)	(12.573)	(11.476)	(1.108)
Female turnout t	62.216	62.243	− 0.027	62.346	62.732	− 0.385
	(12.995)	(13.249)	(0.689)	(12.986)	(12.573)	(1.286)
Female party head t	0.219	0.209	0.010	0.255	0.231	0.024
	(0.414)	(0.407)	(0.022)	(0.437)	(0.423)	(0.043)
SC-reserved constituency t	0.203	0.187	0.016	0.193	0.169	0.024
	(0.402)	(0.390)	(0.019)	(0.396)	(0.375)	(0.036)
ST-reserved constituency t	0.111	0.132	− 0.021	0.114	0.107	0.007
	(0.315)	(0.339)	(0.016)	(0.319)	(0.310)	(0.029)

Columns (1)–(3) compare unconditional means of predetermined constituency variables at the beginning of the current term in t (rather than at the beginning of the term $t-1$) between female-led constituencies with male-led constituencies in our mixed gender races sample. Columns (4)–(6) additionally condition the sample to close races that are decided by margin of 5% or less

Table 24 Balance in constituency and candidate characteristics: close versus non-close constituencies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All			Men			Women		
	Close	Non-close	Difference	Close	Non-close	Difference	Close	Non-close	Difference
Panel A: predetermined constituency characteristics									
Growth of light density t-1	3.293	5.974	− 2.681	3.511	8.008	− 4.497	3.048	3.681	− 0.633
	(30.222)	(38.854)	(2.277)	(30.140)	(46.041)	(3.605)	(30.402)	(28.549)	(2.632)
Share incompete projects t-1	0.026	0.034	− 0.008	0.047	0.025	0.022	0.003	0.043	− 0.040
	(0.129)	(0.143)	(0.017)	(0.175)	(0.097)	(0.022)	(0.021)	(0.174)	(0.026)
Lag share nonfarm employment	5.002	5.244	− 0.242	5.748	5.245	0.502	4.008	5.243	− 1.235
	(3.626)	(5.214)	(0.811)	(4.175)	(6.385)	(1.309)	(2.493)	(3.500)	(0.829)
Log electors t-1	11.817	11.793	0.024	11.818	11.761	0.058	11.815	11.828	− 0.013
	(0.601)	(0.613)	(0.037)	(0.577)	(0.669)	(0.053)	(0.630)	(0.542)	(0.050)
Number candidates t-1	10.566	11.679	− 1.114	10.560	12.459	− 1.900	10.573	10.832	− 0.259
	(7.128)	(34.992)	(1.868)	(7.274)	(47.979)	(3.471)	(6.975)	(7.428)	(0.671)
Turnout t-1	65.868	65.087	0.781	66.104	65.372	0.732	65.588	64.766	0.822
	(10.941)	(11.975)	(0.702)	(10.427)	(11.668)	(0.927)	(11.542)	(12.316)	(1.069)
Female turnout t-1	61.770	60.726	1.045	62.262	60.842	1.420	61.192	60.599	0.593
	(12.929)	(13.332)	(0.827)	(12.285)	(12.813)	(1.084)	(13.662)	(13.887)	(1.269)
Female MLA t-1	0.306	0.255	0.050*	0.301	0.213	0.088**	0.311	0.303	0.008
	(0.461)	(0.436)	(0.027)	(0.460)	(0.410)	(0.035)	(0.464)	(0.460)	(0.041)
Incumbent t-1	0.697	0.684	0.014	0.684	0.717	− 0.033	0.713	0.648	0.065
	(0.460)	(0.465)	(0.029)	(0.466)	(0.451)	(0.039)	(0.454)	(0.478)	(0.043)
Female party head t-1	0.202	0.150	0.052**	0.202	0.165	0.037	0.201	0.133	0.068**
	(0.402)	(0.357)	(0.023)	(0.403)	(0.372)	(0.033)	(0.402)	(0.340)	(0.033)
SC-reserved constituency t-1	0.195	0.205	− 0.010	0.171	0.198	− 0.027	0.223	0.214	0.010
	(0.397)	(0.404)	(0.024)	(0.377)	(0.398)	(0.032)	(0.418)	(0.410)	(0.036)

Table 24 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All			Men			Women		
	Close	Non-close	Difference	Close	Non-close	Difference	Close	Non-close	Difference
ST-reserved constituency t-1	0.113	0.131	− 0.018	0.114	0.146	−0.032	0.112	0.113	− 0.002
	(0.317)	(0.337)	(0.020)	(0.318)	(0.353)	(0.028)	(0.316)	(0.317)	(0.028)
Aligned with state govt t-1	0.607	0.656	− 0.049*	0.619	0.671	− 0.053	0.593	0.639	− 0.046
	(0.477)	(0.469)	(0.028)	(0.474)	(0.464)	(0.038)	(0.482)	(0.474)	(0.042)
Aligned with central govt t-1	0.353	0.336	0.017	0.322	0.356	− 0.034	0.390	0.314	0.076**
	(0.410)	(0.402)	(0.024)	(0.410)	(0.412)	(0.034)	(0.408)	(0.389)	(0.035)
INC legislator t-1	0.259	0.284	− 0.025	0.275	0.297	− 0.022	0.240	0.269	− 0.029
	(0.439)	(0.451)	(0.027)	(0.448)	(0.457)	(0.037)	(0.428)	(0.444)	(0.039)
BJP legislator t-1	0.172	0.182	− 0.011	0.147	0.178	−0.031	0.201	0.188	0.013
	(0.378)	(0.386)	(0.023)	(0.355)	(0.383)	(0.030)	(0.402)	(0.391)	(0.035)
Panel B: candidate characteristics									
Educated	0.818	0.855	− 0.037	0.870	0.889	− 0.019	0.762	0.818	− 0.056
	(0.387)	(0.353)	(0.039)	(0.339)	(0.315)	(0.047)	(0.429)	(0.387)	(0.061)
MLA's age	47.246	48.582	− 1.336	48.671	50.185	− 1.514	45.646	46.899	− 1.253
	(10.691)	(9.818)	(1.048)	(9.939)	(9.537)	(1.386)	(11.341)	(9.861)	(1.556)
Total assets ('000 Rs.)	6902.366	11338.543	− 4436.177	6061.714	8202.431	− 2140.717	7859.415	14815.537	− 6956.121
	(11914.105)	(32770.404)	(2867.379)	(9860.372)	(16893.489)	(2120.832)	(13907.696)	(43970.661)	(5587.216)
Total liability ('000 Rs.)	732.233	665.473	66.760	724.553	544.983	179.570	741.619	792.765	− 51.146
	(2406.121)	(3559.485)	(358.284)	(2337.882)	(1174.566)	(249.937)	(2509.085)	(4967.294)	(713.294)
Criminal	0.224	0.212	0.012	0.321	0.268	0.053	0.103	0.148	−0.045
	(0.418)	(0.409)	(0.040)	(0.470)	(0.444)	(0.059)	(0.306)	(0.356)	(0.049)
SC legislator	0.189	0.206	− 0.018	0.148	0.234	− 0.086	0.231	0.179	0.052
	(0.393)	(0.406)	(0.047)	(0.359)	(0.425)	(0.067)	(0.425)	(0.385)	(0.067)

Table 24 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All			Men			Women		
	Close	Non-close	Difference	Close	Non-close	Difference	Close	Non-close	Difference
ST legislator	0.038	0.063	− 0.025	0.037	0.036	0.001	0.038	0.089	− 0.051
	(0.191)	(0.243)	(0.027)	(0.191)	(0.187)	(0.031)	(0.194)	(0.286)	(0.044)
Muslim legislator	0.060	0.038	0.022*	0.071	0.050	0.021	0.048	0.025	0.023
	(0.237)	(0.191)	(0.012)	(0.258)	(0.218)	(0.018)	(0.213)	(0.156)	(0.014)

Columns (1)–(3) compare mixed gender races in which victory margin was within 5% (close races) with mixed gender races with a larger victory margin (non-close races). The subsequent columns further break down close and non-close races by the gender of the legislator. Columns (4)–(6) compare close and non-close male winners of mixed-gender races. Columns (7)–(9) compare close and non-close female winners. Standard deviations in parentheses except in columns (3), (6), and (9) which have standard errors in parentheses. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels from tests of no differences, respectively

Table 25 External validity: candidates with positive and negative party swings

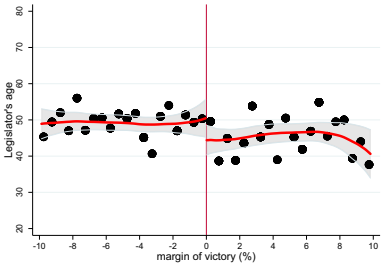
	(1)	(2)
	Growth of $light_{t+1}$	
	Positive party swing	Negative party swing
Female legislator	14.79**	15.48*
	[7.25]	[8.37]
R^2	0.03	0.04
N	407	256
Bandwidth	7.26	4.67

This table replicates the results in column (1) of Table 1 for subsamples of candidates with postive (model 1) and and negative party swings (model 2). Negative and positive party swings are defined based on Eq. (4). See also Notes to Table 1

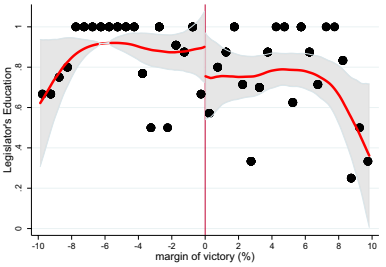
Table 26 Re-contest and re-election rates by legislator gender and whether close election

	(1)	(2)	(3)	(4)	(5)	(6)
	Close			Non-close		
	Female	Male	Difference	Female	Male	Difference
Prob(Winning)	0.180	0.267	− 0.087*	0.316	0.356	− 0.040
	(0.385)	(0.444)	(0.047)	(0.465)	(0.479)	(0.027)
Prob(Winning|Rerunning)	0.290	0.435	− 0.145**	0.524	0.558	− 0.033
	(0.456)	(0.498)	(0.069)	(0.500)	(0.497)	(0.037)
Rerunning	0.621	0.613	0.008	0.602	0.639	− 0.037
	(0.487)	(0.489)	(0.055)	(0.490)	(0.481)	(0.028)

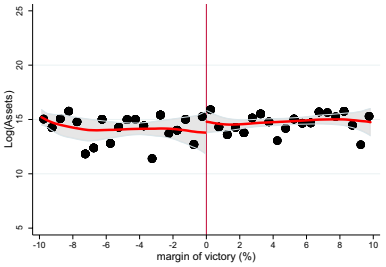
Columns (1)–(3) compare the likelihood that an incumbent legislator reruns and gets reelected after mixed-gender races in which victory margin was within 5% (Close races). Column (4)–(6) compare the likelihood of re-running and re-election after mixed-gender races with a larger victory margin (Nonclose races). The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels from tests of no differences, respectively



(a) Winner's age

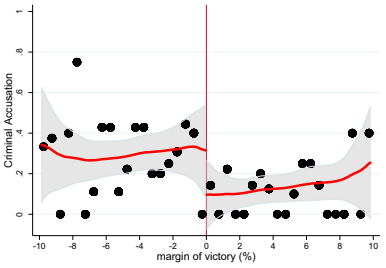


(b) Education

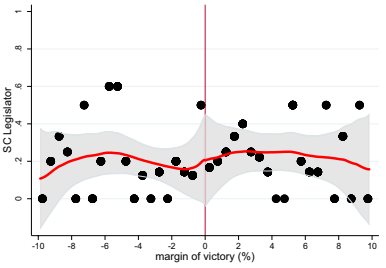


(c) Total Assets

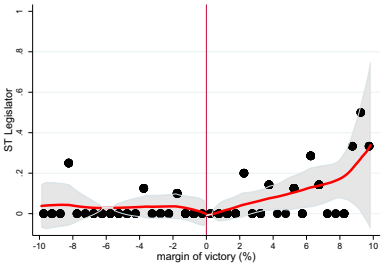
(d) Total Liabilities



(e) Criminal



(f) SC legislator



(g) ST legislator

(h) Muslim legislator

Fig. 10 Differences in legislator characteristics. Each variable is plotted against female margin of victory in mixed gender races, which is the difference between vote shares of a female candidate and male candidate in mixed gender races. Mixed gender races are in which a woman either won or was a runnerup against a man. By construction, margin of victory is positive for female legislators and negative for male legislators. Each dot represents a local average in bins of 0.5 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, triangular kernel and a 5 percent bandwidth. The figures also depict a 95 percent confidence interval for each variable around the solid curve

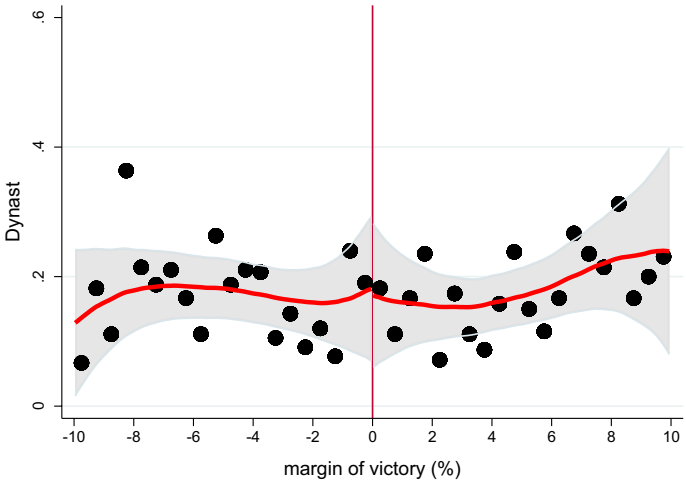


Fig. 11 Propensity to be dynasts among men and women in close elections. This figure plots a dummy indicating whether a MLA is a dynast against female margin of victory in mixed gender races, which is the difference between vote shares of a female candidate and male candidate in mixed gender races. Mixed gender races are in which a woman either won or was a runnerup against a man. By construction, margin of victory is positive for female legislators and negative for male legislators. Each dot represents a local average in bins of 0.5 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, triangular kernel and a 5 percent bandwidth. The figure also depicts a 95 percent confidence interval for each variable around the solid curve

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