The Effects of Malapportionment on Economic Development: Evidence from India's 2008 Redistricting

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Abstract

Does the unequal formal representation of people in legislatures ("malapportionment") affect development? Answering this question is critical for assessing the welfare costs of malapportionment. We argue that representation might spur development as the desire for reelection incentivizes legislators to provide for their districts, and as voters hold politicians to account for doing so. Since this is the case, malapportionment might cause unequal development. Using data from a natural experiment in India due to redistricting, we show that a 10% increase in representation causes a 0.6% increase in night lights, a frequently used proxy for development. Reapportionment, or the equalization for representation, attenuates this effect. Consistent with the theory, the effect of representation is larger in districts with legislators and voters that are able to hold the executive to account.

The empirical case against unequal legislative representation or malapportionment is incomplete. Although a voluminous literature examines the effects of unequal representation on coalition composition (Bhavnani 2018; Lee 2000), the distribution of funds (Ansolabehere et al. 2002; Galiani et al. 2016; Knight 2008) and public policy (Ardanaz and Scartascini 2013), we know of no work that examines its effects on economic development. Yet, understanding whether and why malapportionment affects development—which is arguably the ultimate outcome of the other outcomes studied in the literature—is critical for assessing the welfare costs of unequal representation.

We draw on the usually separate literatures on malapportionment reviewed above and the distributive politics literature (see Golden and Min 2013 for a review) to argue that unequal legislative representation might affect developmental outcomes. We focus on two of the many reasons that this could be the case. First, politicians might wish to improve the development outcomes of their constituencies to be reelected. And second, voters might work to ensure that politicians are held accountable for the delivery of better development. As we argue below, the operation of both mechanisms is increasing in the relative representation of districts. Since representation affects development, malapportionment or unequal representation causes unequal development.

To test our argument, we examine the effects of malapportionment on night light output across India's administrative districts. A substantial literature employs night lights as a measure of development outcomes, particularly in contexts where development is hard to track (Asher and Novosad 2017; Chen and Nordhaus 2011; Henderson et al. 2012). India is an appropriate case because although the degree of malapportionment is around the world average (Samuels and Snyder 2001), the country has substantial sub-national variation in the degree of unequal political representation (Bhavnani 2018). Focusing on India also allows us to leverage abrupt changes in the degree of representation due to redistricting to estimate the causal effects of malapportionment. Our analysis of this natural experiment suggests that a 10% increase in representation increases light output by 0.6%, which is the equivalent of 25% of the average annual increase in light output. We also find that reapportionment attenuates the effect of malapportionment. Our results are robust to examining the effect of malapportionment on another development outcome and a number of specification changes. Lastly, the data suggest that the benefits of increased representation are concentrated, as suggested by the theory, in places with legislators and electorates that we have a priori reasons to believe would affect development.

In addition to contributing to the literature on malapportionment, our paper contributes to the literature on democracy and development. Much of this literature focuses on the "extensive" margin, examining the effects of transitions to democracy on development (Przeworski et al. 2000). In this paper, we focus on the "intensive" margin, examining whether more or more equal representation within a large democracy improves development.[1]

1 How malapportionment affects development

Building on the literature, we focus on bottom-up and top-down reasons that representation could affect development. Since representation affects development, unequal representation leads to unequal development.

First, to take a bottom-up view, voters hold politicians to account when they are empowered. For example, Besley and Burgess (2002) shows that India's central government is more likely to respond to food shortfalls in states with more informed electorates. The operation of this mechanism will likely be increasing in the number of legislators per capita (or decreasing in malapportionment), as voters with more representatives have more opportunities to hold politicians to account. While the opposite is possible—more representatives could make it difficult for voters to apportion credit to politicians, and might therefore undermine accountability (Gulzar and Pasquale 2017)—this possibility is attenuated by the fact that India has single member districts, which helps voters to connect outcomes with politicians (Carey 2008). We also draw on the literature to note that we expect that certain types of voters—such as those that are informed—might especially be able to hold politicians to account (Besley and Burgess 2002; Björkman and Svensson 2009).[2]

[1]In this sense, our paper is similar to the burgeoning literature on the effects of the deepening of the franchise (Miller 2008).

[2]Some recent works fail to find that information allows voters to hold politicians to account (Raffler et al. 2018).

A second reason that development might be increasing in representation is top-down. Politicians frequently try to secure their reelection by targeting particular constituencies for benefits that, in turn, might impact development (Brollo and Nannicini 2012; Tavits 2009). In the context of India, Baskaran et al. (2015) shows that politicians boost the supply of electricity to constituencies aligned with the ruling party or coalition. Min (2015) shows this to be the case particularly around elections, and Bohlken (2018) finds that national politicians channel resources to places with co-partisan state legislators. Although this literature identifies different logics for the distribution of government resources (for example, there is disagreement over whether core or swing voters or districts are targeted), all these mechanisms could conceivably be increasing in the number of representatives per capita (or decreasing in malapportionment), as more legislators can exert more effort to improve development outcomes. Although having more legislators increases the free-rider problem, and increases the opportunity for politicians to claim credit for others' activities, these dynamics are less likely in single-member district systems such as India's where responsibilities are relatively clear (Carey 2008). Moreover, in parliamentary systems such as India, legislators from governing coalitions—rather than the opposition—might be particularly able to influence development outcomes, since the government is dependent on their votes for their majority (Asher and Novosad 2017).

To summarize, malapportionment or differences in relative representation might affect development as more politicians affect development to a greater degree, and as more politicians give voters greater opportunities to hold politicians to account. More politicians could do the opposite—that is, they could make politicians less likely to deliver development due to collective action, free-riding and credit claiming problems—but these possibilities are less likely in India's single member districts than would be the case in (say) a multimember district system (Carey 2008).

2 Malapportionment in India's states

As is the case in many countries, the Indian constitution secures for its citizens one-person one-vote. In the country's state legislatures, which are the focus of this paper, this is ensured by providing for a universal franchise and decadal "delimitation" or redistricting. The country's 29 states are divided into administrative districts, with relatively fixed boundaries. These administrative districts are divided into single-member assembly constituencies that elect Members of the Legislative Assemblies to state legislatures. During delimitation, each administrative district within a state is assigned single-member seats or constituencies in proportion to share of the state population. However, the Indian government froze redistricting in 1976, thereby causing an increasing degree of malapportionment across the country for the next several decades. The redistricting freeze expired in 2008, and the redistricting that followed has substantially equalized representation within state legislatures.

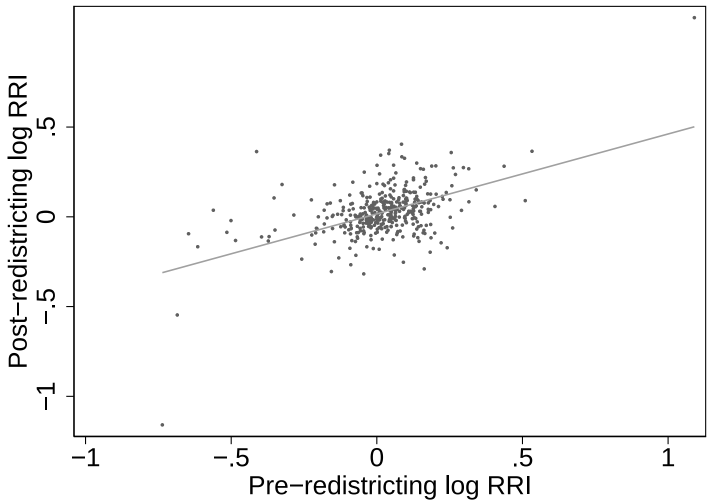
Following the literature, we may measure the degree of malapportionment across India's districts using the relative representation index or RRI. The RRI is calculated as the seats per capita in a district divided by the seats per capita in the state ($v_{d,s,t}/\bar{v}_{s,t}$, where v is the seats per capita in the district, $\bar{v}$ is the seats per capita in the state, and d, s, and t denote the district, state and year, respectively).[3] Due to data constraints, we calculate the RRI using the number of registered voters in each district, rather than population.[4] Districts with RRIs greater than one are overrepresented, those with RRIs less than one are underrepresented, and districts whose RRI equals one give people a vote equal to the average. Figure 1 plots the log RRI before and after redistricting, illustrating the fact that the degree of malapportionment across India's administrative districts was substantially reduced after redistricting (the slope of the fitted line is less than one).

Bhavnani (2018) argues that the 1976 freeze in redistricting was implemented for apolitical and non-partisan reasons, to not reward high population growth states with additional representation. Consistent with this argument, the freeze was instituted at a time of widespread paranoia

[3]Within each state, the number of seats per capita would be a reasonable measure of representation. However, since our analysis uses data from India's 15 largest states, we normalize this term by seats per capita in each state.

[4]More specifically, the Election Commission of India releases data on the number of registered voters, and not the population, of each district in election years. Reassuringly, population figures from the 2001 census are highly correlated with the number of registered voters in the election temporally closest to 2001 ($\rho > 0.95$). This is perhaps not surprising in India since the state rather than citizen is responsible for voter registration. Bhavnani (2018) also uses registered voters rather than population to measure malapportionment.

Figure 1: The Relative Representation Index across India's districts before and after redistricting



2

Notes: The line of best fit has slope 0.4.

about population growth in India, which also led to forced sterilizations. Furthermore, simulations suggest the freeze did not increase the seat shares of the Congress party that instituted it (Bhavnani 2018). Lastly, the redistricting that did occur in May 2008 due to the lapsing redistricting freeze was implemented by a nonpartisan, constitutionally mandated commission and does not appear to have been influenced by partisanship (Iyer and Shivakumar 2012). Given this, we use the redistricting of 2008 as a natural experiment with which to examine the effects of representation. Our strategy parallels the use of redistrictings in the United States and Japan as natural experiments (Ansolabehere et al. 2002; Horiuchi and Saito 2003).

3 Empirical strategy and data

To measure economic development at the subnational level, we employ median night light output for the villages in each of India's administrative districts, as made available at http://india.nightlights.io/. Night lights have been increasingly used as a proxy for economic development (Asher and Novosad 2017; Chen and Nordhaus 2011; Henderson et al. 2012), although a few works have also used it as a measure of urbanization (Zhou et al. 2015) and/or electrification (Baskaran et al. 2015; Min

2015).[5] Using a sample of developing countries, Henderson et al. (2012) estimates that the elasticity of GDP growth with respect to light output growth is 0.3. In a robustness test, we also proxy for development using a count of the investment projects under implementation in India's administrative districts.

Light output data have the advantage of being collected by satellite, objectively, and without the problems of survey non-response and political interference. They are therefore particularly useful in developing country contexts, and for measuring economic growth for subnational units for which GDP growth figures are unavailable. That said, nighlights data have problems as well, including sensor saturation or top-coding, light blooming beyond its origins, and technical difficulties due to cloudy weather. Since this is the case, we also analyze an second subnational measure of development that we introduce later. The median light output measure varies between 0–63.

The administrative district is the appropriate unit of analysis because it is the level at which most administrative decisions, including those relating to government-sponsored development programs, are made. We do not use electoral constituencies, which are nested among districts, as our unit of analysis since their boundaries change in 2008.[6]

The key independent variable employed is the logarithm of the previously-introduced relative representation index (RRI) for each administrative district in India. To calculate the effect of representation on economic development, we estimate:

$$Y_{d,s,t} = \alpha + \beta RRI_{d,s,t} + \gamma X_{d,s,t} + \delta_{s,t} + \eta_{d,s} + \varepsilon_{d,s,t} \tag{1}$$

where Y is log light output (in a robustness test, this is the log of the number of investment projects under implementation), RRI is the Relative Representation Index, X is a set of controls, including

[5] We were able to find 43 scholarly works—working papers, published papers and books—that used night lights data. 61% of these used night lights to measure development, while another 20% used it to measure urbanization and/or population density. 16% of the works used nightlights to proxy for electrification and/or electricity consumption.

[6] Indeed, we would not have a natural experiment to analyze if constituency boundaries did not change. In countries with single member district systems such as India, large changes in malapportionment in short periods are necessarily accompanied by boundary changes. This need not be the case in multi-member district systems.

the lagged dependent variable and the logarithm of the number of registered voters, which could directly affect public goods, $\delta_{s,t}$ are state-year fixed effects, $\eta_{d,s}$ are district fixed effects and ε is a normally distributed error term. d indexes administrative districts, which are nested within states (s), and t indexes time. Standard errors are clustered by state-year. The estimate of interest is β, the effect of changes in the RRI on changes in light output.

Using this strategy, the causal effect of changes in the RRI is statistically identified using the abrupt change in the number of seats across districts due to redistricting. This is the case since although changes in RRI could be due to changes in registered voters or seats in states, or due to changes in registered voters or seats in districts, the first three of these possibilities are controlled for in the analysis. The number of the registered voters and seats in states are controlled for using state-year fixed effects, and the number of registered voters in districts are controlled for directly. The variation in the RRI that remains then is simply due to the change in the number of seats in districts due to redistricting.

The data used in this paper are a balanced panel, covering India's 15 largest states (with 88% of the country's population) over 2004–2012. The data sources and coverage details are noted in the Online Appendix; the data are summarized in Online Appendix Table 2. Redistricting took effect in May 2008, and applied to all elections held from then on.

4 Malapportionment affects development

To start with, we use OLS to examine the correlation between log light output and the log RRI, controlling for the number of registered voters and lagged light output (regression 1 of Table 1). The controlled correlation is negative and statistically insignificant at conventional levels. This regression fails to control for the many confounds that state-year and district fixed effects would absorb. We include these in regression 2, and thereby implement equation 1. This regression suggests that the estimate of the effect of changes in malapportionment due to redistricting on log light output is statistically and substantively significant. A 10% increase in representation causes a 0.6% increase in light output. Since the mean annual increase in light output is 2.5%, this change is equivalent to approximately 25% of annual light output growth.[7] Since the elasticity of GDP growth with respect to light output is estimated to be 0.3 (Henderson et al. 2012), this suggests a GDP growth rate increase of 0.2%.

Having estimated the causal effect of representation on light output, we examine the effects of redistricting on the effects of the RRI. To do so, we add the interaction of the RRI with a dummy for post-delimitation elections (the uninteracted effect of the post-delimitation dummy is absorbed by the state-year fixed effects). This analysis, presented in regression 3, suggests that the causal effect of the RRI is attenuated after redistricting. The estimated effect of the RRI post-redistricting (the sum of the first two coefficients in the regression) is statistically indistinguishable from zero. This is consistent with our theory, since the equalization of representation should and does blunt the effects of differences in representation.

Our statistical analysis suggests that improved representation boosts economic development, as measured by night lights. To buttress our interpretation of the night lights data as development, we respecify our dependent variable as the (log) number of investment projects under implementation in India's districts. The underlying data are from the Center for the Monitoring of the Indian Economy's CapEx database, which tracks investments in infrastructure, manufacturing and services, implemented by the public and private sectors. Regression 1 of Online Appendix Table 3 examines the bivariate relationship between log projects and log RRI, and suggests no statistically significant relationship. Regression 2 implements our preferred specification with fixed effects, and suggests that a 10% increase in representation increases the number of projects by 1.9%, although this estimate is only statistically significant at 11%. Regression 3 adds the interaction of the RRI with a dummy for post-delimitation elections and suggests again that the causal effect of malapportionment (which is now estimated to be larger and statistically significant) is blunted after redistricting.

Our main results are also robust to a number of additional tests, including to respecifying the

[7] Our results are consistent both with reapportionment redistributing development across districts and also with it increasing overall levels of development. Ascertaining which of these is the case would require a different (state- rather than district-level) research design.

Table 1: Does malapportionment affect light output?

	1	2	3
Ln Relative Representation Index (RRI)	-0.0230	0.0592**	0.0682**
	(0.0171)	(0.0248)	(0.0274)
Ln RRI x Post-redistricting			-0.0550
			(0.0418)
Ln registered voters	0.0138***	0.0926***	0.0603**
	(0.00391)	(0.0242)	(0.0297)
Lagged ln light output	0.964***	0.237***	0.234***
	(0.00678)	(0.0445)	(0.0448)
State-year fixed effects?	N	Y	Y
District fixed effects?	N	Y	Y
Observations	3222	3222	3222
Adjusted R-squared	0.87	0.96	0.96

Notes: The dependent variable is ln light output. Standard errors, clustered by state-year from regression 2 on, in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

dependent variable as the proportionate change in light output (regression 1 of Online Appendix Table 4), to respecifying the independent variable as log seats, which is arguably more easily interpretable than the RRI (regression 2), to dropping the lagged value of log light output (concerns of Nickell bias might warrant dropping the term; regression 3), and to controlling for the (post-treatment) proportion of representatives that are members of governing coalitions (regression 4).[8]

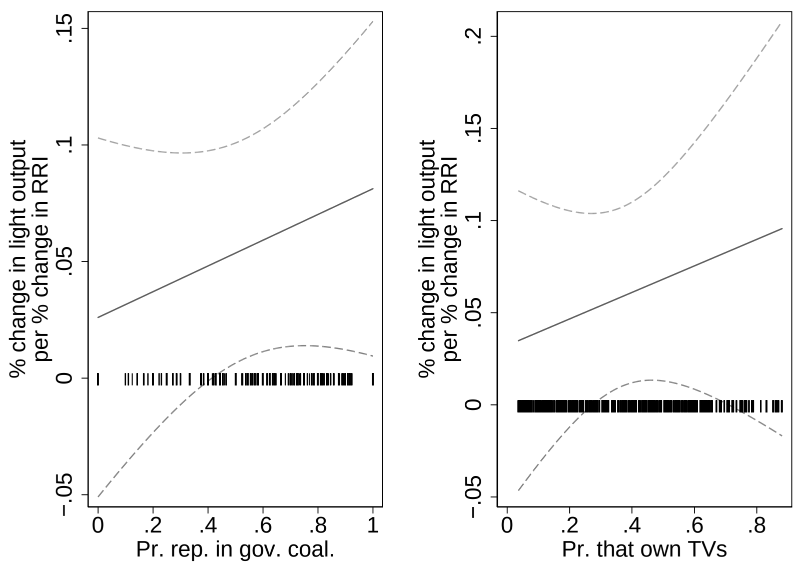
4.1 ... particularly if legislators and voters are powerful

As argued previously, malapportionment might affect development outcomes for top-down, strategic reasons, as politicians work to develop their constituencies. An observable implication of this mechanism is that the effects of additional representation should be particularly discernible in

[8] We do not control for this variable in the main specification (or indeed others like it, such as partisan vote shares, or the proportion of representatives in the cabinet) since its values are realized after the treatment is assigned. Controlling for post-treatment variables would bias the estimated effect of malapportionment, since malapportionment might work precisely through these variables (King 1991; King and Zeng 2007). For an example of such a mechanism, please see the next section.

districts with powerful legislators. To test this possibility, we interact the proportion of state legislators in governing coalitions with the RRI (regression 1 of Online Appendix Table 5). Note this analysis does not purport to be causal. We are merely examining whether the effects of the RRI that we have established are concentrated in the districts suggested by the theory. The interaction term is positive and statistically significant, suggesting that does indeed malapportionment boost light output largely in districts with a high proportion of representatives in governing coalitions. The first plot in Figure 2 maps the variation in the effect of representation on light output as the proportion of state legislators in governing coalitions varies. It suggests that the RRI boosts light output in the approximately 60% of district-years that have more than half of their state legislators in governing coalitions. This is consistent with the theory: while malapportionment affects development outcomes, it particularly does so when state legislators are in governing coalitions.

Figure 2: The effect of malapportionment on light output as the proportion of representatives in the governing coalition and those that own TV vary, with 95% confidence intervals



Notes: The coefficients underlying the plots are from the two regressions in Online Appendix Table 5. The rug plots display the distribution of proportion of representatives in the governing coalition, and the proportion of the rural population that owns TVs. See text for details.

The second mechanism that we test is that representation affects light output bottom-up, as voters hold politicians to account. Since districts with high TV ownership rates should be particularly able to hold politicians to account (TV could embolden citizens, by making them aware of, or able to, demand their rights, and by improving their access to information), we should expect the positive effects of increased representation to particularly hold in these contexts. To test this, we interact the TV ownership rates (unfortunately, these data are only available from 2007/08 and are therefore not predetermined for the entire panel; regression 2) with the log RRI. The interaction term is positive but is not statistically significant at conventional levels. Marginal effects are plotted in the second plot of Figure 2, which suggests that greater representation increases light output in most of the districts where at least 30% of the population owns TVs. In regression 3, we control for the two mechanisms simultaneously. Doing so substantially weakens the evidence in favor of all the mechanisms, possibly due to collinearity.

5 Conclusion

In this paper, we argued that malapportionment might affect economic development. Using a natural experiment due to India's 2008 redistricting, we demonstrated that increases in representation increase light output, and that reapportionment attenuates the effects of representation. Weaker evidence suggests that the positive effect of greater representation is concentrated in constituencies with legislators and electorates that we have a priori reasons to believe will be influential. Malapportionment is ubiquitous and is, to an extent, unavoidable. We now know that in one important context, it has significant welfare consequences.

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Online Appendix for "The Effects of Malapportionment on Economic Development: Evidence from India's 2008 Redistricting"

Data sources, coverage and summary

- Light output: Light output data for the median village in each district-month-year were downloaded from http://india.nightlights.io/ in February 2016. Most district-month-years had multiple measures of median light output, taken by different satellites. The median light output for each district-year was calculated in two steps. First, for each district-month-year, light output was set to the median light output as measured across multiple satellites. Second, for each district-year, light output was set to the median of the 12 monthly light output measures for that year.

- Number of projects under implementation: From the Center for Monitoring Indian Economy (CMIE).

- Ln registered voters: Linearly imputed using data on the registered number of voters in each district in election years. Underlying data are from Bhavnani, Rikhil R., 2014, "India National and State Election Dataset," doi:10.7910/DVN/26526, Harvard Dataverse, V2.

- Ln Relative Representation Index (RRI): Calculated using data from Bhavnani (2014) and registered voters data, calculated as above.

- Prop. of representatives in the governing coalition: Imputed from cabinet data. Cabinet data are coded using "Who's Who" directories, state government websites and responses to Right to Information requests.

- Prop. that own TVs: From the 2007/08 District Level Household and Facility Survey.

Online Appendix Table 1: Data coverage

State	Number of districts
Andhra Pradesh	21
Bihar	36
Gujarat	21
Haryana	19
Himachal Pradesh	12
Karnataka	25
Kerala	14
Madhya Pradesh	45
Maharashtra	29
Punjab	14
Rajasthan	26
Tamil Nadu	23
Uttar Pradesh	61
West Bengal	12
Total districts	358
Total years (2004–2012)	9
Sample size	3,222

Online Appendix Table 2: Summary statistics

	Mean	Std. Dev.	Min.	Max.
Ln light output	1.29	0.40	0.49	3.30
Prop. change in light output	0.02	0.15	-0.38	0.89
Ln projects under implementation	2.43	1.46	0.00	7.51
Ln Relative Representation Index (RRI)	0.03	0.16	-1.55	1.11
Ln registered voters	13.99	0.71	10.01	16.71
Prop. of representatives in the governing coalition	0.65	0.27	0.00	1.00
Prop. of representatives in the cabinet	0.12	0.14	0.00	1.00
Prop. literates, imputed	0.60	0.11	0.27	0.90
Prop. literates, 2001	0.54	0.12	0.24	0.85
Prop. that own TVs	0.36	0.21	0.00	0.88

Additional tables

Online Appendix Table 3: Robustness tests, 1/2

	1	2	3
Ln Relative Representation Index (RRI)	-0.0784	0.187	0.230**
	(0.0824)	(0.113)	(0.113)
Ln RRI x Post-redistricting			-0.329*
			(0.187)
Ln registered voters	0.0764***	0.167	-0.0399
	(0.0211)	(0.110)	(0.176)
Lagged ln projects under implementation	0.882***	0.206***	0.205***
	(0.0101)	(0.0295)	(0.0294)
State-year fixed effects?	N	Y	Y
District fixed effects?	N	Y	Y
Observations	3136	3136	3136
Adjusted R-squared	0.74	0.88	0.88

Notes: The dependent variable is the log of the number of investment projects under implementation. Standard errors, clustered by state-year from regression 2 on, in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Online Appendix Table 4: Robustness tests, 2/2

Dependent variable:	Prop. change in light output	Ln light output		
	1	2	3	4
Ln Relative Representation Index (RRI)	0.0592**		0.0777***	0.0601**
	(0.0248)		(0.0260)	(0.0248)
Ln registered voters	0.0926***	0.0334	0.101***	0.0946***
	(0.0242)	(0.0249)	(0.0273)	(0.0238)
Lagged ln light output	-0.763***	0.237***		0.236***
	(0.0445)	(0.0445)		(0.0447)
Ln seats		0.0592**		
		(0.0248)		
Prop. of representatives in the governing coalition				0.0246**
				(0.0112)
State-year fixed effects?	Y	Y	Y	Y
District fixed effects?	Y	Y	Y	Y
Observations	3222	3222	3293	3222
Adjusted R-squared	0.73	0.96	0.96	0.96

Notes: Standard errors, clustered by state-year, in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Online Appendix Table 5: What are the mechanisms by which malapportionment affects light output?

	1	2	3
Ln Relative Representation Index (RRI)	0.0260	0.0322	-0.0105
	(0.0393)	(0.0445)	(0.0626)
Ln RRI x Prop. of representatives from the governing coalition	0.0552		0.0606
	(0.0587)		(0.0599)
Prop. of representatives in the governing coalition	0.0225**		0.0227**
	(0.0112)		(0.0112)
Ln RRI x Prop. that own TVs		0.0720	0.0887
		(0.101)	(0.103)
Ln registered voters	0.0930***	0.0947***	0.0955***
	(0.0240)	(0.0248)	(0.0246)
Lagged ln light output	0.236***	0.236***	0.236***
	(0.0446)	(0.0445)	(0.0445)
State-year fixed effects?	Y	Y	Y
District fixed effects?	Y	Y	Y
Observations	3222	3222	3222
Adjusted R-squared	0.96	0.96	0.96

Notes: The dependent variable is ln light output. In regression 3–5, the uninteracted effects of literacy and TV ownership are absorbed by the district fixed effects. Standard errors, clustered by state-year, in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.