Elections and Rural Road Construction: Theory and Evidence from India*

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Abstract

This paper analyzes the existence of electoral cycles in infrastructure provision in the context of a large rural road building program in India. We use data covering 150,000 roads over a decade to demonstrate an increase in road building activity before state elections. These electoral cycles in rural road building do not translate into efficiency losses in terms of quality, cost or delay. However, we find evidence that politicians build roads with a lower stipulated construction time before elections. In line with our model's predictions, we also find that electoral constituencies with a larger share of uninformed voters, as measured by the fraction of illiterate population, display larger electoral cycles.

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1 Introduction

An influential theoretical literature starting from Nordhaus (1975) argues that economic outcomes will follow the electoral calendar due to fiscal manipulation by opportunistic politicians to boost their re-election prospects (Lindbeck 1976; Rogoff and Sibert 1988; Rogoff 1990; Persson and Tabellini 1990). However, empirical evidence on physical outcomes such as unemployment has been mixed at best: moving to cycles in policy variables, however has produced some credible evidence, in particular on budgetary and monetary variables[1]. The literature initially consisted mostly of either cross-country studies[2] or studies focused on developed countries.[3] Recently, however some progress has been made for developing countries at the sub-national level.[4] An underlying theme running through these results is that political cycles should logically be more apparent in outcomes where there is greater discretion and control of instruments by the government, and where targeting to pivotal groups of voters is possible.[5]

In this paper, we provide evidence for electoral cycles in public infrastructure - road building - even when the state government does not control the budget on roads, when there are multiple levels of government involved, and when targeting of roads to particular constituencies is ruled out. Despite these constraints, state legislators can still affect program outcomes through informal lobbying with the local bureaucracy (Jensenius and Suryanarayan 2015; Bussell 2019) and in the specific case that we consider i.e. road building, through more formal channels such as participating in the planning stage (N.R.R.D.A 2012; Lehne et al.

[1] Dubois (2016) provides a survey.

[2] See, for example, Shi and Svensson (2006); Brender and Drazen (2005); Streb et al. (2009); Persson et al. (2003); Michelitch and Utych (2018) among others.

[3] See, for example, McCallum (1978), Klein (1996), Galli and Rossi (2002), Veiga and Veiga (2007), Grier (2008), Potrafke (2010), Aidt et al. (2011), Efthyvoulou (2012), Katsimi and Sarantides (2012), Potrafke (2012), Mechtel and Potrafke (2013), Aidt and Mooney (2014), Stolfi and Hallerberg (2016), Bove et al. (2017) among others.

[4] See, for example, Akhmedov and Zhuravskaya (2004), Khemani (2004), Brender and Drazen (2005), Cole (2009), Vergne (2009), Drazen and Eslava (2010), Aidt and Eterovic (2011), Baskaran et al. (2015), Mironov and Zhuravskaya (2016), Klomp and de Haan (2016) among others.

[5] Although there is a lot of evidence for electoral cycles, there is also some documentation of null results, such as- Jensen et al. (2020); Berger and Woitek (1997) among others.

2018). We show that state-level incumbents are able to manipulate the road building process such that roads that are likely to be ready by the next election are built at the expense of roads that take longer to build. It is possible that this lowers welfare if e.g. "easy to build" roads come at the expense of roads that connect possibly very remote areas to highways.

The *Pradhan Mantri Gram Sadak Yojna* (PMGSY) was introduced in December 2000- it is the world's largest rural roads program, with a budget of $41 billion, with built in accountability and transparency features. The 2001 census formed the basis of determining whether villages qualified for the program, on the basis of stated population thresholds (Goyal, 2019). This federally sponsored scheme aimed to provide all weather road connectivity to previously unconnected habitations of India, ensuring that all habitations with population over 1000 get a road by 2003 and the ones with population over 500 get a road by 2007. The funding for this program comes from the federal government and is overseen by a national agency, but the actual execution of the program falls in the hands of the state government. Therefore, multiple decision-makers are involved in various stages of this program.

We use unique data that map all roads built under PMGSY over a decade (2000-01 to 2012-13), to census villages and then to state-level constituencies using geo-coded location and constituency shape files. Another distinctive feature of our data is information on initial and subsequent stages of a road's construction from administrative records - sanction, award of road construction contracts (or award) and finally road construction (or completion). We are, thus, able to observe detailed program implementation at each stage, at the road level, within each constituency. Therefore, we show that electoral cycles exist not only in allocation but also in real outcomes.

Our identification strategy exploits the staggered nature of constitutionally mandated scheduled state level elections in India to estimate the effect of an incumbent politician's tenure on rural road construction under PMGSY. We, thus, rely on constitutionally mandated scheduled elections for our analysis since scheduled elections cannot be strategically timed by politicians. This ensures timing of elections are exogenous to road-building out-

comes. Our empirical analysis shows that in the fourth year of an incumbent's term, i.e. two years before the elections are due in the five-year fixed term of the incumbent, 2 extra roads are sanctioned under PMGSY, the initial stage of the program. This represents a 40% increase over the mean. Although formal involvement of politicians is largely limited to the sanctioning stage, we should see an electoral cycle in subsequent stages of the road building program either because the spike in sanctioning translates into awards and completion or because of informal involvement of politicians in the final two stages (award and construction) (Lehne et al. 2018) of road building. We, thus, turn to the subsequent stages of the PMGSY program to find that following the spike in sanctioning outcomes in the fourth year of an incumbent's term, award and completion outcomes spike significantly on the fifth year (last year) of the incumbent's term. Our findings are robust to alternative empirical strategies - (1) we drop from the sample all the term years leading up to a midterm election; (2) we use an instrumental variable strategy where scheduled election dummies serve as instruments for the actual election dummies.

To understand whether increases in road building before elections translate into efficiency losses or increased costs, we turn to other measures of road building such as quality, delay, expenditure per kilometre and stipulated construction time, available in the administrative data. Using these measures, we demonstrate that the spike in outcomes before election does not systematically worsen the quality of or increase construction delay and costs for roads that are completed. However, we find that the stipulated construction time of roads decreases right before elections, hinting that politicians might target easier to build roads before elections. The opportunity cost of building roads that have shorter stipulated times, is that roads that are more difficult e.g. roads in geographically difficult terrain get delayed.

To explain these results we build on the model of electoral cycles in Shi and Svensson (2006). We show that when voters care about politician competence, misallocation of road spending towards those roads that have lower stipulated times for completion, can take place in periods before elections even when voters fully anticipate this. We also show theoretically

that misallocation is likely to be driven by those constituencies that have a higher share of uninformed voters. The reason is that informed voters know the competence level of the incumbent, while uninformed have to infer the competence of the incumbent from the roads that are built in period t and knowing the equilibrium strategy of the incumbent.

In line with the model's predictions, we find that electoral cycles are more pronounced in electoral constituencies with a larger share of uninformed voters as measured by the fraction of illiterate population in the constituency. We find that the magnitude of electoral cycle is higher in areas where voters don't particularly have the ability to assess incumbent's competence, i.e., in areas with higher share of uninformed voters. We also rule out the competing channel of a learning effect on the part of an incumbent legislator with less administrative experience. Specifically, we look at constituencies with first-time legislators where we would expect the learning effect to be more salient, if it exists. We find no such evidence.[6]

Our paper primarily contributes to the literature on electoral cycles at the subnational level in developing countries. Studies have shown that electoral cycles are larger in developing countries relative to developed countries (Shi and Svensson 2006). India, as a developing country, a federation and a democracy, is a particularly interesting context to study electoral cycles. In the Indian context, Khemani (2004) studies state budgets and documents no strong impact on aggregate fiscal variables but on individual budget components. Cole (2009) observes electoral cycle in public sector bank loans, and finds that election year credit booms induced substantially higher default rates. Min and Golden (2014) and Baskaran et al. (2015) examines electoral cycles in electricity losses and electricity provision respectively. Fagernäs and Pelkonen (2020) finds that teacher transfers and hiring increases after state elections and Bhattacharjee (2022) uncovers evidence of electoral cycles in child health outcomes.

We extend this literature, first, by uncovering evidence of electoral cycles in a novel context. Unlike previous research that has focused on more macroeconomic outcomes and

[6]We do not find evidence of effect of electoral cycles in PMGSY on re-election probability of incumbents. There is no heterogeneity in our results by electoral competition or center-state political alignment.

fiscal instruments such as state budgets, credit or more narrowly targetable outcomes such as teacher hiring and transfers, we look at a broad-based public good, viz. infrastructure building. Infrastructure provision is poor in developing countries (Banerjee et al. (2006)).[7] Since infrastructure is one of the key drivers of economic growth, a large-scale rural road building program like PMGSY is particularly important for broad-based development, and finding electoral cycles in this context is particularly concerning. Apart from the large scale of the program[8], it is worthwhile to note that PMGSY is amongst the more rule-based (Aggarwal 2018) programs in India, with little scope for manipulation. Further, unlike the other outcomes studied in the literature such as state budgets, agricultural credit, health expenditure, which come under the purview of either state governments or the federal government, in the case of PMGSY both the state governments and the federal government have joint decision-making powers making it a particularly interesting context to study,

Second, we show exact strategic timing on the part of the incumbent politicians in infrastructure programs that have long gestation periods between inception and completion. To the best of our knowledge, no other paper in the literature shows electoral cycles in successive stages of a program. Our results indicate that politicians time their effort strategically in the phase of PMGSY where they have the most significant formal role, i.e. sanctioning during the fourth year of their terms so that there is a boost in the more visible aspects of road building, i.e. awards and completion right before elections. Moreover, we are also able to show the exact mechanism through which politicians achieve this; they do so by targeting easier to build roads i.e. roads with lower stipulated construction time before elections. Our results further suggest that the overall welfare implication of such strategic timing are ambiguous since electoral cycles in magnitude of road building do not have any corresponding electoral cycles in unit costs and other efficiency measures of road building

[7] Andres et al. (2014) find that countries in South Asia need to invest between 6.6 and 9.9 percent of 2010 gross domestic product per year till 2020 to close their infrastructure gap compared to the 6.9 percent of gross domestic product invested in infrastructure by South Asian countries in 2009.

[8] More than 550,000 kms of rural roads having been constructed at a cost of US$ 40 billion over 19 years (2000-2018) since the program's roll out (Goyal (2019)).

such as quality and delay. However, our results suggest that this spike in road building is achieved by targeting easier to build roads before elections, leading to delays in roads that might potentially have led to greater increases in productivity.

Finally, unlike most papers in this literature, which either use state-level (Khemani 2004) or district-level data (Cole 2009), we are able to provide more reliable estimates of election cycles due to more disaggregated spatial level panel data at the constituency level. Constituency level panel data allow us us to study electoral cycles at the level at which state elections are held, by including constituency fixed effects to account for unobserved (time invariant) heterogeneity in constituency characteristics.

A growing literature has emerged in the context of *Pradhan Mantri Gram Sadak Yojna*, the world's largest rural public road delivery program. Almost all the papers in this literature show positive effects of rural road infrastructure on critical measures of development such as market integration (Aggarwal 2018), occupational choice (Asher and Novosad 2020), education (Adukia et al. 2020), healthcare utilization (Aggarwal 2021) and agricultural production (Shamdasani 2021). We show evidence of manipulation of program's functioning, i.e. how election timing influences the implementation of PMGSY, which can potentially impede program benefits.

The remainder of the paper is organized as follows. In Section 2, we describe the institutional background. Section 3 provides a theoretical model. The datasets are described in Section 4 and the empirical strategy in section 5. The main results are contained in Section 6 while Section 7 discusses the possible mechanisms behind our results. Finally, Section 8 concludes.

2 Institutional background

2.1 The PMGSY program

The *Pradhan Mantri Gram Sadak Yojna* (PMGSY) was introduced in December 2000. This federally sponsored scheme aimed to provide all weather road connectivity to previously unconnected habitations of India, ensuring that all habitations with population over 1000 get a road by 2003 and the ones with population over 500 get a road by 2007.

The program has been described as 'unprecedented' in scale and scope - between 2001 - 2010, it provided paved roads to over 100 million people, about 14.5% of rural population, or 47% of rural unconnected population of India, as of 2001 census (Aggarwal, 2018). The funding for this program comes from the federal government and is overseen by a national agency, but the actual execution of the program falls in the hands of the state government. Therefore, multiple decision-makers are involved in various stages of this program. We are interested in the role of state legislator or MLA (Member of Legislative Assembly), but first we outline the process of road planning, approval and clearance of road work, in order to profile the true scope of this program, and then argue that MLAs play an important role in all the stages of road building.

The framework of PMGSY consists of two distinct stages - an initial one-time preparation of road plan, and a yearly planning and clearance activity. Each of these stages involve multiple players at the local, state and federal levels, as outlined below.

2.2 Preparation of Road Plan

A simplified overview of the key phases of the program is given in Figure 1. The program begins at the block and district[9] level, with the formation of District Rural Roads Plan

[9]A district is an administrative unit of an Indian state. Districts can be sub-divided into *tehsils* or blocks, which can further be sub-divided into *Gram Panchayats* or village councils. The electoral district at the state level, on the other hand, is known as assembly constituency (AC), from where members of *state level* legislative assemblies (MLAs) are directly elected to serve five year terms. Each district is divided into several ACs in order to facilitate elections. At the *national level*, each state is divided into several national

(DRRP) and the core network, under the supervision of district Program Implementation Units (PIUs) which are set up by the state level road development agency (also known as SRRDA or the State Rural Road Development Agency).[10] These two planning documents are created for identifying eligible roads that could be constructed to improve the existing all-weather road connectivity at the district level.[11]

The plans are initially approved by the *Intermediate Panchayat*, and then overseen by the *District Panchayat*.[12] At this stage, it is also simultaneously shared with the Members of Parliaments and Legislative Assembly of the state (MP and MLA, respectively) for their feedback. Note that this marks the first instance of involvement from political actors. After ensuring that the suggestions of the politicians (MLAs and MPs) are given full consideration, the plan is forwarded to the state level standing committee.[13] This committee finalizes the DRRP, and also sends a copy of the plan to the federal government for approval.

Once the core network is ready, the states are required to prepare a comprehensive priority list of all proposed road links under PMGSY. The list is updated annually, by removing roads taken up under PMGSY or other programs, and a copy of this list is sent along with the annual proposals to all elected representatives in the state (N.R.R.D.A, 2005).

electoral districts called parliamentary constituencies (PCs), from where members of parliament (MPs) are directly elected to serve five year terms in the Indian House of Commons. Each PC consists of two to three ACs from within a state. Election of MPs are held concurrently at national level, whereas state level elections of MLAs are staggered.

[10]The DRRP consists of the existing network of roads in the district and the proposed new roads for PMGSY, while the core network identifies new roads required to assure all-weather connectivity for previously unconnected habitations (N.R.R.D.A, 2012) .

[11]For a detailed description of the entire process of road formation, clearance, disbursal and monitoring, see N.R.R.D.A (2005).

[12]In India, *Panchayati Raj* Institutions is a system of local governments at three levels: the top-level *District Panchayat* at the (administrative) district level; the intermediate (block) level *Panchayat Samiti* or *Intermediate Panchayat*; and the village level *Gram Panchayat*. Direct elections in India are held at the *Gram Panchayat* level, state level (for MLAs) and at national level (for MPs).

[13]The state level standing committee is headed by the Chief Secretary/ Additional Chief Secretary in each state. It is created for the purpose of overseeing PMGSY road construction.

2.3 Annual Planning and Clearance of Road Work

The annual flow of activity in PMGSY is summarized via Figure 2. Once the core network is prepared, it is possible to estimate the length of roads in each district. The list of road works is finalized each year at the district level. The funds for road construction are released at the federal level on a quarterly basis, subject to the satisfactory implementation of the program (i.e. subject to implementation of all the steps of Figure 1).[14] Every year, the list of roads is finalized at the district level through a consultative process involving lower level local governments and other elected representatives. Then, the state level agency for road development, State Rural Road Development Agency (SRRDA) vets the annual proposals so that they are in accordance with all guidelines, and then places it in front of the state level standing committee. This committee is in charge of finalising detailed reports for each prospective road. The proposals are then sent to the national agency for road development (the National Rural Roads Development Agency or the NRRDA), which operates under the supervision of the federal government.[15]

2.3.1 Road Clearance

At the federal level, the roads pass through the Ministry of Rural Development (MoRD) for clearance. The ministry then communicates the sanctioning of roads to the state governments. This sanctioning marks the first step of the process that is observable in our database (Figure 2).

After the cleared proposals have been communicated by the federal ministry, the implementation process begins at the state level. The state level agency invites tenders to award roads to contractor (observed in the "award of sanctioned roads through tenders" step, in

[14] Over the period we consider, the costs of implementation are borne entirely by the federal government. However, any cost overruns are borne by the state government.

[15] The National Rural Road Development Agency (NRRDA) is the federal level agency, set up under the chairmanship of the Minister of Rural Department (MoRD) to manage overall implementation. Before sending them to the national agency, the proposals are also technically assessed by expert institutions, appointed by the federal government.

bold in Figure 2). Upon successful completion of tendering, the contractors commence work on the roads. These last two steps are also observed in our database.

2.3.2 Disbursement of Funds

Under PMGSY, roads have to be completed within a stipulated time period. The cost of the sanctioned roads is made available to the state level agency in instalments, subject to fulfillment of completion conditions.[16]

Funds are released from the federal ministry subject to implementation of all the steps of Figure 1. Each year, the states distribute the allocated fund among the districts and also communicate this district-wise allocation to the federal ministry. The state level agency authorizes a high-ranking officer, only who can draw and disburse funds to the contractors.

Hence, the federal government is in charge of sanctioning funds, but fund disbursement and road execution lie within the state's purview, with the federal government overseeing it all through the centralized monitoring system in place.[17]

2.4 Maintenance and Quality Control

Ensuring the quality of roads is primarily the responsibility of the state governments, in particular, the executive engineer of the district level program implementation units. Periodic inspections are carried out by the Quality Control Units set up by the state governments, as well as by the federal government who engage independent monitors for inspection, at random, for doing a thorough quality control check and rate the checked roads as poor/ average/ satisfactory.

The online management and monitoring system or OMMS is the chief mechanism for

[16]The first instalment in a particular year amounting to 25% of the value of roads cleared by the Ministry is released after the road has been cleared by the Ministry. The release of remaining instalments is subject to utilization of 60% of the total available funds as well as completion of at least 80% of the road works up to the previous year.

[17]The Online Management and Monitoring System or the OMMS is the online software where officials are required to furnish all information related to the program as prescribed by the national level agency NRRDA. For more details, see `http://omms.nic.in/`.

monitoring; a case of continued failure to update data on the OMMS actually affects the fund release to the states. This software is directly provided by the NRRDA and not allowed to be modified by the states, which makes it an excellent source of information on the many aspects of the program. Further, it covers all aspects of the program planning, implementation, quality control measures and maintenance.

The roads constructed under this program are expected to be of very high standard, requiring no major repairs for at least five years after completion of construction. To this end, the state government obtains guarantees, valid for five years, from the contractor. After five years, the responsibility of maintenance is transferred to relevant local government institution.

2.5 Role of State Legislators

The program outcomes are measured at the level of the state or assembly constituency in our analysis. Our aim is to estimate the electoral cycle resulting from state elections in PMGSY provision. The staggered nature of election timing at the state level provides the necessary variation to estimate electoral cycles. In the next few paragraphs, we elaborate on the role of the Member of Legislative Assembly (MLA), directly elected by voters in their assembly constituencies (ACs), in general and in the PMGSY program.

In the wider context of Indian polity, the role of MLAs in their constituencies is multi-faceted. As Jensenius and Suryanarayan (2015) notes -

> "Officially, the main task of local Indian politicians is to represent their constituents in the state assembly. In reality, however, the work in the legislative assembly is a minor part of their work."

Jensenius and Suryanarayan (2015) further point out that much more important to the MLAs are all their unofficial tasks of delivering pork and helping people out with their individual problems. MLAs are often approached by their constituents, party workers and other

elected officials for their assistance in a variety of issues- future roads, delivery of government benefits and services, and request to appeal to the local bureaucrats etc. These leaders often provide assistance to their constituents by writing letters, helping them overcome bureaucratic bottlenecks and can even threaten bureaucrats with an unfavorable transfer/ harm (Jensenius and Suryanarayan, 2015; Bussell, 2019).

Specifically, for PMGSY road work, the suggestions of MLAs are requested during the process of drawing up the rural roads plan and considered fully before approval. Further, they are often present in district planning meetings to make sure that the interests of their constituents are not overlooked in the plan.[18] MLAs also play a ceremonial role in laying the foundation or in the inauguration ceremony of roads, which are public events. Within 15 days of the issue of work order to the contractor, standardized signboards with PMGSY logo are erected on either end of the road, containing information on length, estimated cost etc. These activities help to attribute the credit of delivery to them. [19]

3 Theory

We build a model that borrows from the electoral cycles literature (Rogoff and Sibert 1988; Shi and Svensson 2006; Drazen and Eslava 2010). The details of the model are in the Appendix. Briefly, the model shows that incumbents would like to signal their competence to voters by manipulating the expenditure on roads in election periods. The key assumption is that competence is a shock that the incumbent observes only after decisions on roads have been made. The shock itself is a moving average of time t and $t-1$ shocks. This process implies that only shocks that happen one period before are informative of the next period competence. Moreover elections happen only every other period. Voters would like a "competent" politician in the next non election period as that ensures more roads are

[18] Recall that the district level committees play a significant role in road planning, both through the one-time preparation and the annual proposal of roads, as outlined in section 2.2 and section 2.3. See N.R.R.D.A (2012) for more details.

[19] See Goyal (2019) for a more detailed description of attribution of PMGSY roads.

completed for any fixed allocation. Politicians have incentives to increase road budgets (sanctioned roads) in election periods to improve the competence signal but not in non election periods. Therefore when the incumbent is making decisions on how much to allocate to roads in election periods, they will either go over the socially optimal budget (given the opportunity costs of roads) or they will increase the proportion spent on roads with lower stipulated time to complete. Voters are rational and anticipate such manipulation but party competition ensures that such misallocation takes place in equilibrium even though election results are unaffected. Secondly there is a difference between voters who are informed and, therefore can work out the exact manipulation and voters who are uninformed and have to guess the extent of manipulation. It is only the latter that matter for the probability of winning. We therefore get two main predictions:

(1) Sanctions and completions will be higher in the years just before election relative to other years. Moreover sanctions will be higher for roads which have shorter stipulated times.

(2) ACs with a higher share of uninformed voters display larger electoral cycles.

4 Data

4.1 Program Data

The PMGSY data set covers the years 2000-01 to 2012-13 financial years[20]. We have data on 18 major states under this program.[21] Program outcomes are observed at the road level. The census data, the source of our control variables, are reported at the village level, and

[20]Financial years run from April to March of next calendar year. Program activities in PMGSY follow this financial year system.

[21]The states included in this study are Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal. We do not consider Uttarakhand, which split off from Uttar Pradesh in 2000, since the state had a delimitation in 2002 which makes matching of constituencies difficult.

the election data are at the pre-2008 delimitation assembly constituency level.[22]

To conduct our analysis at the assembly constituency level, we need to aggregate up the village level census data and the road level program data to the assembly constituency level which we accomplish through the following steps. First, we map the roads to census villages by using the administrative data sets available from the government website (http://omms.nic.in/)[23]. Then using Geographic Information Systems (GIS)[24], we map this data (road-census village matched data) to assembly constituencies.[25]

A brief summary of our main outcome variables is presented in Panel I of Table 1. The outcomes are separated into three distinct phases, each one indicating a separate stage of road construction[26]. The first phase is sanctioning, where we consider the total number of roads sanctioned, the total sanctioned length (in kms) and the amount sanctioned (in INR millions)[27] in a financial year in an assembly constituency. On an average, we find that about 4.8 roads are sanctioned in a financial year, with a total sanctioned amount of INR. 13.45 million and with a total length of 19.87 kms. The second stage is award of sanctioned roads to contractors. From Table 1, we see that on an average, about 4.35 roads are awarded to contractors every year with a total length of about 18.04 kms. The third and final stage is the completion of awarded roads. We see from Panel I of Table 1 that on an average, about

[22]Delimitation refers to the redrawing of boundaries of various parliamentary and assembly constituencies. The last delimitation was carried out in 2008, on the basis of the 2001 census. The main objective of delimitation was to equalize the population across constituencies. This exercise makes the pre and post delimitation constituencies incomparable. Hence we focus on the pre-delimitation period so that we have consistent constituency boundaries which lets us use constituency fixed effects. The PMGSY program was launched in 2000, and the major part of the program was executed during politicians' terms who were elected during the pre-2008 delimitation period. From Figure B1, we observe that indeed, the pre-2008 delimitation politicians were responsible for getting the majority of the roads sanctioned in most states.

[23]This website is the online repository of all road level information on PMGSY.

[24]We thank Raphael Susewind for providing us with the shapefiles.

[25]For matching the road data with the village shape-files, we compare state, district and block names between the two data sets and manually verify that they are consistent. Next, we employ a fuzzy string-matching process to match villages between census shape files and PMGSY administrative data set. This gives us high quality merging, with 93 percent exact match in village names.We then aggregate the program outcomes at the constituency level, by intersecting the village level shape-files (2001 census villages) with assembly constituency shape files. We find that close to 93% roads do not cross constituency boundaries. Therefore, we retain only the roads that can be matched to a single constituency.

[26]Please refer to the steps marked in bold, from Figure 2.

[27]INR stands for Indian Rupee. For comparison, 1 USD is roughly equal to INR 79.10 as of 5th August, 2022.

3.54 roads are completed each year, with a yearly average total expenditure amount of INR 7.65 million.

We use the next set of variables as measures of program efficiency in PMGSY. In our sample, the per kilometre expenditure is about INR 0.57 million.[28] The quality variable (proportion of satisfactory roads) is a measure for the proportion of roads that received "satisfactory" rating in national quality inspection, out of the total number of completed roads that were subject to quality inspection in that constituency.[29] From Table 1, we see that on an average, about 48 percent of the roads subject to national quality inspection pass the quality check. As a measure of delay in completion, we look at the the average time overrun which calculates the average difference in days between the actual and the pre-designated date of completion (as specified in the contract) of a road in an assembly constituency. We also consider the stipulated construction time which measures the average number of days between the road award date and the pre-designated end date of construction (as specified in the contract) of a road in an assembly constituency. We find that a road typically should take 336.16 days or close to 1 year to complete, from award to completion. However, the actual construction time is much higher with the time overrun being about 258.46 days on average.

4.2 Election Data

We use state legislative assembly election data from Election Commission of India (ECI) covering elections between 1996 and 2007. This data set records the name, age, sex, total votes received of the candidates, the election year and the total number of voters and electors base for all constituencies. We merge the election data set (follows calendar year) with

[28] Note that amount sanctioned and expenditure are two distinct variables. Recall that roads are first drawn up, approved by various authorities and then sanctioned from the federal government. After that, roads are allocated to contractors via a tendering process, and then the contractors start building. The expenditure variable is generated in this latter stage.

[29] The designation of "satisfactory road" is assigned by a National Quality Monitor, if the road meets the standards of materials and execution of work. Otherwise, it is designated as "unsatisfactory" or "required improvement".

the PMGSY data (follows financial year)[30]. Next, we generate the year-wise election cycle dummies, that corresponding to each of the five years of a typical term of an MLA. These year-wise dummies account for our main set of regressors.

4.3 Controls

We use the 2001 census data to obtain information on demographic and socio-economic variables at the AC level, which could potentially be correlated with program implementation. We use the total population of constituency and the share of population belonging to marginalized caste groups (Scheduled Castes and Scheduled Tribes) in the constituency population as demographic controls.[31] To measure development at the constituency level, we also include share of the proportion of villages with a school in the AC. Finally, information on terrain at the 2001 census district level is taken from Iyer (2010).[32] From Panel II of Table 1 we find that the average constituency population stands at about 223,660, the proportion of reserved population is about 18%, while in a typical constituency, about 81% of villages have a primary school, as per the 2001 census. In our sample at the district level, the proportion of barren/rocky area is 0.7% on an average.

[30]We use the following process: if an incumbent starts her term from October or earlier in a financial year, then she has at least six months or more of that year to execute the program and hence that year is counted as the first year of her term. However, if she starts her term from November or later, then she has less than six months of the financial year left to do any work, and consequently the next financial year is counted as the first year of her term.

[31]Indian society has traditionally been stratified into a number of castes which are hereditary, endogamous groups and were originally based on occupation. Scheduled Caste (SC) is an administrative category, which consists of a number of castes which are economically and socially backward and have been historically subjected to discrimination. Similarly, Scheduled Tribe (ST) is another administrative category which comprises of a group of indigenous tribes who are economically and socially backward (Deshpande 2011).

[32]We use the proportion of barren/rocky area at the district level from the data-set of Iyer (2010), who extracted the district level geographical information from India Agriculture and Climate Data Set, World Bank (`https://ipl.econ.duke.edu/dthomas/dev_data/datafiles/india_agric_climate.htm`). This information is given for 1991 district boundaries, which we then mapped on to 2001 district boundaries, using Kumar and Somanathan (2009).

5 Empirical Strategy

5.1 Impact of Electoral Cycle

To capture the presence of electoral cycles, we employ a regression model similar to Cole (2009). We create the following dummy variables: S_{st}^{-k}, $k = 0, ..., 4$ that take the value 1 if the next *scheduled* election is k years away for state s in time t. The following regression gives the estimate of the entire cycle:

$$Y_{idst} = \gamma_i + \psi_t + \beta_0 S_{st}^{0} + \beta_1 S_{st}^{-1} + \beta_2 S_{st}^{-2} + \beta_3 S_{st}^{-3} + \tau Z_{ids} \times t + \epsilon_{idst} \quad (1)$$

where Y_{idst} denotes program outcome in assembly constituency (AC) i of district d in state s in time t. The first year of an incumbent's term (i.e. S^{-4}) is taken as the reference group. The coefficients β_i, $i = 0, ..., 3$ measure the effect of election timing with respect to this reference group. We include AC fixed effects (γ_i) and year fixed effects (ψ_t). The vector Z_{ids} consists of time invariant base level characteristics from the 2001 census, at AC level i of district d in state s, such as the total population, the proportion of reserved population, and presence of schools. We interact these socio-economic and demographic variables with a linear time trend ($Z_{ids} \times t$) and include that as a set of control variables. Standard errors are clustered at the state level[33].

It is mandated by the constitution, that state elections are scheduled every five years. In order to claim causality, the state election cycles must be exogenous to the program outcomes we study. The claim of exogeneity of election timing will be valid if the elections were in fact held in every quinquennial year during the period of our study. Sometimes, however, actual elections are held one, two, three or four years after the last election, i.e. before their scheduled time owing to various reasons, such as a change in coalition leadership in the state government (Cole 2009) or other political developments such as changes in the

[33]Since there are only 18 states in our sample, we have a small number of clusters. Hence we use the wild cluster-bootstrap method (Roodman et al. 2019.)

ruling coalition. These elections are known as midterm elections. Midterm elections can pose a threat to identification if the timing of their occurrence is endogenous. For example, program outcomes can affect the decision to call for early elections, in which case, the timing of such midterm elections can be correlated with unobservable factors which affect program outcomes. Since we use *scheduled* election cycle dummies (rather than actual) as our main set of regressors, it circumvents the issue of incumbents strategically choosing the time of election, as the midterm election years are still counted as middle of term (Khemani 2004). Figure 3 illustrates an example of how the scheduled and the actual election cycle dummies can diverge from one another in the case of a midterm election. Additionally, midterm elections were very infrequent during our period of study, 2000-01 to 2012-13 with only three midterm elections occurring during this period[34].

In order to affirm our main results, we use two alternative empirical strategies as robustness checks for our main results. In the first check, we only consider the sample of elections where scheduled and actual elections coincide. Thus, we drop from the sample all the term years leading up to a midterm election, so that the remaining years correspond to only years leading up to a scheduled elections, and re-estimate equation (1). By dropping observations corresponding to midterm election years, we ensure that the timing of election in the analysis sample is exogenously determined through scheduled election timing and is not strategically manipulated by politicians.

In the second alternative empirical strategy, we employ an instrumental variable strategy, using the scheduled election dummies S_{st}^{-k} as instruments for *actual* election dummies to indicate if an election is k years away, $k = 0, ..., 4$ (Cole, 2009). The scheduled election dummies follow the cycle illustrated in Figure 3, resetting after every midterm election. Hence, the scheduled election cycle dummies are closely correlated with the actual election cycle dummies, yet do not suffer from the same problem as actual election cycle dummies, in that these are not vulnerable to incumbents strategically choosing the timing of the elections

[34]Midterm elections have become increasingly less frequent over time in India. Cole (2009) shows that the presence of midterm elections was low, and not a concern even in the previous decade of 1992-1999.

when economic conditions are advantageous. Hence, these dummies are a natural choice of instruments for the actual election cycle (Khemani 2004).

6 Main Results

Do elections affect road building? To answer this question, we look at the temporal variation in road building outcomes across the incumbent's term by estimating equation (1). We focus on the sanctioning stage since politicians have the maximum scope to affect outcomes at this stage through formal channels. From Table 2, we observe a clear spike in sanctioning activities, such as, total sanctioned roads, total length sanctioned and total amount sanctioned on the fourth year of an incumbent's term (see Table 2). These increases are statistically significant, and sizeable. For example, from the column 1 of Table 2, we find that on the fourth year of an incumbent's term, 1.586 extra roads are sanctioned as compared to the base, which is the first year of the term. Given that the average number of sanctioned roads is 4.8 (from summary stats Table 1), this increase translates to a 33 percent increase over the mean in the fourth year of the electoral term. Similarly, the total sanctioned road length shows an approximately 29.2 percent rise over the mean (an increase of 5.808 km of total sanctioned road length on the fourth year, from column 2 of Table 2; the mean sanctioned road length is 19.87 km), and the annual total sanctioned amount displays almost a 21.6 percent rise over mean (an increase of about 2.911 million INR of total sanctioned amount on the fourth year, from column 3 of Table 2; the annual average is at 13.45 million INR).

As an alternative empirical strategy, we estimate equation 1, but by restricting the sample to only scheduled elections, i.e. by excluding the years leading up to midterm elections. The results, reported in Table 3 confirm our main findings. From column 1 of Table 3, we find that the coefficient of 1 year till next election is 2.205 for number of sanctioned roads, this increase translates to a 45.9 percent increase over mean. Similarly, the total sanctioned road length shows a 40.3 percent rise over the mean (an increase of 8.001 km of total sanctioned

road length on the fourth year, from column 2), and the annual total sanctioned amount displays a 34.2 percent rise over mean (an increase of 4.604 million INR), from column 3 of the same table. Hence, from these tables we find that the impact of electoral cycle on sanctioning outcomes is, if anything, marginally bigger when we drop all mid-term elections.

In our second alternative empirical strategy, we instrument the four actual election cycle dummies with scheduled election cycle dummies. Similar to the scheduled election dummies, the actual election dummies indicate if the actual election was 0, 1, 2, 3, or 4 years away, with the first year of an incumbent's term (i.e. dummy to indicate the actual election is 4 years away) taken as the reference group. The results from the instrumental variable regression for sanctioning outcomes are reported in Table 4. These estimates are similar to our main results in Table 2 with the same sign and higher magnitude, thus lending confidence in our main empirical strategy.

To understand the efficiency and cost implications of electoral cycles in road building, we test for electoral cycles in measures such as quality, delay, expenditure per kilometre and stipulated construction time. The results are presented in Table 5. We do not find any statistically significant impact of election timing on quality of roads, time overrun and per kilometre expenditure. However, the roads that are built on the last year of the term have about 18.673 days shorter stipulated construction time (5.5 percent reduction over its mean), indicating that during the last year of their term incumbent state legislators are more likely to choose roads that can be built quickly. The statistically insignificant impact on quality, time overrun and cost are consistent with a major feature of PMGSY since its inception, which is the presence of a centralised monitoring system. This monitoring system was put in place to limit corruption Lehne et al. (2018). Time overrun and per kilometre cost are more easily observable in the central monitoring database, and hence incumbent politicians will be wary of engaging in activities which lead to their increase right before elections. Instead, we show that they sanction roads in such a manner that roads which take less time to build are completed right before elections.

Finally, we test for electoral cycles in the next two stages of PMGSY after sanctioning; awards and completion. This is necessary to test so that we can check if legislator effort which results in electoral cycles in sanctioning translates into electoral cycles in more visible road building outcomes such as awards and completion. Table 6 and Table 7 demonstrate that the sanctioning spike is followed by an increase in award and completion activities on the fourth and fifth year of an incumbent's term. The number of awards increases by 1.546 on the fourth year of incumbent's term, which is a 35.5 percent rise over the mean of 4.35. It also increases on the year of next election as well, by 0.662, which is a 15.2 percent increase over the mean of 4.35. Similarly, total road length of awarded roads also show a significant increase of 4.31 (approximately 23.8 percent over the mean of 18.04) on the fourth year of the incumbent's term. Completion outcomes show a similar pattern of increase in road completion and total road length of completed roads on the fifth year of the term. The number of completed roads in a constituency increases by 0.961 on the fifth year of incumbent's term (27.1 percent increase over mean of 3.54), and total completed length of sanctioned roads increases by about 2.782 km (approximately 20.6 percent increase over mean, which is 13.49 km), all statistically significant increases. The total expenditure on completed roads also increases on the fifth year, but is not statistically significant.

Our results indicate that sanctioning outcomes peak on the fourth year of the incumbent's term while the corresponding award and completion outcomes peak respectively on the fourth and fifth year of the term. This pattern of sanctioning outcomes peaking in the fourth year of the incumbent's term while completion outcomes peaking in the year of the elections is interesting since it suggests strategic timing of effort by politicians to get a boost in outcomes right before elections even for outcomes like roads which have a relatively high gestation period. Since the mean time taken for road completion (award to completion) is 1.6 years, we expect incumbent politicians to already take this into account so that they are able to influence the real outcomes right before elections. Hence we should see a spike in sanctioning outcomes in the fourth year of an incumbent's term while the corresponding

spike in completion outcomes would show in the final year of the term.

7 Mechanisms

In this section, we provide some suggestive evidence on two counts- first, we discuss how politicians bring about electoral cycles, and then we try to understand why electoral cycles exist.

One possible way in which politicians are able to induce electoral cycles in road building is through choosing to build relatively easier to build roads before elections. We had provided some evidence of this mechanism earlier in Section 6 where we saw that roads completed right before elections have significantly shorter stipulated construction time (column 4, Table main-quality). To provide additional evidence on this channel, we now look at the variation of cycle magnitude across different geographical terrain. Barren and rocky areas without vegetation can be more prone to issues such as soil erosion, slope stability, earthwork cost etc.[35] This, in turn, makes road construction in such areas 'difficult'. In Table 9, we use the proportion of barren/rocky areas in a district at the baseline (2001), and interact it with our main election dummies. We find that indeed, prior to elections, sanctioning activities for all three outcomes (number of sanctioned roads, sanctioned length and amount sanctioned) become lower in constituencies belonging to districts with more difficult terrain.

Next, we provide some suggestive evidence on mechanisms of why electoral cycle exists. Our model in Section 3 highlights that in presence of electoral incentives, incumbents generate increases in road building activity right before elections, possibly in greater amounts in areas with high information asymmetries. In line with our model's prediction, we find some suggestive evidence of the presence of information asymmetry (Rogoff 1990; Shi and Svensson 2006), as our leading explanation for electoral cycles in rural road building under PMGSY. Information asymmetry typically manifests as a lack of voter awareness, which hinders them from holding politicians accountable and therefore, increases the magnitude of

[35]For example, F.A.O. (1992) provides an overview of different types of costs associated with roadwork.

electoral cycle. We use the proportion of illiterate population in an assembly constituency as a measure of the share of uninformed voters. We interact this variable with the dummies for electoral cycle, with a focus on the road sanctioning activities (number of sanctioned roads, sanctioned length and amount sanctioned) as a measure of politician effort. The results are presented in Table 10. The results indicate that the magnitude of electoral cycle in road sanction is significantly higher in constituencies having a larger share of illiterate population.

There could also be other possible explanations of electoral cycles in rural road-building. One possibility is that electoral cycles are generated through the presence of a learning effect; incumbents become more experienced in executing the program as their term progresses, thus giving rise to electoral cycles. The findings from our sanctioning outcomes, however, indicate otherwise. According to the results in Table 2, the peak in sanctioning outcomes occur not on the fifth year of incumbent's term, but on the years before the fifth year. If electoral cycle is generated through a learning process, then we should expect it to increase monotonically over the years of the term, and consequently the peak should be in the fifth year.

Secondly, learning over the course of one's term should be more salient for first-time MLAs who have little experience, compared to MLAs with experience. To test for this, we interact a dummy (called first-time MLAs) that takes the value 1 if the incumbent is a first-time MLA and 0 otherwise. When interacting this dummy with the cycle dummies, we find no significant effect of the interaction of this variable with the cycle dummies for the sanctioning outcomes (Table 8), which likely indicates the absence of any learning effect.[36]

[36]We also examine if road delivery varies with the level of electoral competition faced by an incumbent MLA. In general, it is plausible that incumbents will focus on increasing program delivery in highly competitive areas right before elections, for effectively targeting swing voters (Baskaran et al., 2015; Cole, 2009). We use a dummy variable to identify constituencies that exhibit lower than the median of margin of victory in MLA elections, to measure the level of political competition in a constituency. Margin of victory is measured as the gap between of the winner's vote share from the share of the runner-up in the last election. The results (reported in Table B1) show that road sanctioning is not significantly larger in constituencies with higher levels of electoral competition. To analyze the impact of partisan vertical affinities between multiple tiers of government on the presence of electoral cycle in the sanctioning outcomes, we also constructed an alignment variable, which is a dummy that takes value one if an incumbent belongs to the same political party as the state Chief Minister and the Prime Minister. We call this type of alignment "seamless alignment". We interact this dummy with the electoral cycle dummies, and present the regression results in Table B2. We find that seamless alignment does not have a significant effect on the magnitude of electoral cycle likely because of the accuracy in attribution of credit for roads to the different levels (see Goyal (2019)). Finally,

Taken together, the results in this section seem to indicate that information asymmetry is a leading reason behind pre-electoral increases in rural road building outcomes under PMGSY, rather than politicians learning to better implement the program in the course of their electoral term.

8 Conclusion

In this paper, we provide evidence of electoral cycle in a nationwide road program in India, through multiple successive stages of road building. Using road level data from eighteen states of India spread over a decade, we capture an increase in road sanctioning activities, followed by increase in road delivery prior to state elections. PMGSY is a scheme that is supposed to be rules based and local politicians cannot change roads once approved in the core network. Moreover the central government monitors performance closely and funds are released only conditional on successful performance. Therefore it is surprising that even in this context we find evidence of manipulation. We find that politicians target easier to build roads right before elections in the sense that roads with lower stipulated construction time get built more before elections. However we do not find any significant impact on various efficiency measures related to quality, cost and delay due to electoral cycles.

We also provide suggestive evidence on possible mechanisms. In line with our model's predictions, we show that assembly constituencies with a larger share of uninformed voters, as measured by the fraction of illiterate population, display larger electoral cycles. We also rule out competing explanations behind our results such as the presence of a learning effect leading to electoral cycles.

we also capture the correlation of the magnitude of pre-electoral spike in sanctioned roads, by estimating the equation $Re-election_{idst} = \gamma_i + \psi_t + \beta_1 \overline{C}_{idst} + \beta_2 \overline{dev\text{-}C}_{idst} + \tau Z_{ids} \times t + \epsilon_{idst}$, where the dependent variable $Re-election_{idst}$ is a dummy equal to 1, if the incumbent was re-elected in the next election in AC i of district d in state s in electoral term t. The total road outcome from the electoral term is split into two parts; the term $\overline{C}_{idst}$ captures the average PMGSY outcome, for all years in the current term except the peak year. Our main regressor of interest is the second part, $\overline{dev\text{-}C}_{idst}$, which measures the deviation of the average PMGSY outcome of the peak year from rest of the years of current term (i.e. measurement of the magnitude of electoral cycle). As reported in columns 1, 2 and 3 of Table B3, we do not find any statistically significant results for sanctioning outcomes.

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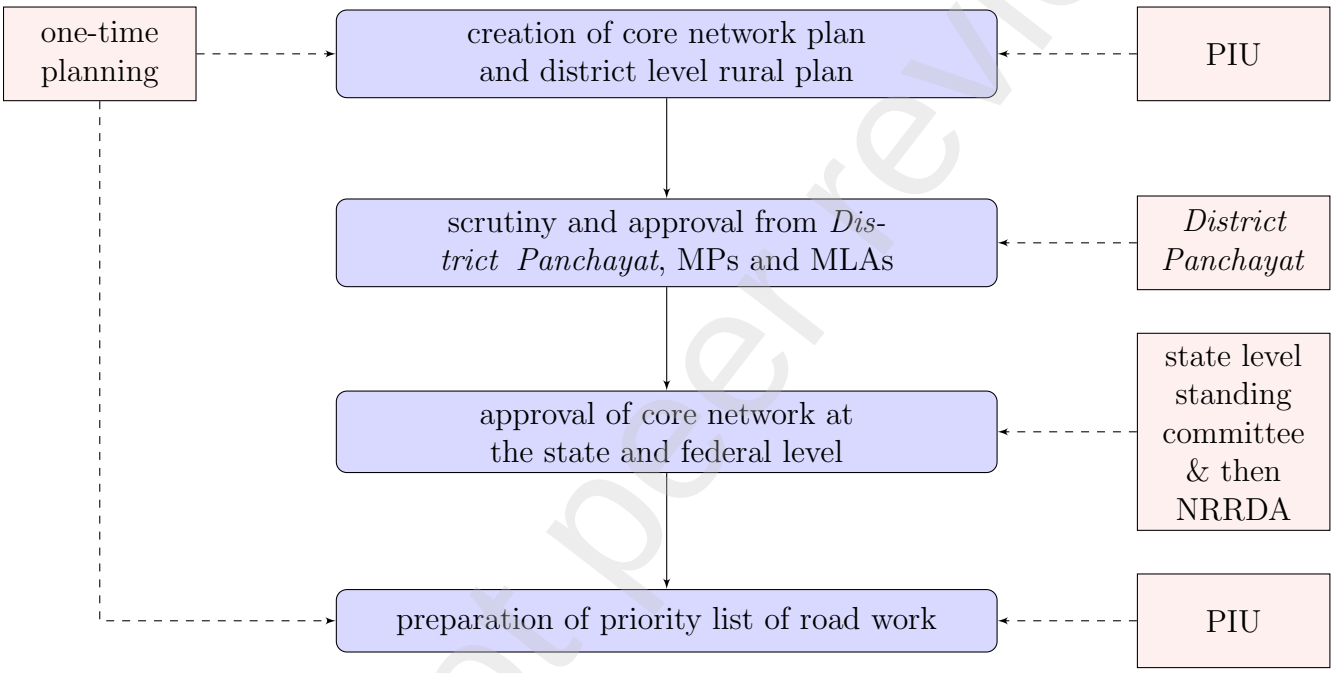
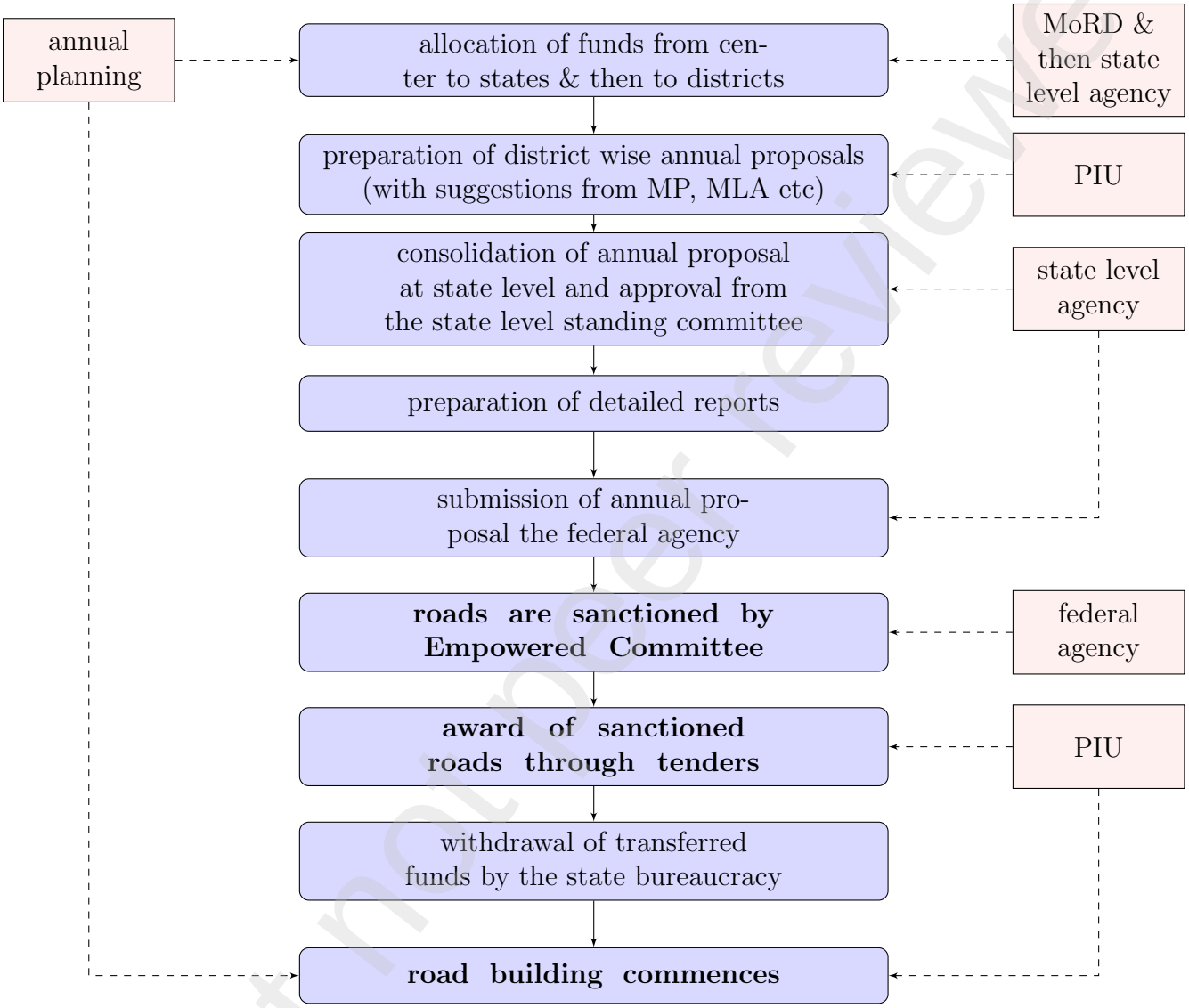
Figure 1: Preliminary Stages of PMGSY Road Planning (One Time Design)



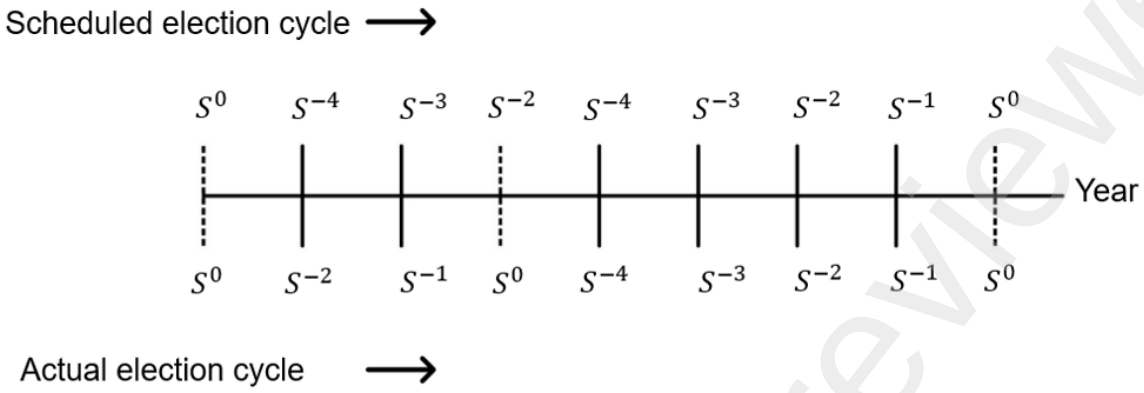
Notes: Flow chart showing a simplified overview of the initial road planning and approval activity (a one-time process). The relevant authority for each step is given in the right-hand side. The Program Implementation Units (PIU) are set up at the district level for implementing the program at state level. The National Rural Road Development Agency (NRRDA) is the federal level agency, set up under the chairmanship of the Minister of Rural Department (MoRD) to manage overall implementation. MP and MLA, respectively, are the Members of Parliaments and Legislative Assembly of the state. The *District Panchayat* or District Council is the third tier of the rural local government (*Panchayati Raj*) system and functions at the district levels in all states.

Figure 2: Annual Flow of PMGSY Work



Notes: Flow chart showing a simplified overview of the annual PMGSY activity. The boxes with bold phrases indicate that the corresponding steps are observed in the program data. The relevant authority for each step is given in the right-hand side. The Program Implementation Units (PIU) are set up at the district level for implementing the program at state level. The National Rural Road Development Agency (NRRDA) is the federal level agency, set up under the chairmanship of the Minister of Rural Department (MoRD) to manage overall implementation. MP and MLA, respectively, are the Members of Parliaments and Legislative Assembly of the state. The *District Panchayat* or District Council is the third tier of the rural local government (*Panchayati Raj*) system and functions at the district levels in all states. The Empowered Committee is chaired by a senior level bureaucrat from the Department of Rural Development for dealing with PMGSY proposals.

Figure 3: Scheduled and Actual Election Cycle



Notes: In this figure, the dotted lines indicate election years in a typical state. In the top panel, the dummies S_{st}^{-k}, $k = 0, ..., 4$ indicate if a *scheduled* election is k years away in state s in time t. In the bottom panel, the dummies S_{st}^{-k}, $k = 0, ..., 4$ indicate if the *actual* election was k years away in state s in time t. For the first and third dotted line, the elections are held in their scheduled time, hence the election dummies are identical for scheduled and actual election cycle leading up to these years. The second dotted line indicates an instance of midterm election, and the corresponding cycle dummies leading up to the midterm election diverge for the two cases.

Table 1: Descriptive Statistics

	Mean	Std. Dev
Panel I. Assembly Constituency Level Road Outcomes		
Outcomes Related to Road Sanctioning		
number of roads sanctioned	4.80	6.47
total length (km) of roads	19.87	27.98
amount sanctioned (INR millions)	13.45	21.11
Outcomes Related to Road Award		
number of roads awarded	4.35	5.59
total length (km) for awarded roads	18.04	25.09
Outcomes Related to Road Completion		
number of roads completed	3.54	4.40
total length (km) for completed roads	13.49	18.43
expenditure for completed roads (INR millions)	7.65	10.61
Quality and Efficiency Measures		
proportion of satisfactory roads	0.48	0.48
average time overrun (days) for a completed road in the AC	258.46	371.01
expenditure per km of completed roads (INR millions)	0.57	0.38
average stipulated construction time (days) for a completed road in the AC	336.16	187.19
Panel II. Assembly Constituency Demographic and Socio-Economic Characteristics		
proportion of reserved population in AC	0.18	0.10
total population in AC ('1000)	223.66	121.11
proportion of villages with primary school in AC	0.81	0.17
proportion of barren/rocky area in district	.007	.015
No of ACs	2999	

Notes: Unit of observation is assembly constituency-financial year for road outcomes, and assembly constituency-election year for election outcomes. Sample contains data for 18 states over the years FY 2000-01 to FY 2012-13. Amount sanctioned and total expenditure are adjusted for inflation using CPI-AL. The proportion of satisfactory roads indicates roads that meet the standards of materials and execution of work, when inspected by a National Quality Monitor. Otherwise, roads are designated as "unsatisfactory" or "required improvement".The time overrun (in days) is the gap between actual and pre-designated date of completion (as specified in the contract) or the delay. The gap between award and pre-designated construction date is called the stipulated construction time.

Table 2: Impact of Electoral Cycle on Sanctioning

	number of sanctioned roads	sanctioned length (km)	amount sanctioned (INR millions)
	(1)	(2)	(3)
year of next election (S^0)	-0.680	-1.044	-1.170
	[0.235]	[0.618]	[0.559]
1 year till next election (S^{-1})	1.586*	5.808**	2.911*
	[0.080]	[0.035]	[0.084]
2 years till next election (S^{-2})	1.663	2.709	3.763
	[0.118]	[0.368]	[0.251]
3 years till next election (S^{-3})	0.403	-1.538	-1.330
	[0.408]	[0.281]	[0.195]
observations	14040	14040	14040
year fixed effects	yes	yes	yes
year x AC characteristics	yes	yes	yes
AC fixed effects	yes	yes	yes

Notes: Each column represents a separate regression specification, computed using the following scheduled election dummy variables for each year of incumbent's term, named: 4 years till next election (base category, omitted), 3 years till next election (i.e. S^{-3}), 2 years till next election (i.e. S^{-2}), 1 year till next election (i.e. S^{-1}) and year of next election (i.e. S^0) respectively. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Standard errors are clustered at the state level, using wildcluster bootstrapping. p values are reported below coefficients: * p< .10, ** p< .05, *** p< .01

Table 3: Impact of Electoral Cycle on Sanctioning (Dropping Midterm Elections)

	number of sanctioned roads	sanctioned length (km)	amount sanctioned (INR millions)
	(1)	(2)	(3)
year of next election (S^0)	-0.408	0.151	-0.202
	[0.422]	[0.934]	[0.902]
1 year till next election (S^{-1})	2.205***	8.001***	4.604***
	[0.002]	[0.003]	[0.008]
2 years till next election (S^{-2})	2.110**	4.174	5.087
	[0.047]	[0.154]	[0.106]
3 years till next election (S^{-3})	0.571	-1.139	-0.954
	[0.323]	[0.515]	[0.479]
observations	12728	12728	12728
year fixed effects	yes	yes	yes
year x AC characteristics	yes	yes	yes
AC fixed effects	yes	yes	yes

Notes: Each column represents a separate regression specification, computed using the following scheduled election dummy variables for each year of incumbent's term, named: 4 years till next election (base category, omitted), 3 years till next election (i.e. S^{-3}), 2 years till next election (i.e. S^{-2}), 1 year till next election (i.e. S^{-1}) and year of next election (i.e. S^0) respectively. The analysis sample consists of observations where scheduled and actual election dummies coincide. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Standard errors are clustered at the state level, using wildcluster bootstrapping. p values are reported below coefficients: * p< .10, ** p< .05, *** p< .01

Table 4: Impact of Electoral Cycle on Sanctioning (2SLS)

	number of sanctioned roads	sanctioned length (km)	amount sanctioned (INR millions)
	(1)	(2)	(3)
year of next election (S^0)	-0.750	-1.772	-1.751
	[0.249]	[0.499]	[0.468]
1 year till next election (S^{-1})	2.116**	6.801**	3.306
	[0.027]	[0.031]	[0.159]
2 years till next election (S^{-2})	1.645	2.035	3.463
	[0.158]	[0.559]	[0.357]
3 years till next election (S^{-3})	0.186	-2.924	-2.726
	[0.775]	[0.183]	[0.129]
observations	14040	14040	14040
Cragg Donald F stat	3273.736	3273.736	3273.736
year fixed effects	yes	yes	yes
year x AC characteristics	yes	yes	yes
AC fixed effects	yes	yes	yes

Notes: Each column represents a separate instrumental variable regression specification, computed using the following election dummy variables for each year of incumbent's term, named: 4 years till next election (base category, omitted), 3 years till next election (i.e. S^{-3}), 2 years till next election (i.e. S^{-2}), 1 year till next election (i.e. S^{-1}) and year of next election (i.e. S^0) respectively. The relevant instruments are the equivalent scheduled election dummies. Expenditure are measured in INR millions. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Standard errors are clustered at the state level, using wild-cluster bootstrapping. p values are reported below coefficients: * p< .10, ** p< .05, *** p< .01

Table 5: Impact of Electoral Cycle on Quality, Delay and Cost

	proportion of satisfactory roads	time overrun (days)	expenditure per km (INR millions)	stipulated construction time (days)
	(1)	(2)	(3)	(4)
year of next election (S^0)	0.382	-4.205	-0.014	-18.673**
	[0.105]	[0.875]	[0.431]	[0.024]
1 year of till next election (S^{-1})	0.328	-39.592	-0.002	-4.422
	[0.103]	[0.378]	[0.946]	[0.838]
2 years of till next election (S^{-2})	0.109	-10.932	0.010	-6.574
	[0.714]	[0.751]	[0.718]	[0.689]
3 years of till next election (S^{-3})	0.235	-14.670	0.032	9.464
	[0.613]	[0.725]	[0.393]	[0.432]
observations	711	11860	11834	11747
year fixed effects	yes	yes	yes	yes
year x AC characteristics	yes	yes	yes	yes
AC fixed effects	yes	yes	yes	yes

Notes: Each column represents a separate regression specification, computed using the following scheduled election dummy variables for each year of incumbent's term, named: 4 years till next election (base category, omitted), 3 years till next election (i.e. S^{-3}), 2 years till next election (i.e. S^{-2}), 1 year till next election (i.e. S^{-1}) and year of next election (i.e. S^0) respectively. Proportion of satisfactory roads a measure for the proportion of "satisfactory road" as designated by a National Quality Monitor. The time overrun (in days) is the gap between actual and pre-designated date of completion (as specified in the contract) or the delay. The gap between project award and pre-designated construction date is called the stipulated construction time. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Standard errors are clustered at the state level, using wildcluster bootstrapping. p values are reported below coefficients: * p< .10, ** p< .05, *** p< .01

Table 6: Impact of Electoral Cycle on Award

	number of roads awarded (1)	length (km) (2)
year of next election (S^0)	0.662*	2.968
	[0.096]	[0.110]
1 year till next election (S^{-1})	1.546***	4.310**
	[0.004]	[0.020]
2 years till next election (S^{-2})	0.481	0.345
	[0.225]	[0.801]
3 years till next election (S^{-3})	0.349	1.593
	[0.416]	[0.114]
observations	13148	13148
year fixed effects	yes	yes
year x AC characteristics	yes	yes
AC fixed effects	yes	yes

Notes: Each column represents a separate regression specification, computed using the following scheduled election dummy variables for each year of incumbent's term, named: 4 years till next election (base category, omitted), 3 years till next election (i.e. S^{-3}), 2 years till next election (i.e. S^{-2}), 1 year till next election (i.e. S^{-1}) and year of next election (i.e. S^0) respectively. For columns 2-4, analysis sample consists of observations where scheduled and actual election dummies coincide. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Standard errors are clustered at the state level, using wildcluster bootstrapping. p values are reported below coefficients: * p< .10, ** p< .05, *** p< .01

Table 7: Impact of Electoral Cycle on Completion

	number of completed roads (1)	length (km) (2)	expenditure (INR millions) (3)
year of next election (S^0)	0.961***	2.782**	1.089
	[0.008]	[0.024]	[0.183]
1 year till next election (S^{-1})	0.337	0.909	0.462
	[0.372]	[0.289]	[0.535]
2 years till next election (S^{-2})	-0.097	0.448	0.942
	[0.572]	[0.709]	[0.367]
3 years till next election (S^{-3})	-0.193	0.132	0.374
	[0.576]	[0.884]	[0.462]
observations	11860	11860	11860
year fixed effects	yes	yes	yes
year x AC characteristics	yes	yes	yes
AC fixed effects	yes	yes	yes

Notes: Each column represents a separate regression specification, computed using the following scheduled election dummy variables for each year of incumbent's term, named: 4 years till next election (base category, omitted), 3 years till next election (i.e. S^{-3}), 2 years till next election (i.e. S^{-2}), 1 year till next election (i.e. S^{-1}) and year of next election (i.e. S^0) respectively. For columns 4-6, analysis sample consists of observations where scheduled and actual election dummies coincide. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Standard errors are clustered at the state level, using wildcluster bootstrapping. p values are reported below coefficients: * p< .10, ** p< .05, *** p< .01

Table 8: Persistence of Electoral Cycle (First-time MLAs)

	number of sanctioned roads	sanctioned length (km)	amount sanctioned (INR millions)
	(1)	(2)	(3)
S^0 x first-time MLA	0.087	1.963	1.877
	[0.838]	[0.334]	[0.187]
S^{-1} x first-time MLA	-0.038	-1.367	-1.764
	[0.952]	[0.560]	[0.242]
S^{-2} x first-time MLA	-0.381	1.091	-0.570
	[0.852]	[0.745]	[0.913]
S^{-3} x first-time MLA	-0.099	0.040	-0.431
	[0.838]	[0.981]	[0.745]
year of next election (S^0)	-0.614	-1.894	-1.935
	[0.258]	[0.401]	[0.388]
1 year till next election (S^{-1})	1.638*	6.651**	3.985*
	[0.094]	[0.028]	[0.056]
2 years till next election (S^{-2})	1.899	2.215	4.139
	[0.262]	[0.764]	[0.495]
3 years till next election (S^{-3})	0.425	-1.678	-1.192
	[0.346]	[0.398]	[0.334]
first-time MLA	-0.528	-2.155**	-2.091***
	[0.127]	[0.017]	[0.007]
observations	13974	13974	13974
year fixed effects	yes	yes	yes
year x AC characteristics	yes	yes	yes
AC fixed effects	yes	yes	yes

Note: Each column represents a separate regression specification, computed using the following scheduled election dummy variables for each year of incumbent's term, named: 4 years till next election (base category, omitted), 3 years till next election (i.e. S^{-3}), 2 years till next election (i.e. S^{-2}), 1 year till next election (i.e. S^{-1}) and year of next election (i.e. S^0) respectively. The variable first-time MLA is a dummy that takes the value 1 if the incumbent is a first time MLA, 0 if she is not. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Standard errors are clustered at the state level, using wildcluster bootstrapping. p values are reported below coefficients: * p< .10, ** p< .05, *** p< .01.

Table 9: Heterogeneity of Electoral Cycle in Sanctioning Outcome by Barren or Rocky Terrain Districts

	number of sanctioned roads	sanctioned length (km)	amount sanctioned (INR millions)
	(1)	(2)	(3)
S^0 x barren or rocky terrain	-36.731*	-145.699**	-116.729**
	[0.075]	[0.032]	[0.043]
S^{-1} x barren or rocky terrain	-43.665*	-90.431	-58.503*
	[0.072]	[0.209]	[0.089]
S^{-2} x barren or rocky terrain	-22.235	-100.664	-108.508
	[0.423]	[0.226]	[0.233]
S^{-3} x barren or rocky terrain	-15.410	-13.599	41.390
	[0.260]	[0.644]	[0.413]
year of next election (S^0)	-0.511	-0.364	-0.572
	[0.355]	[0.860]	[0.758]
1 year till next election (S^{-1})	1.829**	6.221**	3.194*
	[0.038]	[0.026]	[0.059]
2 years till next election (S^{-2})	1.733*	3.053	4.253
	[0.095]	[0.327]	[0.232]
3 years till next election (S^{-3})	0.453	-1.667	-1.795
	[0.384]	[0.254]	[0.106]
observations	13832	13832	13832
year fixed effects	yes	yes	yes
year x AC characteristics	yes	yes	yes
AC fixed effects	yes	yes	yes

Notes: Each column represents a separate regression specification, computed using the following scheduled election dummy variables for each year of incumbent's term, named: 4 years till next election (base category, omitted), 3 years till next election (i.e. S^{-3}), 2 years till next election (i.e. S^{-2}), 1 year till next election (i.e. S^{-1}) and year of next election (i.e. S^0) respectively. The variable 'barren or rocky terrain' is measured at district level, & sourced from Iyer (2010). This variable captures proportion of the district that is barren or rocky. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Prop illiterate indicates the proportion of illiterate population in a constituency, according to 2001 census. Standard errors are clustered at the state level, using wildcluster bootstrapping. p values are reported below coefficients: * p< .10, ** p< .05, *** p< .01

Table 10: Heterogeneity of Electoral Cycle by Baseline (2001) Illiterate Population

	number of sanctioned roads	sanctioned length (km)	amount sanctioned (INR millions)
	(1)	(2)	(3)
S^0 x prop illiterate	5.662***	16.153**	15.573**
	[0.005]	[0.018]	[0.017]
S^{-1} x prop illiterate	6.593*	19.349	8.085
	[0.081]	[0.128]	[0.331]
S^{-2} x prop illiterate	10.935*	22.776	24.628
	[0.093]	[0.275]	[0.388]
S^{-3} x prop illiterate	-0.593	-6.049	-5.483
	[0.795]	[0.396]	[0.407]
year of next election (S^0)	-3.667**	-9.477*	-9.495*
	[0.014]	[0.051]	[0.058]
1 year till next election (S^{-1})	-1.917	-4.410	-1.343
	[0.229]	[0.472]	[0.774]
2 years till next election (S^{-2})	-4.221	-9.523	-9.539
	[0.119]	[0.224]	[0.360]
3 years till next election (S^{-3})	0.660	1.641	1.415
	[0.623]	[0.693]	[0.670]
observations	14040	14040	14040
year fixed effects	yes	yes	yes
year x AC characteristics	yes	yes	yes
AC fixed effects	yes	yes	yes

Notes: Each column represents a separate regression specification, computed using the following scheduled election dummy variables for each year of incumbent's term, named: 4 years till next election (base category, omitted), 3 years till next election (i.e. S^{-3}), 2 years till next election (i.e. S^{-2}), 1 year till next election (i.e. S^{-1}) and year of next election (i.e. S^0) respectively. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Prop illiterate indicates the proportion of illiterate population in a constituency, according to 2001 census. Standard errors are clustered at the state level, using wildcluster bootstrapping. p values are reported below coefficients: * p< .10, ** p< .05, *** p< .01

Appendices

A Model

Before getting into the model we describe some of the institutional features used in setting it up. First, consider the process of sanctioning of roads: The states after consultations with various levels including local government representatives, MLAs and MPs send a list of proposals to the centre that details the road length needed (based on the core network) for new connectivity and upgradation and this leads to the states annual allocation across districts (80% for new works, 20% for upgrades). The proposals are clubbed into Annual proposals for each state and sent to the Ministry of Rural Development (MoRD) which has an empowered committee to sanction these proposals. Although all three levels, federal, state and local are involved in the sanctioning decision, our model assumes a unitary actor: the MLA or state representative at the AC level. The reason is that for the PMGSY roads credit accrues to all three levels of government and there is little ambiguity because of the signs posted along the road, the inauguration ceremonies carried out by the state government and the active involvement of the MLA (Goyal (2019)).

We adapt the model in Shi and Svensson (2006) to our setting. There are 2 parties, L and R competing for state level elections and a continuum of voters in each AC. Voters' utility in a representative AC is given by:

$$U_{i,t} = \sum_{t}^{T} (r_t + \delta_i z_t) \tag{2}$$

where z is a binary variable taking the value $-\frac{1}{2}$ if L is elected and $\frac{1}{2}$ if R is elected. All voters are alike in their preferences over the public good r_t - the number of new roads at time t but they differ in the parameter δ_i which captures the effect of candidates' other policies or valence on voters' utility. Voters with $\delta_i < 0$ are biased in favor of party L and voters with

$\delta_i > 0$ prefer party R all else equal. We assume that δ_i is distributed uniformly on $[-\frac{1}{2}, \frac{1}{2}]$. We assume discount factor to be 1.

We denote the type of roads in an AC by those that are easy (E) and those that are harder (H) to build. Type E roads are completed within period t. However type H roads can be completed only in the next period-harder roads require more time to complete. Voters observe only total roads built in period t. Sanctioned expenditure on roads of type θ is denoted by $g_t(\theta)$ where $\theta \in \{E, H\}$. θ is observed by the MLA but not by voters.

We consider decisions of the MLA/ state government representative in each AC. Each MLA influences the road building process. For simplicity we assume the state government and MLA belong to party L. As discussed earlier, the MLA is involved along with the state and central government in the sanctioning of roads. The PMGSY funds for a set of roads is allocated by the centre to the state, the state does not finance roads except in case of cost overruns, therefore the state government or the MLA do not internalize the cost of taxes on consumption, as in the original Shi and Svensson (2006) model.[37]

The role of the MLA in sanctioning is to present the roads that they deem to be high priority for each tranche at the beginning of the sanctioning process. This would involve costing of the roads, so in effect, sanctioning implies that the MLA affects the total amount and allocation of funds on roads for the year for his AC. This informs the modelling choice below.

Politician utility for a representative party and representative AC at time t in an AC is given by: $U_t = \sum_t^T \gamma(g_t(E) + g_t(H)) - c(g_t(E)) - c(g_t(H)) + X$ where $\gamma(\cdot)$ denotes per capita welfare due to type E and H roads sanctioned, $c(g_t(\theta))$ denotes the costs of type θ roads and X denotes the per period ego rents from office.

The timing of events is as follows: At the beginning of period t, the MLA chooses $g_t^i(\theta)$. The shock happens after the decisions have been made (in the middle of the period t) and elections happen at end of period t. There is no election in periods $t-1$ and $t+1$. The next

[37]The funds provided by the centre via taxes on diesel are distributed across districts by the state government and finally across roads by the MLA.

election is in period $t+2$.

While $g_t(\theta)$ affects the number of roads built, the actual sanctions, construction and road completion depends on the competence of the local MLA. Thus, the number of roads completed and observed by voters at the end of time t is given by: $r_t = g_t(L) + \eta_t$, where $\eta_t = \mu_t + \mu_{t-1}$ is a competence shock that consist of a Moving Average of time t and $t-1$ shocks. This process implies that only shocks that happen one period before are informative of the next period competence. Each μ is an i.i.d random variable with mean 0, finite variance and distribution function $F(\mu)$ and pdf $f(\mu)$ with $f(0) = 0$. We also assume that $f(x) < f(0)$ for all $x > 0$. E.g. a normal distribution would satisfy these requirements. Note that the completed roads in period t do not include H type roads. $B_t(\theta) = \sum_\theta g_t(\theta)$ is the total sanctioned budget for roads of all types. The expenditure allocation on roads and the total budget is chosen by the incumbent to maximize the social welfare and ego rents across all periods of the election term.

A.1 Equilibrium without elections

Note that X is guaranteed to the incumbent across all periods in this case. Therefore there is no gain to be had from strategically choosing the timing and the type of roads to get sanctioned as there is no link between periods. This is a series of one period problems which we can solve by backward induction. Maximize $U_t = \gamma(g_t(E)+g_t(H))) - c(g_t(E)) - c(g_t(H))$.

We assume $\gamma'(\cdot) > 0$, $\gamma''(\cdot) < 0$ to guarantee a unique interior solution. Cost functions are assumed to be quasi convex in g_t.

In this case the optimal allocation is $\gamma'(g_t(\theta)) = c'(g_t(\theta))$ for each θ for each time period. Therefore allocations are stationary across time between H and E roads. Assuming there are enough unconnected roads remaining, the budget across all periods is also constant. Denote these optimized levels as $g^*(E), g^*(H)$ and B^*.[38] Note that these are independent

[38]The argument does not depend on having different costs or benefits for H and L roads- only the time taken to build roads is important. However there is a cost to building more E roads compared to the optimal allocation if the benefits of H roads are higher- in this case the benefit function should be different to ensure

of t. Although these are the optimal levels, we assumed that E roads can be built faster in the same period than H. Therefore by increasing spending on E roads the total roads that voters observe will be higher. Total roads built in realisation in period t are given by $\sum_\theta r_t(\theta) = g^*(L) + \eta_t$ which is less than the sanctioned roads $g^*(L) + g^*(H) + \eta_t$, given that H roads are not observed in period t. For simplicity denote $\sum_\theta r_t(\theta) = r_t$

A.2 Equilibrium with elections

In the post election period, $t+1$ the incumbent does not face an election until period $t+3$ so he has no incentive to manipulate the allocation as the incumbent's competence in period $t+3$ is unrelated to his competence in period $t+1$. Since voters ignore the information from observed roads r_{t+1} for competence in period $t+3$, there is no incentive to manipulate B_{t+1} or the allocation across E and H roads. However r_{t+1} does depend on μ_t, so voters care about μ_t since they care about roads in period $t+1$.

So the incumbent's objective function is a series of two period problems t and $t+1$. The incumbent has a two period maximization problem: $U^i = \gamma(g_t(E) + g_t(H)) - c(g_t(E)) - c(g_t(H)) + X + P_{win}\left(\gamma(g_{t+1}(E) + g_{t+1}(H)) - c(g_{t+1}(E)) - c(g_{t+1}(H)) + X\right)$. The link between periods comes from the voters utility which affects the probability of winning for the incumbent, P_{win}.

Denote any extra expenditure on roads in period t over and above B^* by d_t. If the incumbent exceeds the optimal sanction B^* i.e. $d_t > 0$ for some period t then the cost of this extra expenditure is felt in period $t+1$ - it may affect the total state budget - i.e. some works that have been sanctioned in period t cannot be carried out, and as a result this may delay the next set of sanctions for the state government (see PMGSY rules). It is also possible that the budget remains at B^* but the allocation changes so that d_t represents the extra E roads that are built at the expense of H roads relative to the optimal benchmark without elections.

that the optimal allocation of E and H roads is not symmetric.

The cost to the MLA of over spending (or misallocating) in period t by d_t is denoted as $R(d_t)$, is felt in period $t+1$ and is increasing and convex. For example it may represent a cut in the budget for the next period from B^* to $B^* - R(d_t)$. Fewer roads are sanctioned in the next period for the AC that is not following the optimal road allocations/budget for each period.[39] Alternately it can be interpreted as the opportunity cost induced by the misallocation of H and E roads- the loss in income due to lack of connectivity of remote areas.

Working backwards, in period $t+1$ the choice of $g_{t+1}(\theta)$ does not affect ego rents as these are guaranteed until the next election period, $t+3$. Therefore $d_{t+1} = 0$. Therefore in period $t+1$ the (endogenous) budget is $B^* - R(d_t)$. $R(d)$ is a continuous function with $R(0) = 0$, $R'(0) = 1$, and $R''(d) > 0$ for all $d > 0$. The optimal choice of total roads is therefore lower than the socially optimal level by $R(d_t)$. $r_{t+1} = B^* - R(d_t) + \eta_{t+1}$ (alternately the allocation of the stock of E and H roads is not optimal).

In period t, the incumbent can increase expenditure on E roads by d_t to increase his chances of re-election: either by over spending on the socially optimal budget or under spending on $g_t(H)$. In either case, the cost next period is $R(d_t)$. Below we assume that there is excess spending over the socially optimal budget for ease of exposition, but the analysis is the same for allocation of roads. Note too, that in each period the total roads observed under this assumption are E roads sanctioned in period t and H roads sanctioned in period $t-1$. The only difference between election and non election periods are the terms $d_t, R(d_t)$. Therefore $\sum_\theta r_t(\theta) = B^* + d_t + \eta_t$.[40]

In period t voters vote for the incumbent vs the challenger. W.l.o.g we assume that the incumbent is the L party so we now denote the incumbent by superscript L and the

[39] If $d_t > 0$ the costs of that will be carried over into $t+1$ in the form of fewer roads being sanctioned (the rules for PMGSY are such that sanctions are conditioned on state performance- thus if some H roads are in the core network but have been delayed then either the cost of such roads might increase or the next period sanctioned budget maybe reduced- we capture these costs by $R(d)$. Alternately, if the sanctioned budget in period t is suboptimally high, then this would be discovered by the state and central level bodies that approve the budget and would have repercussions of $R(d)$ for the next budget.

[40] Since d_t enters as an additive term it does not affect B^* when we assume d_t is an excess over budget term.

challenger by superscript R.

Given symmetry once in office, the two parties choose exactly the same policies. However the challenger's competence is not known, while for the incumbent -voters can deduce the competence level in period t. Utility of voters in period $t+1$ with challenger is $= B^* - E_t(R(d_t^*)) + E_t(\eta_{t+1}^R) + \delta_i z$. Note that $E_t(\eta_{t+1}^R) = E_t(\mu_t^R) + E_t(\mu_{t+1}^R) = 0$. Utility of voters with incumbent in period $t+1$ is $= B^* - E_t(R(d_t^*)) + E_t(\eta_{t+1}^L) + \delta_i z$. But $E_t(\eta_{t+1}^L) = E_t(\mu_t^L)$, which can be deduced from g_t^* and μ_{t-1}^L. Therefore the difference between incumbent and challenger, conditional on the same δ_i is $= E_t(\mu_t^L)$. Note that $\delta_i < 0$ for an L party supporter. Therefore, a voter will vote for the incumbent iff $E_t(\mu_t^L) - \delta_i \geq 0$. The share of votes for the incumbent using the distribution of δ_i is $E_t(\mu_t^L) + \frac{1}{2}$.

We assume that a share σ (informed) of voters observe d_t, while $1-\sigma$ (uninformed) fraction only observe total roads. All agents observe μ_{t-1}. Informed voters observe d_t, therefore they can deduce μ_t^L using the equation $r_t = B^* + d_t + \mu_{t-1}^L + \mu_t^L$, where μ_{t-1}^L is observed by everyone and d_t is observed by informed voters only. So informed voters vote for the incumbent iff $\mu_t^L - \delta_i \geq 0$. The share of informed votes for the incumbent is $\mu_t^L + \frac{1}{2}$.

Uninformed voters do not observe d_t. However they anticipate the equilibrium strategy of the incumbent, and estimate d_t by $\hat{d}_t$. Thus, $r_t = B^* + \hat{d}_t + \mu_{t-1}^L + \hat{\mu}_t^L$. Using the expression for $\hat{\mu}_t^L = r_t - B^* - \hat{d}_t - \mu_{t-1}^L$ and substituting for $B^* = r_t - d_t = \mu_{t-1}^L = \mu_t^L$ we have $\hat{\mu}_t^L = d_t - \hat{d}_t + \mu_t^L$. Therefore the share of votes for the incumbent from uninformed voters is given by: $d_t - \hat{d}_t + \mu_t^L + \frac{1}{2}$. The probability of winning is the probability that the total vote share is bigger than $\frac{1}{2}$.

Then the probability of winning is given by:

$$P_t = Pr\left(\sigma\left(\mu_t^L + \frac{1}{2}\right) + (1-\sigma)\left(d_t - \hat{d}_t + \mu_t^L + \frac{1}{2}\right) \geq \frac{1}{2}\right) = Pr(\mu_t^L \geq (1-\sigma)(\hat{d}_t - d_t)) \quad (3)$$

Using the distribution function for μ_t we have $Pr(\mu_t^L \geq (1-\sigma)(\hat{d}_t - d_t)) = 1 -$

$F\left((1-\sigma)(\hat{d}_t - d_t)\right)$

At the beginning of period t therefore the incumbent chooses d_t, to maximize two period utility given by:

$$\begin{aligned} & B^* + d_t + X \\ + \quad & \left(1 - F\left((1-\sigma)(\hat{d}_t - d_t)\right)\right)(B^* - R(d_t) + X) \\ + \quad & F\left((1-\sigma)(\hat{d}_t - d_t)\right)(B^* - R(d_t)) \end{aligned} \tag{4}$$

The FOCs are:

$1+(1-\sigma)F'((1-\sigma)(\hat{d}_t - d_t))X - R'(d_t) = 0$. In equilibrium, rational expectations imply that $\hat{d}_t = d_t$. Therefore we have $1 + (1-\sigma)f(0)X - R'(d_t) = 0$ It follows from Shi and Svensson (2006) that the electoral cycle is more pronounced when X is higher or when σ is lower, i.e. the share of uninformed voters is higher. Moreover since the cycle is anticipated by voters it has no effect on re-election probability in equilibrium.

If the only distortion is a misallocation between L and H roads but no over spending, d_t cancels out but we still have $R'(d) > 0$ and the FOCs change to:

$(1-\sigma)F'((1-\sigma)(\hat{d}_t - d_t))X - R'(d_t) = 0$. The comparative statics remain the same.

Therefore we get the following predictions:

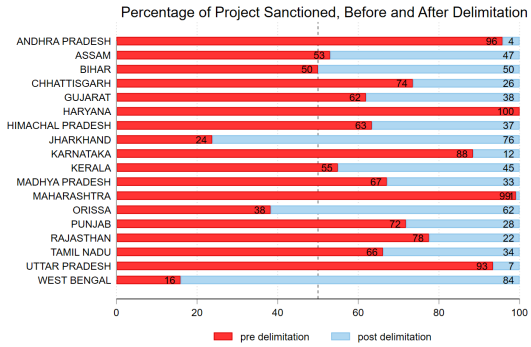
(1) Sanctions and Road completions will be higher in the years just before election relative to other years

(2) ACs with a higher share of uninformed voters display larger electoral cycles.

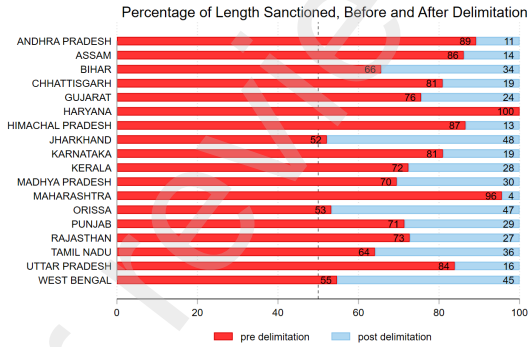
B Additional Analysis

Figure B1: Program Delivery By Pre and Post 2008 Delimitation MLAs, Statewise

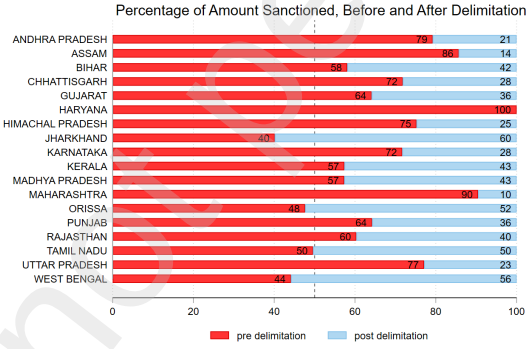
1(a): Number of Sanctioned Roads



1(b): Total Length Sanctioned (km)



1(c): Total Amount Sanctioned (million INRs)



Notes: The data covers the years 2000-01 to 2012-13. The three figures show the percentages of sanctioned roads (1a), percentage of length sanctioned (1b), and percentage of amount sanctioned (1c) for each state in our sample for the pre and post 2008 delimitation period.

Table B1: Heterogeneity of Electoral Cycle in Sanctioning Outcome by Electoral Competition

	number of sanctioned roads	sanctioned length (km)	amount sanctioned (INR millions)
	(1)	(2)	(3)
S^0 x high comp	0.161	0.093	-0.599
	[0.618]	[0.948]	[0.579]
S^{-1} x high comp	0.304	0.726	-0.248
	[0.583]	[0.743]	[0.895]
S^{-2} x high comp	0.343	-0.623	-0.430
	[0.615]	[0.824]	[0.796]
S^{-3} x high comp	0.596*	2.296	0.902
	[0.077]	[0.128]	[0.496]
high comp	-0.203	-0.449	0.428
	[0.618]	[0.772]	[0.768]
year of next election(S^0)	-0.753	-1.056	-0.854
	[0.182]	[0.622]	[0.634]
1 year till next election(S^{-1})	1.444	5.492*	3.067
	[0.122]	[0.077]	[0.125]
2 years till next election(S^{-2})	1.490	3.039	3.979
	[0.169]	[0.347]	[0.191]
3 years till next election(S^{-3})	0.109	-2.658	-1.779
	[0.841]	[0.146]	[0.130]
year fixed effects	yes	yes	yes
year x AC characteristics	yes	yes	yes
AC fixed effects	yes	yes	yes
observations	14040	14040	14040
R^2	0.157	0.198	0.268

Notes: Each column represents a separate regression specification, computed using the following scheduled election dummy variables for each year of incumbent's term, named: 4 years till next election (base category, omitted), 3 years till next election (i.e. S^{-3}), 2 years till next election (i.e. S^{-2}), 1 year till next election (i.e. S^{-1}) and year of next election (i.e. S^0) respectively. Amount sanctioned is measured in INR millions. highcomp is a dummy for constituencies with lower than median level of margin of victory. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Standard errors are clustered at the state level, using wild cluster bootstrapping. p values are reported below coefficients: * p< .10, ** p< .05, *** p< .01

Table B2: Heterogeneity of Electoral Cycle in Sanctioned Projects by Political Alignment of Incumbent

	number of sanctioned roads	sanctioned length (km)	amount sanctioned (INR millions)
	(1)	(2)	(3)
S^0 x aligned (both)	-0.095	-0.313	-4.596
	[0.960]	[0.967]	[0.332]
S^{-1} x aligned (both)	1.757	6.964	0.459
	[0.346]	[0.324]	[0.912]
S^{-2} x aligned (both)	2.563	7.943	1.356
	[0.326]	[0.416]	[0.772]
S^{-3} x aligned (both)	-0.458	-1.382	-3.263
	[0.439]	[0.608]	[0.124]
aligned (both)	1.052	3.002	4.096
	[0.376]	[0.449]	[0.160]
year of next election (S^0)	-0.770	-1.327	-0.666
	[0.269]	[0.578]	[0.726]
1 year till next election (S^{-1})	1.159	4.129**	2.488
	[0.195]	[0.050]	[0.174]
2 years till next election (S^{-2})	1.185	1.233	3.370
	[0.431]	[0.737]	[0.445]
3 years till next election (S^{-3})	0.447	-1.373	-0.904
	[0.395]	[0.377]	[0.369]
year fixed effects	yes	yes	yes
year x AC characteristics	yes	yes	yes
AC fixed effects	yes	yes	yes
observations	14040	14040	14040
R^2	0.169	0.205	0.272

Notes: Each column represents a separate regression specification, computed using the following scheduled election dummy variables for each year of incumbent's term, named: 4 years till next election (base category, omitted), 3 years till next election (i.e. S^{-3}), 2 years till next election (i.e. S^{-2}), 1 year till next election (i.e. S^{-1}) and year of next election (i.e. S^0) respectively. Aligned (both) is a dummy indicating that the incumbent belongs to the same party as the Chief Minister of state and to the party of the Prime Minister. Amount sanctioned is measured in INR millions. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Standard errors are clustered at the state level, using wild cluster bootstrapping. p values are reported below coefficients: * p< .10, ** p< .05, *** p< .01

Table B3: Persistence of Electoral Cycle

dependent variable: Re-election dummy	(1)	(2)
deviation from project sanctioned on year of spike	0.003	
	[0.593]	
project sanctioned on years except year of spike	0.003	
	[0.635]	
average projects sanctioned (full mandate)		0.000
		[0.859]
year fixed effects	yes	yes
year x AC characteristics	yes	yes
AC fixed effects	yes	yes
observations	5915	5915
R^2	0.023	0.023

Notes: Each column represents a separate regression specification. The panel data is collapsed at election year-assembly constituency level. The deviation variables are a measurement of the magnitude of electoral cycle, i.e. it's the deviation of the average outcome of the peak year from rest of the years of current term. Number of sanctioned projects peaked on the fourth year of incumbent's term. The regressions control for AC (assembly constituency) level demographic and amenities information such as AC population, proportion of SC & ST population and proportion of villages with a school in the AC which are obtained from the 2001 census. Standard errors are clustered at the state level, using wild cluster bootstrapping. p values are reported in parentheses: * p< .10, ** p< .05, *** p< .01