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Tender competitiveness and project performance in India's PMGSY scheme

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Abstract

As part of India's e-governance revolution, details of tenders for rural road construction programmes were made publicly available. We analyse these tender data for six states, covering more than 20,000 road projects undertaken under India's flagship rural roads development scheme – PMGSY. We find that matching these tender details to other administrative data sources on the completion of these projects is challenging, and we examine to what extent data quality correlates with road characteristics. We also analyse the relationship between the competitiveness of the tendering process and the cost and quality of the roads constructed. Greater competition in both the technical and financial evaluation is associated with lower cost overruns and better performance on quality inspections. Nonetheless, we show that even after the introduction of e-procurement a large proportion of tenders remain uncompetitive.

Keywords: public procurement; infrastructure; auctions

JEL Codes: D72, D73, L14, O18

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1. INTRODUCTION

Over the last decade, the Government of India has introduced e-governance initiatives in almost all its key departments. These initiatives typically encompass information management systems that render administrative data publicly accessible. From 2004 onward, Indian states have gradually introduced e-procurement in the country's largest rural infrastructure programme, Pradhan Mantri Gram Sadak Yojana (PMGSY). Under this programme more than 100,000 previously unconnected villages have been provided with all-weather road access.

Our paper builds on our earlier work (Lehne et al., 2018), in which we show that state-level politicians influence the allocation of road contracts in favour of connected firms. We also find that the roads built by connected contractors are more expensive and also more likely to be missing in the population census even if they appear as completed in the administrative data.[1] These findings raise the question as to how exactly politicians influence the allocation of contracts, given that PMGSY tendering is subject to strict rules. The current project leverages the rich data on this process that is publicly available thanks to the introduction of e-procurement in PMGSY. Our work relates closely to a recent study by Lewis-Faupel et al. (2016), who study e-procurement in the context of PMGSY in India and public works in Indonesia. These authors find that e-procurement improved the quality of PMGSY road construction. They identify the entry of higher quality contractors from outside regions as the main mechanism behind the observed quality improvements. The key distinction between the PMGSY data used in this project and those in Lewis-Faupel et al. (2016) and Lehne et al. (2018) is that we observe not just the final contract, but individual bids by all firms competing at every stage of the procurement process. This allows us to evaluate how the competitive dynamics of individual tenders relate to contract allocation and the quality of subsequent construction.

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[1] This finding is in line with work showing the influence of Members of Legislative Assembly (MLAs) on local development outcomes, as in Asher and Novosad (2017), Asher and Novosad (2018), Bohlken (2016), Gulzar and Pasquale (2016), Jensenius (2016), Prakash et al. (2017). It also confirms the importance of political connections, as in Sukhtankar (2012). Moreover, it provides a channel that can explain the large private returns of holding political office for MLAs, as documented by Firsman et al. (2014). Finally, we show that the career concerns of local bureaucrats can mitigate political influence, which is in line with the findings of Nath (2016). Outside of the Indian context, this existing paper relates closely to Mironov and Zhurvaskaya (2016) who study political corruption in public procurement in Russia.

Our paper attempts to shed further light on the mechanics of the tendering process and how it interacts with corruption in the scheme. One of the principal theoretical arguments for the introduction of e-procurement is that it provides transparency and accountability. We therefore first evaluate the quality of data in the e-procurement system and how it relates to road characteristics. We find significant variation in the quality of online tender records, suggesting that the scheme only provides partial transparency. However, we find no evidence of a relationship between missing data and road performance (i.e. no evidence that information is concealed strategically). Secondly, we relate the competitiveness of the tendering process to measures of project performance. More competition in both the technical and financial evaluation stage of the tendering process, is associated with lower overruns and an increased likelihood that roads pass quality inspections. As our data concern almost exclusively tenders submitted under e-procurement, our analysis provides an important qualification of the findings of Lewis-Faupel et al. (2016). While they report improved road outcomes under e-procurement, our work suggests that e-procurement has not eliminated irregularities and does not in itself break the relationship between tender competitiveness and contractor performance.

A large body of existing work has introduced techniques and measures to uncover corruption with tender data. Padhi and Mohapatra (2011) provide a broad overview of methods used in this literature, and illustrate these measures in the context of Indian public works data (of an unnamed department). Much of the existing literature focuses on collusion between bidders. In a seminal paper, Porter and Zona (1993) study highway construction in the US and find evidence of collusive behaviour through phony bids. Morozov and Podkolzina (2013) identify collusion through similar rotating bidding schemes in Russian road construction. Conley and Decarolis (2012) study collusion in the specific context of average bid auctions, which are used for Italian public procurement, and apply their tests of collusion to a dataset of road contracts in Turin. In recent work, Andreyanov et al. (2017) focus on *bid leakage,* i.e. cases in which the auctioneer shares details of the auction with a preferred firm so that the latter wins the auction. Bid leakage implies that preferred bidders have to submit quotes late and are likely to bid only slightly below the runner-up. Using the timing of bids and the dispersion of prices as diagnostics, the authors find that between 8% and 16% of Russian public procurement auctions suffer from bid leakage. While the development of corruption diagnostics based on bidding data has seen much progress, it is striking that these methods are rarely used to identify determinants of corruption. The data collected in our project could be used to study the distribution of bidding prices – and we plan to do so in future work.

In the current paper, however, we focus on the first stage of the bidding process – the one in which firms are evaluated on their technical capacity before their bids are considered in the actual auction. We find evidence of irregularities even at this stage. In addition, we can link auction details to actual measures of contractor performance, which is rare in the literature on auction diagnostics..

2. BACKGROUND

2.1 PMGSY[2]

In the year 2000, an estimated 330,000 Indian villages or habitations – out of a total of 825,000 – were not connected to a road that provided all-weather access (NRRDA 2005). Their inhabitants were cut-off from economic opportunities and public services (such as health care and education). To address this lack of connectivity, the Indian government launched the Pradhan Mantri Gram Sadak Yojana (PMGSY) in December 2000. Its goal was to ensure all-weather access to all habitations with populations over 1,000 by the year 2003, and to those with more than 500 inhabitants by 2007. In hill states, desert and tribal areas, as well as districts with Naxalite insurgent activity, habitations with a population over 250 were targeted (NRRDA 2005). The proposed network of roads was determined ex-ante in 2001, and the implementation of PMGSY in subsequent decades has consisted of the gradual realisation of this "Core Network".

The programme has been described as "unprecedented in its scale and scope" (Aggarwal 2017), with roadwork for over 125,000 habitations completed and another 22,000 under construction as of November 2016.[3] A second phase of the scheme (PMGSY II), launched in 2013, targets all habitations with populations over 100. According to World Bank estimates, expenditures under PMGSY had reached 14.6

[2] This section draws heavily on Lehne et al. (2018).
[3] OMMAS (Online Management, Monitoring and Accounting System), http://omms.nic.in/, accessed in November 2016.

billion USD by the end of 2010, with a further 40 billion USD required for its completion by 2020 (World Bank, 2014).

Several studies have focused on the first-order research question that arises in relation to PMGSY: its impact on habitations and the lives of their inhabitants. Asher and Novosad (2016) analyse the employment effects of the programme in previously unconnected villages. They find that a new paved road raises participation in the wage labour market with a commensurate decrease in the share of workers employed in agriculture. This translates into higher household earnings and a rise in the share of households who live in houses with solid roof and walls. Aggarwal (2017) also finds a positive effect on employment and reduced price dispersion among villages. While these studies analyse *what* PMGSY has achieved, this paper looks at *how* it has been implemented, in line with Lehne et al. (2018), and focuses on the tendering process.

Compared to other public works programmes, the implementation of PMGSY stands out because of its reliance on private contractors combined with relatively strong monitoring and quality assurance provisions, designed to limit the scope for undue corruption. All tenders have to follow a competitive bidding procedure, for which the rules were prescribed by the National Rural Roads Development Agency (NRRDA) and set out in the so-called Standard Bidding Document (SBD). The SBD consists of a two envelop tendering process administered at the circle level. Each bid consists of both technical and financial volumes. The technical bids are opened first. Contractors have to fulfil eligibility criteria, including factors such as their current workload and experience. Only the financial bids of contractors whose technical bids are found to meet the requirements are evaluated, and subject to meeting the technical standards, the lowest bidder has to be selected. After the contract has been assigned, administrative data on the programme is gathered, while central and state-level inspectors can carry out quality inspections. In spite of these provisions, there remains clear scope for corruption, and the financial incentives are sizeable given the scale of the project.[4]

[4] Existing work reports that the price bid of only one firm was evaluated in 95% of a random sample of 190 road contracts issued between 2001 and 2006 in Uttar Pradesh; i.e. only one bid submitted or all other bids were disqualified based on technical requirements (Lewis-Faupel et al., 2016).

A large number of newspaper reports document alleged corruption in PMGSY.[5] Corruption in PMGSY could take several forms, and the possible manipulation of road allocations is one of the challenges for impact evaluations of the programme (Asher and Novosad, 2016).[6] In Lehne et al. (2018) we document a specific form of corruption: interventions by state-level parliamentarians (MLAs) in the allocation of road contracts (but not of the location of roads) within their constituencies. It is important to highlight that MLAs in this context should be in no way involved in the tendering process or the selection of contractors. In fact, they are granted practically no official role in the implementation of PMGSY whatsoever.[7] Funding for PMGSY comes primarily from the central government. The scheme is managed by local Programme Implementation Units (PIUs), which are under the control of State Rural Roads Development Agencies (SRRDA). These agencies are responsible for inviting tenders and awarding contracts. Given their lack of formal involvement, any systematic relationship between MLAs and the contractors working in their constituencies can therefore, in itself, be construed as evidence for an irregularity in the allocation of contracts.

3. DATA

3.1 PMGSY road data

The administrative records of projects sanctioned under PMGSY are publicly available in the Online Management, Monitoring, and Accounting System (OMMAS). As of January 2019 this dataset contained the agreement details of 169,901 projects. The data include: the date of contract signing, sanctioned cost, proposed length, and the name of

[5] Examples include articles in “The Hindu” on April 11 2012, “The Economic Times” on March 8 2013, “The Arunachal Times” on March 6 2013, the online news-platform “oneindia” on July 31 2006, and “Zee News” on 30 August 2014. For example, the “oneindia” article reports that the former Chief Minister of Sikkim accused the current administration of “widescale corruption” in the implementation of PMGSY and “alleged that the works were awarded to relatives of Chief Minister, Ministers and MLAs of the state”.

[6] These authors find that the habitation population figures reported to PMGSY had been manipulated, particularly around the 1,000 and 500 population cut-offs used to target the programme.

[7] MLAs are mentioned in the PMGSY guidelines, but only in reference to the initial planning stage. Intermediate panchayats and District panchayats were responsible for drawing up a planned “Core Network” which encompasses all future roadwork to be carried out under PMGSY. These plans were to be circulated to MPs and MLAs, whose suggestions were to be incorporated. MLAs could therefore have influenced which habitations were targeted ex-ante through official channels. However, this role is irrelevant for the timing of the construction work and assignment of road contracts, on which MLAs have no formal influence. Moreover, these consultations took place prior to our sample period. The majority of MLAs in our sample were not in office at the time and therefore had no opportunity to review the planned network. Our results are unchanged when we drop MLAs who were in office prior to 2001 from the sample (see Appendix Table A10).

the company awarded the contract. In addition to the agreement details, which precede road construction, the OMMAS also contains later data on the physical progress of work, data on completed roads, and reports from subsequent quality inspections. We use this information to construct four measures of project performance: the time to completion (in days), the final cost per km, cost overruns (final cost/agreement cost), and a variable which indicates whether a road failed the most recent quality inspection.

3.2. PMGSY tender and bidding data

The main source of tender data is the dedicated e-procurement website on which detailed information on the process is publicly available.[9] We collect this data for 5 contiguous states: Bihar, Jharkhand, Odisha, Uttar Pradesh, and West Bengal, between 2008 and 2016 (2017 for Jharkhand). We complement this data with tendering data collected directly from the Chhattisgarh State Rural Road Development Agency (SRRDA) covering 2001-2017, as well as administrative data of the Jharkhand SSRDA between 2001 and 2009.

The tender data contain separate records for the two stages of the process: the technical evaluation and the financial auction. Observations are at the bid level. Every firm that bids for a project is listed, along with its performance in the technical evaluation. Firms that pass the technical evaluation also appear in the 'Financial Bid Opening' document, where the size of their bid is recorded.

3.3 Matching road-level data to tender information

In principle, all roads constructed under PMGSY should be tendered electronically.[10] For the states and years in our sample, the dataset described in section 3.2 should therefore provide the tendering information for all roads in the OMMAS dataset (section 3.1). However, we found it hard to match PMGSY roads for which agreements had been signed to the corresponding tenders, even if a Package ID should theoretically enable such a match. Mismatches between these data sources could be the result of random or systematic administrative errors. They could even reflect strategic manipulation, for example if administrators attempt to make information on any corrupt tenders harder to

[9] https://pmgsytenders.gov.in/nicgep/app
[10] Odisha had a threshold of Rs 10 million (http://www.ocac.in/Content/3/14/16/45) above which e-procurement was mandatory.

access for the public, contractors, or internal monitors. Systematic differences between matched and unmatched roads could bias any results that combine tender details with administrative road characteristics. Moreover, any mismatches could be interesting in their own right as they shed light on the functioning of a data system that should facilitate monitoring and increase transparency in government contracting. We therefore investigate the quality of the tender data, as measured by the match rate of the administrative road data, directly as part of our analysis.

4. RESULTS

4.1. Descriptive statistics

Table 1 presents descriptive statistics for the datasets we use in this paper. We have information at three levels of analysis: tenders, bids, and roads. At the tender level, our summary statistics make it immediately clear that the tendering process is surprisingly uncompetitive: 44% of tenders have only 1 bidder, the average number of bidders per tender is around 2. At the bid level, we see that 77% pass the technical evaluation stage. As a result of the limited competition for tenders, the ex-ante probability of winning is around 50%.

At the level of completed PMGSY roads, we observe a variety of characteristics of the road project, like length and cost, as well as details on the performance of the contractor (overruns and failing internal quality inspections). 24% of roads failed the latest internal quality inspection, which confirms that contractor performance is a key concern in this context. We are able to merge around 84% of PMGSY roads to a tender. In the subsequent section, we will investigate whether road characteristics can explain the quality of our match. For the roads we match, about 30% has only one bidder.

Figure 1 compares different states in terms of the competitiveness of tenders. The share of tenders with only one bidder ranges between 22% (Bihar) and more than 70% (West Bengal). While Uttar Pradesh has a strikingly lower share of tenders with just one bidder, it has a much higher rate of rejection on technical grounds. The final share of tenders with multiple contractors in the financial stage (i.e. those where an auction actually took place) ranges between 18% (West Bengal) and 35% (Bihar). While this range is not negligible, our observation that the tendering process lacks competitiveness clearly holds throughout our sample states.

Figures 2-5 map these measures at the district level. Focusing on the final participation of multiple bidders in the financial stage, Figure 5 reflects substantial variation across districts in all states in our sample, and with the exception of Bihar, there are no clear geographical clusters of districts with a more competitive tendering process.

4.2. Correlates of data quality

As highlighted in the previous section, we were unable to merge the totality of PMGSY roads for which an administrative record exists to the corresponding tender. We think it is important to study the correlates of our ability to merge roads to tender data for two reasons. First, it is possible that data is strategically withheld, for example in an attempt to hide details about the tendering process that could expose corruption. If such behaviour occurred, it would be important to document its scale and understand its determinants. Even if data is not strategically withheld, it is likely that the merge status is not random. It is important for us to report the correlates of the merge status, so that we can assess how it affects the interpretation of any results that we derive from our merged dataset (which we will use in section 4.3).

Table 2 studies how the merge rate correlates with predetermined characteristics. We find that more “visible” roads, i.e. roads that are longer or part of a larger package of roads (tendered at the same time), are more likely to be merged. Roads for which the State government funds a larger share are more likely to be missing. In table 3, we show road completion measures. Merged roads are more expensive, which is in line with our earlier finding that larger projects are more likely to be merged. Importantly, merged roads are not significantly different in terms of their overruns or their probability of failing a quality inspection. We conclude from these results that our ability to merge roads to tenders is not fully random, in that larger roads are more likely to enter our merged sample. However, our findings are not consistent with the most intuitive form of strategic data manipulation, which would have implied better performance outcomes for merged roads.

4.3. Tender competitiveness and road outcomes

Table 4 shows how the tendering process relates to road outcomes. We focus on participation and the technical evaluation stage in particular. Time overruns do not seem to correlate significantly with these characteristics. However, cost over-runs are significantly lower for roads that had more than 1 bidder (2.5 percentage points lower on average), a higher number of bidders (overruns drop by 0.5 percentage points for each additional bidder), and a higher number of bidders passing the technical evaluation stage (4.2 percentage points lower on average). The total cost per kilometre, controlling for a range of road characteristics that explain its cost, is also significantly lower when more bidders reach the actual auction stage (by approximately 2% of the mean cost). Finally, roads for which contracts were awarded under more competitive conditions are more likely to pass internal quality inspections. Taken together, these findings suggest that greater competition for contracts is associated with better road outcomes, both in the quality and the cost dimension.

These findings may not be surprising. Firms operating in thin markets could be adversely selected and have limited incentives to perform well (i.e. they are subject to moral hazard concerns). However, it is possible that the administration reinforces these channels through favouritism and corruption. A particularly powerful instrument for the departments that run these tendering processes is the technical evaluation phase. The financial evaluation leaves no room for discretion, as auctioneers are expected to select the lowest bidder. In contrast, the criteria used for the technical evaluation give substantial leeway to the auctioneers. In Table 5 we test whether auctioneers use technical evaluations strategically to steer the outcome of auctions, possibly to the advantage of favoured contractors. If bureaucrats are neutral arbitrators, each firm should be judged on its own merit, and the technical evaluation of a given firm's bid should be independent of whether other firms pass the technical evaluation.

In Table 5, we find strong evidence to the contrary: a firm's bid is more likely to fail the technical evaluation if another firm passes. This result holds even when we include firm fixed effects, which could absorb all the time-invariant components of firm quality. Our findings suggest that bureaucrats use the technical evaluations to steer the outcome of the tendering process by limiting the number of firms that make it to the financial stage. In principle, bureaucrats could have noble motives and use their influence to favour better-performing contractors. However, this interpretation does not seem consistent with Table 4, which showed that roads with fewer bidders in the financial stage were more expensive and of similar (if anything lower) quality. These results are consistent with corruption in the evaluation of PMGSY bids: bureaucrats could use their influence to help favoured firms to benefit from economic rents. Even if we cannot show directly how money changes hands, it is conceivable that bureaucrats are willing to interfere in the tendering process in exchange for bribes.

5. CONCLUSION

Our paper presents new data on the tendering process in PMGSY, India's major rural road construction scheme. Even if our data is based on an electronic procurement system designed to provide transparency, we were not able to locate tenders for a sizeable share of roads. The road projects we were able to merge tended to be larger, but importantly we found no evidence of strategic hiding of information.

A striking observation in our data is that tenders tend to be extremely uncompetitive, in that a large share attracts only one bidder. This stylized fact is particularly surprising, given that our data covers exclusively tenders that were subject to e-procurement, which has been shown to increase participation in the bidding process by Lewis-Faupel et al. (2016). The lack of competitiveness in the tender stage may have real welfare costs, as we show that more competitive tenders are associated with better road outcomes in terms of cost and quality. While our analysis cannot ascertain strict causality, it offers support for policies that aim to improve the competitiveness of tenders. The one instrument that is directly controlled by the administration is the technical evaluation stage. We show that evaluations in this stage do not appear to be independent and may be used to circumvent the financial bidding stage. Again, this influence may have real costs, as tenders that reach the financial stage with more than one firm are cheaper and have similar (or even better) road outcomes. These patterns suggest that technical evaluations suffer from undue influence, which policy makers could address through improved monitoring of administrators involved in the technical evaluation.

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APPENDIX: FIGURES AND TABLES

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Panel A: Tender-level					
Number of bidders	19453	2.19	1.61	1	24
Only one bid	19453	0.44	0.50	0	1
multiple bids, one accepted	19453	0.18	0.38	0	1
Panel B: Bid-level					
accepted in technical eval.	42306	0.77	0.42	0	1
lowest financial bid	19962	0.63	0.48	0	1
won by less than 1%	16096	0.07	0.25	0	1
won	31763	0.53	0.50	0	1
# of past bids in district	42580	3.35	5.55	0	70
Panel C: Road-level					
Road length (kms)	23418	3.57	3.10	0	45
Bridge length (meters)	23418	1.33	11.64	0	361.29
Bridge dummy	23418	0.02	0.14	0	1
Total cost (100000s rupees)	23418	160.60	132.58	3.99	1832.40
State cost share	23418	0.01	0.05	0	1
Asian Development Bank (ADB) funding	23418	0.15	0.36	0	1
World Bank (WB) funding	23418	0.10	0.30	0	1
Cost per km	22954	46.60	15.80	6.91	303.93
Time to completion (days)	16795	666.47	351.58	10	3070
Final cost per km	20558	42.95	16.05	0.03	359.46
Cost overruns	20889	0.96	0.27	0	7.35
Failed inspection	20126	0.24	0.42	0	1
Merge to tender data	23418	0.84	0.36	0	1
# of bidders	19496	3.45	3.70	1	50
One bidder	19496	0.30	0.46	0	1
More than one bidder accepted	19496	0.58	0.49	0	1

Notes: Road level outcomes are for all PMGSY roads in the time period for which a representative amount of tender data is available: starting in the year 2012 for Bihar, 2007 for Chhattisgarh, 2007 for Jharkhand, 2009 for Odisha, 2012 for Uttar Pradesh, and 2012 for West Bengal. Data were scraped/collected in 2016 which marks the end year of the sample.

Table 2: Ex-ante determinants of match to tender data

Merge with tender data	(1)	(2)	(3)	(4)	(5)	(6)
Log road length	0.0265***	0.0279***			0.0246***	0.0276***
	(0.0073)	(0.0064)			(0.0076)	(0.0064)
Bridge	-0.3056***	-0.2655***			-0.2390**	-0.1837*
	(0.0949)	(0.0967)			(0.1050)	(0.1052)
# of roads in package	0.0178***	0.0185***			0.0178***	0.0178***
	(0.0047)	(0.0050)			(0.0046)	(0.0049)
ADB funding			0.0591	0.1076*	0.0536	0.1030*
			(0.0397)	(0.0575)	(0.0382)	(0.0541)
WB funding			-0.0273	-0.0970	-0.0430	-0.1184**
			(0.0501)	(0.0601)	(0.0514)	(0.0598)
State cost share			-1.0687***	-1.1059***	-0.3437***	-0.3577**
			(0.1666)	(0.1495)	(0.1273)	(0.1398)
State FE	X		X		X	
Year FE	X		X		X	
District-year FE		X		X		X
Observations	23,418	23,418	23,418	23,418	23,418	23,418
R-squared	0.1434	0.4001	0.1195	0.3886	0.1478	0.4061

Note: Regressions at the level of PMGSY roads. The dependent variable is a dummy for whether a given road could be matched to a tender in the tender-level dataset. Columns (1) and (2) control for road pre-determined characteristics of the package. Columns (3) and (4) control for funding characteristics: ADB and WB funding are dummy variables. State cost share is a the share of the total cost funded by the state government. Standard errors clustered at district level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Ex-post outcomes depending on merge with tender data

Dep var:	Time to completion (days)		Final cost per km		Cost overruns		Failed inspection	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Merge with tender data	-36.9602	-23.7288	1.6914***	1.8199***	-0.0157	0.0178	0.0157	0.0163
	(23.8301)	(22.0771)	(0.4587)	(0.4612)	(0.0126)	(0.0108)	(0.0165)	(0.0166)
Log road length		64.7661***		-1.0431***		0.0045		-0.0012
		(6.5010)		(0.2159)		(0.0048)		(0.0049)
Bridge		507.8904***				-0.0339		-0.1320
		(121.4075)				(0.1117)		(0.1177)
# of roads in package		-16.3023***		-0.2217***		0.0000		-0.0002
		(5.9141)		(0.0797)		(0.0024)		(0.0019)
ADB funding		-37.0055***		0.9559*		0.0148		0.0002
		(13.1207)		(0.5124)		(0.0175)		(0.0198)
WB funding		-46.8674		-2.4264		0.0201		0.0454
		(30.4359)		(1.6534)		(0.0506)		(0.0298)
State cost share		-120.0766		55.6502		1.9280***		0.5446**
		(146.9849)		(42.5557)		(0.5111)		(0.2414)
District-year FE	X	X	X	X	X	X	X	X
Observations	16,795	16,795	20,577	20,577	20,909	20,909	20,126	20,126
R-squared	0.3919	0.4156	0.5794	0.5839	0.2344	0.2897	0.1346	0.1353

Note: Regressions at the level of PMGSY roads. Time to completion measures the number of days from the agreement to the completion of the road. Final cost per km is the per-km cost in 100000s of rupees. Cost overruns is the ratio of the final cost on completion to the initial agreement cost. Failed inspection is a dummy variable that takes the value of one if a road failed the most recent state or national inspection. Standard errors clustered at district level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Competition and road-level outcomes

Dep var:	Time to completion (days)			Final cost per km			Cost overruns			Failed inspection		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Number of bidders	1.1035			-0.0560			-0.0050***			-0.0038***		
	(1.2661)			(0.0569)			(0.0012)			(0.0014)		
Only one bidder		-7.1258			0.3689			0.0256***			0.0164*	
		(10.9953)			(0.3327)			(0.0061)			(0.0098)	
Multiple bidders pass technical evaluation			14.0531			-0.8915***			-0.0417***			-0.0121
			(10.6836)			(0.2953)			(0.0062)			(0.0105)
Road-level controls	X	X	X	X	X	X	X	X	X	X	X	X
District-year FE	X	X	X	X	X	X	X	X	X	X	X	X
Observations	14,150	14,150	14,150	17,367	17,367	17,367	17,466	17,466	17,466	17,307	17,307	17,307
R-squared	0.3935	0.3935	0.3937	0.6026	0.6026	0.6030	0.2751	0.2724	0.2751	0.1410	0.1407	0.1406

Note: Regressions at the level of PMGSY roads for the subsample of matched roads. The dependent variables are as defined in Table 3. Each is regressed on (i) the number of bidders in the tender (ii) a dummy variable that takes the value of one if there was only one bid and (iii) a dummy variable for whether multiple bids passed the technical evaluation i.e. whether there was a competitive financial bid. Standard errors clustered at district level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: independence of technical evaluation

Dep var: Accepted in tech eval.	(1)	(2)	(3)	(4)
One other firm passed	-0.1218***	-0.1228***	-0.0796***	-0.0792***
	(0.0148)	(0.0148)	(0.0151)	(0.0151)
More than one other firm passed	-0.1250***	-0.1261***	-0.0360	-0.0346
	(0.0203)	(0.0198)	(0.0235)	(0.0232)
Bidder count	0.0006	0.0008	-0.0068	-0.0072
	(0.0041)	(0.0039)	(0.0058)	(0.0057)
Past experience PMGSY		0.0015**		-0.0001
		(0.0007)		(0.0008)
Past experience in district		0.0031*		0.0018
		(0.0016)		(0.0012)
Firm local to district		-0.0268***		-0.0242**
		(0.0089)		(0.0098)
Year FE			X	X
District year FE	X	X		
Firm FE			X	X
Observations	36,290	36,290	36,290	36,290
R-squared	0.1748	0.1800	0.5045	0.5049

Note: Regressions at the level of individual bids. The dependent variable is a dummy which takes the value of one if a firm's bid passed the technical evaluation. Columns 1 and 2 include district-year fixed effects while columns 3 and 4 include firm fixed effects to account for unobserved firm-specific characteristics that affect rejection rates. Standard errors clustered at district level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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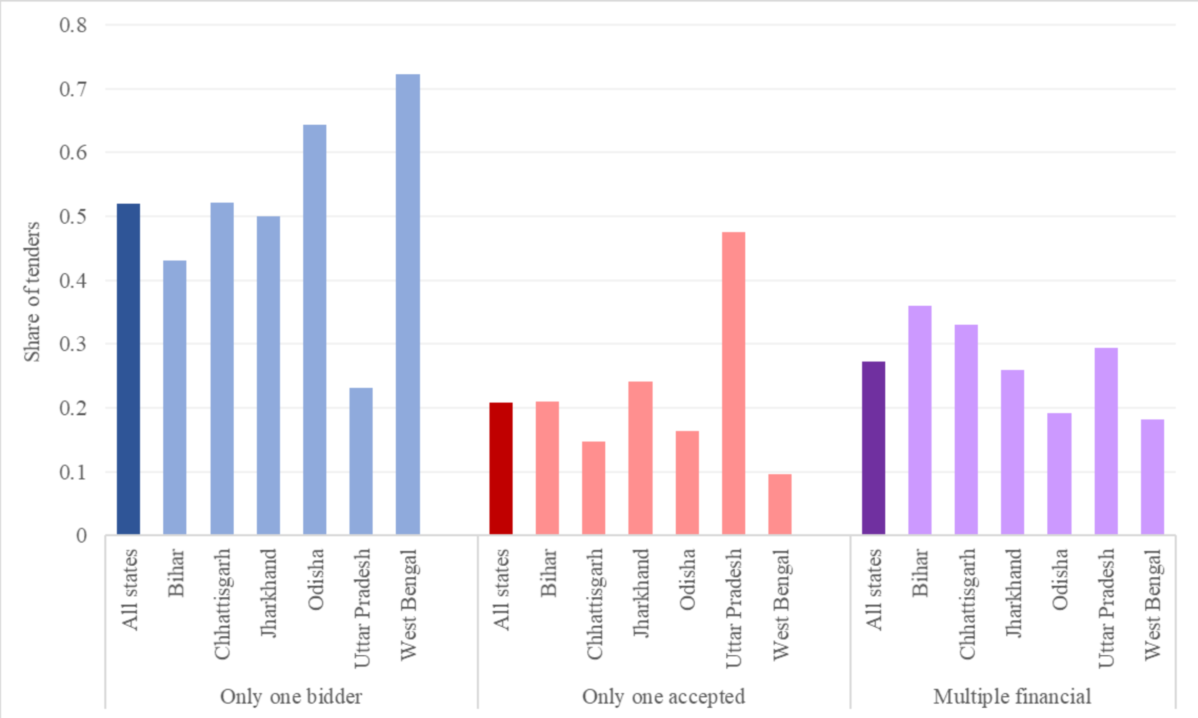
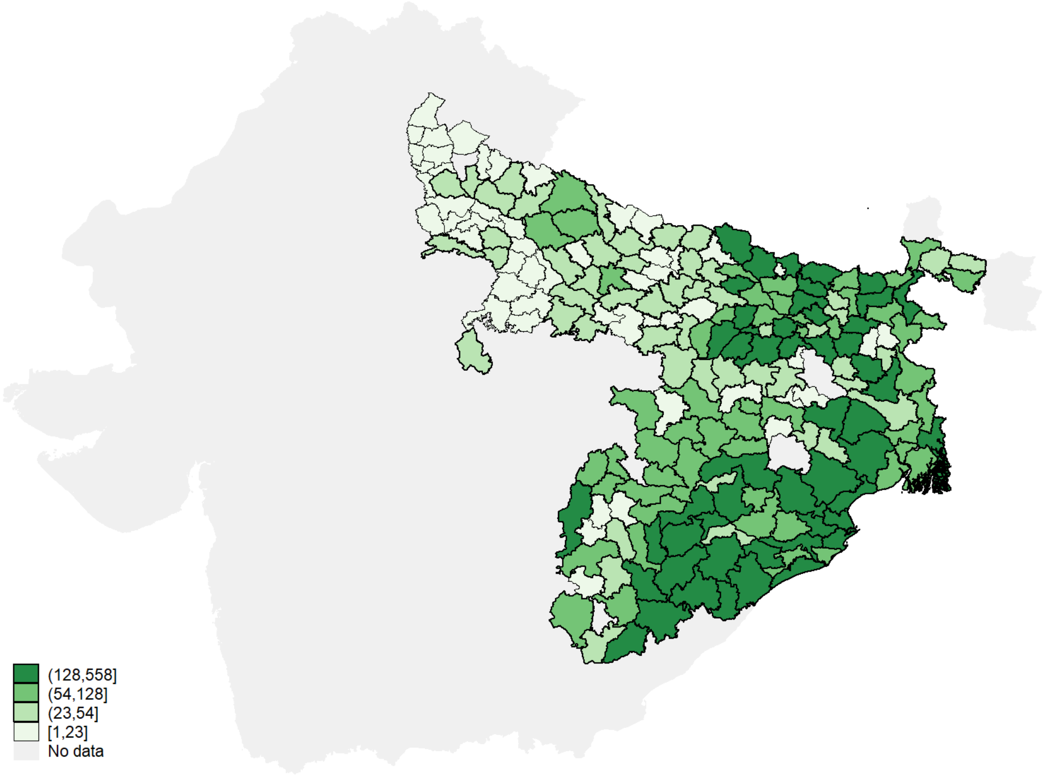
Figure 1: State-wise comparison of competition in tendering process



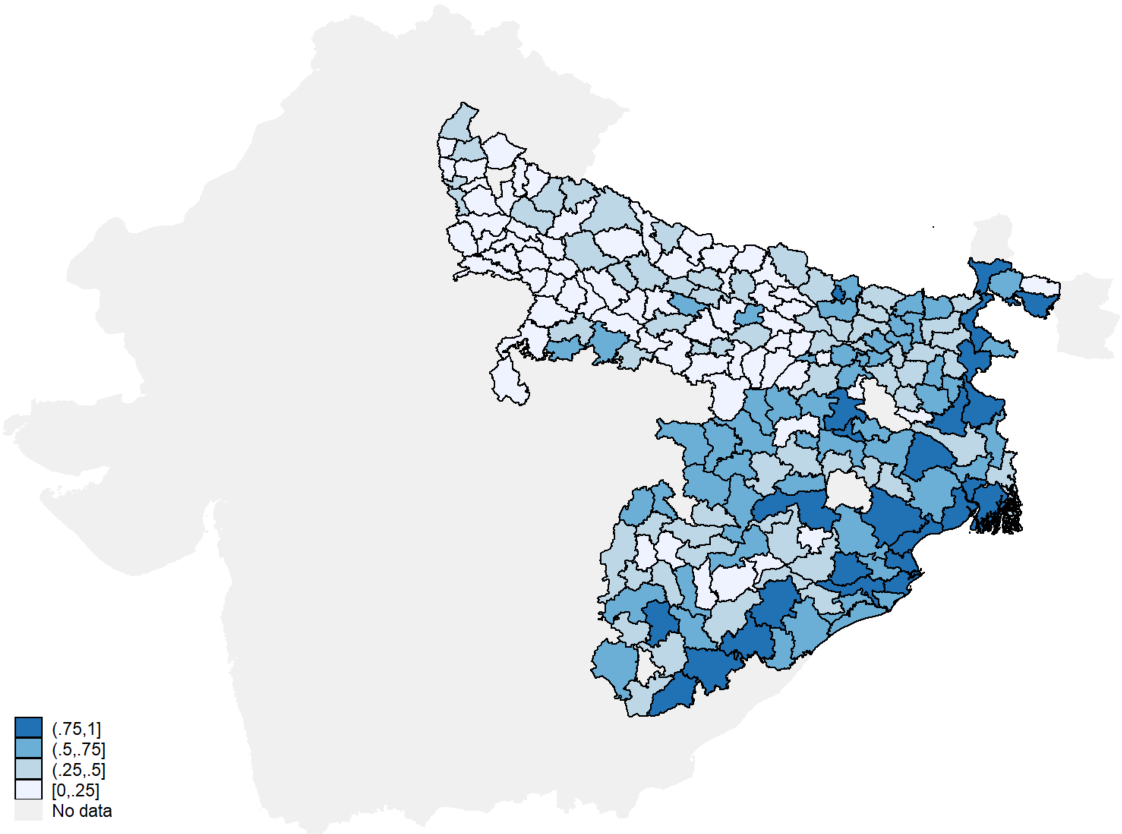
Note: Figure plots competitive characteristics of tendering by state. The first panel shows the share of a states' tenders for which only one firm bid. The second panel shows the share of tenders for which multiple firms bid but only one firm passed the technical evaluation. The third panel shows the share of tenders for which multiple bids passed the technical evaluation stage, i.e. the share with a competitive financial auction. For each states the shares add up to one (all shares exclude any tenders where missing information implies the outcome cannot be determined).

Figure 2: Number of tenders per district



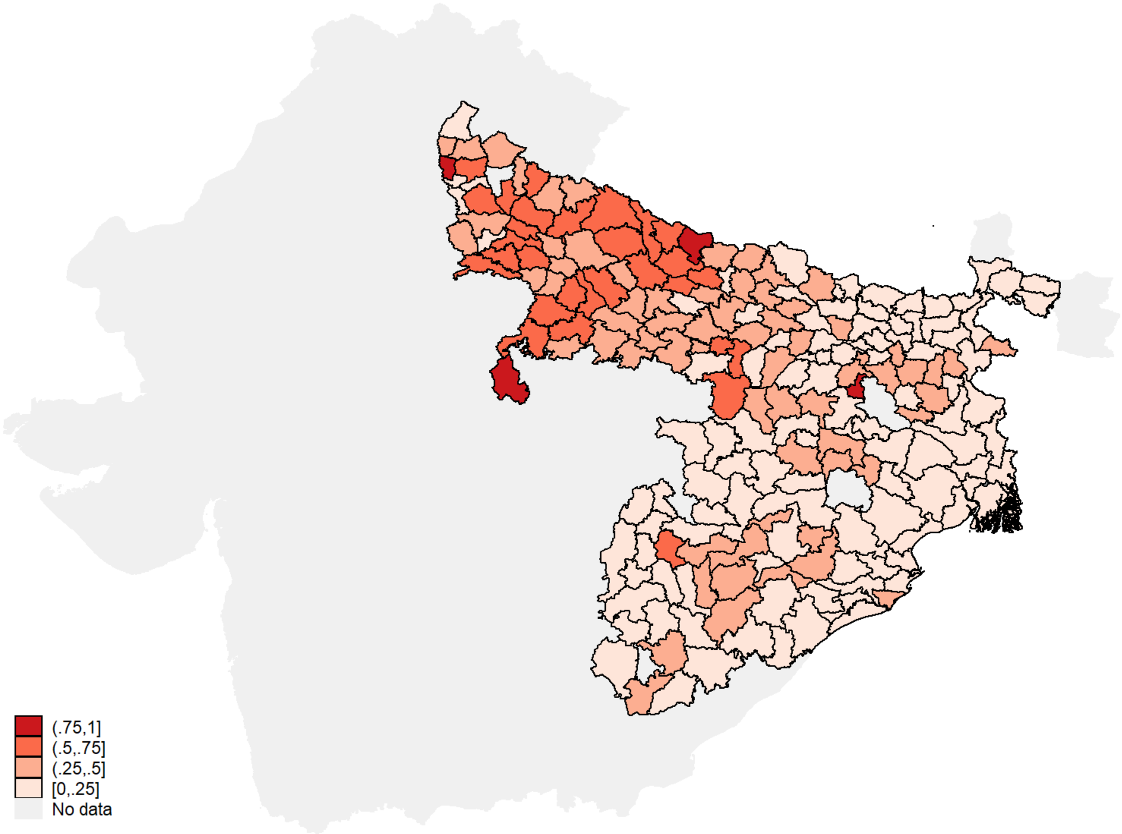
Note: Map shows the total number of tenders by district for sample districts.

Figure 3: Share of tenders with only one bidder



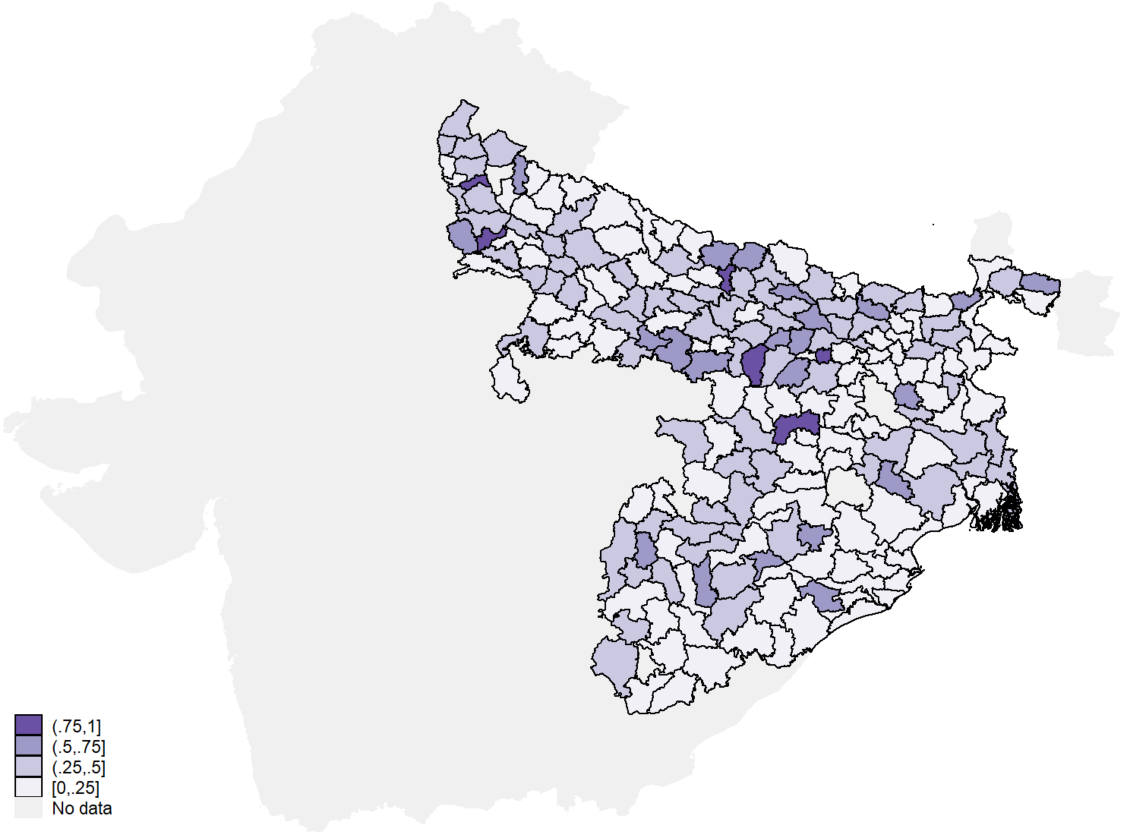
Note: Tender characteristics at the district level, as in figure 1.

Figure 3: Share of tenders with only one firm (out of multiple bidders) passing the technical evaluation



Note: Tender characteristics at the district level, as in figure 1.

Figure 4: Share of tenders with multiple firms passing the technical evaluation



Note: Tender characteristics at the district level, as in figure 1.

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