The Effect of Competition on Corruption: Evidence from Contractors' Internal Records*

Aamer Shahid† Stephan Litschig‡

June 2024

Abstract

This paper investigates the extent to which competition for public contracts reduces project-level rents and bribe payments to public officials. Water supply and sanitation project contractors for the provincial government of Punjab in Pakistan were interviewed on the condition of anonymity and gave access to 237 project-level construction ledgers. Under collusion, contractors pay about 15 percent of the project budget in kickbacks on average. Under competition for the contract, the winning bid and associated available rents go down by about 11 percentage points. Even under competition, public officials take almost 10 percent of the project budget in bribes.

Keywords: Rents, competition, corruption, bribery, public works
JEL: D73, D78, H41, H83, K42

*We are grateful for comments from Boo Teik Khoo, Tetsushi Sonobe, Anh Tran and Keiichi Tsunekawa. We also received helpful feedback from seminar participants at Osaka University, University of Tokyo, Hitotsubashi University and Keio University. We acknowlededge financial support for data collection from the Japanese Society for the Promotion of Science (Kakenhi 25101002, "Emerging State Project SONOBE A01 Group"). The views expressed in this paper are those of the authors and not necessarily those of the National Accountability Bureau of Pakistan. All errors are our own.

†National Accountability Bureau of Pakistan.
‡National Graduate Institute for Policy Studies, Tokyo, s-litschig@grips.ac.jp.

1 Introduction

Does competition among firms constrain corruption by reducing excess profits from which public officials in charge of tax or regulation compliance can extract bribes? Theory is ambiguous, as competition may actually increase corruption, depending on the industrial organization of the sector (Bliss and Di Tella 1997), on how well bureaucrats are monitored (Ades and Di Tella 1999) and on whether corruption is coercive (surplus-shifting) or collusive (cost-reducing). Empirically, recent studies based on firm-level data have documented positive associations between measures of industry-level competition and bribery (e.g. Alexeev and Song 2013, Diaby and Sylvester 2015).

This paper provides evidence on the effect of competition for public contracts at the project-level based on contractors' internal records. We focus on water supply and sanitation projects commissioned by the Public Health Engineering Department (PHED) of the provincial government of Punjab in Pakistan. Punjab province is home to about 110 million people and the PHEDs allocation for water and sanitation infrastructure projects represents about 9 percent of the provincial infrastructure development budget. All PHED contracts are awarded through first-price auctions and project implementation is monitored by PHED officials.

As in Tran (2014) we exploit a personal connection to an actual bribe-paying contractor. In order to improve the generalizability of our findings, we also approached 48 additional A-class contractors, which are firms with considerable experience that are allowed to bid for contracts of any size. While random sampling from the universe of about 500 A-class contractors was not possible, we attempted to include contractors from all 36 districts in Punjab. Ultimately, 28 Chief Executive Officers (CEOs) agreed to be interviewed on the condition of anonymity. In addition to being interviewed, each of the CEOs also gave us access to their project-level construction ledgers spanning from 2007 to 2017. From these ledgers we extract the value of the contract or winning bid, material and labor costs, bribe payments by payee (PHED and other public officials as well as politicians) and project profit. The resulting project-level dataset includes 237 contracts and covers 29 districts.

It is natural to ask why almost 60 percent of the CEOs we approached agreed to cooperate. After all, both bribe-taking and bribe-payment are illegal in Pakistan. However, in contrast to solicitation of bribes, bribe-payment has hardly ever been prosecuted. In fact, our interviews suggest that most

CEOs were not even aware that bribe-payment is illegal since it is so common. On the contrary, most CEOs perceived themselves as victims of extortion and hoped that the government would do something about bribe-solicitation by public officials.

Both qualitative and quantitative results suggest that the level of bribes depends on whether the contract was awarded competitively or through collusion between contractors and the engineer in charge of the project. Only about one third of the contracts in our sample were awarded competitively. Under collusion, candidate contractors submit empty bids, which are then filled out by the engineer to ensure that the contract is awarded at the "full rate" or official reserve price in order to maximize available rents. Losing bidders are promised to be accommodated in future auctions. Contractors on average pay about 15 percent of the project budget in bribes with 11 percent going to the PHED district engineer, 3 percent to the politicians who sponsored the project and another roughly 1 percent to other public officials from the finance department and office of the Accountant General (AG). Contractors' profit margins under collusion are about 13 percent. If a member of the bidding ring becomes impatient or if there is a new entrant for example, contractors may instead compete for the contract and submit actual bids. We estimate that under competition, the winning bid and available rents go down by about 11 percentage points, accounting for contractor, award year, and district fixed effects. This reduces the average bribe payment by almost 6 percentage points, while reduced cost and profit margins account for another 5 percentage points reduction. Even under competition, public officials and politicians together take almost 10 percent of the project budget in bribes, while contractors still enjoy a roughly 10 percent profit margin. Overall, these results suggest that competition is only partially successful at reducing bribery in public infrastructure projects in this setting.

Our first contribution lies in the quality of the data on bribe payments and profits. The data are likely accurate because contractors have an incentive to keep track of all costs - including bribes - in order to accurately assess profitability. Moreover, our assistants transcribed the data directly from individual project ledgers. With the exception of Tran (2014), existing work on competition and corruption has instead relied on indirect survey-based measures, i.e. asking respondents how much they think other firms pay in bribes (e.g. Alexeev and Song 2013, Diaby and Sylvester 2015). The average bribe (15 percent) and profit margins (13 percent) we estimate in the absence

of competition are similar to the 15 percent kickback and 16 percent profit rates of the trading company analyzed by Tran (2014). While the levels of bribery and profit from our sample may not be representative of all PHED A-class contractors in Punjab, they likely provide a lower bound to the extent that contractors who pay higher bribes and make higher profits refused to participate in our study. Indeed, the level of bribery we find is somewhat lower than the 25 percent of project cost found in road construction in Indonesia (Olken 2007).

Second, we provide the first evidence about the effect of competition on bribery in public infrastructure projects, which are notorious for corruption (Campos et al. 2021). Existing work has instead focused on the link between competition and corruption in the manufacturing sector. As expected, the reported levels of bribery in Alexeev and Song (2013) and Diaby and Sylvester (2015) are an order of magnitude lower compared to bribery in infrastructure projects documented here and in Olken (2007).

The third innovation is that we measure competition at the level of individual projects, rather than at the level of an entire sector or industry. This means that we are able to identify the immediate effect of competition for the public contract. In other words, we are able to quantitatively answer the question "by how much do profits and bribes go down if contractors compete for a given public contract instead of colluding?". In contrast, empirical studies such as Alexeev and Song (2013) and Diaby and Sylvester (2015) focus on measures of competition based on the industrial organization of different sectors. Effectively, these studies tell us that bribes are higher when an entire industry is more competitive, perhaps because firms are under higher pressure to cut costs.

Fourth, our results corroborate the findings on corruption in procurement from two recent studies. Since bribes are paid not only to PHED officials overseeing contract execution but also to the politicians (principals) who sponsored the projects, our results underscore the empirical relevance of models that consider self-interested principals (Chiappinelli 2020) as opposed to purely benevolent types (Laffont and Tirole 1993). The second related study by Bandiera et al. (2021) finds that limiting the authority of monitors from the AG's office in Punjab to approve purchases led to a decrease in price for generic goods. Our results suggest that this price reduction might have been driven at least in part by a reduction in bribes rather than red tape.

The paper proceeds as follows. Section 2 describes the institutional background and data. Section 3 presents the qualitative results based on interviews with contractors. Section 4 describes our estimation approach and Section 5 presents the quantitative results. Section 6 concludes.

2 Institutional background and data

2.1 Institutional background on public health engineering in Punjab

The Public Health Engineering Department (PHED) is responsible for ensuring the provision of water supply and sanitation infrastructure in Punjab. The PHED has one office for development work in each district, which is headed by an executive engineer. A typical PHED public works project is implemented as follows. First, funds are allocated to each province in the annual budget. National and provincial members of parliament negotiate funding with the provincial government for the projects in their constituencies to be completed through the PHED. The finance department of the provincial government then allocates funds to the PHED for project execution. Each project needs to obtain a technical sanction, i.e. approval to conduct the project from a PHED engineer. Once the project is sanctioned, a contract for project execution is put out to tender by the office of the respective executive engineer in a given district. The call contains information about the issuance and opening dates of the tender documents as well as the so-called full rate, i.e. the maximum the PHED is willing and able to pay based on the available budget. Only registered firms can get tender documents which are issued in their names by the office of the executive engineer. On the tender opening date, firms are supposed to put their sealed bids in a locked tender box placed in the office of the executive engineer. On the same day at a pre-specified time, tender documents are opened in front of all the candidate contractors and the head clerk is asked to make a comparative statement of the rates quoted by each contractor. The head clerk announces the rates and the contract is awarded to the lowest bidder. PHED engineers then supervise the entire process of project execution. Contractors are paid in tranches according to the portion of work completed. The bill for completed work then needs to be processed and approved by the office of the Accountant General Pakistan Revenues (AG) before it issues a check in favor of the firm.

2.2 Sample and data

The firms executing most of the work for the PHED in Punjab are A-class contractors, which are allowed to bid for contracts of any size. Ideally, we would have taken a random sample from the universe of about 500 such A-class contractors. This was not possible however, given the sensitive nature of our investigation and inaccessibility of a centralized A-class contractors register. Instead, we exploited the network of an actual bribe-paying contractor to approach 48 additional A-class contractors. In order increase the generalizability of our results we attempted to include contractors from all districts in Punjab. Ultimately, 28 Chief Executive Officers (CEOs) agreed to be interviewed on the condition of anonymity. Interviews took place in their respective offices during two months in the summer of 2017. In addition to being interviewed, the CEOs also gave us access to their project-level construction ledgers spanning from 2007 to 2017. Research assistants transcribed the data directly from individual project ledgers. The 237 contracts in our sample cover 29 of the 36 districts in Punjab. About half the projects were for the provision of village water supply and the other half for water sanitation/sewage systems. Figure 1 shows a map of Punjab province with approximate project locations.

The total budget allocated to a given project can be decomposed as follows:

$$\text{Budget - Discount = Winning bid = Costs (Materials, Labor, Taxes) + Total bribe + Profit.} \quad (1)$$

The winning bid is the value of the contract to the firm, i.e. project budget minus the winning discount. Contractors also refer to the winning rate, expressed as a percentage of the project budget. A firm is bound to complete the contract at the agreed price and meeting the agreed terms, conditions and project specifications. Ex-post adjustments due to weather events or input price changes for example are not allowed. Costs are the material and labor expenses incurred by the contracting firm for the completion of the contract, as well as income and sales taxes paid. Total bribe is the sum of all the bribes given to the engineering department and other public officials, as well as to the politicians who sponsored the project. Profit is after cost, taxes and bribes. In order to compare the magnitudes of the various project components across contracts of varying size and levels of competition, we scale each component by the project budget.

3 Qualitative evidence on the bribe process

Without exception, the 28 CEOs interviewed for this study indicated that they had to pay bribes to literally every kind of public official or politician involved in the project. Politicians are paid for their efforts to secure funding for the project. Finance department officials get paid for releasing the funds. PHED engineers get their cut for approving that the contracted work is done according to specifications. Finally, officials from the AG's office require compensation for final approval and issuing a check to the contractor. The CEOs were also very clear that the PHED executive engineer makes every effort to award the contract on full rates, i.e. to use the entire project budget in order to maximize available rents. Candidate contractors are asked to hand over the signed and filled out tender forms to the executive engineer and designate the winner for the current round. The executive engineer then completes the tender forms by adding the bid information, making sure that all except the winning quote are above the budget. If all goes according to plan, other participating contractors are accommodated in future tenderings. However, sometimes a member of the bidding ring becomes impatient or a new entrant appears. In such cases collusion breaks down and contractors submit actual bids.

4 Estimation approach

Our goal is to estimate to what extent competition for the contract affects the winning rate, i.e. the LHS of equation (1), as well as the RHS components, project cost, bribes and profit. Under collusion, the contract is awarded at the full rate or official reserve price in order to maximize available rents. Our key variable "Competition" takes value zero in these cases. When contractors instead compete for the contract and submit actual bids, the "Competition" variable takes value 1. Figure 1 shows that for about half the districts in our sample, there is variation in whether the contract was awarded under collusion (hollow circle) versus under competition (full circle).

Let Y_{pcdt} denote the outcome variable for project p won by contractor c in district d and period t, β the (constant) effect of competition, α_c contractor fixed effects, γ_t award year fixed effects, δ_d district fixed effects, and U_{pcdt} the influence of other unobserved factors that affect the outcome.

The full fixed effects specification is then as follows:

$$Y_{pcdt} = \beta Competition_{pcdt} + \alpha_c + \gamma_t + \delta_d + U_{pcdt}. \quad (2)$$

To complement the fixed effects specifications, we also present estimates that additionally control for project-level covariates X_{pcdt} such as project budget, a dummy for water supply projects as well as the travel distance from the project site to each of three central government anti-corruption agencies in Lahore, Multan, and Rawalpindi. Standard errors are clustered at the contractor level. Causal interpretation of the β estimate hinges on the untestable assumption that project-level unobservables are uncorrelated with whether firms competed for the contract, conditional on fixed effects and other controls. We also report estimates that are adjusted for selection on unobservables based on Oster (2019) assuming proportional selection. Standard errors in this last specification are based on 200 bootstrap replications.

5 Quantitative results

5.1 Impacts of competition on winning bid and main project components

Table 1 presents estimates of the effect of competition on the winning bid and main project components. The first column shows the mean of the respective outcome variable and its standard deviation under collusion. Column (2) shows the difference in mean outcomes between contracts awarded under competition versus collusion. Column (3) adds contractor and award year fixed effects, column (4) adds district fixed effects, and column (5) adds additional controls. Column (6) reports estimates adjusted for selection on unobservables (Oster 2019) assuming proportional selection.

Panel A shows results for the winning bid as a share of the project budget. The simple difference in column (2) is about -0.09 while the fully adjusted impact estimate accounting for contractor, award year, district fixed effects and additional controls in column (5) is -0.11. The adjusted-for-unobservables estimate in column (6) is about -0.15. All estimates are significantly different from zero at least at 1 percent. These results indicate that competition reduces the winning bid and associated available rents by at least 11 percentage points.

Panel B presents results for the total bribe as a share of the project budget. Under collusion the mean total bribe is a bit over 15 percent, with a standard deviation of 2.4 percentage points. The simple difference and adjusted estimates in columns (2) through (5) suggest that competition reduces the average bribe payment by almost 6 percentage points. Again, all estimates are comfortably significant at 1 percent. The estimate in column (6) is also about -0.07 but very noisy. Overall, these results suggest that public officials and politicians together still take almost 10 percent of the project budget in bribes even under competition.

Panels C and D show that under competition, profit and cost as a share of the project budget together go down by about 4-5 percentage points, driven mostly by a reduction in profits. The statistical significance varies: most effect estimates for profit are still significant at the 10 percent level while they are not significant for project cost. Given that contractors have a 13 percent profit margin under collusion, the results show that contractors still enjoy a roughly 10 percent profit margin even under competition.

5.2 Impacts of competition on bribe payments by recipient

Table 2 presents disaggregated results by recipient. Column (1) of Panel A shows that PHED engineers get almost 11 percent of the project budget in bribes under collusion. Under competition this amount gets reduced by 4 to 5 percentage points, with little variation across specifications. All estimated reductions are statistically different from zero at 1 percent. Panels B and C show that officials from the finance department and AG's office together also get slightly over 1 percent of the project budget irrespective of whether the contract was awarded through collusion or competition. It is also noteworthy that there is no variation in the amount paid to finance department officials, i.e. they get paid exactly 1 percent in each project. Finally, Panel D shows that the politicians who sponsored the project get about 3 percent of the project budget in bribes on average under collusion. In contrast to public officials however, the standard deviation of 0.2 is substantial and in some projects politicians are not paid at all. Under competition, the bribe to politicians gets reduced by about 2 percentage points, significant at 1 percent in most specifications. In sum, literally every kind of public official or politician involved in these projects receives bribes and competition is only detrimental to executive engineers and politicians.

6 Conclusion

The main finding of this study is that competition is only partially successful at reducing bribery in water and sanitation infrastructure projects in Punjab. A plausible explanation is that public officials and politicians play key roles in the project cycle, enabling them to exact a price irrespective of available rents. Another explanation is that at least some of the payments are actually cost-reducing for the contractor, rather than pure extortion. The second key finding is that politicians are heavily benefiting from the status quo. This implies that combating bribery by changing bureaucrats' incentives alone, such as by increasing salaries of engineers for example, is unlikely to be effective. A more fruitful approach may be through a campaign finance reform that allows politicians to raise more funds legally, rather than having to rely on kickbacks from construction projects to recover what they spent on the campaign. Future work might thus consider the campaign finance aspect of corruption in public procurement in more detail, both theoretically and with data.

7 References

Alexeev, M. and Y. Song, 2013, "Corruption and Product Market Competition: An Empirical Investigation," *Journal of Development Economics*, 103: 154-166.

Ades, A. and R. Di Tella, 1999, "Rents, Competition and Corruption," *Amercian Economic Review*, 89(4): 982-993.

Bandiera, O., M. Best, A. Khan and A. Prat, 2021, "The Allocation of Authority in Organizations:A Field Experiment with Bureaucrats," *Quarterly Journal of Economics*, 136(4): 2195-2242.

Bliss, C. and R. Di Tella, 1997, "Does Competition Kill Corruption?" *Journal of Political Economy*, 105(5): 1001-1023.

Campos, N., E. Engel, R. D. Fischer and A. Galetovic, 2021, "The Ways of Corruption in Infrastructure: Lessons from the Odebrecht Case," *Journal of Economic Perspectives*, 35(2): 171-190.

Chiappinelli, O., 2020, "Political Corruption in the Execution of Public Contracts," *Journal of Economic Behavior & Organization*, 179: 116-140.

Diaby A. and K. Sylwester, 2015, "Corruption and Market Competition: Evidence from Post-Communist Countries," *World Development*, 66: 487-499.

Laffont, J.-J. and J. Tirole, 1993, *A Theory of Incentives in Procurement and Regulation*, MIT Press.

Olken, B. A., 2007, "Monitoring corruption: evidence from a field experiment in Indonesia," *Journal of Political Economy*, 115(2): 200-249.

Oster, E., 2019, "Unobservable Selection and Coefficient Stability: Theory and Evidence," *Journal of Business and Economic Statistics*, 37(2): 187-204.

Tran, A., 2014, "Which Regulations Reduce Corruption? Evidence from the Internal Records of a Bribe-paying firm," *Unpublished manuscript*.

Table 1: Impacts of competition on winning bid and main project components

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: winning bid as share of project budget						
Competition (0/1)	1.000	-0.093	-0.105	-0.108	-0.110	-0.148
	[0.000]	(0.016)	(0.019)	(0.020)	(0.017)	(0.020)
R-squared		0.54	0.72	0.77	0.80	0.80
Panel B: total bribe as share of project budget						
Competition (0/1)	0.153	-0.056	-0.058	-0.057	-0.057	-0.068
	[0.024]	(0.005)	(0.006)	(0.006)	(0.005)	(0.356)
R-squared		0.54	0.66	0.74	0.76	0.76
Panel C: profit as share of project budget						
Competition (0/1)	0.130	-0.020	-0.028	-0.033	-0.036	-0.080
	[0.039]	(0.016)	(0.018)	(0.019)	(0.016)	(0.030)
R-squared		0.04	0.39	0.53	0.57	0.57
Panel D: project cost (material, labor, taxes) as share of project budget						
Competition (0/1)	0.717	-0.017	-0.018	-0.019	-0.017	-0.017
	[0.039]	(0.011)	(0.010)	(0.012)	(0.012)	(0.028)
R-squared		0.03	0.59	0.62	0.64	0.64
Contractor fixed effects		No	Yes	Yes	Yes	Yes
Award year fixed effects		No	Yes	Yes	Yes	Yes
District fixed effects		No	No	Yes	Yes	Yes
Additional controls		No	No	No	Yes	Yes

Notes: OLS estimates. There are 237 project-level observations. Column (1) shows the mean and standard deviation of the outcome variable under collusion in each panel. Competition indicates that the project was awarded below full rates. Additional controls include project budget, dummy for water supply projects and travel distance from project site to each of three central government anti-corruption agencies in Lahore, Multan, and Rawalpindi. Standard errors in column (2) through (5) are clustered at the contractor level. Column (6) reports estimates adjusted for selection on unobservables (Oster 2019) assuming proportional selection. Standard errors in column (6) are based on 200 bootstrap replications.

Table 2: Impacts of competition on bribe payments by recipient

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: bribe to PHED officials as share of project budget						
Competition (0/1)	0.107	-0.035	-0.036	-0.036	-0.037	-0.043
	[0.015]	(0.005)	(0.005)	(0.007)	(0.005)	(0.014)
R-squared		0.52	0.72	0.75	0.80	0.80
Panel B: bribe to AGPR officials as share of project budget						
Competition (0/1)	0.003	-0.001	-0.000	-0.000	-0.000	-0.000
	[0.002]	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-squared		0.03	0.99	1.00	1.00	1.00
Panel C: bribe to finance department officials as share of project budget						
Competition (0/1)	0.010	-0.001	-0.001	-0.001	-0.001	-0.012
	[0.000]	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-squared		0.37	0.77	0.82	0.84	0.84
Panel D: bribe to politicians as share of project budget						
Competition (0/1)	0.033	-0.020	-0.021	-0.019	-0.019	-0.013
	[0.20]	(0.003)	(0.003)	(0.003)	(0.003)	(0.173)
R-squared		0.19	0.45	0.58	0.59	0.59
Contractor fixed effects		No	Yes	Yes	Yes	Yes
Award year fixed effects		No	Yes	Yes	Yes	Yes
District fixed effects		No	No	Yes	Yes	Yes
Additional controls		No	No	No	Yes	Yes

Notes: OLS estimates. There are 237 project-level observations. Column (1) shows the mean and standard deviation of the outcome variable under collusion in each panel. Competition indicates that the project was awarded below full rates. Additional controls include project budget, dummy for water supply projects and travel distance from project site to each of three central government anti-corruption agencies in Lahore, Multan, and Rawalpindi. Standard errors in column (2) through (5) are clustered at the contractor level. Column (6) reports estimates adjusted for selection on unobservables (Oster 2019) assuming proportional selection. Standard errors in column (6) are based on 200 bootstrap replications.

Figure 1: Project sites in Punjab