Cartels in Infrastructure Procurement – Evidence from Lebanon

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ABSTRACT. We study cartels in public infrastructure procurement and analyze the conditions under which they succeed in generating rents. We first conceptualize the interplay of the central actors of a procurement project, notably the contractor, the procurement agency, as well as the supervision and design consultants. By focusing on consultants, our framework includes important yet understudied actors in cartels that design tenders, evaluate bids, and supervise the implementation of projects. We go on to explore an original dataset of infrastructure procurement contracts in Lebanon and analyze the conditions under which powerful political elites can broker deals to overprice and/or overspend contracts. To examine how cartels operate, we identify the political connections of contractors and consultants and classify them according to their "quality" in terms of access to institutional functions of the implementing agency. We argue that design consultants serve as the lynchpin of the cartel by reducing transaction costs for searching, bargaining, and enforcing of corrupt deals.

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Keywords: Procurement, cartels, middlemen, politically connected firms, Lebanon

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"Corrupt implementing firms always need corrupt consultants. And both are related to a corrupt official. Always!"

CEO of a major Lebanese infrastructure development firm

1. Introduction

Two broad observations motivate our study. First, public infrastructure procurement constitutes a major source of rents for elites, notably in countries with weak governance and control of corruption (Bosio *et al.*, 2022; Dávid-Barrett and Fazekas, 2020). As spending on procurement accounts for 12.6% of gross domestic product (GDP) in high-income countries and 13.6% in upper-middle-income countries on average (in 2015) (Djankov, Islam and Saliola, 2016), public procurement offers ample incentives for elites to interfere, even in countries with strong institutions and control of corruption (Goldman, Rocholl and So, 2013; Hessami, 2014). As such a high share of spending makes procurement a crucial part of government operations and for pursuing most development outcomes (Fazekas and Blum, 2021), even small improvements in procurement practices can have large welfare effects.

Second, an increasing body of research highlights the importance of networks, or cartels, to understand corruption in public procurement (Adam *et al.*, 2022; Fazekas, Sberna and Vannucci, 2022), including for infrastructure (Hudon and Garzón, 2016). While corruption was previously conceived mostly as a principal-agent problem (Ugur and Dasgupta, 2011), recent studies increasingly conceptualize corruption leveraging network theory (Marquette and Peiffer, 2018). Most of these studies, however, focus on the functionality of cartels, rather than their mechanisms (Fazekas, Sberna and Vannucci, 2022), even though analyzing the governance of such networks is crucial to understand their persistence and how to undermine them (Sberna, 2014).

In this paper, we explore the mechanisms of cartels in Lebanon's infrastructure procurement sector, formed by contracting firms, consultants, and political elites. We analyze a data set of all 394 infrastructure procurement contracts awarded between 2008 and 2018 by Lebanon's Council for Development and Reconstruction (CDR), by far the country's most important infrastructure development agency and central pillar of the power-sharing arrangement by providing a major source of rents for sectarian elites (Leenders, 2012; Mahmalat, Atallah and Maktabi, 2022).[1] By identifying the political connections of both the contractor as well as the consultancy firms involved in the implementation of a procurement contract, we go beyond previous studies' focus on contractors and analyze the interplay between the development agency (in this case CDR), the contractor, and consultants. Notably, we are not primarily interested in understanding *whether* elites extract rents via CDR. As we have shown in previous work, politically connected contractors receive contracts that are inflated by almost 33 percent vis-à-vis the average contract (Mahmalat, Atallah and Maktabi, 2022). Instead, we examine *how* cartels operate. More specifically, we leverage a series of expert interviews with politicians, officials, contractors, and consultants to generate and test hypotheses to identify the conditions under which the cartel succeeds in generating rents.

In doing so, we introduce two methodological novelties. First, we focus on procurement consultants, an immensely important player in the procurement process with a large degree of influence and discretion in different phases of a project cycle, earning them the label "masters of the game."[2] Consultants are involved in the design of a project, the evaluation of bids, the supervision of project implementation, as well as the assessment of claims and variation orders of ongoing projects. Despite their importance,

[1] As a formally independent institution, CDR enjoys special prerogatives to plan and execute large public infrastructure projects of which it has handled the vast majority after Lebanon's civil war (1975-1990). In the 394 contracts for infrastructure projects from 2008 to 2018, CDR has awarded projects totaling $3.98 billion that involved $1.76 billion in foreign funding, thereby vastly outspending other procurement institutions. In the absence of natural resources, CDR became a central pillar for Lebanon's power-sharing arrangement.

[2] To use the words of the director of a large consultancy firm interviewed for this project.

however, the role of consultants has, to our knowledge, not received systematic treatment in the literature on procurement cartels. We conceptualize the role of consultants and shed light on the mechanisms of brokerage between different actors.

Second, we differentiate the "quality" of a political connection. We initially follow previous studies in defining a firm to be politically connected (a politically connected firm, or "PCF") if at least one of its board members or the CEO is a politician, a close relative of a politician, or a publicly known friend of one (Faccio, 2006; Rijkers, Baghdadi and Raballand, 2017; Diwan and Haidar, 2020). In a second step, however, we assign a connection to different circles of elites in order to better reflect the complexity of the phenomenon and distinguish the mechanisms by which connections matter. We follow the approach outlined in Mahmalat, Atallah and Maktabi (2022) and associate each connected firm to either of two groups of politicians. "PCF1" are those firms connected to the board members of CDR or to the small group of political elites that openly serve as their protégés and thereby reserved a "seat at the table" at the board of CDR.[3] "PCF2" are firms connected to any other prime minister, president, minister, member of parliament, or party elite that held office during this period.

We make two arguments. First, design consultants serve as the lynchpin of the cartel. For overpricing, contracts are inflated only when both the designer and contractor are connected to an elite with a "seat at the table" (i.e., they are PCF1). We estimate that these contracts are overpriced by roughly $3.5 million, or 35%, vis-à-vis the average contract, totaling $160 million for the period under investigation. For overspending, projects designed by PCF1 designers are more likely to be overspent and have larger cost overruns. Notably, it does not matter whether the supervisor of a project is politically connected.

Second, the ability of elites to act as brokers depends on their influence over formal decision-making processes, rather than their political function. We find that only PCF1 connections matter for either rent generation channel. Other (PCF2) elites, including very powerful ones such as ministers, party figureheads or militia leaders, play no systematic role in the workings of the cartel. These results suggest that high-level brokerage works through the institutional channel, rather than other conceivable mechanisms that could influence the allocation of rents, such as coercion (Berman et al., 2017; Rizkallah, 2017) or distribution by quotas (Dibeh, 2005; Salloukh, 2019; Mahmalat, 2020). Even in countries with weak bureaucracies such as Lebanon, elites, as brokers, need to control formal institutional functions via loyal personnel within which they enjoy a long-time horizon to reduce searching, bargaining, and enforcement costs.

We make three contributions to the literature. First, we add to the literature on procurement cartels and organized crime (for a review, see Sberna, 2014). As the analysis of cartels is inherently difficult due to their clandestine nature, the few studies that provide insights into their mechanisms are mostly qualitative. Hudon and Garzón (2016) leverage testimonies of elected officials and witnesses to investigate the workings of a procurement cartel in Quebec, Canada, and show how contractors paid kickbacks to politicians for preferential treatment by financing political parties. Jancsics and Jávor (2012) and Jancsics (2015) leverage a series of expert interviews with actors involved in a cartel in Hungary to describe how elites design and coordinate multilevel structures of corrupt networks within and among organizations. Quantitative insights come mostly from an important body of literature that identifies indicators to detect cartels (Adam *et al.*, 2022), as well as from analyses of public procurement in Italy, for which the involvement of the Italian Mafia is found to impact the performance of public procurement in Italian municipalities (Ravenda *et al.*, 2020). To our knowledge, our study is the first to provide quantitative insights into the mechanisms of cartels in infrastructure procurement.

[3] The connections of CDR board members to political elites are public knowledge and, in most cases, obvious from close family relationships. The members are: Nabil El-Jisr (president), brother of Samir El-Jisr (former member of parliament of the Future Movement), appointed president by Prime Minister Rafic Hariri in 1995 and again by Prime Minister Fouad Siniora (both Future Movement) in 2006; Yasser Berri (first deputy), brother of Nabih Berri (Amal Movement), speaker of parliament since 1992; Alain Kordahi (second deputy, deceased); Ghazi Haddad (secretary general), close to President Michel Aoun; Malek Ayyas (board member), close to Walid Jumblatt; Yahya El-Sangari (board member), brother-in-law of former prime minister Omar Karami; and Walid Safi (deputy to the government), close to Walid Jumblatt.

Second, our results add to the literature on brokers, or middlemen, another rarely examined phenomenon for which it is notoriously difficult to obtain insights (Stokes *et al.*, 2013). Recent evidence suggests that middlemen are often, if not always, key actors in corrupt exchanges as they are able to reduce transaction costs and make corrupt exchanges feasible in the first place (Lambsdorff, 2007). Della Porta and Vannucci (2012), for example, provide a range of examples on the involvement of middlemen and suggest that they are active even in high levels of government. Bussell (2017) provides a theoretical framework to explain the conditions under which middlemen play a role. She argues that the demand for middlemen increases whenever an interaction is repeated frequently and among partners that are unfamiliar with each other. As most accounts lack differentiation between levels of brokerage, we add to this literature by illustrating how brokerage can happen at the highest levels of government and that the ability of elites to serve as middlemen depends on the extent to which these were able to penetrate administrations with loyal personnel.

Lastly, we contribute to the literature that investigates the effects of firms' political connections on economic outcomes. Previous studies show how political connections of board members boost a firm's corporate value (Fisman, 2001; Faccio, 2006; Goldman, Rocholl and So, 2009) while the presence of PCFs is found to hinder job creation and competitiveness of affected sectors (Rijkers *et al.*, 2014; World Bank, 2015). Evidence from Lebanon is available on the effects of political connections on job creation (Diwan and Haidar, 2020), rent-seeking from procurement contracts (Mahmalat, Atallah and Maktabi, 2022), and political outcomes (Chaaban, 2019; Mahmalat and Atallah, 2019). Recent contributions also provide evidence on the extent to which PCFs receive higher value public procurement contracts, both in developed and developing countries (Goldman, Rocholl and So, 2013; Hessami, 2014; Baránek and Titl, 2020; Dávid-Barrett and Fazekas, 2020b). Schoenherr (2019), for example, finds that connections of firms to an incoming president in the Republic of Korea led to allocative distortions both in the allocation and renegotiation of contracts. We add to these findings by providing evidence that the "quality" of connections matters in determining which firms can access rent generation mechanisms.

While we abstain from claiming generalizability of our results, we believe that they provide important insights into how elites can extract and distribute rents from public institutions in countries with weak bureaucracies. While CDR is a formally independent institution, the use of external design and supervision consultants is common practice among procurement agencies worldwide (Asian Development Bank, 2013). Cartels and allocative distortions in public procurement have been documented even for countries with comparably low levels of corruption, such as South Korea (Schoenherr, 2019), the United States (Goldman, Rocholl and So, 2013), Italy (Ravenda *et al.*, 2020), or OECD countries more generally (Hessami, 2014). Such findings suggest that these effects are also plausible in countries with a weaker governance framework (Dávid-Barrett and Fazekas, 2020b; Bosio *et al.*, 2022), particularly where elites face fewer constraints to penetrate public institutions with loyal personnel (Mahmalat and Zoughaib, 2022).

We proceed as follows. Section 2 provides an overview of the interplay between the major actors within the procurement cartel and develops hypotheses. Section 3 describes our data and methods. Section 4 analyzes the mechanisms by which consultants facilitate rent generation, after which section 5 addresses endogeneity concerns. Section 6 discusses the results. Section 7 concludes by outlining policy recommendations.

2. Cartels and infrastructure procurement

Many crimes cannot be committed alone. Whenever a crime requires iterative and complex interactions, such as in public procurement, individual actors need partners or networks to fulfill interrelated tasks (Lambsdorff, 2007; Sberna, 2014; Lessing, 2021). These networks bring together a range of heterogenous actors, who need to ensure deferred reciprocity (as transactions are often intertemporal), interact in indirect mutuality (partners are often linked through middlemen or brokers), and ensure disguise of payments (as corrupt deals are illegal) (Adam *et al.*, 2022).

To address these issues, these networks face classical collective action problems (Lambsdorff, 2002; Della Porta and Vannucci, 2012). Corrupt exchanges are, by definition, not enforceable by law and lack an ex-ante definition of property rights. Actors lack opportunities for third-party enforcement and ex-post regulation, increasing insecurity and risks of cheating or defection especially when deals are complex and include intertemporal transactions (Sberna, 2014). Moreover, while partners need to disguise their transactions, they acquire potentially damaging information about each other. Corrupt exchanges, therefore, tend to rely on middlemen who provide the necessary information and brokerage to link different partners (Lambsdorff, 2007, pp. 221–222; Bussell, 2017).

Cartels address the demand for a governance structure that allows parties to trust in each other's willingness to respect informal rules and mutual (intertemporal) commitments. In such more complex relationships, "a combination of *first-party* internalized mechanisms of self-sanctioning, reciprocal *second-party* bonds of trust, and other forms of *third-party* guarantees is needed that allows exchanges of precarious property rights" (Della Porta and Vannucci, 2012, p. 30, emphasis in text). Notably, (threats of) physical coercion can be an important resource to provide guarantees and prohibit an individual's exit from the cartel (ibid.). Following Lambsdorff (2002), the goal of cartels is to reduce transaction costs in three domains, namely searching for partners, bargaining, and enforcing of contracts. In verifying this framework in an application to public procurement contracts of Italian municipalities, Fazekas, Sberna and Vannucci (2022) contend that "extra-legal governance services provided [by cartels] may become an integral and functional component of corruption transactions in public procurement." (p. 4)

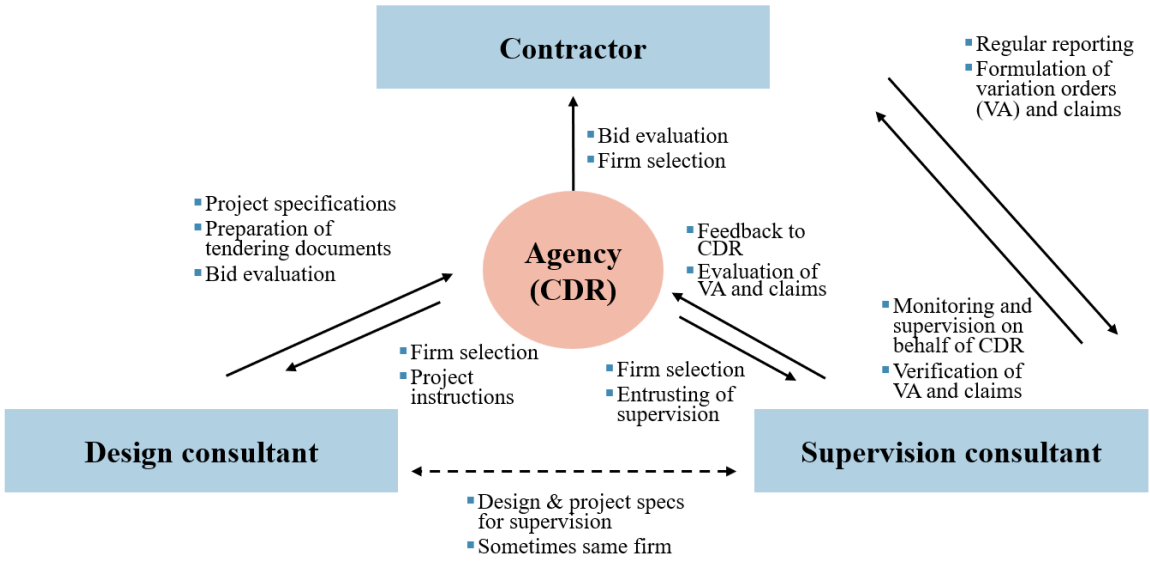
Middlemen, or brokers, assume a crucial role in minimizing these transaction costs (Lambsdorff, 2007; Della Porta and Vannucci, 2012; Stokes *et al.*, 2013; Bussell, 2017). Brokers generally establish the contacts between two parties, search for appropriate counterparts, conduct negotiations, and often facilitate the exchange of resources. The demand for brokers varies with the nature of the corrupt exchange. Bussell (2017), for example, argues that the demand for middlemen is higher for transactions that are frequent but involve potential participants that are unfamiliar with each other.

As crimes vary in complexity and value, different levels of brokerage require a different set of expertise of the broker (Stokes *et al.*, 2013). As we hypothesize, to minimize transaction costs of high-value transactions such as infrastructure procurement, brokerage requires three conditions. First, brokers need to control important institutional functions via loyal personnel in order to limit competition among consultants and contractors and minimize costs arising from the searching and matching of partners. Second, they need long-term trusting relationships to partners to reduce bargaining costs and facilitate dealmaking. And third, they need to enjoy a long-time horizon in order to reduce enforcement costs and ensure that all actors honor a deal in deferred reciprocity. In what follows, we review the process of infrastructure procurement of CDR and identify how the different actors involved in the cartel enable these conditions.

"The masters of the game" – Consultants in infrastructure procurement

Infrastructure procurement requires the coordination of a complex set of tasks among a variety of actors. Due to the high degrees of specialization each project requires and the resource constraints public institutions face, any agency—in this case, CDR—avails not only of contracting firms to implement projects, but also of consultancy firms for design and supervision. Figure 1 provides a schematic depiction of how the four main players are interconnected.

Figure 1: Schematic overview of interrelationships among parties in infrastructure procurement



After CDR conceives of a given project, it assigns a consultant to design it, specify its parameters and requirements, provide a cost estimate, as well as develop the terms of references based on which the contractors can bid. After CDR publishes the bidding documents and coordinates the tendering process, the designer often supports CDR in the technical evaluation of incoming bids. CDR, then, awards a contract to an infrastructure development firm (contractor) based on criteria that can vary according to the requirements outlined by the funding organization.

In case the initial contract with the designer does not include project supervision, CDR opens a separate tender for consultancy firms to bid on the project supervision. These supervision consultants are "the eyes on the ground" for CDR, doing "basically everything other than management."[4] Even site visits by CDR personnel are announced in advance in coordination with the contractor and occur only sporadically. Eventually, the supervisor assesses whether all contract requirements are met and the contractor has delivered all works as specified.

Supervisory consultants (henceforth, supervisor) also play a major role in the management of cost overruns. These overruns can occur from two sources, variation orders or claims. Variation orders are a modification of the original contract to change the scope or technicalities of a project and are usually prepared and thereby approved by a consultant. Claims, by contrast, result from unforeseen difficulties a contractor faces to implement the project. For such claims, the supervisor has to provide an assessment for CDR as to whether the claim is justified.

In these interrelationships, the design and supervision consultants have a significant degree of influence over the success of a project. While the designer can influence the specifications of a project and thereby affect contract prices or the competition among bidding firms, supervisors determine how a contractor can overspend a contract or deliver quality work.

Hypotheses

We investigate how cartels facilitate rent generation to infer insights into the three central tasks of cartels (searching, bargaining, and enforcing). To that end, we develop three sets of hypotheses that disaggregate different conditions under which the cartel can succeed in generating rents. These hypotheses are informed by previous work on indicators for the detection of cartels (Adam *et al.*, 2022), as well as

[4] Quote of a former CDR project engineer interviewed for this project.

a set of expert interviews we conducted with CDR officials, members of parliament, bureaucrats, professors, as well as CEOs and engineers of leading contractors and consulting firms. The interviews were conducted between December 2021 and May 2022, followed an open-ended, semi-structured interview guideline, and provided rich anecdotal evidence of alleged cases of collusion.

Searching

The first function of the cartel should be to reduce searching costs by minimizing the number of actors involved. This places the role of design consultants into the focus, as these have some discretion over the tendering process and can influence the number of firms eligible to bid. We differentiate two broad ways in which the cartel can generate rents – through overpricing (H1) or overspending of a contract (H2) – and identify a number of sub-hypotheses to specify the conditions under which overpricing or overspending can happen.

Overpricing

Our first two hypotheses serve as a baseline in which a reduction of searching costs is not needed to overprice (H1.1 and H1.2), i.e., the designer does not need to limit the competition of firms at tendering stage. First, when designer and supervisor are the same firm, the consultant would have opportunities to include excessive provisions in project design, knowing they will be "covered-up" in the supervision stage. In another potential configuration, politicians broker a deal between connected designers, supervisors and the CDR board, which would approve excessive provisions in tender documents.

H1.1: When the designer and supervisor are the same firm, contractors can overprice a contract.
H1.2: When both the designer and supervisor are PCFs, contractors can overprice a contract.

In our second two hypotheses (H1.3 and H1.4), designers reduce searching costs by limiting competition among firms, such as by "tailoring" tender documents, or arbitrarily excluding firms that have submitted bids. Such limited competition enables favored firms to overprice. A politician would leverage their political connections to broker deals between designers and contractors to know for which firm to tailor the design or bidding process. In a first configuration, contracts would be inflated when the designer is connected, independently of whether the contractor is connected as well. In a second configuration, politicians would also need a connection to a contractor to be able to broker a deal.

H1.3: When a designer is a PCF, contractors can overprice a contract.
H1.4: When a designer and the contractor are PCFs, contractors can overprice a contract.

Overspending

Secondly, rent generation can happen via overspending of contracts. Cost-overruns are a common phenomenon in infrastructure procurement (Flyvbjerg, Skamris Holm and Buhl, 2003), and can be used by cartels to generate rents (Ravenda *et al.*, 2020). In our second set of hypotheses, we investigate whether and under which condition contractors can overspend a contract.

We start with a set of hypotheses that do not depend on a reduction of searching costs (i.e., a connected designer limits competition beforehand). In H2.1, it would be sufficient when designer and supervisor are the same firm. Sloppy design or inflated provisions would be covered up during the implementation stage by the supervising team of the same firm. In H2.2, supervisor and contractor interact frequently with each other. A trusting relationship can emerge based on which contracts can be overspent.

H2.1: When the designer and supervisor are the same firm, contracts are more likely to be overspent.
H2.2: When the supervisor and contractor execute contracts frequently together, contracts are more likely to be overspent.

We moreover investigate whether supervisors play the central role in allowing projects to be overspent. In H2.3, they would enable a contractor to file for excessive variation orders or claims and use their political connections to ensure that these are approved by the CDR board. In H2.4, both supervisors and contractors would be required to be politically connected to do so.

H2.3: When the supervisor is a PCF, contracts are more likely to be overspent.
H2.4: When both the supervisor and contractor are PCFs, contracts are more likely to be overspent.

In a fifth hypothesis, we test whether cost overruns are possible when searching costs are reduced at the design stage. Politically connected designers would limit competition among contractors and know that elites facilitate the approval of designs that require adjustments during the implementation stage of a project.

H2.5: When the designer is a PCF, contracts are more likely to be overspent.

Bargaining

In the above hypotheses, we have assumed that elites have similar bargaining costs regardless of which politician or elite a firm is connected to. Previous studies from other country contexts have found various attributes of a political connection to matter, such as party affiliation (Goldman, Rocholl and So, 2013; Baránek and Titl, 2020), or the political function (Schoenherr, 2019). Following previous work on elite-capture of public institutions in Lebanon (Leenders, 2012; Salloukh, 2019; Mahmalat and Zoughaib, 2022), however, we hypothesize that elites which were able to penetrate public institutions with loyal personnel have a larger degree of discretion over decisions in the board of CDR.

In a third hypothesis, we test whether the "quality" of a political connection helps to reduce bargaining costs. Firms would place higher trust in the ability of elites to honor intertemporal transactions that are "embedded" in the institutional framework and exert discretion over decisions via loyal personnel. We expect that PCF1 elites have lower bargaining costs to broker deals and therefore make overspending and overpricing more likely.

H3: Only PCF1 connections can succeed in overpricing or overspending contracts.

Enforcing

A central issue of corrupt exchanges is deferred reciprocity, making enforcement costly. Many deals require that mutual promises are honored with a time-lag, as not all resources are available at the same time (for example, promises for upcoming projects can only be kept once these projects are implemented). PCF1 elites, then, should face lower costs to enforce deals than other (PCF2) elites with direct discretion over decision making and are able to provide kickbacks in future contracts.

H4: PCF1 consultants involved in the cartel are compensated with inflated contracts in intertemporal transactions.

3. Data and methods

We leverage two sources of data. First, we analyze a data set of all 394 infrastructure procurement contracts awarded by CDR between January 11, 2008, and March 12, 2018. The data set contains the name of the contract and winning firm, the initially awarded contract value, the sources of funding, the project location(s), the sector, and other identifying information about each contract. We obtained the data from CDR with a formal request pursuing the access to information law.

Second, for each infrastructure contract, we reviewed the webpage of CDR to identify the actualized expenditure of each contract, as well as the names of design and supervision consultants. We also

recorded the values of supervision consultancies and matched each consultancy to its corresponding infrastructure contract.

The dependent variables

Our key dependent variables are the contract values for infrastructure and consultancy projects. We chose contracts—rather than projects—since bargaining takes place over contracts.[5] Of the 394 contracts in our data set, we record 384 contracts for which we can identify the contractor, 361 of which contained information on the supervision consultancy and 233 of which we can associate a design contract (Table 1). The missing contracts are distributed relatively evenly among sectors in terms of share of contracts, total value, and mean value of contracts. Exceptions are the irrigation and solid waste sectors in which our subsample includes larger values, which are, however, the smallest sectors with 11 and 12 observations. In total, we capture 99.5 percent and 80.6 percent of all contract values with our subsample of supervision and design contracts.

Table 1: Composition of data set based on infrastructure contracts

		Transport	Water works	Solid waste	Irrigation	Education	Other	Total
Total	n	79	106	12	11	73	103	384
	Total contract value	1,162	1,189	507.4	413.6	321.4	392.5	3,986
	Mean contract value	14.7	11.2	42.3	20.7	4.4	3.8	10.1
Supervision	n	74	103	11	8	73	92	361
	% of all contracts	93.7%	97.2%	91.7%	72.7%	100.0%	89.3%	94.0%
	Total contract value	1,158	1,186	505.4	406.9	321.5	385.9	3,964
	% of total contract value	99.7%	99.8%	99.6%	98.4%	100.0%	98.3%	99.5%
	Mean contract value	15.7	11.5	45.9	50.9	4.4	4.2	10.9
Design	n	41	72	8	8	37	67	233
	% of all projects	51.9%	67.9%	66.7%	72.7%	50.7%	65.0%	60.7%
	Total contract value	718.8	1,054	499.4	406.9	222.7	309.4	3,211
	% of total contract value	61.9%	88.7%	98.4%	98.4%	69.3%	78.8%	80.6%
	Mean contract value	17.5	14.6	62.4	50.9	6.0	4.6	13.8

[5] Contracts can encompass multiple projects, all of which are implemented by the same contractor and consultant and pertain to the same contract ID. See Mahmalat, Atallah and Maktabi (2021) for a detailed description.

Notes: All values in million US dollars.

The contract values captured by politically connected supervisors vary significantly among sectors (Table 2). Water works exhibit the most contracts (86), followed by the transport and education sectors. In these sectors, 19, 12, and 21 different contractors won at least one contract, of which nine, four, and four are coded as PCF1. In total, supervisors received contracts amounting to $213 million, much of which has been captured by PCF1 consultants. Consultancy contract values in the solid waste and irrigation sectors, for example, have been captured almost entirely by PCF1 supervisors. Such high levels of concentration of contract values contrast with measurements of market competition. The Herfindahl-Hirschmann Index (HHI), a widely used indicator for industry competitiveness, indicates that the markets for consultancies in the transport, and water works sectors would be competitive, despite that 76% and 73% of projects are captured by PCF1s.[6] PCF2s only play a very minor role in contract allocation.

The allocation of contracts for design consultants exhibits a similar degree of concentration for the solid waste and irrigation sectors. In these sectors, PCF1 designers designed 99% of all contract values. The water works sector, by contrast, has a lower degree of concentration of connected designers.

Table 2: Market competition among sectors

Supervision	**Transport**	**Water works**	**Solid waste**	**Irrigation**	**Education**	**Other**
HHI	2,159	996	4,287	9,171	3,874	895
Number of contracts	64	86	8	8	60	71
Number of contractors	12	19	6	6	21	28
Number of PCF1 firms	4	9	5	5	4	9
Number of PCF2 firms	2	4	0	1	2	1
PCF1 share in value	76%	73%	99%	99%	88%	66%
PCF2 share in value	5.0%	6.0%	0.0%	1.0%	1.0%	2.0%
PCF share in value	81%	79%	99%	100%	89%	68%
Design						
HHI	1,513	1,396	5,953	9,392	3,624	1,076
Number of contracts	41	73	8	8	37	69
Number of contractors	12	21	3	6	17	24
Number of PCF1 firms	5	8	2	4	4	8
Number of PCF2 firms	1	4	0	2	2	1
PCF1 share in value	69%	35%	98%	99%	65%	61%
PCF2 share in value	8.6%	3.3%	0.0%	0.9%	8.4%	3.5%
PCF share in value	78%	39%	98%	100%	74%	64%

Notes: Number of contracts based on supervision contracts, rather than infrastructure contracts. Contract numbers can deviate from the above as the same consultancy contract can supervise several infrastructure contracts. HHI for supervisors based on supervision contract values. HHI for designers based on infrastructure contract values.

Independent variables: Political connections

Our key independent variable of interest is the political connectivity of each firm. We follow Faccio (2006), and others, and code a firm as politically connected when it has at least one board member or CEO who is a politician, a close relative of one, or a publicly known friend. For that purpose, we

[6] The HHI index is calculated as the sum of squares of the percentage share of each competing firm competing in a sector, $HHI = \sum_1^n s_n^2$, and ranges between 10,000 for a perfect monopoly and approaches 0 for many firms with equal market shares. An HHI of up to 1,500 is generally considered a competitive market, while scores above 2,500 indicate a highly concentrated market.

leverage online business directories and Lebanon's commercial registry to look up the name of each firm's board members in addition to collecting data on their size, age, and paid-in capital.

Our approach to identify political connections takes into account that political connections are a complex phenomenon in a country like Lebanon (Leenders, 2012; Diwan and Haidar, 2020). We go beyond previous studies, which establish objective criteria for the identification of connections, such as by name matching of a company's shareholder or CEO names with those of political actors. As such approaches have tended to underestimate results,[7] we instead review each firm in our data set manually via an approach outlined in detail in Mahmalat, Atallah and Maktabi (2021). For each firm, we go through a multi-layered search process that relies on media searches on the names of each board member of a firm with a corresponding name of a politician or their political party. This approach allows us to carefully assess a number of common issues in the identification of political connections, such as whether individuals with matching names are related, connections are "deep" enough to matter, or relevant during the period of investigation. We augment and validate the findings with our key informant interviews and code a firm we have not found reliable information on as connected when multiple interviewees correspond in their assessment of a particular firm.[8]

Moreover, we review the commercial registries as well as the companies' websites to identify firm characteristics, notably their age, size (in number of employees), and paid-in capital. As these directories fail to report some of the characteristics for some firms (Table 3), we use multiple imputations to estimate the missing values for these observations. The goal of using multiple imputations is to maximize the use of available information, minimize estimation bias, and obtain appropriate standard errors (Enders, 2010). We use multiple imputation, rather than other available techniques such as stochastic or deterministic imputation, to minimize the bias of standard errors in our regression analyses. We leverage the *mi estimate* command in Stata using a multivariate normal distribution with 10 imputations and take the contract value as an auxiliary variable.[9]

Table 3: Number of incomplete observations of supervision and design consultants

Supervisors	**Complete**	**Incomplete**	**Total**	**Percent missing**
Age	340	21	361	5.8%
Size	332	29	361	8.0%
Paid-in Capital	260	101	361	28.0%
Designers				
Age	207	26	233	11.2%
Size	203	30	233	12.9%
Paid-in Capital	159	74	233	31.8%

Descriptive statistics

Of the 384 contracts we observe, 160 have been won by PCF1 contractors, capturing 64% of the total value of all contracts (Table 4). We observe a similar concentration of contract value for supervisors,

[7] The widely-cited work of Faccio (2006), for example, uses a data set of firms worldwide and finds no politically connected firms in Zimbabwe and Venezuela—two countries with an arguably weak record for the control of corruption. Even for the United States, where the author's data set includes more than 7,000 firms, her approach only identifies 14 connected firms (p. 374), a number that other works have found to be much higher (Goldman, Rocholl and So, 2009).

[8] Note that the differentiation between PCF1 and PCF2 is mutually exclusive. In the few cases in which we find connections to both circles of elites, we code the firm according to its superior connection (i.e., PCF1) as such firms would prefer invoking their direct connection to decision makers to influence the procurement process, rather than their connection to a third party.

[9] Multiple imputation, however, requires that the mechanism that produces missing values is at least missing at random (MAR) in that the missing values are not completely random but that other observed variables can be used to predict the value of the missing ones. MAR moreover requires the ignorability assumption in that the probability of missing data does not depend on the value of the missing information itself. In our case, missing observations are distributed in a non-systematic way among both small and big firms winning both small and big contracts, as well as those that have other information reported.

who capture 83% of all supervision contract values. PCF1 designers get to design 65% of all contract values, while non-connected firms design almost the same number of contracts as PCF1 designers. Overall, PCF2s do not receive or design larger contract values than non-connected ones.

Table 4: Contract characteristics

	Contractor			Supervisor			Designer		
	PCF 1	**PCF 2**	**Non-PCF**	**PCF 1**	**PCF 2**	**Non-PCF**	**PCF 1**	**PCF 2**	**Non-PCF**
Number of contracts	160	71	153	171	27	100	113	22	101
Value of contracts*	2,544	560.7	878.0	177.1	6.2	30.1	2,101	130.4	988.4
Share in total contract value	64%	14%	22%	83%	3%	14%	65%	4%	31%
Average value of contract*	15.9	7.9	5.7	1.04	0.23	0.30	18.6	5.9	9.8

*Note: * Value in million US dollars. For designers, the table shows the value of infrastructure contracts.*

While PCF1s receive or design larger contracts, they are on average larger firms (Table 5). The number of employees for all three types of firms is larger for PCF1s than for PCF2s or non-connected firms. For consultants, connected firms are on average also older than non-connected ones. Moreover, designers are the largest firms, corroborating many of our interviewees' conjectures that Lebanese consultants enjoy an international reputation of delivering high-value work.

Table 5: Firm characteristics

	Contractors			Supervisors			Designer		
	PCF1	**PCF2**	**Non-PCF**	**PCF1**	**PCF2**	**Non-PCF**	**PCF1**	**PCF2**	**Non-PCF**
Number of firms	31	18	77	11	6	37	10	5	36
Age (number of years)	37.5	34.7	41.1	48.6	36.7	35.6	50.1	34.8	37.6
Size (number of employees)	640	565	388	891	886	766	1,353	1,039	922
Paid-in capital (in mil. USD)	0.63	1.62	5.53	1.98	10.26	0.07	1.37	12.31	0.06

4. How do cartels operate?

Overpricing

We first investigate the hypotheses related to overpricing. We conduct cross-sectional regression analyses in which our dependent variable, *logvalue,* is the natural log value of infrastructure procurement contract *i*. Our key independent variable of interest is the vector *X* that introduces a set of dummy variables *j* to test for each of the hypotheses outlined above. We include various firm characteristics, specifically the natural log of the designer's age in years, size in number of employees, its paid-in capital in U.S. dollars, as well as whether the winning contractor is a PCF1. We also include various fixed effects (FE). Sector FEs account for specificities of each sector, such as their varying degree of competitiveness, the possibility that PCFs sort into higher-value sectors, as well as any natural alignment of a PCF to the political priorities of a party in a specific sector. Governorate FEs capture whether geographical areas require more complex works and whether elites allocate higher-value contacts to specific regions. Year FEs account for other time-invariant heterogeneity. All regressions are run by using the White-Huber sandwich estimator to calculate robust standard errors to account for model misspecifications.

Formally, we estimate the following model in which ε denotes the error term:

$$logvalue_i = \beta_0 + \beta_1 X_{ji} + \beta_2 age_i + \beta_3 size_i + \beta_4 capital_i$$
$$+\beta_5 sector_{ki} + \beta_6 governorate_{li} + \beta_7 year_{mi} + \varepsilon$$

The results are displayed in Table 6. Model 1 tests hypothesis 1.1 and introduces a dummy variable for whether the supervisor is the designer of the same project. The variable is significantly correlated to contract prices with a negative coefficient, suggesting that contracts for which all consultancy services come from the same firm are generally smaller. Models 2 and 3 test hypothesis 1.2 and introduce dummy variables for whether both the supervisor and designer are PCF1 (model 2) or PCF2 (model 3). Models 4 and 5 introduce dummy variables for whether the designer of a project is a PCF1 (model 4) or PCF2 firm (model 5). None of these specifications turn out to be significantly related to contract values.

Models 6 and 7 test hypothesis 1.4 and include a dummy variable for whether both the designer and the contractor are either both PCF1 (model 6), and whether the designer is PCF2 while the contractor is PCF1 (model 7). The resulting coefficient for model 6 is highly significant, while the coefficient for PCF1 contractors loses statistical significance. This result signifies an important finding in that, unless designers are PCF1, even contractors close to the CDR board do not capture overpriced contracts. A designer that is connected to other politicians, however, does not design larger contract values, even when their projects are won by PCF1 contractors.

Table 6: Regression results

Hypothesis	**H1.1**	**H1.2**		**H1.3**		**H1.4**	
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Supervision contains design	-0.39*						
	(-1.91)						
Supervisor & designer PCF1		0.31					
		(1.51)					
Supervisor & designer PCF2			-0.36				
			(-0.86)				
Designer PCF1				0.30			
				(1.46)			
Designer PCF2					-0.41		
					(-0.96)		
Designer & contractor PCF1						1.18***	
						(5.18)	
Designer PCF2 & contractor PCF1							0.08
							(0.16)
Contractor PCF1	0.44***	0.55***	0.57***	0.57***	0.57***	0.22	0.55***
	(2.74)	(2.83)	(2.83)	(2.95)	(2.85)	(1.30)	(3.43)
Age	0.23	-0.01	-0.02	-0.01	-0.04	0.29	0.45
	(0.73)	(-0.03)	(-0.04)	(-0.01)	(-0.09)	(0.83)	(1.22)

Size	-0.04	0.02	0.04	0.01	0.04	-0.09	-0.07
	(-0.39)	(0.17)	(0.33)	(0.07)	(0.37)	(-0.93)	(-0.63)
Capital	0.04	0.03	0.03	0.03	0.02	0.04	0.05
	(0.84)	(0.59)	(0.48)	(0.63)	(0.41)	(0.83)	(0.89)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
constant	12.46***	12.61***	12.75***	12.63***	12.85***	12.13***	11.15***
	(8.64)	(7.58)	(6.79)	(7.60)	(6.76)	(8.22)	(7.11)
Observations	342	236	236	236	236	384	384

*Notes: Dependent variable is the log value of procurement contracts. PCF indicates dummy variables for all connected firms. PCF1 captures firms connected to the inner circle of elites that controls the CDR board. PCF2 includes firms of all political elites. Regression model uses robust standard errors; The table shows beta coefficients and t-statistics in parentheses; Significance levels: * p<0.10, ** p<0.05, *** p<0.01.*

We can assign an approximate economic value to the effect size of model 6. We follow an approach by Goldman, Rocholl and So (2013) and calculate the marginal increase in contract values after including all control variables. We first take the estimated coefficient for a model in which we calculate the marginal effect of model 6 without including any controls (~1.7, not reported in table 6). We then use model 6 to calculate the marginal impact of observing a pair of PCF1 designer and contractor. We calculate the reduction of the effect size by dividing the coefficients of model 6 by those of the model without controls and find that the increase in contract value goes down to ~60% of its univariate estimated value. This leaves an increase of $3.5 million, or almost 35%, for a contract of a PCF1 designer-contractor pair relative to the average contract.[10] Observing 45 such PCF1 designer-contractor pairs, this amounts to roughly $160 million in overpricing of contracts throughout the period of investigation.

Overspending

We go on to investigate our hypotheses related to the overspending of contracts. Table 7 provides the results of a set of logistic regressions to estimate the likelihood that a project is being overspent given a vector of dummy variables for each hypothesis. Formally, we estimate the following model

$$\Pr(Overspent = 1) = F(\beta_0 + \beta_1 X_{ji} + \beta_2 logvalue_i + \beta_3 SVduration_i + \beta_4 SVforeign_i + \beta_6 funding_{origin_{ki}} + \beta_5 sector_{ki} + \beta_6 governorate_{li} + \beta_7 year_{mi})$$

where *overspent* is a dummy variable that takes the value of 1 when a contract *i* is overspent, *X* is a vector of dummy variables to test our hypotheses *j*, *logvalue* the natural log of the contract value, *SVduration* the duration of the supervision period in years, *SVforeign* a dummy variable for whether the supervisor is a foreign firm, and *funding_origin* denotes a vector for the origin of the donor *k*, that is, whether the funding was provided from domestic, Arab or Western sources. By differentiating the origin of funds, we take into account potential differences in the requirements different funders assign to the supervision and monitoring of projects.

[10] The calculation is as follows. Table 6 shows the mean values of contracts by political connection. We subtract the mean contract value of PCF1 firms ($16.36 million) from the mean value of all contracts ($10.4 million). We multiply the resulting difference of the univariate results ($16.36 - $10.4 = $5.96 million) with the fraction of the marginal effects ($\frac{e^{1.18}}{e^{1.7}} = 0.59$ or 59.45%) to obtain the value of $3.5 million.

Models 1 and 2 show that contracts are not more likely to be overspent when the same consultant does both the design and supervision (H2.1), while frequent interactions between contractor and supervisor are also not related to overspending (H2.2). Models 3 to 6 highlight that contracts are also not more likely to be overspent when supervisors are politically connected (H2.3 and H2.4). Model 5 even shows that supervisors that are not connected to the same circle as contractors are less likely to let costs overrun (model 5).

Model 7 shows that contracts designed by PCF1 designers are more than 2.5 times as likely to be overspent (H2.5). This result draws once again attention to the potential role of designers in a cartel by indicating that they get away with lower quality work that requires or allows for more extensive adjustments in the implementation stage. PCF2 designers, by contrast, even have a lower likelihood to overrun costs (model 7). Lastly and contrary to the previous results on overpricing, connected designer-contractor pairs are not more likely to overspend contracts (model 8).

These results hold despite accounting for the complexity of a project, as proxied by the supervision period and the overall value of the contract. All our specifications show that larger and more complex contracts are generally more likely to be overspent, highlighting the difficulties in administering more complex projects.

Table 7: Regression results on the likelihood of overspending

Hypothesis	**H2.1**	**H2.2**	**H2.3**	**H2.4**		**H2.5**		
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Supervision contains design	0.06							
	(0.15)							
Repeated interactions contractor & supervisor		0.18						
		(0.64)						
Supervisor PCF1			0.41					
			(1.32)					
Supervisor & contractor PCF1				0.21				
				(0.61)				
Supervisor PCF2 & contractor PCF1					-2.03***			
					(-3.35)			
Designer PCF1						1.02**		
						(2.51)		
Designer PCF2							-1.54**	
							(-2.38)	
Designer & contractor PCF1								0.24
								(0.52)
Supervision period	0.11***	0.11***	0.11***	0.11***	0.12***	0.09**	0.10**	0.11***
	(3.39)	(3.42)	(3.26)	(3.32)	(3.50)	(2.21)	(2.48)	(3.39)
Log contract value	0.59***	0.58***	0.58***	0.58***	0.63***	0.48***	0.53***	0.57***
	(4.39)	(4.50)	(4.43)	(4.44)	(4.52)	(3.16)	(3.29)	(4.33)
Foreign supervisor	0.54	0.57	0.78	0.60	0.71	1.43**	1.19*	0.57
	(1.17)	(1.25)	(1.55)	(1.27)	(1.42)	(2.26)	(1.86)	(1.23)
Arab donor	0.49	0.51	0.52	0.49	0.51	0.50	0.34	0.47

	(1.26)	(1.33)	(1.35)	(1.28)	(1.33)	(1.00)	(0.69)	(1.22)
Western donor	0.06	0.09	0.10	0.11	-0.03	0.11	-0.21	0.08
	(0.14)	(0.21)	(0.24)	(0.24)	(-0.07)	(0.19)	(-0.38)	(0.19)
Sector FE	YES	YES	YES	YES	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Constant	-10.95***	-10.99***	-11.14***	-10.88***	-11.72***	-10.17***	-10.11***	-10.68***
	(-5.12)	(-5.40)	(-5.36)	(-5.24)	(-5.17)	(-4.40)	(-4.08)	(-5.07)
Observations	329	329	329	329	329	219	219	329
R2	0.25	0.25	0.26	0.25	0.27	0.31	0.31	0.25

*Notes: Dependent variable is a dummy variable for whether a contract is overspent. PCF indicates dummy variables for all connected firms. PCF1 captures firms connected to the inner circle of elites that controls the CDR board. PCF2 includes firms of all political elites. Regression model uses robust standard errors; The table shows beta coefficients and t-statistics in parentheses; Significance levels: * p<0.10, ** p<0.05, *** p<0.01.*

We test the economic significance of these results and specify an additional model to understand whether those contracts are overspent by larger margins. We calculate the log value of a project's cost overruns, that is, the discrepancy between the amount of the initially awarded contract and the actualized expenditures. Using this discrepancy as a dependent variable, table 8 shows that contracts supervised by connected consultants or executed by connected contractors are not overspent by a larger margin. Model 2 indicates that frequent interactions between a contractor and supervisor is weakly associated with higher cost overruns. Model 5 indicates that supervisors connected to another circle than contractors manage to keep cost overruns smaller. Model 7 shows that projects designed by PCF1 designers, while already more likely to be overspent, are associated with significantly larger cost overruns. Projects designed by PCF2 designers, by contrast, are associated with lower actualized costs vis-à-vis the initial contract value.

Table 8: Regression results on cost overruns

Hypothesis	**H2.1**	**H2.2**	**H2.3**	**H2.4**			**H2.5**	
Discrepancy	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Supervision contains design	-0.08							
	(-0.07)							
Repeated interactions contractor & supervisor		1.64*						
		(1.96)						
Supervisor PCF1			1.78*					
			(1.89)					
Supervisor & Contractor PCF1				0.89				
				(0.83)				
Supervisor PCF2 & contractor PCF1					-5.23**			
					(-2.52)			
Designer PCF1						2.83**		
						(2.27)		
Designer PCF2							-3.90**	
							(-2.15)	

Designer & contractor PCF1								0.14
								(0.09)
Supervision period	0.32***	0.32***	0.29***	0.30***	0.31***	0.34***	0.37***	0.31***
	(3.97)	(4.08)	(3.66)	(3.72)	(3.94)	(3.27)	(3.57)	(3.88)
Foreign supervisor	1.59	1.73	2.53*	1.79	2.15	4.32**	3.59*	1.59
	(1.17)	(1.31)	(1.78)	(1.30)	(1.56)	(2.22)	(1.89)	(1.17)
Log contract value	1.27***	1.24***	1.22***	1.23***	1.30***	0.78*	0.87**	1.26***
	(3.58)	(3.59)	(3.55)	(3.48)	(3.80)	(1.82)	(1.99)	(3.52)
Arab donor	1.58	1.81	1.76	1.60	1.60	1.67	1.23	1.57
	(1.36)	(1.59)	(1.49)	(1.38)	(1.40)	(1.04)	(0.79)	(1.36)
Western donor	0.52	0.70	0.73	0.68	0.25	0.23	-0.37	0.52
	(0.35)	(0.48)	(0.49)	(0.46)	(0.17)	(0.13)	(-0.20)	(0.35)
Sector FE	YES	YES	YES	YES	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Constant	-18.97***	-19.82***	-20.10***	-18.69***	-19.93***	-14.55**	-13.64**	-18.91***
	(-3.50)	(-3.97)	(-3.91)	(-3.59)	(-3.89)	(-2.33)	(-2.11)	(-3.50)
Observations	329	329	329	329	329	221	221	329
R2	0.28	0.29	0.29	0.28	0.30	0.34	0.33	0.28

*Notes: Dependent variable is the log value of the discrepancy between initially awarded contract amount and actualized expenditures. PCF indicates dummy variables for all connected firms. PCF1 captures firms connected to the inner circle of elites that controls the CDR board. PCF2 includes firms of all political elites. Regression model uses robust standard errors; The table shows beta coefficients and t-statistics in parentheses; Significance levels: * p<0.10, ** p<0.05, *** p<0.01.*

5. Addressing endogeneity: Complex projects or cartels?

We can think of two narratives to explain the correlation between the political connections of design consultants and our outcome variables. In the first one, consultants "implement" deals struck between elites and connected contractors. Elites would pre-allocate contracts among connected firms and leverage their connections to designers in order to ensure that the "right" firm is winning a given tender with a margin above what a competitive market would yield. As the designer is involved in both the formulation of tender documents as well as evaluation of bids, designers have a range of tools at their disposal to reduce *searching costs*, such as by tailoring documents to specific firms, excluding allegedly non-compliant bids of competing firms, or enabling the filing of claims or variation orders due to unspecific or poor project design. Consultants would be compensated for their involvement, notably for the risks to be discovered while implementing the deal, via kickback payments, either in the form of direct cash payments or inflated supervision contracts.

In the second narrative, PCF1 designers are qualified to take on more technically demanding projects. These contracts would be larger than the average because of their more complex technical provisions and are more likely to be overspent because of the difficulty to foresee all eventualities. In this narrative, consultants would ascend to better connections as they are firms with specific technical capacities that implement more demanding projects.

We cannot formally address this classic endogeneity problem in our setup as this would require additional data on past firm performances and extensive fieldwork with a wider set of firms. However, based on a review of CDR's governance and additional tests, we argue that narrative two is implausible in

that two conditions are not met for it to hold true. First, firms should be able to compete for superior connections. And second, to the extent that connected consultants are themselves part of the rent generation scheme, they should receive larger contracts irrespective of their involvement in the cartel.

As per condition one, competition among firms for superior connections remained closed during the period of investigation. According to its establishment decree, the CDR board should be composed of seven to 12 members with a mandate of five years. During the period of investigation, however, the CDR board consisted of only five members which remained almost unchanged since 2004.[11] Yet, quorum and voting rules for decisions on awards still apply as if the board was fully staffed. For board decisions to be binding, all five board members must attend the meeting and must agree. In line with theoretical work (Huck, Normann and Oechssler, 2004), a small number of actors with a necessity for unanimous decisions is an important precondition for elites to ensure deferred reciprocity in repeated interactions. That way, the access of firms to larger contracts is blocked by way of competing for connections. As neither the board nor their protégés have changed during the period investigated, firms' performance cannot explain their ascendance to superior connections.

Second, PCF1 supervisory consultants receive inflated contracts only when they serve as designers. To show this, we conduct an additional set of regressions in which we take the value of supervision contracts as a dependent variable.[12] Models 1 to 5 of Table 9 show that only PCF1 consultants receive larger contract values than the average, even after including our set of controls for company and project characteristics. Model 6 re-estimates model 5 without multiple imputations, showing that the results are not sensitive to the imputation of missing values.

In models 7 and 8, we include coefficients to test whether contract values depend on a supervisor's service as a designer in the cartel. In model 7, we include a dummy variable for whether a supervisor has designed any project otherwise, which turns out to be positive and significant. Model 8, by contrast, includes a dummy for whether PCF1 supervisors design a project within the same contract, which is not associated with larger contract values.

These results suggest that PCF1 consultants receive inflated contracts themselves as a function of their involvement in the cartel. PCF1 supervisors appear to receive larger contracts in deferred reciprocity, that is, only when they have been serving as a designer and have been part of the rent generation scheme otherwise. Even when PCF1 supervisors design the same project, they do not receive larger contracts, further hinting at a complex system of awards that is intertemporal in nature. The economic value of this increase corresponds to approximately 0.21 million U.S. dollars on the average contract, or 29 percent,[13] an increase of approximately the same order of magnitude identified above.

[11] In 2009, the government issued a decree with which it extended the mandate of the current board "until the appointment of a new board" (Rizk, 2019). The only changes of the board were a new president, appointed in 2006, while one board member passed away in 2011.
[12] Some supervision contracts cover multiple infrastructure contracts. For these contracts, we calculate the sum of the infrastructure contract values to be included in the models as log contract value.
[13] The calculation follows the same logic as outlined above, based on the effect sizes of models 1 and 7.

Table 9: Regression results on the value of supervision contracts

	1	2	3	4	5	6	7	8
PCF 1	0.67***		0.25***		0.22**	0.23*		
	(3.58)		(2.75)		(2.15)	(1.94)		
PCF 2	-0.20			-0.13	-0.05			
	(-0.63)			(-0.78)	(-0.31)			
PCF		0.21**						
		(2.22)						
PCF1 SV serving as designer otherwise							0.24**	
							(2.32)	
PCF1 SV designing same project								0.01
								(0.13)
Supervision period		0.10***	0.10***	0.10***	0.10***	0.11***	0.11***	0.09***
		(6.63)	(6.61)	(6.50)	(6.67)	(6.09)	(6.95)	(6.03)
Supervision contains design		0.47***	0.45***	0.44***	0.48***	0.45***	0.48***	0.43***
		(3.78)	(3.74)	(3.56)	(3.67)	(2.88)	(3.70)	(2.90)
Log contract value		0.63***	0.63***	0.63***	0.63***	0.62***	0.62***	0.64***
		(13.50)	(13.47)	(13.46)	(13.59)	(12.17)	(13.55)	(11.94)
Age		0.73***	0.62***	0.66***	0.64***	0.48*	0.66***	0.60***
		(4.18)	(3.36)	(3.12)	(3.14)	(1.73)	(3.50)	(2.87)
Size		-0.09**	-0.07	-0.05	-0.08	-0.05	-0.08*	-0.08*
		(-2.05)	(-1.56)	(-1.08)	(-1.47)	(-0.89)	(-1.76)	(-1.74)
Capital		0.05***	0.04**	0.04**	0.04	0.05**	0.04**	0.04**
		(3.27)	(2.26)	(2.00)	(1.64)	(2.33)	(2.13)	(2.28)
Foreign supervisor		0.53**	0.55**	0.44*	0.50**	0.14	0.52**	0.48**
		(2.10)	(2.28)	(1.74)	(2.09)	(0.30)	(2.19)	(2.05)
Sector FE	NO	YES	YES	YES	YES	YES	YES	YES
Governorate FE	NO	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	NO	NO	NO	YES	YES	YES	YES
Constant	11.80***	-1.51*	-1.04	-1.17	-1.14	-0.27	-1.19	-1.09
	(85.72)	(-1.79)	(-1.20)	(-1.19)	(-1.22)	(-0.23)	(-1.35)	(-1.10)
Observations	297	275	275	275	275	205	275	190

*Notes: Dependent variable is the log contract value of supervision contracts. PCF indicates dummy variables for all connected firms. PCF1 captures firms connected to the inner circle of elites that controls the CDR board. PCF2 includes firms of all political elites. Regression model uses robust standard errors; The table shows beta coefficients and t-statistics in parentheses; Significance levels: * p<0.10, ** p<0.05, *** p<0.01.*

Lastly, an alternative version of the second narrative could hold that CDR anticipates during the bid evaluations that connected designer/contractor pairs will deliver higher quality work, justifying higher prices. We exclude this possibility. First, connected designers are associated with more likely and larger cost overruns, indicating, if anything, lower quality work that require more frequent and larger amendments. Second, the technical part of bidding evaluations, often supervised by donors, is generally assessed as competitive in the sense that the lowest bid does win a tender. Additional reviews of bidding documents[14] as well as our interviews confirm that CDR would not be able to systematically award connected contractors with such inflated contracts even if these would submit stronger bidding documents. A former evaluation engineer of CDR illustrates this point by highlighting that "looking at the financial envelope takes away all the tension [of a bid evaluation]." In line with the first narrative, and corroborated by existing literature (Baránek and Titl, 2020), collusion must have happened beforehand at the design stage.

[14] While CDR does not publish details on bids, we could review the documents of a sample of 30 large tenders based on a request for access to information.

6. Discussion

Our results chime with narrative one and help identifying the conditions under which elites can broker deals. Two channels emerge in which the conditions for rent generation are met (Figure 2). First, for overpricing, both the designer and the contractor need to be PCF1. Second, for overspending, only the designer needs to be PCF1. Disaggregating the functions of a cartel helps explain this seemingly contradictory result.

Design consultants are the lynchpin of the cartel by performing the critical task of limiting competition and thereby minimizing *searching costs*. To ensure that the "right" designer is in place, CDR restricts the list of designers eligible to bid for design contracts to a handful of firms, leveraging a discretion that is larger than for other contracts, such as in construction. This is corroborated by our interviews with non-connected designers, who lamented the non-competitive practices to bid for design contracts. In that way, elites can make sure to work with trusted partners, the precondition to ease the searching and matching of actors. Designers, then, leverage their prerogatives over bidding documents and discretion over who can be excluded from bidding to ensure that bidding documents are tailored to meet a deal and that the "right" firm wins a contract. As a result, even PCF1 contractors who are powerful actors in Lebanon's political economy and close aides to the most powerful elites of the country (Leenders, 2012) do not receive overpriced contracts unless the designer is also a PCF1.

While searching costs need to be minimized for both channels, differences arise for *bargaining costs*. As overpricing requires deferred reciprocity, bargaining costs are higher for overpricing than for overspending of contracts. In the former channel, a deal has to be honored with a time-lapse of months or even years, which requires a trusted relationship among actors and therefore close connections. In the latter channel, by contrast, a deal to overspend can be honored on the spot. As all actors can be compensated immediately via kickback payments resulting from an approved claim or variation order, no extensive trust relationship needs to exist in order to bargain even complex deals.

For the same reasons, *enforcement costs* are also more costly in the overpricing than for the overspending channel. The long-time horizon of elites and the CDR board appears to be the necessary precondition for making actors trust that other actors will eventually (be forced to) honor the deal. These costs are only low for PCF1 elites with a "seat at the table," as PCF2 elites would have to impose much larger efforts to be able to credibly enforce a deal.

Figure 2: Summary of conditions for rent generation

	Searching Costs	**Bargaining Costs**	**Enforcement Costs**
Channel/ Description	… incurred for matching partner of a corrupt deal	… incurred for ensuring the buy-in of all actors	…for ensuring that deal is honored by all sides
Overpricing Contractor **and** designer need to be PCF1	**Low** when contracts allocated to connected (i.e., trusted) designers who limit competition among bidders by… ▪ Tailoring tender documents ▪ Disqualifying non-connected bidders	**High** as actors need to be compensated in *deferred reciprocity* which is only possible when contractor is also connected (i.e., trusted)	**High** due to deferred reciprocity necessitating long-time horizons of actors

Overspending Designer only needs to be PCF1	▪ Facilitating "flow" of information among connected bidders ▪ Delivering lower quality designs	**Low** as one-time interaction enables immediate compensation	**Low** as one-time interaction enables withholding of rewards in case of non-compliance

In that way, our results advance the theoretical contribution of Bussell (2017) on the conditions under which middlemen can broker corrupt deals. She argues that "a middleman's value is determined by the combination of access to high-quality information and relationships, acquired through repeat exposure to similar corrupt transactions, and the ability to use these resources to facilitate exchange between otherwise unlinked individuals" (p. 469). According to Bussell, it is the frequent repetition of transactions that create "opportunities for cultivating relationships", requiring an "up-front investment to develop the trust of […] agents" (p. 468).

Our results qualify this argument for high-level brokerage. Even in countries with weak bureaucracies such as Lebanon, elites, as brokers, can access high-quality information and build trusted relationships only when they have control of formal institutional functions via loyal personnel within which they enjoy a long-time horizon.

7. Conclusion

Instead of reciting the results, we conclude by outlining policy implications. While we abstain from claiming generalizability, we believe our results can guide the identification of "red flags" in similar contexts (Ferwerda, Deleanu and Unger, 2017) and improve cartel screening by qualifying where to search (Adam *et al.*, 2022). The example of CDR shows that, in an otherwise well-functioning institution, corrupt deals might rarely be visible in the technical work of evaluating tenders and bids, or even to monitor the implementation of projects. Rather, dealmaking is "displaced" (Dávid-Barrett and Fazekas, 2020a) and seems to happen in the less technical pre-implementation stages in which a procurement agency retains a degree of discretion that has a higher likelihood to remain unchecked by accountability mechanisms. This discretion can include measures such as short-listing of eligible (often connected) design consultants, or the determination of which bids of contractors are eligible in the first place.

One effective way to undermine the ability of cartels to coordinate appears to be to shorten the time horizons of the representatives of elites in the board of institutions such as CDR. Implementing legal requirements of rotating a sufficiently large board makes trust relationships more difficult to maintain and defections from cartels more likely (see also Lambsdorff, 2007). As these connections have a significant economic value, even small improvements in undermining cartel coordination can have large welfare effects. Capacity building, on the other hand, will have limited effects as long as elites maintain discretion over parts of the tendering process that take place before technical evaluations start. In the case of Lebanon, this is of high contemporary relevance as significant amounts of donor aid are pledged to facilitate the improvement of public infrastructure (Atallah, Dagher and Mahmalat, 2019) to recover from a severe economic crisis.

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