The company you keep: Renegotiations and adverse selection in transportation infrastructure

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Abstract

We study the effects of a country's propensity to renegotiate transportation infrastructure contracts on the technical efficiency of the firms they attract. Firms are characterized by their ability to lobby and by their technical efficiency. In equilibrium, countries with a higher propensity to renegotiate contracts attract less efficient firms, that are better at renegotiating. This leads to costlier transportation infrastructure and lower welfare. Countries with institutional settings with a higher propensity for renegotiation, or where more net welfare is "up for grabs" in renegotiations, procure transportation infrastructure at a higher cost. We provide anecdotal evidence of the link between renegotiation in public procurement and a firm's ability to renegotiate contracts.

Keywords: Procurement; Institutions; Governance; Costs; Auction.

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1 Introduction

A country's institutional and legal setup determines the propensity to renegotiate procurement contracts, especially large transportation infrastructure contracts. Once a procurement contract is agreed upon, the parties' relationship changes from a competitive relation to a bilateral monopoly (Williamson, 1976). This leads to the possibility of renegotiating the contract and provides an advantage for firms that are better at renegotiating contracts but are not necessarily more efficient. As Saussier and Tirole (2015) put it, a competitive process tends to select, not the best candidate, but rather the one that has the greatest faith in their power of renegotiation.[2]

We couple this observation with the fact that multinational construction and engineering firms tend to specialize in specific sets of countries. There are several forces at play in this specialization process, among others, the ease of working in comparable institutional setups, learning by doing of an institutional setup, and history dependence; to which we add a country's propensity to renegotiate contracts.

We show that the propensity to renegotiate (and the depth of renegotiations) of a country alters the types of firms that are attracted to the country.[3] In particular, we show that countries with a high propensity to renegotiate contracts tend to attract engineering and construction companies specialized in renegotiation. We show that these companies will be less efficient –in the engineering sense– than those attracted to countries with better institutions and a lower propensity to renegotiate contracts. This leads to higher-cost projects in countries prone to renegotiate contracts, even though the bidding for the projects is competitive.

Our results are based on the observation that under competition for government procurement contracts, there are two dimensions of firm efficiency: engineering (or cost) efficiency and lobbying or renegotiating ability. Firms that are worse in both dimensions disappear, because they are at a competitive disadvantage. In turn, this means that when comparing any two firms, one will be better at cost reduction and the other firm will be better at renegotiating contracts. Our base model captures this tradeoff by considering two types of firms, one with a relative advantage in cost-efficiency, the other with a relative advantage in lobbying. We generalize this observation to a continuum of firms by assuming the existence of an efficiency frontier in a two-dimensional technical efficiency-renegotiating ability frontier (TRF).

Our observation depends on the assumption that it is not easy for firms to move along the TRF. In other words, firms that are good at renegotiation but technically weak in one project cannot suddenly become technically proficient in a second project. This is reasonable since the abilities in-

[2]"*Le mécanisme d'appel d'offres ne conduit donc plus forcément à sélectionner le meilleur candidat (le moins-disant ou le mieux-disant) mais celui qui a le plus confiance dans son pouvoir de renégociation.*" (Saussier and Tirole, 2015).

[3]In our formal model, we conflate both aspects –depth and propensity– into a single variable, the amount of social welfare that can be appropriated by the firm under renegotiation. This sidesteps the problem that some countries with strong institutions may renegotiate often i.e., use discretion in the sense of Bosio, Djankov, Glaeser, and Shleifer (2022), but their results are fair, in the sense that not a lot of additional social welfare goes to the firm.

volved in both aspects require specific investments. We also assume that a government's propensity to renegotiate is independent of the type of firm it attracts, which is consistent with the concept that the propensity to renegotiate is a characteristic that depends on the institutions in the country.

Another possible objection to our model is that the existence of a TRF assumes that a firm cannot excel both at building and renegotiating the project. We address this issue by extending our base model to endogenize firm formation. Firms are a partnership between two types of agents, an engineer in charge of building the project and a lawyer in charge of renegotiating the contract. Forming a firm requires an arrangement to share profits between both agents. We assume that agents that are better at lobbying are also better at negotiating the internal contractual arrangements within the firm. We find conditions under which the best engineer does not choose the most effective lawyer because the income she gives up when negotiating the distribution of profits with the lawyer are larger than the profits created for the firm by incorporating the most effective lobbyist.

Our setting does not require corrupt firms, but contract renegotiation have been associated to corruption (see Campos et al. (2021) for the Odebrecht corruption case and its *modus operandi*). There is a cluster of abilities, including lobbying, corrupting public officials, and rallying public support, that is closely linked to renegotiating ability and thus explain that renegotiation is often coupled with corruption, especially in countries with weak institutions. Our results then imply that countries with a larger propensity to renegotiate contracts will attract companies prone to paying bribes, in contrast to countries with strong institutions that deter opportunistic renegotiations, that will draw more efficient firms.

There is anecdotal evidence that is broadly consistent with the implications of our model. In the largest corruption case ever prosecuted under the US Foreign Corrupt Practices Act (FCPA), the Brazilian infrastructure conglomerate Odebrecht paid US$735 million in bribes in ten countries in Latin America, in exchange for larger and more convenient contract renegotiations (Campos et al., 2021). The three countries in the region with the best control of corruption indices –Uruguay, Chile and Costa Rica— were not among the countries where Odebrecht conducted business.[4] This suggests that Odebrecht had a competitive advantage in bribing and thus specialized in countries with weak institutions.

The next section describes the literature on contract renegotiation in infrastructure. The section following presents the simple model with many firms of two types. Next, we present extensions to the case of two firms having monopoly power, and to the case of a continuum of firms. Next, we present a model of firm formation yielding our structure of engineering-biased and lobbying-biased firms, and the final section concludes.

[4]Both Transparency International's Corruption Perception Index and the World Governance Indicator's Control of Corruption Index place Uruguay, Chile and Costa Rica with the best evaluations in Latin America for controlling corruption. These countries are not mentioned in Odebrecht's plea agreement with the US Department of Justice.

2 Relation to the literature

The literature on contract renegotiation in the infrastructure sector, especially public-private partnerships (PPPs) in the transportation sector, is very extensive. Contract renegotiations may lead to opportunistic behavior that is socially detrimental, but may also provide flexibility that is socially desirable.

For Latin America, where the experience with infrastructure PPPs has been well studied, the early study by Guasch (2004) showed the extent of contractual renegotiations in the early stages of PPP adoption in the region, especially in the transportation sector.[5] Estache, Guasch, Limi, and Trujillo (2009) use data of PPPs in Latin America to argue that even though multidimensional auctions are natural for complex projects, they are vulnerable to corruption and opportunistic behavior, especially opportunistic renegotiation. A detailed analysis of the Chilean PPP program renegotiations appears in Engel, Fischer, Galetovic, and Hermosilla (2009), where they show that renegotiations were used to circumvent budgetary controls by Congress. de Castro e Silva Neto, Cruz, and Sarmento (2017) study the renegotiations of PPP programs in Brazil. They show that many projects are renegotiated early on and attributes this feature to deficiencies in planning and, more generally, to the weakness of the Public Authority. Bitran, Nieto-Parra, and Robledo (2013) study the extent of renegotiations in Colombia, Peru and Chile, showing that the value of the projects increased substantially after renegotiations, especially in Colombia, where renegotiations led to cost increases that averaged 108.8%.

Another strand of the literature looks at the empirical evidence of the effects and importance of renegotiation in procurement and to the relation between strategic lowballing and renegotiations in competitive auctions. Bajari, Houghton, and Tadelis (2014) study highway pavement contracts in the US, finding that renegotiation has important adaptation costs. Decarolis and Palumbo (2015) study procurement in Italy between 2000 and 2007 and find that there are fewer renegotiations when the same firm is involved at the design and construction stages, in line with the potential advantages of PPPs due to bundling (Hart, 2003). Ryan (2020) studies electric power contracts in India and shows that firms deliberately do not index contracts to fuel price costs to lowball contracts and induce renegotiations after cost increases. Politically connected firms (i.e., with an advantage in contract renegotiation) index less. Without contract renegotiation, bids would be higher but margins would be lower, because there would be no ex post price increases. Jung, Kosmopoulou, Lamarche, and Sicotte (2019) study road construction contracts in Vermont and show that bidders act strategically, skewing their itemized bids to obtain an advantage in future renegotiations of the contract.

An extensive literature focuses on large and complex projects that often end up costing much more than initial estimates. Herweg and Schwarz (2018) show that in complex projects which are

[5]Guasch (2004, Table 1.7) finds that 54.7% of contracts in the transportation sector had been renegotiated, in contrast to the 30.0% of renegotiations of all contracts. These also include the water and sanitation, telecommunications, and electricity sectors.

difficult to specify, renegotiations are likely and the projects end up costing more, even when using efficient awarding procedures. In a study of procurement Baldi, Bottasso, Conti, and Piccardo (2016) study this issue in Italy, showing that complex projects are more likely to be awarded by negotiation. In complex projects, there is more lowballing, projects tend to go to local firms and delays are larger.[6] Chong, Staropoli, and Yvrande-Billon (2014) study the entire set of French public procurement in the construction sector between 2005 and 2007. They find a link between the type of contract (negotiated or open auction contracts) and conclude that contracts that are auctioned are renegotiated at a much higher rate than negotiated contracts.

The renegotiation of complex contracts has also been analyzed from a political economy perspective, see Flyvbjerg et al. (2003) for an influential contribution. Flyvbjerg, Garbuio, and Lovallo (2009) argues that delusion and deception play a part in projects that do not fulfill expectations, either because costs rise in excess or demand it too low. In turn this leads to project renegotiation. The reasons for this are not only miss-estimations but also often politically motivated decisions. More directly, Engel, Fischer, and Galetovic (2019) examine a political economy model where the possibility of reelection is improved by spending in public works. The government will renegotiate infrastructure contracts to add additional works, sidestepping the normal budgetary process. In doing this the government shifts debt onto future administrations.

As mentioned above, Bosio et al. (2022) provide evidence that relates the discretion of the Public Authority (contract renegotiation is a type of discretion) to the institutional setting. The authors show that in countries with good institutions and trust, discretion leads to better results in procurement, whereas in countries with weaker institutions, rigidity of contracts is preferred. Earlier studies of these issues contrasted rigidity and flexibility. Ross and Yan (2015) show that the choice between the rigidity of PPP contracts and the more flexible traditional procurement methods depends on factors such as the likelihood of renegotiation, the productivity of the private party, switching costs and the relative bargaining power. Bajari and Tadelis (2001) show that when it is costly to the principal to specify completely a complex project and there are transaction costs associated to renegotiations, it might be worthwhile to use cost-plus contracts instead of fixed price contracts.

Finally, there is a literature on renegotiation of infrastructure contracts and corruption. In a review of corruption in transport infrastructure, Kenny (2009) associates contract renegotiation to corruption. Iossa and Martimort (2016) use a theoretical model to show that corrupt officials will prefer incomplete contracts, which leave ample score for future renegotiation. Guasch, Laffont, and Straub (2007) study government-led concessions in Latin America and find a relation between corruption variables and the extent of renegotiation. As mentioned earlier, Campos et al. (2021) provide systematic evidence that bribes for infrastructure projects buy larger and more convenient renegotiations.

[6] A lowball bid is one that is substantially lower than the the estimated value of the project.

3 The two types of firm case

We begin with the simple case of two types of firms characterized by their efficiency and renegotiating-ability parameters. Countries have a parameter α describing their propensity to renegotiate contracts. We show that there is a threshold $\bar{\alpha}$ that selects between efficient and inefficient firms, so that governments that renegotiate less than $\bar{\alpha}$ attract efficient firms.

Let W be the gross social welfare produced by a government project, that requires an upfront investment. There are no other costs of the project. Let R be the bidding variable (assumed to be the revenue requested by a firm) for building or supplying the project. The winning bid is the lowest value of R. Then the net social welfare ex ante is $V = W - R$, assuming that the firms are not necessarily domestic, so their surplus is not included in social welfare.[7] Let α be the fraction of the ex ante net social welfare that will be renegotiated.[8] Thus αV is the amount "up for grabs" (Wernerfelt and Zeckhauser, 2010) which is an institutional characteristic of the the country.

There are two firms types of $i = 1, 2$, with many firms of each type. They are characterized by an inefficiency parameter θ_i and a renegotiating-ability parameter $\rho_i \in [0, 1]$. The inefficiency parameter θ_i measures the firm's cost of achieving the required investment. We assume that $W > \theta_i$ for all i so that society benefits from having the project built, even if this is done by the less efficient firm. The renegotiation parameter ρ_i is the fraction of net social welfare up for grabs, i.e., that will be captured by the firm in a renegotiation. We assume $\theta_1 < \theta_2$ and $\rho_1 < \rho_2$, that is, type 1 firms have a comparative advantage in efficiency while type 2 firms have a comparative advantage in renegotiating. Then the total profits for a firm of type i when making a bid R are:[9]

$$\Pi_i(R) = R - \theta_i + \alpha\rho_i V, \tag{1}$$

i.e., the bidding revenue variable, minus the cost of investment, plus the ex post benefits of renegotiation. Recalling that $V = W - R$ we have

$$\Pi_i(R) = (1 - \alpha\rho_i)R - \theta_i + \alpha\rho_i W.$$

It follows that the value of R that leads to zero profits for a type-i firm is:

$$R_i = \theta_i - \frac{\alpha\rho_i}{1 - \alpha\rho_i}(W - \theta_i) < \theta_i. \tag{2}$$

[7] If firms are domestic, the results continue to hold so long as the weight on firm profits is lower than the weight on consumer welfare in the social welfare function, see Laffont and Tirole (1993, Ch. 1).

[8] More generally, the parameter α can be interpreted as the expected fraction of net social welfare that will be renegotiated. This includes, among others, the case where a fraction α of projects are renegotiated, but where all the net social welfare is up for grabs.

[9] The expression that follows assumes that the government renegotiates the original contract without receiving anything in return: i.e., it is a weak negotiator. It is not difficult to adapt the problem to the possibility of regulatory takings, or to include a risk of expropriation, so long as firms that are better negotiators stand to lose less from opportunistic renegotiations of the original contract by the government.

Thus, firms bid below their costs, and the extent by which they lowball increases with α and ρ,[10] that is, firms bid more aggressively when renegotiations are relatively more important.

The competitive assumption and the presence of a large number of firms of each type means that a type 1 firm wins if its zero-profit bid is smaller than the corresponding bid for a type 2 firm. This is equivalent to having:

$$R_1 = \theta_1 - \frac{\alpha\rho_1}{1-\alpha\rho_1}(W-\theta_1) < R_2 = \theta_2 - \frac{\alpha\rho_2}{1-\alpha\rho_2}(W-\theta_2),$$

that is:

$$\theta_2 - \theta_1 > \alpha[\rho_2(W-\theta_1) - \rho_1(W-\theta_2)]. \tag{3}$$

For low values of α (for example $\alpha = 0$), the terms on the left hand side of (3) dominate in the comparison between R_1 and R_2, and more efficient firms (smaller values of θ) will build the project. Conversely, as α increases, the terms on the right hand side of (3) become more important and the ability to renegotiate matters more. Let $\bar{\alpha}$ be the value of α for which (3) holds with equality:

$$\bar{\alpha} = \frac{\theta_2 - \theta_1}{\rho_2(W-\theta_1) - \rho_1(W-\theta_2)}. \tag{4}$$

Then $\bar{\alpha}$ is the critical value of the renegotiation parameter that discriminates between the two types of firms (since $\theta_1 < \theta_2$, $\rho_1 < \rho_2$ and $W - \theta_2 > 0$ we have $\bar{\alpha} > 0$). If $\alpha > \bar{\alpha}$ the winning firms will always be inefficient. Firms that are good at renegotiating are more likely to win when the social value of the project, W, increases, because there is more social welfare at stake in a renegotiation. On the other hand, efficient firms are more likely to win when the technical difference between firms increases.

Result 1 *Countries with renegotiation parameter*

$$\alpha < \bar{\alpha} = \frac{\theta_2 - \theta_1}{\rho_2(W-\theta_1) - \rho_1(W-\theta_2)}$$

will attract only efficient firms. By contrast, countries with $\alpha > \bar{\alpha}$ only attract inefficient firms.

The economic intuition behind this result is that the competitive procedure through which rents are dissipated is biased in favor of firms with a comparative advantage in renegotiating.[11] The winning firm has two sources of revenues: its winning bid R and the amount it obtains when renegotiating, which by (2) is $\alpha\rho_i V = \alpha\rho_i(W - R_i) = \alpha\rho_i(W-\theta_i)/(1-\alpha\rho_i)$. The latter amount is larger

[10] $\partial(\theta_i - R_i)/\partial(\alpha\rho_i) = (W-\theta_i)/(1-\alpha\rho_i)^2 > 0$.

[11] This provides yet another example of why all open minimum price auctions are not made equal. See for example, Bajari and Tadelis (2001), Athias and Nuñez (2008) and Herweg and Schwarz (2018). Note also the policy recommendation in Saussier and Tirole (2015).

in countries where renegotiations are pervasive, thereby allowing firms with an advantage in renegotiating to lowball by more when bidding R and obtain a larger compensation for underbidding when the contract is renegotiated.

Note that ex post social welfare $W_{\text{ep}} = W - R - \alpha\rho V$ satisfies:

$$W_{\text{ep}} = W - \theta_i,$$

and therefore is higher for countries that manage to attract efficient firms.

4 Extensions

4.1 The case of two firms

Suppose there are only two firms, one of each type. In this case, one of the two firms has a degree of monopoly power, in the sense that it can undercut ('limit-price') the other firm and obtain rents. Assuming no collusion, the winning firm selects a bidding value R such that the other firm makes zero profits.[12] Therefore, firm i wins if $\Pi_i(R_j) > 0$, with Π_i defined in (1) and R_j denoting the revenue of firm i's competitor. By an analysis that is identical to the previous one, we obtain

Result 2 *In countries with renegotiation parameter*

$$\alpha < \bar{\alpha} = \frac{\theta_2 - \theta_1}{\rho_2(W - \theta_1) - \rho_1(W - \theta_2)}$$

the winner will be the efficient firm. Otherwise, the inefficient firm wins.

This means that in the presence of monopoly power, governments that renegotiate more than $\bar{\alpha}$ will face winning bids from inefficient firms. If firm i wins, ex post social welfare is equal to:

$$W_{\text{ep}} = \frac{1 - \alpha\rho_i}{1 - \alpha\rho_j}(W - \theta_j).$$

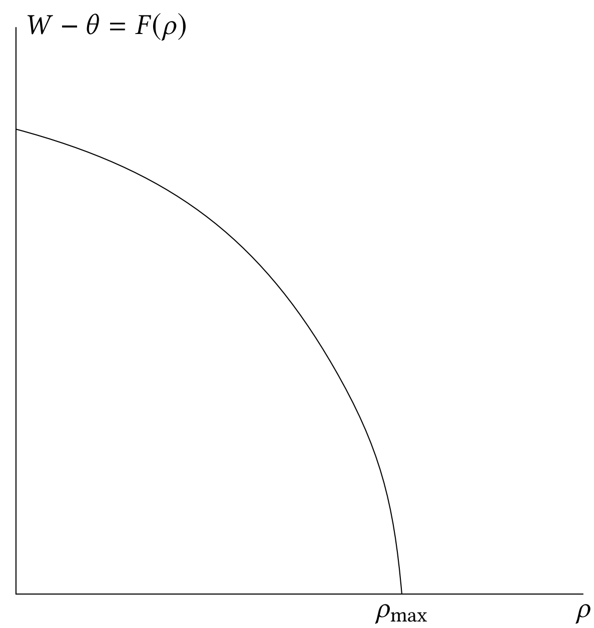
As in Section 3, social welfare is higher in countries with a lower propensity to renegotiate contracts. The difference is that now the winning firm obtains rents. Since the firm that wins is of the same type as in the case with a large number of firms of both types, ex-post social welfare is lower than in the case considered in Section 3.

[12]Minus a very small, positive ϵ that ensures that it wins. A more rigorous formulation assumes that firm i's actual cost is a draw from a distribution with mean θ_i and variance σ^2, that both draws are independent, and that the project is assigned in a second-price auction. Limit pricing then corresponds to the case where the variance of the distributions that determine the θ_i tends to zero.

4.2 A continuum of firms

Assume that there is a continuum of firms that describe a downwards-sloping two-dimensional technical efficiency-renegotiating ability frontier (TRF) in $(W - \theta, \rho)$ space (see Figure 1). It must be downwards-sloping because of our assumption that firms that are worse in both dimensions, technical efficiency and renegotiating ability, do not survive. It seems reasonable to assume that the TRF is concave. The intuitive argument is that when close to the maximum technical efficiency, a small increase in efficiency can only be obtained by sacrificing a fairly large amount of renegotiation ability, and vice-versa at the other extreme of the TRF. In that case, we may characterize the TRF by $W - \theta = F(\rho)$, with $F' < 0$ and $F'' < 0$. Whether we assume one or a large number of firms of each $(W - \theta, \rho)$-type is irrelevant since the winning firm will have no ex-post rents even in the case with limit pricing.

Figure 1: Technical efficiency-renegotiation frontier



It follows from the firm's zero-profit condition that the bid R from a firm of type $(W - \theta, \rho)$ will be:

$$R = W - \frac{F(\rho)}{1 - \alpha\rho}. \tag{5}$$

Minimizing over ρ for fixed α implies that the renegotiation ability of the winning firm, $\rho(\alpha)$, is characterized by:

$$(1 - \alpha\rho)F'(\rho) + \alpha F(\rho) = 0. \tag{6}$$

Implicit differentiation of (5) w.r.t. α followed by imposing (6) leads to:

$$\frac{\partial R}{\partial \alpha} = -\frac{\rho F(\rho)}{(1-\alpha\rho)^2} < 0, \tag{7}$$

showing that the extent of lowballing increases with α.
Implicit differentiation of (6) with respect to α leads to:

$$\frac{\partial \rho}{\partial \alpha} = \frac{\rho F'(\rho) - F(\rho)}{(1-\alpha\rho)F''(\rho)} > 0. \tag{8}$$

Using (7) and (8), and then (6) to get rid of $F'(\rho)$, yields

$$\frac{\partial W_{\text{ep}}}{\partial \alpha} = \frac{\partial}{\partial \alpha}(1-\alpha\rho)(W-R) = -\left(\rho + \alpha\frac{\partial \rho}{\partial \alpha}\right)(W-R) - (1-\alpha\rho)\frac{\partial R}{\partial \alpha} = \frac{\alpha[F(\rho)]^2}{(1-\alpha\rho)^3 F''(\rho)} < 0.$$

A generalization of our previous results follows:

Result 3 *For every value of the renegotiation parameter α, there exists a unique associated pair $(W-\theta, \rho)$ describing the technical efficiency and renegotiation parameters of the winning firm. Moreover, an increase in the value of α selects firms that are less technically efficient, leads to more lowballing, and decreases ex post social welfare.*

5 Endogenous Firm Formation

One question that remains is why don't technically competent firms hire the most effective lobbying services to provide renegotiation prowess? If that were true, we would not have a downwards sloping relationship between technical expertise and lobbying ability, the assumption that drives our results. In this section we assume that firms require both technical expertise (of varying degrees) and marketing-lobbying ability in order to renegotiate a contract. Before firms are formed, engineers with technical expertise search for marketing/lobbying agents. There are distributions of both types of agents and they need to be matched. The abilities of agents are displayed, and the issue is whether engineers will be voluntarily matched with marketing-lobbying types, and viceversa, in such a way that we obtain a downwards-sloping relationship between technical expertise and lobbying ability.

Forming a firm requires an arrangement for the sharing of profits between the engineers and the lobbying-marketing agents. It is natural to assume that agents that are better at lobbying are also better at negotiating the internal contractual arrangements within the firm, i.e., we would expect a better lobbyist to obtain a higher share of the profits of the firm. We denote the fraction of firm profits accruing to the engineer as $G(\rho)$, which is decreasing as ρ increases and satisfies $G(0) = 1$.

Notice first that all unattached lobbyists want to form a firm with the best unattached technical expert because she generates the largest surplus which can later be renegotiated. Therefore, technical experts can choose any unattached lobbyist. We consider the case with two types of engineers and two types of lobbyists. At issue are the conditions on the profit sharing function G required to have the highest unattached engineer choose to match to the lobbyist with the least ability. The following result provides such conditions.

Result 4 *Assume there are two engineers, with productivity parameters θ_1 and θ_2, $\theta_1 < \theta_2$, and two lobbyists, with renegotiation parameters ρ_1 and ρ_2, $\rho_1 < \rho_2$. Engineers and lobbyists need to pair up in firms to compete for a project of characteristics (W, α). Assume $\alpha \leq \bar{\alpha}$ defined in (4). Then if G is concave and*

$$\frac{1}{2(1-\alpha)^2 - (1-\rho_1)^2\alpha^2} \leq \frac{W-\theta_2}{\theta_2-\theta_1} \leq -\frac{(1-\alpha\rho_1)G'(\rho_1)}{2\alpha G(\rho_1)}, \tag{9}$$

the more efficient engineer sets up a firm with the less effective lobbyist and they win the project.

Proof See the Appendix. ∎

Result 4 provides sufficient conditions to have the most efficient engineer prefer the less effective lobbyist. The lobbyist's contribution to firm value cannot be too high, as captured by the condition $\alpha < \bar{\alpha}$, or otherwise the most efficient engineer prefers to pair with the better lobbyist. But this also means that there can only be one firm in a world of high α, as it is superior in all respects to the firm that combines the worse engineer and the worse lobbyist. For the same reason, the profit sharing function G must have enough curvature for the better engineer to find it unattractive to form a firm with the best lobbyist, despite the fact that such a firm maximizes total firm profit. This is captured by the second inequality in (9). Integrating this inequality between $\rho = 0$ and ρ and using the assumption that $G(0) = 1$ implies that:[13]

$$G(\rho) \geq (1-\alpha\rho)^{\gamma} \equiv G_U(\rho),$$

with $\gamma \equiv 2(W-\theta_2)/(\theta_2-\theta_1)$. It follows that the curvature of G, as captured by the absolute log-derivative, must be at least as large as that of $G_U(\rho) = (1-\alpha\rho)^{\gamma}$.

Next we extend the above result to the case of two projects that differ in the importance of renegotiations. Both projects could be located in different countries, be under the jurisdiction of different local governments, or belong to different industries. As in the previous result, there are two engineers and two lobbyists. The following proposition provides conditions under which the more efficient engineer pairs with the less effective lobbyist to build the low renegotiation parameter project, while the less efficient engineer and the more effective lobbyist build the project where renegotiations are more important. The main insight from this paper, that projects that involve large renegotiations tend to attract firms that are good at renegotiating but not productively efficient, now emerges in a context where the technical efficiency-renegotiating ability frontier is determined endogenously.

[13] The inequality is obtained rewriting the expression as $G'(\rho_1)/G(\rho_1) \leq \alpha\gamma/(1-\alpha\rho_1)$ and integrating.

Result 5 *Two engineers, with productivity parameters θ_1 and θ_2, $\theta_1 < \theta_2$, and two lobbyists, with renegotiation parameters ρ_1 and ρ_2, $\rho_1 < \rho_2$, set up firms to compete for two projects. Each project has gross welfare W, yet they differ in their renegotiation parameters, which are α_L and α_H, with $\alpha_L < \bar{\alpha} < \alpha_H$ and $\bar{\alpha}$ defined in* (4). *Each engineer-lobbyist pair can build only one project.*

If G is concave and satisfies condition (9) *evaluated at $\alpha = \alpha_H$, engineer θ_1 pairs up with lobbyist ρ_1 to build the low α project, while engineer θ_2 pairs with lobbyist ρ_2 to build the high α project.*

Proof See the Appendix. ∎

6 Conclusion

We provide a model explaining why certain firms in the transportation sector specialize in countries with weaker governance for procurement work. We show that one factor is that the institutional setup in the country leaves too much value up for grabs in contract renegotiations and therefore favors firms that are better lobbyists, at the cost of engineering ability. Conversely, countries with good governance tend to attract firms whose advantage lies in engineering, which leads to lower project costs overall. We extend the result with two types of firms to the case of imperfect competition and therefore rents, and to the case of a continuum of firms. Finally, we endogenize firm formation and find a negative relation between the engineering ability of the agent responsible for building the project and the lobbying ability of the agent in charge of renegotiations. This has important policy implications: countries that tend to renegotiate a large fraction of the value of infrastructure projects will end up attracting less efficient firms, leading to costlier projects.[14]

Recall also the association between lobbying and corruption mentioned in the introduction. US companies are conspicuously absent from the infrastructure PPP business in Latin America, a sector that has grown rapidly over the last three decades and that is characterized by frequent contract renegotiations (see Guasch (2004) and Guasch et al. (2008)). One possible explanation is that US companies are relatively more constrained in paying bribes abroad than their European counterparts, because of the Foreign Corrupt Practices Act (FCPA) of 1977. This groundbreaking legislation prohibits American individuals and corporations from bribing foreign government officials and led to a sharp fall of US business activities in bribe-prone countries (Hines, 1995). In contrast, similar legislation applying to European companies was passed much later and its enforcement has been weaker. For example, Spain, a major player in the infrastructure PPP sector in Latin America, signed the OECD Convention on Combating Bribery of Foreign Public Officials in International Business Transactions only in 1997. By 2014 it had only 9 investigations and a not single prosecution.[15] This

[14] In Engel et al. (2021) we discuss various specific policies that reduce renegotiations in transportation infrastructure projects and provide evidence of their effectiveness.

[15] "The OECD's Working Group on bribery [...] continues to have serious concerns over the extremely low level of Spain's enforcement of its foreign bribery laws, with not a single prosecution out of only 9 investigations in almost 15 years since joining the OECD Anti-Bribery Convention." OECD (2014).

is in contrast to the US, which had prosecuted more than 130 cases under the FCPA by the same date (Securities and Exchange Commission, 2022). To the extent that US firms are arguably more efficient than their Spanish counterparts, this would be evidence consistent with the models we develop in this paper.

References

Athias, L., Nuñez, A., 2008. Winner's curse in toll road concessions. Economic Letters 101 (3), 172–174.

Bajari, P., Houghton, S., Tadelis, S., April 2014. Bidding for incomplete contracts: An empirical analysis of adaptation costs. American Economic Review 104 (4), 1288–1319.

Bajari, P., Tadelis, S., Autumn 2001. Incentives versus transaction costs: A theory of procurement contracts. The RAND Journal of Economics 32 (3), 387–407.

Baldi, S., Bottasso, A., Conti, M., Piccardo, C., 2016. To bid or not to bid: That is the question: Public procurement, project complexity and corruption. European Journal of Political Economy 43, 89–106.

Bitran, E., Nieto-Parra, S., Robledo, J. S., April 2013. Opening the black box of contract renegotiations: An analysis of road concessions in Chile, Colombia and Peru. Working Paper 317, OECD.

Bosio, E., Djankov, S., Glaeser, E., Shleifer, A., April 2022. Public procurement in law and practice. American Economic Review 112 (4), 1091–1117.

Campos, N., Engel, E., Fischer, R., Galetovic, A., 2021. The ways of corruption in infrastructure: Lessons from the Odebrecht case. Journal of Economic Perspectives 35 (2), 171–190.

Chong, E., Staropoli, C., Yvrande-Billon, A., 2014. Auction versus negotiation in public procurement: looking for empirical evidence. In: Brousseau, E., Glachan, J.-M. (Eds.), The Manufacturing of Markets: Legal, Political and Economic Dynamics. Cambridge University Press, pp. 120–142.

de Castro e Silva Neto, D., Cruz, C. O., Sarmento, J. M., 2017. Understanding the patterns of PPP renegotiations for infrastructure projects in Latin America: The case of Brazil. Competition and Regulation in Network Industries 18 (3-4), 271–296.

Decarolis, F., Palumbo, G., 2015. Renegotiation of public contracts: An empirical analysis. Economics Letters 132, 77–81.

Engel, E., Fischer, R., Galetovic, A., August 2019. Soft budgets and renegotiation in public-private partnerships. Economics of Transportation 17, 40–50.

Engel, E., Fischer, R., Galetovic, A., Hermosilla, M., Verano 2009. Renegociación de concesiones en Chile. Estudios Públicos 113, 151–205.

Engel, E., Fischer, R. D., Galetovic, A., November 2021. When and how to use public-private partnerships in infrastructure: Lessons from the international experience. In: Glaeser, E. L., Poterba, J. M. (Eds.), Economic Analysis and Infrastructure Investment. University of Chicago Press, Ch. 6.

Estache, A., Guasch, J.-L., Limi, A., Trujillo, L., 2009. Multidimensionality and renegotiation: Evidence from transport-sector public-private-partnership transactions in Latin America. Review of Industrial Organization 35 (41), 1573–7160.

Flyvbjerg, B., Bruzelius, N., Rothengatter, W., 2003. Megaprojects and Risk: An Anatomy of Ambition. Cambridge University Press.

Flyvbjerg, B., Garbuio, M., Lovallo, D., February 2009. Delusion and deception in large infrastructure projects: Two models for explaining and preventing executive disaster. California Management Review 51, 170–193.

Guasch, J. L., 2004. Granting and Renegotiating Infrastructure Concessions: Doing it Right. The World Bank, Washington.

Guasch, J. L., Laffont, J.-J., Straub, S., 2007. Concessions of infrastructure in Latin America: Government-led renegotiation. Journal of Applied Econometrics 22 (7), 1267–1294.

Guasch, J. L., Laffont, J. J., Straub, S., 2008. Renegotiation of concession contracts in Latin America. International Journal of Industrial Organization 26, 421–442.

Hart, O., 2003. Incomplete contracts and public ownership: Remarks and an application to public-private partnerships. Economic Journal 113, C69–C76.

Herweg, F., Schwarz, M. A., 2018. Optimal cost overruns: Procurement auctions with renegotiation. International Economic Review 59 (4), 1995–2021.

Hines, J. R., Septmber 1995. Forbidden payment: Foreign bribery and american business after 1977. Tech. Rep. 5266, NBER Working Paper.

Iossa, E., Martimort, D., 2016. Corruption in PPPs, incentives and contract incompleteness. International Journal of Industrial Organization 44, 85–100.

Jung, H., Kosmopoulou, G., Lamarche, C., Sicotte, R., 2019. Strategic bidding and contract renegotiation. International Economic Review 60 (2), 801–820.

Kenny, C., 2009. Measuring corruption in infrastructure: Evidence from transition and developing countries. Journal of Development Studies 45 (3), 314–332.

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

OECD, December 2014. Statement of OECD working group on bribery on spain's efforts to amend its penal code and to enforce its foreign bribery offence.

Ross, T., Yan, J., april 2015. Comparing public–private partnerships and traditional public procurement: Efficiency vs. flexibility. Journal of Comparative Policy Analysis: Research and Practice 17, 1–19.

Ryan, N., 2020. Contract enforcement and productive efficiency: Evidence from the bidding and renegotiation of power contracts in india. Econometrica 88 (2), 383–424.

Saussier, S., Tirole, J., 2015. Renforcer l'efficacité de la commande publique. Notes du Conseil d'Analyse Économique 3 (22), 1–12.

Securities and Exchange Commission, November 2022. SEC Enforcement Actions: FCPA Cases.

Wernerfelt, N., Zeckhauser, R., 2010. Denying the temptation to grab. In: Hogan, W., Sturzenegger, F. (Eds.), The Natural Resources Trap. The MIT Press, Ch. 6, pp. 197–226.

Williamson, O., 1976. Franchise bidding for natural monopoly–in general and with respect to CATV. Bell Journal of Economics 7, 73–104, spring.

Appendix

Proof of Results 4 and 5

We denote by $\Pi_{ij}(R)$ the profit function of a firm composed of an engineer with productivity θ_i and a lobbyist with renegotiation parameter ρ_j, this firm is referred to as the ij firm, $i, j = 1, 2$. The breakeven level of revenue for firm ij is denoted by R_{ij}.

Proof of Result 4

From (2) we have

$$R_{ij} = \frac{\theta_i - \alpha\rho_j W}{1 - \alpha\rho_j}, \tag{10}$$

and therefore

$$\Pi_{11}(R_{22}) = (\theta_2 - \theta_1) - \frac{\alpha(\rho_2 - \rho_1)}{1 - \alpha\rho_2}(W - \theta_2), \tag{11a}$$

$$\Pi_{22}(R_{11}) = \frac{\alpha(\rho_2 - \rho_1)}{1 - \alpha\rho_1}(W - \theta_1) - (\theta_2 - \theta_1), \tag{11b}$$

$$\Pi_{12}(R_{21}) = (\theta_2 - \theta_1) + \frac{\alpha(\rho_2 - \rho_1)}{1 - \alpha\rho_1}(W - \theta_2). \tag{11c}$$

The above expressions imply

$$\Pi_{11}(R_{22}) > 0 \iff \alpha < \bar{\alpha}, \tag{12a}$$

$$\Pi_{22}(R_{11}) > 0 \iff \alpha > \bar{\alpha}, \tag{12b}$$

$$\Pi_{12}(R_{21}) > 0, \forall \alpha. \tag{12c}$$

Part 1 now follows from noting that for $\alpha \geq \bar{\alpha}$, (12b) implies that firm 22 would beat firm 11 while (12c) implies that firm 12 beats 21. It follows that the best option (in fact, only option) for the θ_1-engineer is to pair up with the ρ_2-lobbyist, since this is the only option that yields positive profits under competition for the project. They win the project and obtain profits $G(\rho_1)\Pi_{12}(R_{21})$ and $(1 - G(\rho_1))\Pi_{12}(R_{21})$ respectively.

Part 2 follows from noting that (12a) implies that firm 11 would beat 22 while (12c) implies that firm 12 beats 21. By contrast with the previous case, in this case the θ_1-engineer has to choose between two prospects with positive profits. Forming a firm with lobbyist ρ_1 is the best choice if and only if

$$G(\rho_1)\Pi_{11}(R_{22}) > G(\rho_2)\Pi_{12}(R_{21}),$$

which is equivalent to

$$\frac{\Pi_{12}(R_{21}) - \Pi_{11}(R_{22})}{(\rho_2 - \rho_1)\Pi_{12}(R_{21})} < -\frac{G(\rho_2) - G(\rho_1)}{(\rho_2 - \rho_1)G(\rho_1)}. \tag{13}$$

Concavity of G implies that the right hand side of (13) is bounded from below by $-G'(\rho_1)/G(\rho_1)$. The remainder of the proof consists in showing that the left hand side of (13) is decreasing in ρ_2, for $\rho_2 > \rho_1$. An upper bound for this expression then is obtained by letting ρ_2 converge from above to ρ_1.

Denoting the left hand side of (13) by $H(\rho_1, \rho_2)$, from (11a) and (11c) it follows that

$$H(\rho_1, \rho_2) = \frac{[(1-\alpha\rho_1)^{-1} + (1-\alpha\rho_2)^{-1}]\alpha(W-\theta_2)}{(\theta_2-\theta_1) + \frac{\alpha(\rho_2-\rho_1)}{1-\alpha\rho_1}(W-\theta_2)}. \tag{14}$$

Some patient algebra then implies that

$$\frac{\partial H}{\partial \rho_2} < 0 \iff \theta_2 - \theta_1 < [2(1-\alpha\rho_2)^2 - (\rho_2-\rho_1)^2\alpha^2](W-\theta_2). \tag{15}$$

Bounding $2(1-\alpha\rho_2)^2$ from below by $2(1-\alpha)^2$, and $-(\rho_2-\rho_1)^2\alpha^2$ by $-(1-\rho)^2\alpha^2$, combined with the first inequality in (9) then shows that H is decreasing in ρ_2. Letting ρ_2 converge, from above, to ρ_1 in (15) then implies that G must satisfy:

$$\frac{2\alpha(W-\theta_2)}{(1-\alpha\rho_1)(\theta_2-\theta_1)} < -\frac{G'(\rho_1)}{G(\rho_1)},$$

which follows from the second inequality in (9). ∎

Proof of Result 5

Arguments similar to those used in the previous proof show that 11 beats 22 for the low-α project while 22 beats 11 for the high-α project. Also, 12 beats 21 for both projects and obtains higher profits under the high-α project.

All that remains to be shown is that the concavity of G and (9) imply that the θ_1-engineer is better off pairing with the ρ_1-lobbyist, that is, that:

$$G(\rho_1)\Pi(R_{22}, \alpha_L) > G(\rho_2)\Pi_{12}(R_{21}, \alpha_H),$$

where now we need to keep track of the dependence of Π on α.

The function that plays the role of $H(\rho_1, \rho_2)$ in the proof of Result 5 is given by:

$$H(\rho_1, \rho_2, \alpha_L, \alpha_H) = \frac{[\alpha_H(1-\alpha_H\rho_1)^{-1} + \alpha_L(1-\alpha_L\rho_2)^{-1}](W-\theta_2)}{(\theta_2-\theta_1) + \frac{\alpha_H(\rho_2-\rho_1)}{1-\alpha_H\rho_1}(W-\theta_2)}.$$

Noting that this function is bounded from above by $H(\rho_1, \rho_2, \alpha_H, \alpha_H)$, and that the latter is equal to the expression in (15) evaluated at $\alpha = \alpha_H$. The remainder of the proof is analogous to the corresponding part of the proof of the previous result. ∎