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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.

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.[1]

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.[2] 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

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[1] "*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).

[2] 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 et al. (2022), but their results are fair, in the sense that not a lot of additional social welfare goes to the firm.

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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 involved 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.[3] 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.

[3] 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.[4] Estache et al. (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 et al. (2009), where they show that renegotiations were used to circumvent budgetary controls by Congress. de Castro e Silva Neto et al. (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 et al. (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 et al. (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 et al. (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 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 et al. (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.[5] Chong et al. (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

[4] 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.

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

influential contribution. Flyvbjerg et al. (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 et al. (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 et al. (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 et al. (2007) study government-led concessions in Latin America and find a relation between corruption variables and the extent of renegotiation. Similarly, Guasch and Straub (2009) use a panel of water and transport concessions to show that country-level corruption is a determinant of renegotiations in these contracts. As mentioned earlier, Campos et al. (2021) provide systematic evidence that bribes for infrastructure projects buy larger and more convenient renegotiations.

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 cost-efficient and cost-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.[6] Let α be the fraction of the ex ante net social welfare that will be renegotiated.[7] Thus αV is the amount "up for grabs" (Wernerfelt and Zeckhauser, 2010) which is an institutional characteristic of 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, conditional on winning, are:[8]

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

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:

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

Thus, firms bid below their costs, and the extent by which they lowball increases with α and ρ,[9] 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. *Given a project with welfare W, 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.

[6] 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).

[7] 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.

[8] 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.

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

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.[10] 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 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.[11]

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

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

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. *Given a project with welfare W, 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:

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

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.

In the previous two sections we have examined the case of perfect competition and the case of monopoly with limit pricing (this section). If we were to consider a third firm with parameter values intermediate between those of the two firms of this section, the ability of the original firms to extract rents would decrease, because the limit pricing would be against this intermediate firm. And as we introduce more and more intermediate firms, the scope for profits would decrease. In the limit, we would expect to get a competitive solution. In the next section, we analyze the limiting case by assuming a continuum of firms.

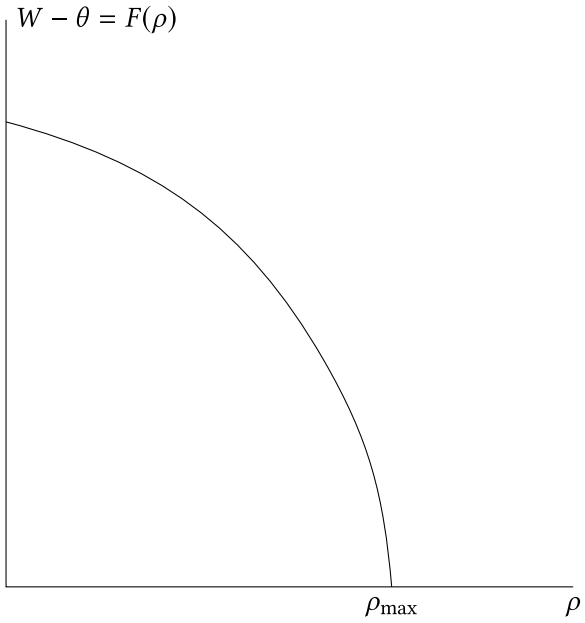

Fig. 1. Technical efficiency-renegotiation frontier.

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 Fig. 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.

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

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

A generalization of our previous results follows:

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

[11] Note that $\bar{\alpha}$ is decreasing in W, because the advantage of having a large value of ρ increases with the amount up for grabs when renegotiating. Thus, the condition that selects an efficient firm is less likely to hold for high-W projects.

[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.

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. Empirical evidence

Ideally, to provide evidence in favor of our model, we require data on the efficiency and renegotiation ability of firms in two countries with markedly different propensities to renegotiate contracts. Using the notation in our model, we would then test whether the average efficiency in the high-α country is lower than in the low-α country and whether, in contrast, the average renegotiation ability of firms in the high-α country is higher.

To the best of our knowledge, no such data exist. Yet the evidence presented in Giannetti et al. (2021) comes close to what we need. This paper studies China's November 2012 anti-corruption drive. They argue that the drive was largely unanticipated by market participants, "so its launch was exogenous to firm performance and corporate policies". This can be reinterpreted in terms of our model as an unexpected decrease in the α parameter of our model. The authors use this unexpected break to compare firm efficiency before and after the anti-corruption drive. They find that firm efficiency increased: technological efficiency improved, sales growth increased, and the cost of debt fell. They also find that measures of the intensity of firm-level corruption decreased. This provides evidence of the mechanism in our model since corruption in the infrastructure sector leads to larger renegotiations (see Guasch and Straub (2009), Campos et al. (2021)).[13]

Finally, Ryan (2020) studies the impact of weak enforcement of Indian procurement contracts for electricity power supply and its effects on efficiency. This paper shows that renegotiation of contracts is widespread, and that firms underbid for the contracts, in the expectation of future renegotiations. The magnitude of these effects increases with the degree of connectedness to the government, a proxy for the ability to renegotiate a contract (a larger value of ρ). Ryan (2020) then builds a structural model of the Indian procurement market and uses it to simulate the effects of strict contract enforcement (i.e., no renegotiations). This may be interpreted as a large reduction of α. The results are a reduction in underbidding and lower overall costs, because of more competition, and because projects are allocated to more efficient bidders. Interpreted through the lense of our model, Ryan's paper shows that lowering α results in a winner with smaller values of both ρ and θ, that is, a firm that is more efficient and less effective when renegotiating contracts.

6. Endogenous firm formation

One question that remains is why do not 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.

The evidence we presented in the preceding section, suggests that the tradeoff we highlight is present. In this section we provide a simple setting where the tradeoff emerges with endogenous firm formation.

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 a way that yields a downwards-sloping relationship between technical expertise and lobbying ability.

We consider 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, $\rho_1<\rho_2$. The firm formed by engineer θ_i and lobbyist ρ_j is referred to as firm (i,j). The question we address in this section is under what conditions the efficient engineer pairs with the weak lobbyist and form the firm 11 while the inefficient engineer pairs with the strong lobbyist to form the firm $(2,2)$.

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 an engineer that pairs with lobbyist ρ_i by G_i and assume $G_2<G_1$.

Consider next the case of only one project. Notice that all unattached lobbyists want to form a firm with the best unattached technical expert because she generates the largest rents to be split between the engineer and the lobbyist. This implies that the efficient engineer, θ_1, can choose the lobbyist she prefers. The following result provides a necessary and sufficient condition for the more efficient engineer to choose the less efficient lobbyist.

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 $\alpha\le\bar{\alpha}$ defined in (4). Then engineer θ_1 chooses lobbyist ρ_1 if and only if*

$$G_1\Pi_{11}(R_{22})>G_2\Pi_{12}(R_{21}), \tag{9}$$

with

$$\Pi_{11}(R_{22})=(\theta_2-\theta_1)-\frac{\alpha(\rho_2-\rho_1)}{1-\alpha\rho_2}(W-\theta_2), \tag{10}$$

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

Proof. We denote by $\Pi_{ij}(R)$ the profit function of firm (i,j), and by R_{ij} the breakeven level of revenue for firm (i,j). From (2) we have

$$R_{ij}=\frac{\theta_i-\alpha\rho_jW}{1-\alpha\rho_j}, \tag{12}$$

which leads to (10), (11) and

$$\Pi_{22}(R_{11})=\frac{\alpha(\rho_2-\rho_1)}{1-\alpha\rho_1}(W-\theta_1)-(\theta_2-\theta_1). \tag{13}$$

The three expressions obtained above imply

$$\Pi_{11}(R_{22})>0\iff\alpha<\bar{\alpha}, \tag{14a}$$

$$\Pi_{22}(R_{11})>0\iff\alpha>\bar{\alpha}, \tag{14b}$$

$$\Pi_{12}(R_{21})>0,\forall\alpha. \tag{14c}$$

From Result 2 we have that $\alpha<\bar{\alpha}$ is necessary for firm $(1,1)$ to win. This condition is not sufficient, since evidently $\Pi_{11}(R_{22})<\Pi_{12}(R_{21})$. If the profit share received by the engineer did not depend on the lobbyist with whom she partnered, the former would not choose to pair with the weak lobbyist. A necessary and sufficient condition that ensures that the efficient engineer will obtain a larger rent when pairing with the less effective lobbyist is Condition (9). ■

If $\alpha>\bar{\alpha}$, or if $\alpha<\bar{\alpha}$ and (9) does not hold (the advantage of the effective lobbyist when negotiating with the engineer is relatively small), the efficient engineer will choose the most effective lobbyist

[13] For example, Campos et al. (2021) analyze 88 contracts by the Brazilian conglomerate Odebrecht in 8 countries in Latin America and find that costs increased on average by 6% among projects with no bribe payments in contrast with 70% for contracts with bribe payments.

and the tradeoff central to this paper does not emerge in our model of endogenous firm formation.

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. That projects that involve large renegotiations tend to attract firms with a comparative advantage in renegotiations, now emerges in a context where the technical efficiency-renegotiating ability frontier is determined endogenously.

Result 5. *Two engineers, with productivity parameters θ_1 and θ_2, $\theta_1 < \theta_2$, and two lobbyists, with renegotiation ability ρ_1 and ρ_2, $\rho_1 < \rho_2$, set up firms to compete for two projects.*[14] *Each project has gross welfare W, yet they differ in the propensity to renegotiation parameters α, which are α_1 and α_2, with $\alpha_1 < \bar{\alpha} < \alpha_2$ and $\bar{\alpha}$ defined in (4). Then the efficient engineer will form a firm with the less efficient lobbyist if and only if*

$$G_1 \Pi_{11}(R_{22}, \alpha_1) > G_2[\Pi_{12}(R_{21}, \alpha_1) + \Pi_{12}(R_{21}, \alpha_2)]. \tag{15}$$

The above condition will hold if G_2 is sufficiently smaller than G_1. Furthermore, when the above condition holds, firm $(1,1)$ will build the α_1-project while firm $(2,2)$ will build the α_2-project.

Proof. If engineer-θ_1 pairs up with lobbyist ρ_1, it follows from (14a) that firm $(1,1)$ will win the α_1-contract and from (14b) that firm $(2,2)$ will win the α_2-contract. Engineer-θ_1's profit share from pairing with lobbyist-ρ_1 then is

$$\text{Profit of engineer-}\theta_1 \text{ in firm } (1,1) = G_1 \Pi_{11}(R_{2,2}, \alpha_1),$$

where the second argument in Π_{11} above (and also in Π_{12} below) refers to the value of α of the corresponding contract.

On the other hand, it follows from (14c) that engineer-θ_1 will win both contracts if she forms a firm with lobbyist ρ_2. Her share of the firm's profits then is

$$\text{Profit of engineer-}\theta_1 \text{ in firm } (1,2) = G_2[\Pi_{12}(R_{2,1}, \alpha_1) + \Pi_{12}(R_{2,1}, \alpha_2)].$$

Comparing both expressions derived above for the efficient engineer' profit share, we conclude that condition (15) is necessary and sufficient for the efficient engineer to choose the less effective lobbyist and build only the low-α contract. ■

The above result shows that the tradeoff central to this paper *may* emerge in a model with endogenous firm formation. It also shows that, if condition (15) does not hold, the firm with the more efficient engineer and the most effective lobbyist will win all contracts. The model underlying Result 5 can be extended to add realism, for example by adding an extra cost from building more than one project or by examining what happens when the values of W differ across projects. The message that emerges, though, does not change. If the share of profits for the efficient engineer is sufficiently larger when pairing up with the less efficient lobbyist in the low-α country, this engineer will prefer to form a firm with this lobbyist, despite the fact that total firm profit would be larger if she paired up with the more effective lobbyist.

[14] We assume that θ_i, ρ_i are the same for both projects.

7. 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.[15] We provide evidence that decreases in corruption in China and reduced renegotiation in India, lead to more efficient firms, which is consistent with out model.

CRediT authorship contribution statement

Eduardo Engel: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Ronald D. Fischer:** Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. **Alexander Galetovic:** Conceptualization, Formal analysis, Methodology.

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