Renegotiation of Concession Contracts in Latin America[*]

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Abstract

We construct a regulation model in which renegotiation occurs due to the imperfect enforcement of concession contracts. This enables us to provide theoretical predictions for the impact, on the probability of renegotiation of a concession, of regulatory institutions, institutional features, economic shocks and of the characteristics of the concession contracts themselves.

Then we use a data set of nearly 1000 concessions awarded in Latin America and the Caribbean countries from 1989 to 2000, covering the sectors of telecommunications, energy, transport and water, to test these predictions.

Finally, we derive some policy implications of our theoretical and empirical work.

JEL Codes: D7, L5, O54

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1 Introduction

Beginning in the late 1980s, developing countries, with Latin American and Caribbean countries taking the lead, began allowing significant private sector participation in the provision of infrastructure services by transferring parts of utilities' operation from government management and control to that of private enterprises.[1] In addition to attempting to improve efficiency by better management, one of the leading reason behind the strategy to bring private sector participation in infrastructure was the urgent need for sizable investment to improve performance and coverage. Given the scarcity of public funds for investments and the competing needs in the social sectors, most countries opted for the transfer of the provision of infrastructure services to the private sector. Private sector participation can and has been accomplished with significant success in a variety of forms, ranging from management contracts, to concessions and to full privatizations. Practically, at least in Latin America and the Caribbean region, seldom a call to the private sector to take over and operate an infrastructure service has had no taker.

In sectors such as telecommunications, and to some extent in electricity generation and gas (the often pioneer sectors), private sector participation was accomplished by outright privatization-divestiture, accompanied by structural reforms of market structure and of the regulatory framework. However, in many cases, particularly for the transport[2] (ports, airports, roads and railroads), water and sewage sectors, and some segments of the electricity sector, legal, political and constitutional restraints hindered or made very difficult the outright sale of public infrastructure utilities to private parties, who quite often were foreign companies, making the issue even more complicated. Many countries, therefore, resorted to innovative strategies for introducing private sector participation in the provision of public infrastructure services when the state could not or did not want to transfer ownership of public assets to private agents. Amongst the alternatives to outright privatization, concessions to the private sector for the right to operate the service for a limited length of time have emerged as the salient mode. A concession is the right to use the assets of a former state company for a limited period of time (usually 20 to 30 years), being fully responsible for all investments and having to secure a number of targets specified in the contract. At the end of the concession, all the assets go back to the government, so de facto the concession's only asset, in contrast to privatization, is the right to the cash-flow of the users' receipts from the service. Throughout the last 15 years, concessions have been used in 67% of the private sector participation cases worldwide, all sectors included.

Despite some gains and improvements in infrastructure sector performance, private

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[1]See for example Sanchez and Corona (1993) and Harris (2003).
[2]On the transport sector, see Gómez-Ibáñez and Meyer (1993).

sector participation by concession has often produced mixed results, raising, in a number of countries, questions about the concession model. Among them are frequent conflicts with operators in complying with contract clauses, tariffs perceived to be excessive, abandonment of the concession by the operator or the taking over of the concession by the government as a result of claimed bankruptcy of the operator[3], discontent with price levels and services, poor attention to users, and above all, the perceived high incidence of renegotiation of contracts shortly after the award of the concession, often to the detriment of consumer welfare. In most cases, particularly in the water and transport sectors, contracts have been renegotiated, impacting sector performance and compromising the credibility of the country and sector involved. In Latin America, 53% of the concessions in the transport sector and 76% of those in the water sector were renegotiated, and this took place on average only 3.1 and 1.6 years after the signing of the contract respectively. Moreover, this recorded high incidence of renegotiation is likely to be underestimated, since the process is ongoing and additional concessions will probably be renegotiated in the coming years.

Some renegotiation is desirable and is to be expected as contracts are in practice necessarily incomplete. Exogenous events that are not induced by either the government or the operator can significantly affect the financial equilibrium of firms, and can be used as an opportunity to redistribute rents. Typical examples would be an internal or external macroeconomic shock, such as the devaluation in Argentina in 2001, or the one in Brazil in 1999. However, the high incidence of renegotiations, particularly in early stages, appears to be beyond the expected or reasonable levels, and raises concerns about the validity of the concession model in which renegotiations would not be taken into account. It might induce excessive opportunistic behavior by the new operators, or by the government, in detriment to the efficiency of the process and overall welfare.

Once an enterprise has been granted a concession in an infrastructure sector -and the eventual bidding competitors are gone- that enterprise may correspondingly be able to take actions that "hold up" the government, for example through insisting on renegotiating the regulatory contract ex post, or through regulatory capture. The extensive informational advantages that the enterprise possesses over the government (as well, likely, as over other potential operators) and its perceived leverage vis à vis the government in a bilateral negotiation is a powerful potential factor to seek renegotiation of the contract and secure

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[3]Examples are the highway concession program in Mexico in the early 1990s, the water concession in the provinces of Tucuman and Buenos Aires in Argentina, and in the city of Cochabamba in Bolivia, and a number of BOT (build operate transfer) concessions in the water sector in Mexico. The incidence of concessions abandoned and taken over by the government has been significant in other countries outside the Latin American and Caribbean region, such as in Indonesia, Thailand, China, in East Asia, and there have been a few cases in Africa, in Senegal, Nigeria, Kenya, Zimbabwe and Gambia. Most of those abandonments have been in the roads, water and sanitation and in the power sector. Overall, 3 to 4% of concessions have been abandoned (see Harris (2003)).

a better deal than the initial one. However, the effectiveness of the regulatory framework matters significantly in limiting the incidence of renegotiation.

Moreover, it is not only the firm that may behave opportunistically. Quite often, the necessary investments are of the "sunk" type and highly specific, that is, costs that cannot easily be recouped or salvaged if the economic atmosphere deteriorates or if the operator were to discontinue operations. This may also tempt governments to take regulatory actions that expropriate the available quasi-rents once costs are sunk.

The procurement and regulation literature[4] has been written for developed countries in which the quality of institutions yields a level of enforcement of contracts so high that renegotiations can be considered as secondary at least as a first approximation. On the contrary, for less developed countries (LDCs) it appears that renegotiation is an important phenomenon calling for both theoretical and empirical analysis.

Imperfect enforcement leading to renegotiations is a major characteristic, which must be understood to provide a useful theoretical framework for procurement policy and regulation in LDCs. This has been emphasized by the 2001 World Development Report (World Bank (2001)), which stresses that "there is a growing consensus that regulation, particularly in poor countries, must be designed with an appreciation of both information asymmetries and difficulties of enforcement".

The literature on regulation and procurement contracts has dealt with asymmetric information within the framework of mechanism design and complete contracts. Then, renegotiation never happens. If the regulator cannot commit not to renegotiate (Dewatripont (1986)) the optimal contract suffers from the ratchet effect, but is still renegotiation-proof (Hart and Tirole (1988), Laffont and Tirole (1990)). Indeed, optimal contracting commits to ex post inefficiencies to mitigate the costs of information rents. Any limitation of commitment yields potential renegotiation which can be anticipated in the initial contract; then, the anticipated outcome of renegotiation can be embedded in the initial contract, which becomes renegotiation-proof, so that no renegotiation occurs along the equilibrium path. The analysis has been extended to cases where some contractual variables require costly auditing (Baron and Besanko (1984), Laffont and Tirole (1993), Khalil (1992)). Auditing of effort levels or states of nature is incorporated into the contracts but does not yield renegotiation.

When can we have actual renegotiations? One way is to postulate that initial contracts are incomplete (Hart and Moore (1988), Green and Laffont (1992), Aghion, Dewatripont and Rey (1994), Segal and Whinston (2002)). The reasons invoked for these contractual incompletenesses are contractual transaction costs difficult to pin down, bounded rationality of players, which are rarely explicitly modeled, or some imperfections of the judicial

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[4]See Laffont and Tirole (1993) for a synthesis.

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system, which are assumed in a rather ad hoc way.

Recently, Bondt (2002) constructed a moral hazard model with ex post penalties, which may not be enforced because of side-contracting between judges and the contractual party. Anderlini, Felli and Postlewaite (2000) instead considered incomplete contracts so that, ex post, judges who maximize social welfare may be willing to void some clauses and this could lead to renegotiations. Laffont (2000) and Laffont and Meleu (2001) offered procurement and regulation models with adverse selection where imperfect enforcement of penalties can be affected by expenditures in enforcement very much in the black box tradition of the Chicago school.[5]

The purpose of this paper is to extend the concession model to accommodate both renegotiations due to unanticipated events and opportunistic behavior by the firms in anticipated events, and then to explore its empirical relevance with a unique dataset on concession contracts in Latin America. In Section 2 of this paper, we extend the theoretical framework of Laffont (2000) to account for a maximal number of realistic characteristics of concession contracts and their environment, among which the existence of a regulatory body, the power of incentives, the existence of investment requirements, the source of financing, and some specific clauses like arbitration rules. We also introduce exogenous shocks (for example affecting cost or demand as the result of some external economic shock), characteristics of the political cycle (shift in the degree of political capture) and of the institutional environment (quality of the bureaucracy or of the legal framework).

We allow for the two main motivations of renegotiation: Incompleteness of contracts calling for Pareto improving renegotiation and enforcement failures, which yield rent shifting renegotiations. This provides us with a whole set of predictions for the probabilities of renegotiation of concession contracts. The model we develop is a model of renegotiations initiated by firms. Renegotiations initiated by governments raise technical issues, which would need a more complex modeling and are left for another paper. In particular, in a world where firms have private information, the anticipation of governments' opportunistic behavior will lead to strategic behavior by firms which may want to hide their information to protect their future rents, inducing a complex ratchet effect.

Then, Section 3 examines a data set of concessions awarded in Latin America and Caribbean countries from 1989 to 2000 covering the sectors of transport and water, and analyzes the renegotiation of these contracts. We perform a probit panel analysis using proxies for the main theoretical variables. The empirical analysis provides a broad support to the predictions derived from the model, the main results being the importance of having a regulator in place to limit renegotiations, the fragility of price caps, the incentive

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[5]The importance of enforcement of laws was stressed by the Chicago school (see Becker (1968), Stigler (1970), Becker and Stigler (1974), Posner (1972) and Polinsky and Shavell (2000) for a recent synthesis), but has been little addressed by modern contract theory.

effect of investment requirements to limit renegotiations, the relevance of economic shocks (more renegotiations during downturns) and political cycles (more renegotiations after elections), as well as the importance of good institutions (bureaucracy, rule of law, control of corruption) to reduce the incidence of renegotiations.

In the concluding section 4, we derive some policy implications of our theoretical and empirical work.

2   The Model

2.1   Optimal Regulation

Consider the concession of a natural monopoly that, in addition to a necessary sunk investment, or fixed cost, F, which is common knowledge, has a variable cost function:

$$C = (\beta - e)\, q, \tag{1}$$

where q is the production level, β is a cost parameter, which is private information of the firm (adverse selection) in $\left\{\underline{\beta}, \overline{\beta}\right\}$ with $\nu = \Pr\left(\beta = \underline{\beta}\right)$ and e is a decision variable of the firm (moral hazard) which decreases cost, but creates to the manager a disutility $\Psi\left(e\right)$ with $\Psi' > 0$, $\Psi'' > 0$, $\Psi''' \geq 0$.

Consumers derive utility $S\left(q\right)$, $S' > 0$, $S'' < 0$ from the consumption of the natural monopoly's good. Let $p\left(.\right)$ be the inverse demand function and $\hat{t}$ the transfer from the regulator to the firm. The firm's net utility writes:

$$U = \hat{t} + p\left(q\right) q - (\beta - e)q - F - \Psi\left(e\right). \tag{2}$$

We assume that cost is ex post observable by the regulator as well as the price and the quantity. So we can make the accounting assumption that revenues and cost are incurred by the regulator, who pays a net transfer $t = \hat{t} + p(q)q - (\beta - e)q - F$. Accordingly, the participation constraint of the firm can be written:

$$U = t - \Psi\left(e\right) = t - \Psi\left(\beta - c\right) \geq 0, \tag{3}$$

where we make use of (1) to substitute e by $\beta - c$, with $c = \frac{C}{q}$, and where the utility of the outside opportunity has been normalized to zero for each type of firm.

To finance the transfer $\hat{t}$, the government must raise taxes with a price of public funds $1 + \lambda$, $\lambda > 0$. Hence, consumers' net utility is:

$$V = S\left(q\right) - p\left(q\right) q - (1 + \lambda)\, \hat{t}. \tag{4}$$

Utilitarian social welfare is then given by the sum of consumers' surplus and the firm utility, here with equal weight of 1 for both:

$$
\begin{aligned}
\widehat{W} &= U + V \\
&= S\left(q\right) + \lambda p\left(q\right) q - \left(1 + \lambda\right)\left(\left(\beta - e\right) q + F + \Psi\left(e\right)\right) - \lambda U.
\end{aligned} \tag{5}
$$

This implies that the government values the rent of the firm as much as consumers' utility, which may not be realistic when the awarded concessionaire is a foreign firm. The key feature, however, is that the regulator dislikes leaving a rent to the firm $\left(-\lambda U \text{ in } (5)\right)$. This occurs as long as the weight of the firm's rent in social welfare is lower that $1 + \lambda$. In subsequent sections, we analyze the effect of making this weight vary.

Under complete information, the maximization of social welfare would lead to[6]:

$$
\begin{aligned}
S'\left(q^*\right) + \lambda\left(p'\left(q^*\right) q^* + p\left(q^*\right)\right) &= \left(1 + \lambda\right)\left(\beta - e^*\right) & (6) \\
\Psi'\left(e^*\right) &= q^* & (7) \\
U &= 0. & (8)
\end{aligned}
$$

We denote $\underline{q}^*, \underline{e}^*, \underline{U}^*$ and $\overline{q}^*, \overline{e}^*, \overline{U}^*$ the complete information solutions corresponding to $\underline{\beta}$ and $\overline{\beta}$ respectively.

Since consumers equate their marginal utility to the price $\left(S'\left(q\right) = p\right)$, equation (6), which says that social marginal utility equals social marginal cost, can be rewritten as a Lerner index formula:

$$
\frac{p - \left(\beta - e\right)}{p} = \frac{\lambda}{1 + \lambda} \frac{1}{\eta\left(p\right)},
$$

where $\eta\left(p\right)$ is the price elasticity of demand. The price is then between the marginal cost $\left(\beta - e\right)$ and the monopoly price p^M defined by $\frac{p^M - \left(\beta - e\right)}{p^M} = \frac{1}{\eta\left(p^M\right)}$.

The marginal disutility of effort $\Psi'\left(e\right)$ is equated to its marginal social gain q (equation (7)), and no rent is given up to the firm (equation (8)) because funds are socially costly $\left(\lambda > 0\right)$.

Suppose now that the regulator cannot observe the effort level e and does not know β. However, he can offer a contract to the firm before the latter discovers its type (see Figure 1 for the timing).

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[6]We make the appropriate assumptions on $S\left(.\right)$ so that W is strictly concave in $\left(q, e\right)$. For more details and motivations about the various assumptions, see Laffont and Tirole (1993).

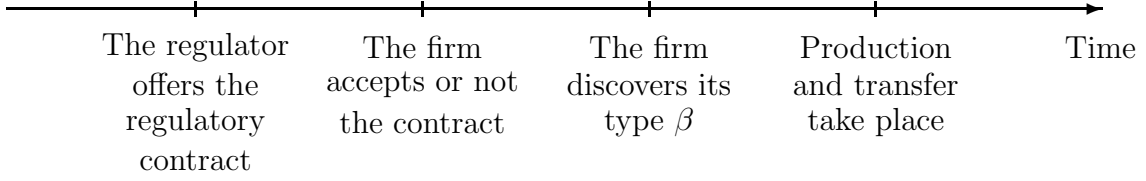| The regulator | The firm | The firm | Production | Time |
offers the	accepts or not	discovers its	and transfer	
regulatory	the contract	type β	take place	
contract				

Figure 1: Timing

Equation (3) shows that the observability of cost reduces the problem to a simple adverse selection problem. From the Revelation Principle, there is no loss of generality in restricting the analysis to direct revelation mechanisms $\left\{ \left(\underline{t}, \underline{c}\right), \left(\overline{t}, \overline{c}\right)\right\}$ which specify for each message $\tilde{\beta} = \underline{\beta}$ or $\tilde{\beta} = \overline{\beta}$ an average cost to achieve and a net transfer from the regulator. The regulatory contract also recommends a production level $\underline{q}$ (or $\overline{q}$) and a total cost $\underline{C}$ (or $\overline{C}$), compatible with $\underline{c}$ (or $\overline{c}$) (between which the firm is indifferent).

However, the direct revelation mechanism must be truthful, i.e., must satisfy the incentive constraints

$$\underline{U} = \underline{t} - \Psi\left(\underline{\beta} - \underline{c}\right) \geq \overline{t} - \Psi\left(\underline{\beta} - \overline{c}\right) \tag{9}$$

$$\overline{U} = \overline{t} - \Psi\left(\overline{\beta} - \overline{c}\right) \geq \underline{t} - \Psi\left(\overline{\beta} - \underline{c}\right), \tag{10}$$

where $\underline{U}$ (resp. $\overline{U}$) represents at a truthful equilibrium the rent of type $\underline{\beta}$ (resp. $\overline{\beta}$).

These constraints can be rewritten:

$$\underline{U} \geq \overline{U} + \Phi\left(\overline{e}\right) \tag{11}$$

$$\overline{U} \geq \underline{U} - \Phi\left(\underline{e} + \Delta\beta\right), \tag{12}$$

where $\Phi\left(e\right) = \Psi\left(e\right) - \Psi\left(e - \Delta\beta\right), \Phi' > 0, \Phi'' > 0$.

Since the firm must accept or reject the contract before it knows its type, its participation constraint must be written ex ante:

$$\nu\underline{U} + \left(1 - \nu\right)\overline{U} \geq 0. \tag{13}$$

Finally, the regulator's maximization program becomes:

$$\max_{\{\underline{q},\underline{c},\underline{U},\overline{q},\overline{c},\overline{U}\}} \nu\left[S\left(\underline{q}\right) + \lambda p\left(\underline{q}\right)\underline{q} - \left(1 + \lambda\right)\left(\underline{c}\underline{q} + F + \Psi\left(\underline{\beta} - \underline{c}\right)\right) - \lambda\underline{U}\right]$$

$$+ \left(1 - \nu\right)\left[S\left(\overline{q}\right) + \lambda p\left(\overline{q}\right)\overline{q} - \left(1 + \lambda\right)\left(\overline{c}\overline{q} + F + \Psi\left(\overline{\beta} - \overline{c}\right)\right) - \lambda\overline{U}\right]$$

s.t. (11) (12) (13).

It is more transparent to rewrite this program in terms of the variables $\left(q, e, U\right)$ rather than $\left(q, c, U\right)$. Let us also denote $W\left(q, e, \beta\right)$ the complete information ex post social

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welfare for a production level q and an effort level e when the efficiency parameter is β, i.e.:

$$W\left(q,e,\beta\right) = S\left(q\right) + \lambda p\left(q\right)q - \left(1+\lambda\right)\left(\left(\beta - e\right)q + F + \Psi\left(e\right)\right).\qquad(14)$$

The regulator's program rewrites:

$$\max_{\{q,e,\underline{U},\bar{q},\bar{e},\bar{U}\}} \nu\left[W\left(\underline{q},\underline{e},\underline{\beta}\right) - \lambda\underline{U}\right] + \left(1-\nu\right)\left[W\left(\bar{q},\bar{e},\overline{\beta}\right) - \lambda\overline{U}\right]$$

s.t. (11) (12) (13).

The regulator makes the participation constraint binding and, substituting in the objective function, maximizes social welfare[7]. For each value of β he finds the complete information optimum. There are many pairs of transfers that structure the rents in such a way that the incentive constraints are satisfied. The main point to notice is that the inefficient type $\overline{\beta}$'s ex post utility is always negative.[8]

This negative ex post utility raises the issue of enforcement. Indeed, once it discovers its type $\overline{\beta}$ the firm would like to renege on the regulatory contract. In a country with strong institutions, the contract is enforced in both states of nature $\underline{\beta}$ and $\overline{\beta}$. As a consequence, asymmetric information does not create any transaction cost for society and the complete information optimal allocation is achieved despite the setting of incomplete information.

At the other extreme, suppose that the regulator anticipates that he will not be able to enforce a negative ex post utility level for the firm. Then, he will choose a regulatory contract, which maximizes expected social welfare under the incentive constraints, but also the ex post participation constraints:[9]

$$\underline{U} \geq 0 \qquad(15)$$
$$\overline{U} \geq 0. \qquad(16)$$

The set of constraints is the same as if the contract was offered to the firm at the interim stage, i.e. once the firm knows its type. We know that in this case the efficient type's incentive constraint (11) and the inefficient type's participation constraint (16) will be the binding ones. Substituting into the objective function of the regulator and

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[7]See Laffont and Martimort (2002).

[8]This loss is minimized when (11) is binding.

[9]We assume here that production is so valuable that shut-down of the inefficient type is not an interesting option.

maximizing, we obtain:

$$\Psi'\left(\overline{e}^{SB}\right) = \overline{q}^{SB} - \frac{\lambda}{1+\lambda}\frac{\nu}{1-\nu}\Phi'\left(\overline{e}^{SB}\right) \qquad (17)$$

$$\Psi'\left(\underline{e}^{SB}\right) = \underline{q}^{SB} = \underline{q}^{*} \qquad (18)$$

$$\underline{U} = \Phi\left(\overline{e}^{SB}\right) > 0, \qquad (19)$$

and the same pricing equations as under complete information[10].

Now, the efficient type captures a positive rent and, to decrease somewhat this socially costly rent, the regulator decreases the effort level in the case $\beta = \overline{\beta}$, while the efficient type's effort level is not distorted.

2.2 Imperfect Enforcement

We want to model more precisely what happens when institutions ensure only an imperfect enforcement of regulatory contracts.

We will assume that when the firm obtains an ex post utility lower than its status-quo payoff, it attempts to renegotiate its regulatory contract[11]. However, with a probability $\pi\left(x\right)$, the regulator is able nevertheless to impose the implementation of the agreed upon contract. This probability depends on the expenses x incurred to finance the functioning of the enforcement mechanism. We assume that $\pi\left(0\right) = 0$, $\lim_{x\to\infty}\pi\left(x\right) = 1$, $\pi_x > 0$, $\pi_{xx} < 0$.

With probability $1 - \pi\left(x\right)$ the regulator is forced to accept a renegotiation. This is modeled using the Nash bargaining solution but assuming that renegotiation is costly (become it takes time say). The status quo payoffs, which obtain if negotiation fails, are determined as follows: the firm loses its fixed cost and gets the utility level $U_0 = -F$. The regulator obtains a status quo payoff that we denote as $W_0 = -H$.

We make appropriate assumptions so that the efficient type firm never wants to renege on its contract[12]. Therefore, costly bargaining takes place under complete information, only when $\beta = \overline{\beta}$. Its outcome solves:

$$\max_{\overline{q},\overline{e},\overline{U}^E} \left\{ \begin{array}{c} \left(\overline{U}^E - U_0\right)\left(\delta W\left(\overline{q},\overline{e},\overline{\beta}\right) - \lambda\overline{U}^E - W_0\right) \\ = \left(\overline{U}^E + F\right)\left(\delta W\left(\overline{q},\overline{e},\overline{\beta}\right) - \lambda\overline{U}^E + H\right) \end{array} \right\}, \qquad (20)$$

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[10]This is due to the fact that the cost function satisfies the separability assumption $C\left(q, h\left(\beta, e\right)\right)$ which implies the dichotomy property, i.e. the absence of incentive correction in the pricing formula (see Laffont and Tirole, 1993).

[11]More precisely, we assume that a firm attempts to renegotiate when its ex post utility level after renegotiation is higher than the utility level specified in the contract. We are considering values of parameters where it is better for the regulator to accept the possibility of renegotiation than to give up such large rents in the initial contract so that no type of firm wants to renegotiate.

[12]See conditions below.

with δ in $(0,1)$ to model the cost of renegotiation.

It yields the complete information production and effort level $\overline{q}^*$, $\overline{e}^*$ and the rent level

$$\overline{U}^E = \frac{\delta W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) + H}{2\lambda} - \frac{F}{2}, \tag{21}$$

i.e. the firm and the regulator share equally the social surplus.

Anticipating the outcome of the renegotiation, the regulator modifies ex ante the contract it offers. From now on, we denote by $\underline{U}_1$ and $\overline{U}_1$ the modified rents once the possibility of renegotiation is taken into account by the regulator.

The sequence of events is now the following. If the firm discovers to be a bad type $\overline{\beta}$, with probability $\pi(x)$ it faces tough enforcement and carries out the project despite a negative utility. With probability $1 - \pi(x)$, it succeeds in forcing a renegotiation. Moreover, when renegotiation happens, we assume that with some (small) positive probability P the parties fail to reach an agreement and the status quo payoffs are implemented.

The resulting probabilities are:

$$
\begin{aligned}
\Pr\left(U = \underline{U}_1\right) &= \nu \\
\Pr\left(U = \overline{U}_1\right) &= (1-\nu)\,\pi\left(x\right) \\
\Pr\left(U = \overline{U}^E\right) &= (1-\nu)\left(1 - \pi\left(x\right)\right)\left(1 - P\right) \\
\Pr\left(U = -F\right) &= (1-\nu)\left(1 - \pi\left(x\right)\right)P.
\end{aligned}
$$

We still need the offer of contracts to be incentive compatible (conditions (11) and (12)) and the new ex ante participation constraint writes[13]:

$$
\begin{aligned}
\nu\underline{U}_1 + (1-\nu)\pi(x)\overline{U}_1 + (1-\nu)(1 - \pi(x))\left(1 - P\right)\overline{U}^E \\
-(1-\nu)(1 - \pi(x))PF &\geq 0. \tag{22}
\end{aligned}
$$

Substituting the outcome of renegotiation into the regulator's objective function, it becomes

$$
\begin{aligned}
\max \nu &\left[W\left(\underline{q}, \underline{e}, \underline{\beta}\right) - \lambda\underline{U}_1\right] + (1-\nu)\pi(x)\left[W\left(\overline{q}, \overline{e}, \overline{\beta}\right) - \lambda\overline{U}_1\right] \\
&+ (1-\nu)(1 - \pi(x))\left(1 - P\right)\left[\delta W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) - \lambda\overline{U}^E\right] \\
&+ (1-\nu)(1 - \pi(x))P\left[-H\right] - (1 + \lambda)x. \tag{23}
\end{aligned}
$$

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[13]Note that the choice of the new levels of rent $\underline{U}_1$ and $\overline{U}_1$, which is not unique, must be made in such a way that the efficient type does not want to mimic the bad type and then renegotiate, i.e. s.t. $\underline{U}_1 \geq \pi\left(x\right)\left[\overline{U}_1 + \Phi(\overline{e})\right] + (1 - \pi\left(x\right))\left(1 - P\right)\left[\overline{U}^E + \Phi(\overline{e}^*)\right] + (1 - \pi\left(x\right))P\left[-F\right]$

Maximizing this objective function by making the participation constraint binding we obtain:

$$\underline{q}^E = \underline{q}^*; \underline{e}^E = \underline{e}^* \tag{24}$$

$$\overline{q}^E = \overline{q}^*; \overline{e}^E = \overline{e}^* \tag{25}$$

$$(1-\nu)\pi'(x^E) = \frac{1+\lambda}{(1-\delta)W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) + P\left[\delta W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) + H + \lambda F\right]}. \tag{26}$$

The probability of renegotiation is given by:

$$\Pr\left(renegotiation\right) = (1-\nu)(1-\pi(x^E)) \tag{27}$$

where, in the right hand side, the second term, which can be labeled as the government's "tolerance for renegotiation", depends on x^E, the investment in enforcement.

What are the main features of the solution above? First, an enforcement mechanism is financed. It is valuable to build an enforcement institution only because the social welfare obtained by the initial contract for $\beta = \overline{\beta}$ is higher than what would result from renegotiation ($W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) > \delta W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right)$), or because renegotiation may fail. This enforcement mechanism is imperfect and its quality is determined by (26). The quality of enforcement decreases (and therefore the probability of renegotiation increases) with the efficiency of ex post bargaining δ.

Note that an increase in the cost of public funds has a different effect on social welfare $W(\overline{q}^*, \overline{e}^*, \overline{\beta})$ depending on the sign of revenue net of cost, i.e.,

$$p(q)q - ((\beta - e)q + F + \psi(e)).$$

It is increasing in λ if revenues exceed cost so that the industry is used as a source of public funds. It is decreasing in λ in the other case. So the net effect of an increase in λ is to decrease enforcement in the second case, which holds in general for the water and transportation industries[14] that we are considering here.[15]

Second, the power of incentives is not intermediary between what is obtained with perfect enforcement (high powered) and self-enforcing contracts (low powered). This is because any rent resulting from ex post renegotiation is captured ex ante in the contract offered by the regulator.

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[14]The effect through $P\lambda F$ can be neglected for P small.

[15]In the absence of a proper measure of the cost of public funds, we will proxy it by the lack of institutional quality (associated with a more inefficient tax system).

2.3 Institutional constraints

Institutional constraints in host countries obviously affect the incidence of renegotiation in concession contracts. In what follows, we introduce in different ways these institutional dimensions in the regulatory contract, focusing specifically on politics, corruption and rule of law.

2.3.1 Politics and State Capture

A simple way to model the incidence of political considerations in the occurrence of renegotiations, is to assume that the government is more or less captured by the firm's stakeholders and overweights or underweights the firm's utility in social welfare[16]. Thus, the maximization program consists of a weighted sum of consumers' surplus and the utility of the firm:

$$W = V + \gamma U,$$

where γ may actually be greater than 1. We simply need to assume, for an interior solution to hold, that $\gamma < 1 + \lambda$, so that the regulator always wants to minimize and not maximize the firm's rent. A value of γ higher than 1 is thus the sign that the interests of the firm and the government are more aligned, i.e. of a higher degree of state capture by the firm's stakeholders. A value of γ less than 1 is a sign that the government is partially captured by the non-stakeholders of the firm.

Solving the same maximization problem as before, we get a value of $\overline{U}^E$ defined by equation (21), where at the denominator λ is replaced by $1 + \lambda - \gamma$. As for x^E, it is now given by

$$(1 - \nu)\pi'(x^E) = \frac{1 + \lambda}{(1 - \delta)W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) + P\left[\delta W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) + H + (1 + \lambda - \gamma)F\right]}. \quad (28)$$

What are the effects of an increase in γ, i.e. of a higher degree of state capture on the probability of renegotiation? From (28) it can be seen that it decreases the equilibrium level of enforcement, which implies more renegotiation. When γ increases, the cost of giving up a rent decreases. Suppose first that renegotiation never fails ($P = 0$). Then this lower cost of the rent has no effect because ex ante contracting enables the regulator to capture this rent. However, if, as we have assumed, politicians do not incur losses when renegotiation fails, the level of capture does not affect social welfare when renegotiation fails. As γ increases, the cost of the rent (when there is no renegotiation or when renegotiation succeeds) decreases. From the firm's participation constraint, it implies that

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[16]See Laffont (2000a).

the social cost of losing the sunk cost F when renegotiation fails decreases as well. It is relatively less costly to provoke renegotiation (because the regulator is relatively less concerned by failure of negotiation) and therefore the level of enforcement decreases. In a dynamic framework, changes of the majority may correspond to shifts in the value of γ. Empirically, we would thus expect the probability of renegotiation to be affected by the results of recent elections. Additionally, we can also expect the existence of a regulator at the time of signing the contract to result in better contracts that would limit the scope for subsequent political capture.

2.3.2 Rule of Law or Corruption

We assume now that the probability of enforcing the agreed upon contract takes the form $\theta \pi (x)$, where the parameter θ stands for the quality of the rule of law or for the level of non-corruption, i.e. of the existing "stock" of institutions. This parameter θ may also represent a more direct channel of political capture when regulators or politicians can be bribed.

Coming back to the basic model, equation (26) can now be written:

$$(1 - \nu)\theta\pi'(x^E) = \frac{1 + \lambda}{(1 - \delta)W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) + P\left[\delta W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) + H + \lambda F\right]}, \qquad (29)$$

so that better rule of law or less corruption implies more investment in enforcement.

The direct effect of an increase in θ is thus to decrease the probability of renegotiation, since it decreases the relative cost of enforcing the initial contract. Thus, we expect that in environments characterized by better rule of law or less corruption there will be less renegotiations.

2.4 Shocks

A simple way to introduce shocks in our framework is to suppose that the distribution of firm's types is subject to an unanticipated noise, so that upon a shock ε, the probabilities of the enterprise being good or bad become $\{\nu + \varepsilon, 1 - \nu - \varepsilon\}$. This can be thought of as a shortcut to model a shock affecting either cost or demand of a fraction of the firms and to take into account Pareto improving renegotiations made possible by unanticipated events.

The probability or renegotiation then becomes:

$$\Pr\left(renegotiation\right) = (1 - \nu - \varepsilon)\left(1 - \pi(x^E)\right), \qquad (30)$$

which decreases as ε increases. This means that positive shocks, such as an increase in demand or a favorable shift in relative prices of inputs or outputs, reduce the probability of renegotiation, while negative shocks (decrease in demand, cost shock) increase the probability of renegotiation.[17]

2.5   Outside Financing and Limited Liability

Consider now the case where the firm is protected by limited liability. However, the firm owns assets, which can be used as collateral if it incurs some debt. The sunk investment has to be made before producing, and financing may take two forms. First, the firm must rely on bank financing but should be guaranteed enough profit to pay back the loan.[18] Second, if private financing is insufficient, the government may finance it. Of course, any combination of these two cases is also possible. Let us introduce the following notations:

A denotes the firm's assets needed for the project.

F is the necessary additional sunk investment.

K is the amount financed by banks' loans ($K \in [0, F]$), so that $K = 0$ implies complete government financing, while $K = F$ corresponds to totally private financing. The interest rate on this loan is r.

As the firm has to repay K, its utility level is now:

$$U = \hat{t} + p(q)q - (\beta - e)q - (1 + r)K - \Psi(e). \tag{31}$$

Moreover, since the bank must be repaid, the firm must have a non negative utility:[19]

$$U \geq 0.$$

This limited liability constraint ensures that the bank is always paid back. To simplify the analysis, we thus consider that the regulator takes this constraint into account in his program and does not include the bank's welfare in social welfare. A further justification is that the bank may be a foreign bank with respect to which default is not affordable.

Since the government finances only $F - K$, at the cost of public fund λ, the equivalent of (14) becomes:

$$W(q, e, \beta) = S(q) + \lambda p(q)q - (1 + \lambda)((\beta - e)q + F + rK + \Psi(e)). \tag{32}$$

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[17]Admittedly, this is a very particular way of extending the model to account for renegotiations due to unexpected events.

[18]Here, we simplify the analysis by excluding renegotiations with the bank itself. It allows us to consider the bank's interest rate as exogenous.

[19]We could specify this limited liability constraint on financial flows $\hat{t} + p(q)q - (\beta - e)q - (1 + r)K \geq 0$. This would introduce more regimes to consider in the program of the regulator below.

Note that the level of K will affect the status quo payoff of the government in case of renegotiation. In what follows, we will assume that $A < F$, so that the firm is able to repay only a share of its debt in case of failure[20]. Two subcases arise. If $K < A$, the bank gets K and the government gets the remainder $A - K$ that covers part of its investment $F - K$, leaving a net loss $F - A$. The status quo payoffs of the firm and the government are respectively:

$$(-A, -H - F + A).$$

If $K > A$, the bank gets only A while the government gets nothing, so it loses $F - K$. Payoffs are then:

$$(-A, -H - F + K).$$

These two cases can be summarized, by noting that the status quo payoffs are:

$$(-A, -H - F + \max(K, A)). \tag{33}$$

With the possibility of renegotiation and the disagreement point now given by (33), ex post bargaining yields:

$$\overline{U}^E = \frac{\delta W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) + H + F - \max(K, A) - \lambda A}{2\lambda}. \tag{34}$$

So, private financing costs more than public financing, but it increases the status quo payoff of the regulator and therefore its bargaining power in the renegotiation. Accordingly, the outcome of renegotiation for the firm decreases with K. Similarly it decreases (resp. increases) with F if $\delta(1 + \lambda) > 1$ (resp. $\delta(1 + \lambda) < 1$). Note that the outcome of renegotiation for the regulator unambiguously decreases with F.

The program becomes then:

$$\max_{\{\underline{q}, \underline{e}, \underline{U}, \overline{q}, \overline{e}, \overline{U}, x\}} \nu\left[W\left(\underline{q}, \underline{e}, \beta\right) - \lambda\underline{U}_1\right] + (1 - \nu)\pi(x)\left[W\left(\overline{q}, \overline{e}, \overline{\beta}\right) - \lambda\overline{U}_1\right]$$

$$+ (1 - \nu)(1 - \pi(x))(1 - P)\left[\delta W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) - \lambda\overline{U}^E\right]$$

$$+ (1 - \nu)(1 - \pi(x))P\left[-H - F + \max(K, A)\right] - (1 + \lambda)x \tag{35}$$

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[20]Were we to consider the case $A > F$, the firm's assets would cover the total losses in case of renegotiation failure. The bank would get K and the government $F - K$, and the status quo payoffs would be $(-F, -H)$, thus being independent of financing.

s.t.

$$\nu \underline{U}_1 + (1 - \nu)\pi(x)\overline{U}_1$$
$$+(1 - \nu)(1 - \pi(x))(1 - P)\overline{U}^E$$
$$-(1 - \nu)(1 - \pi(x))PA \geq 0 \tag{36}$$
$$\underline{U}_1 \geq \overline{U}_1 + \Phi(\overline{e}) \tag{37}$$
$$\overline{U}_1 \geq \underline{U}_1 - \Phi(\underline{e} - \Delta\beta) \tag{38}$$
$$\underline{U}_1 \geq 0 \tag{39}$$
$$\overline{U}_1 \geq 0. \tag{40}$$

The binding constraints are the limited liability constraint of the bad type (40) and either the incentive constraint of the good type (37) or the participation constraint (36). These two constraints can be summarized by writing (using the fact that $\overline{U}_1 = 0$):

$$\underline{U}_1 \geq \max\left\{\Phi(\overline{e}), \frac{(1 - \nu)(1 - \pi(x))\left[PA - (1 - P)\overline{U}^E\right]}{\nu}\right\}.$$

Noticing that now renegotiation happens only if $\overline{U}^E \geq 0$, and assuming that P is small, the second term in parenthesis is negative, so only the incentive constraint (37) is binding ($\underline{U}_1 = \Phi(\overline{e})$). Substituting the values of $\underline{U}_1, \overline{U}_1$ and $\overline{U}^E$, the objective function becomes:

$$\max \nu\left[W\left(\underline{q}, \underline{e}, \underline{\beta}\right) - \lambda\Phi(\overline{e})\right] + (1 - \nu)\pi(x)\left[W\left(\overline{q}, \overline{e}, \overline{\beta}\right)\right]$$
$$+(1 - \nu)(1 - \pi(x))(1 - P)\left[\frac{\delta W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) - H - F + \max(K, A) + \lambda A}{2}\right]$$
$$+(1 - \nu)(1 - \pi(x))P\left[-H - F + \max(K, A)\right] - (1 + \lambda)x. \tag{41}$$

The effort and output levels of the bad type are now distorted because an expected rent is given up to the firm:

$$\Psi'\left(\overline{e}^L\right) = \overline{q}^L - \frac{\lambda}{1 + \lambda}\frac{\nu}{(1 - \nu)\pi\left(x^L\right)}\Phi'\left(\overline{e}^L\right). \tag{42}$$

The presence of the term $\pi\left(x^L\right)$ at the denominator implies a stronger distortion than the second best ex post contracting level $\left(\overline{q}^{SB}, \overline{e}^{SB}\right)$.

As for the level of enforcement, it is given by:

$$(1 - \nu)\pi'(x^L) = \frac{1 + \lambda}{\left[W\left(\overline{q}^L, \overline{e}^L, \overline{\beta}\right) - \delta\left(\frac{1 - P}{2}\right)W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right)\right] + \left(\frac{1 + P}{2}\right)\left[\delta W\left(\overline{q}^*, \overline{e}^*, \overline{\beta}\right) + H + F - \max(K, A)\right] - (1 - P)\lambda A}. \tag{43}$$

What is the effect of variations in F and K on the probability of renegotiation? From the denominator of (43), and taking into account the presence of F and K in the expression of $W\left(\overline{q}, \overline{e}, \overline{\beta}\right)$ it comes that:

$$\frac{\partial x}{\partial K} < 0.$$

This first effect is due to the combined effect that an increase of K increases cost (and therefore decreases the gain from avoiding renegotiation) and improves the regulator's bargaining power[21] and therefore decreases the cost of renegotiation; and for P small enough,

$$\frac{\partial x}{\partial F} < 0.$$

This second effect is also due to the fact that an increase F increases cost.[22] Although it also decreases the bargaining power of the regulator, this cost effect dominates.[23]

There is, however, an incentive effect of the limited liability constraint. Indeed, the expected utility of the firm is now strictly positive. Therefore, it has incentives to invest to increase its expected profit. Suppose that with expenses $i\left(\nu\right)$ $\left(i'\left(\nu\right) > 0, i''\left(\nu\right) \geq 0\right)$ the firm increases the probability that $\beta = \underline{\beta}$. The firm chooses its investment level by solving:

$$\max_{\nu} \ \nu \Phi\left(\overline{e}\right) + \left(1 - \nu\right)\left(1 - \pi\left(x^L\right)\right)\left(\left(1 - P\right)\overline{U}^E - PA\right) - i\left(\nu\right).$$

Assuming for simplicity that it does not take into account the impact of its choice on the regulation, we get immediately that:

$$sign\frac{d\nu}{dX} = -sign\frac{d\overline{U}^E}{dX}.$$

This means that everything that decreases (resp. increases) the firm's bargaining power and therefore the utility from renegotiation increases (resp. decreases) its incentive for investment and therefore decreases (resp. increases) the probability of renegotiation.

From the expression of $\overline{U}^E$ we see that, through this effect, if F increases, either the probability of renegotiation increases (case $\delta(1+\lambda) < 1$) which reinforces the direct effect,

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[21]Note that if renegotiation was involving the bank it would remain true that an increase of K which weakens the bank's position should improve the bargaining power of the regulator.

[22]We have neglected the fact that x^L enters (42) so that there is a feedback effect as a decrease of x decreases $W\left(\overline{q}^L, \overline{e}^L, \overline{\beta}\right)$. This reinforces the effect on x.

[23]This is true whenever $-\left(1 + \lambda\right)\left[1 - \left(1 - P\right)\frac{\delta}{2}\right] + \frac{1+P}{2}\left(-\delta(1 + \lambda) + 1\right) < 0$. This can be rewritten $\left(1 + \lambda\right)\left(1 + \delta P\right) > \frac{1+P}{2}$, which is always verified.

or it decreases (case $\delta(1 + \lambda) > 1$). On the other hand, an increase in K decreases the probability of renegotiation.

Overall, more investment unambiguously increases the probability of renegotiation if $\delta(1 + \lambda) < 1$ and has an ambiguous effect otherwise. More private financing always has an ambiguous effect.

2.6   Regulation, Arbitration and other Contractual Clauses

Concession contracts sometimes contain specific clauses meant to deal with the potential occurrence of renegotiations, as for example the existence of a formal set of arbitration rules in case of disputes, and minimum income guarantees.

Arbitration rules are processes which help settle disputes, thereby making renegotiation less costly, i.e. increase δ. We have seen that a increase in δ decreases x^E and increases the probability of renegotiation. In this case, we would thus expect the existence of formal arbitration rules (higher δ) to increase the probability of renegotiation. On the other hand, the existence of a regulatory body or more experience in concession contracting at the time of award will decrease the probability of renegotiation due to the more obvious effect of greater expertise in contracting.

A minimum income guarantee should decrease the desirability of renegotiation by firms but it also decreases the incentives for effort. However, as discussed above, clauses of the concession affecting the outcome of a potential renegotiation should be treated as endogenous. This endogeneity has two dimensions. First there is a direct self-selection effect. For example, minimum income guarantee clauses are more likely to be introduced in more risky projects. Second, the inclusion of such clauses has a moral hazard effect, in that it may affect the incentive of the firm to behave efficiently as explained above. This implies a countervailing effect on the probability of renegotiation. Ultimately, determining the qualitative impact of such rules requires to take into account both effects, and is an empirical matter.

As for the strength of incentives, it is clear from (42) and (43) that it is determined simultaneously with the level of enforcement. From (43), the higher incentives, the higher the probability of renegotiation. However, to fully appreciate the impact of the strength of incentives on renegotiation one must take into account that a regulatory mechanism is chosen for several periods. A high powered mechanism such as price cap will create more risky revenues in the future and obviously increase the probability of renegotiation. But such a regulation will be chosen by more efficient firms, so that the global effect is again ambiguous.

3 Empirical Analysis

3.1 The Data

We use an original data set, developed by the World Bank, which describes the characteristics of nearly 1,000 concessions awarded in Latin American and Caribbean countries from 1982 to 2000, in the sectors of telecommunications, energy, transport and water. We restrict ourselves to the sectors of transport and water because these are concessions stricto sensu, as opposed to telecommunications and energy projects, which in most cases are privatizations with sales of assets.[24]

We say that a concession contract is renegotiated when a major revision, not envisioned in the original contract, takes place. For example significant changes in tariffs or investments, in the annual fees paid by the operator to the government, in the number of cost components with automatic pass through to tariff adjustments or in the length of the concession. Thus, scheduled ordinary and extraordinary tariff revisions or minor adjustments to the contract are not considered to be a renegotiation. Yet, it should be recognized that there is some element of subjectivity in defining those triggers.

Calls for renegotiations are led by the government, the operator or by both. In the database, only when it was clear to both parties who was the originator of the renegotiation did we use that information. For all other cases we classify the renegotiation as led by both parties jointly. An example is the highway concession program in Mexico. Many of those concessions went bankrupt for a number of reasons, but the high devaluation in 1994 did play a role. There were a number of traffic guarantees and loans from the formerly state owned financial sector. The ensuing bailout or government take-over was broadly the result of a sort of joint call; renegotiations were thus classified as such.

Considering only concessions for which we know whether they were renegotiated or not as of 2000, and at what date this renegotiation took place, and restricting to the 5 countries (Argentina, Brazil, Chile, Colombia, and Mexico) where concessions were granted on a regular basis through the 1990s in theses two sectors, we get a sample of 307 concessions. Table 1 shows the distribution by countries, sectors, and sub-sectors.

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[24]See Guasch (2001) for a detailed description of the data.

				Transport						**Water**	**Total**
	Air	*Bus*	*Rail*	*Road*	*Port*		*Potable water*	*Sewer*	*Compo site*		*Water + Transport*
Argentina	0	1	12	21	4	**38**	5	0	0	**5**	**43**
Brazil	0	0	9	19	8	**36**	3	8	13	**24**	**60**
Chile	5	0	0	14	4	**23**	0	0	2	**2**	**25**
Colombia	5	0	0	17	19	**41**	0	0	7	**7**	**48**
Mexico	2	0	6	36	36	**80**	6	42	3	**51**	**131**
Total	12	1	27	107	71	**218**	14	50	25	**89**	**307**

Table 1: Concessions by country and sector

The database contains detailed information about the characteristics of these concessions, including general details about the projects (sector of activity, year of award), the award process, investment and financing, the duration of the concession, information with respect to the institutional context and the regulator, the type of regulatory framework put in place (price cap or rate of return), and other details of the concession contract like arbitration clauses and income guarantees, among others. Table 2 presents the full list and definitions of variables used in the analysis below, as well as the frequency distribution of dummy variables, and the mean and standard deviation of continuous variables when relevant.

Dummy variables, 1=Yes, 0=No.	Yes	No
Renegotiation: Dummy variable indicating whether there was or not a renegotiation of the concession contract.	162 (52.8%)	145 (47.2%)
Renegotiation initiated by the firm	53 (17.3%)	254 (82.7%)
Renegotiation initiated by the government	94 (30.6%)	213 (69.4%)
Renegotiation initiated by both	15 (4.9%)	292 (95.1%)
Existence of regulatory body: Dummy variable indicating whether there was or not a regulatory body at the time of the concession first coming into operation.	180 (58.6%)	127 (41.4%)
Price cap: Dummy variable indicating whether the tariff regulation imposed by the regulator is a price cap.	283 (92.2%)	24 (7.8%)
Investment requirements: Dummy variable indicating whether there are or not investment requirements as part of the concession contract.	235 (76.5%)	72 (23.5%)
Private financing: Dummy variable indicating whether the project is funded entirely through private funds (without any financial investment of the state, whether local or national) or not.	160 (52.1%)	147 (47.9%)
Bidding process: Dummy variable indicating whether there was or not a bidding process to award the concession.	272 (88.6%)	35 (11.4%)
Minimum income guarantee: Dummy variable indicating whether there is or not a government guarantee in terms of minimum income promissory.	63 (20.5%)	244 (79.5%)
Arbitration process: Dummy variable indicating whether there is or not a formal set of arbitration processes stated in the contract providing for the settlement of a dispute between the concession holder and the government, should such a situation arise.	179 (58.3%)	128 (41.7%)
Election: Dummy variable indicating whether there were or not national elections (legislative or presidential) in any given year. Source: Political Database of the Americas. Georgetown University/Organization of American States. Center for Latin American Studies.	n.r.	n.r.
Continuous variables	**Mean**	**S.D.**
Duration since award: Indicates the number of years a concession has been in operation since its award.	n.r.	n.r.
Duration of concession: Duration, in years, for which the concession is signed for.	21.77	8.95
Corruption: Index from Political Risk Service, International Country Risk Guide; annual values from 1989 to 1995, and 1998 value after that. Range from 1 to 6. Higher value means less corruption.	2.94	0.69
Rule of law: Index from Political Risk Service, International Country Risk Guide; annual values from 1989 to 1995, and 1998 value after that. Range from 1 to 6. Higher value means better rule of law.	2.92	0.99
Bureaucratic quality: Index from Political Risk Service, International Country Risk Guide; annual values from 1989 to 1995, and 1998 value after that. Range from 1 to 6. Higher value means better bureaucratic quality.	3.36	0.61
Growth: Yearly growth rate of GDP in real terms. Source: World Bank and Inter-American Development Bank.	n.r.	n.r.
Exchange rate: Annual evolution of the real exchange rate (calculated as (index rate of year t – index rate of year t-1)/index rate of year t). A positive value indicates depreciation. Source: Inter-American Development Bank.	n.r.	n.r.

Note: For variables varying over time, like the election dummy, duration since award, and macroeconomic variables, the summary statistics are meaningless and are omitted (denoted by n.r.: non relevant).

Table 2: List of variables, source and summary statistics

Table 3 summarizes the sector frequency of the concessions' key characteristics, which are represented through dummy variables.

	Transport				Water			
	Yes		No		Yes		No	
Renegotiations	99	45,4%	119	54,6%	63	70,8%	26	29,2%
Renegotiations initiated by firms	49	22,5%	169	77,5%	4	4,5%	85	95,5%
Renegotiations initiated by Govt.	35	16,1%	183	83,9%	59	66,3%	30	33,7%
Renegotiations initiated by both	15	6,9%	203	93,1%	0	0,0%	89	100,0%
Existence of regulatory body	168	77,1%	50	22,9%	12	13,5%	77	86,5%
Bidding process	185	84,9%	33	15,1%	87	97,8%	2	2,2%
Investment requirements	198	90,8%	20	9,2%	37	41,6%	52	58,4%
Private financing only	139	63,8%	79	36,2%	21	23,6%	68	76,4%
Price cap regulation	199	91,3%	19	8,7%	84	94,4%	5	5,6%
Rate of return regulation	19	8,7%	199	91,3%	4	4,5%	85	95,5%
Arbitration process	172	78,9%	46	21,1%	7	7,9%	82	92,1%
Minimum income guarantee	62	28,4%	156	71,6%	1	1,1%	88	98,9%

Table 3: Characteristics of the concessions by sector

The time structure of the sample is also important. Table 4 presents the number of outstanding concessions by country, from 1989 to 2000, and table 5 shows the occurrence of renegotiations in each country and year, giving first the number of renegotiations initiated by firms, and second the total number of renegotiations regardless of their initiator. In total, 162 of the 307 concessions were renegotiated at some point during the time period under consideration, the bulk of renegotiations taking place in four countries: Argentina, Brazil, Colombia and Mexico. Moreover a look at table 5 reveals the apparent importance of economic fluctuations and political shocks in determining renegotiations. Indeed, the main peaks coincided with clearly identified events: in Argentina in 1990 (hyperinflation and recession), in Brazil in 1999 (devaluation of the real), in Colombia in 2000 (recession) and in Mexico around 1995 (Mexican crisis). Although not all shocks have triggered waves of renegotiations, these facts suggest the consideration of economic and political fluctuations as potential determinants of renegotiations.

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Argentina	1	15	4	3	10	14	23	22	19	11	10	10
Brazil	-	-	-	-	-	1	6	20	36	59	54	30
Chile	-	-	-	1	1	3	6	9	16	19	20	24
Colombia	-	-	-	1	6	18	22	29	37	42	45	43
Mexico	9	23	34	45	61	67	66	52	48	56	58	58

Table 4: Outstanding concessions by country and year

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Argentina	0/0	12/12	2/2	1/1	0/0	0/0	1/1	3/3	10/11	3/3	0/0	0/0	32/33
Brazil	-	-	-	-	-	0/0	0/0	0/0	0/1	0/5	0/24	0/6	0/36
Chile	-	-	-	0/0	0/0	0/0	0/0	0/0	0/0	1/1	0/0	0/0	1/1
Colombia	-	-	-	0/0	0/0	0/0	0/1	0/1	0/0	0/0	1/3	14/14	15/19
Mexico	0/0	0/1	0/1	1/8	0/12	1/14	2/21	0/11	1/3	0/2	0/0	0/0	5/73
Total	0/0	12/13	2/3	2/9	0/12	1/14	3/23	3/15	11/15	4/11	1/27	14/20	53/162

Renegotiations led by firms / total of renegotiations

Table 5: Renegotiations by country and year

As for renegotiations initiated by firms, they amount to 53, of which 49 in the transport sector (12 in railroad, 33 in roads and 4 in port projects) and only 4 in water (2 in potable water, 2 in sewerage projects). Moreover, they concentrate in Argentine and Colombia, while in Brazil and Mexico renegotiations were almost always initiated by the government

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or both. In this paper, we mostly focus on these firm-led renegotiations and, as said before, we leave for another paper the analysis of government-led renegotiations.[25]

We build a panel sample by introducing in any given year macroeconomic variables (GDP growth and real exchange rate appreciation) and a political dummy variable indicating the occurrence of national elections (presidential or legislative). Lastly, to capture the influence of the broad institutional context, we introduce indices of corruption, rule of law and bureaucratic quality. We get an unbalanced rotating panel of 1267 observations, covering 12 years and 307 concessions.

3.2 Probit Analysis

We estimate the following model, which is a linearized version of equation (30) giving the probability of renegotiation:

$$y_{\text{int}} = 1 \left[y_{\text{int}}^* = x_i \alpha_1 + \alpha_2 z_{\text{int}} + E_{nt} \alpha_3 + e_{\text{int}} < 0 \right], \tag{44}$$

where 1 is the indicator function taking value 1 whenever the statement in brackets is true, and 0 otherwise; y_{int} is the binary variable indicating whether concession i, in country n, at time t, is renegotiated or not at the initiative of the firm; x_i is a vector of time invariant characteristics of the concession contracts; z_{int} is the time elapsed, in years, since the award of concession i, in country n; E_{nt} is a vector of environmental characteristics like economic shocks, elections and institutional indices; e_{int} is the error term; and α_1, α_2, and α_3 are the vectors of parameters corresponding to x_i, z_{int}, and E_{nt} respectively.

Table 6 details the correspondence between the key variables highlighted in the model and the proxies included in the empirical model that determine the latent variable in brackets in equation (44).

The probit model, using the panel described above, allows us to take into account the specific characteristics of each individual concession contract, as well as aspects of the environment that evolve over time. The output of these estimations is in Tables 7 to 10.

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[25]In the final section, we perform some robustness checks using as dependent variable the renegotiations initiated by the firm or by both.

Variables of the theoretical model	Variables of the empirical model	Expected effect
Probability of renegotiation	*Renegotiation initiated by the firm*: Dummy variable indicating whether there was or not a renegotiation of the concession contract at the initiative of the firm.	Left-hand variable
The pre-contract asymmetry of information determines the power of incentives	*Price cap*: Dummy variable taken as a proxy for the power of incentives.	+
Cost of public fund λ	*Index of Bureaucratic quality*: Taken as a proxy of the efficiency of the public sector in recollecting and spending tax money. A better index corresponds to a lower cost of public funds.	+
Sunk cost F	*Investment requirements*: Dummy variable indicating whether there are or not investment requirements as part of the concession contract, investment being considered to be mainly sunk.	ambiguous
Cost of renegotiation δ (Probability that the renegotiation fails P)	*Arbitration process*: Process that helps settle disputes, i.e. makes renegotiations less costly. The existence of such a process therefore is considered to correspond to a higher δ (or to a lower P).	+
Shocks ε	*Growth / Exchange rate shocks*: internal or external macroeconomic shocks that impact either cost or demand of the firms.	-
Institutional quality θ	*Indices of corruption / rule of law / bureaucratic quality*: standard perception indices taken as proxies of institutional quality	-
Capture γ	*Elections*: Changes of the political majority are considered to correspond to potential shifts in the level of capture.	+
	Corruption: Higher levels of corruption can be related to more capture.	-
	Existence of regulator: Dummy variable indicating whether there was a regulator or no at the time the contract was signed. The existence of a regulator is expected to limit the potential for political capture (lower γ).	-
Private financing K	*Private financing*: Dummy variable indicating whether the project is funded entirely through private funds, excluding any public investment.	ambiguous

Table 6: Correspondence between variables in the theoretical and the empirical model

3.3 Results

The upper panel of Table 7 shows the results for our basic specification, including the characteristics of the contracts, the regulatory and institutional environment, a sector dummy, political and economic shocks as well as the duration since award of the concession to account for the dynamics of the contract. Column 1 presents the "reduced form" equation, including only truly exogenous variables. The existence of a regulator has a significant and negative impact on the probability of renegotiation, as does better institutional quality, here represented by an index of bureaucratic quality. Older contracts prove more fragile. Finally, shocks represented by fluctuations in the macroeconomic growth

rate significantly affect the probability of renegotiation, i.e. recessions increase it while booms reduce it, and this probability also goes up in years following national elections.

In columns 2 to 5, we add to this basic specification a number of other variables. Concessions regulated by price caps consistently prove more fragile. Both the existence of investment requirements and the exclusivity of private financing increase the occurrence of renegotiations. In column 3, the existence of an arbitration process is not significant, and in column 4, an index of corruption shows that a more corrupt environment increases renegotiations.[26] Not surprisingly, in this case the bureaucratic quality index loses significance. Finally, in column 5, exchange rate movements replace growth fluctuations; the results are unchanged, with lagged measures of exchange rate depreciation significantly increasing the probability of renegotiations by firms.

The lower panel of Table 7 shows the marginal effects associated with the coefficients discussed above. Overall, the most significant feature of the environment having an impact on the probability of renegotiation is the existence of a regulatory body at the time the concession was awarded. This aspect significantly reduces the occurrence of subsequent renegotiations, remains unaltered when controlling for the whole range of characteristics and shocks, and is both statistically and economically significant. Compared to a situation where no regulator is around when the concession contract is signed, the presence of such a regulator consistently implies a reduction in the probability of renegotiation of between 5 and 7,3%. This value is particularly large, considering that the average probability of renegotiation of any individual contract at any point in time is around 1%.[27]

The pre-existence of a regulator in the field where a concession is awarded can first be related to the simple fact that a regulation better designed from the start will reduce the scope for obvious mistakes and lessen the need for later disruptive modifications. Instead, it can be expected that contingencies occurring during the life of the project could be dealt with through a normal revision process inside the existing regulatory framework. Furthermore, the pre-existence of a regulator increases the quality of enforcement by better commitment.

Moreover, this aspect can be related to the deeper issue of contract incompleteness. It is sometimes argued that concession contracts should be made as complete as possible, i.e. trying to include every possible contingency to avoid leaving room for ex post renegotiations.[28] However, there are limits to this approach. First, in a very complex

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[26]This corresponds to a negative sign of the coefficient, due to the fact that a higher value of the index means less corruption (see Table 2 above).

[27]Marginal effects for individual variables may more than offset the average probability of renegotiation. This stems from the fact that marginal effects are computed by making one variable vary (by one unit if continuous, from 0 to 1 if binary) while maintaining all other variables equal to the sample mean. Correlations between variables may then generate the observed effect in probabilities.

[28]See the example of the Buenos Aires water concession, running hundreds of pages and several volumes,

world describing infinite contingencies is just impossible and so contracts are bound to be incomplete. Second, imperfect enforcement limits the effectiveness of these contracts. Finally, complex contracts might be counter-productive if they lack transparency, contain contradictory requirements and lend themselves to opportunistic revision claims. These problems favor an alternative approach, which relies on short concession-specific documents, while general rules regarding concessions would be found in laws and the relevant jurisprudence. With this type of contract, previous experience in dealing with the design of concessions should have an important role in limiting the risk of later renegotiations, and this is precisely what we should expect from a specialized and experienced regulator.

The impact of the different regulatory schemes on the probability of renegotiation can be observed through the price cap variable, which shows up positive and significant in almost all the specifications tested. Thus, price cap schemes are conducive to more renegotiations. This effect is likely to be due to their greater riskiness and fragility to shocks. As for their marginal effect, it appears to be around 1%, lower than the effect of having a regulator but still important. This is an important result calling for more research on this issue, especially since price cap regulation has been used in 75% of the concessions in Latin America, and the region is characterized by a rather volatile economic environment.

The marginal effect for the duration since award indicates that each additional year increases the probability of renegotiation by 0.3 to 0.6%.

If, on top of basic performance requirements (service and quality) and price regulation, concession contracts include investment requirements, they may end up being more sensitive to fluctuations in firm's productivity, shocks and wrong demand forecasts.[29] This may explain the positive effect of the investment variable in Table 7. As for the marginal effects, it ranges between 0.9 and 1.3%. Exclusive private financing also proves to increase the occurrence of renegotiation, although the results are less robust. In columns 2 and 5, where the coefficient is statistically significant, the marginal effect ranges from 1.2 to 1.7%.

Institutional characteristics, as captured by indices of bureaucratic quality or corruption, have both a statistically and economically significant impact on the probability of renegotiation. An increase in one point in the ICRG index used implies an increase in the probability of renegotiation of between 1 and 2%. To illustrate this in our sample, going from the 1998 level of bureaucratic quality of Brazil or Colombia to that of Chile

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mentioned in Klein (1998).

[29]In the transport sector, Engel, Fischer and Galetovic (2001) mention demand forecasts for the Washington D.C. Dulles Airport-Leesburg, Va. toll road, which were overestimated more than fourfold by two consulting companies. Argentine's freight railways concession included investment requirements that proved excessive in view of the ulterior market development (Klein, 1998). Chilean tolled roads experienced huge demand fluctuations during the 1986-1995 period (Engel, Fischer and Galetovic, 2000).

or Mexico would reduce the probability of renegotiation of an individual contract at any point in time by as much as 4%.

Political cycles are likely to have consequences on the occurrence of renegotiation. As our theoretical model suggests, the government's willingness to accept renegotiation of concession contracts might depend crucially on the extent to which its interests are aligned with those of the firm. Our empirical analysis shows that in years following national elections, the probability of renegotiation increases by about 1% even when controlling for the economic cycle. This is a first indication of the importance of political considerations. A more detailed analysis of this aspect would need to consider the nature of political changes. In particular, asymmetries might appear depending on whether the previous government cares more or less for the rents of the firm than its successor (see Aubert and Laffont (2002)). Finally, interactions between the nature of government and institutional characteristics like corruption might also be relevant.

Finally, the effect of economic shocks is as expected and appears to complement rather than substitute for that of contract characteristics discussed before. Fluctuations in the macroeconomic growth rate significantly affect the occurrence of renegotiations, i.e. recessions increase it while booms reduce it. A decrease of one point in the growth rate in any given year increases the probability of renegotiation by 0.2% in the subsequent year and by 0.4% two years later. As for the exchange rate, a 10% depreciation in any given year increases the probability of renegotiation by 0.4% in the subsequent year and by 1.4% two years later. Macroeconomic shocks can be thought of as exerting a negative effect on real income of the population (both through inflation and prices of imported goods in the case of exchange rate depreciation), which in turn depresses the demand for infrastructure services. Additionally, exchange rate depreciation may affect the profitability of concession holders by increasing the cost of capital.

The contract characteristics introduced in columns 2 to 5 (price cap, investment requirements, the structure of financing, arbitration process) refer to clauses in the concession contract which are likely to be introduced or not according to the risk of renegotiation perceived ex ante, and are thus endogenous to the type and the riskiness of the projects undertaken. This highlights the need to address the broader issue of contract endogeneity.

3.4   Addressing Contract Endogeneity

The endogeneity of contracts' clauses has two dimensions. First, there is an ex ante self-selection problem, in that the contracting parties would select specific clauses, type of regulation, extent of investment requirements and financing according to their (sometimes unobservable) characteristics. For example, the inclusion of specific arbitrage rules could

be induced by the government's anticipation of potential renegotiations and of the firm's perceived renegotiation skills. Conversely, minimum income guarantee would be included as a mean to make risky concessions attractive to private agents. A similar problem applies to the type of tariff regulation chosen. A self-selection effect would suggest that more efficient firms would prefer price cap regulation, which is more risky but would allow these firms to get higher rents, but may also lead to think that riskier projects would be regulated by lower-powered (cost plus) schemes. Finally, the size of investment and type of financing that prevails cannot be considered as exogenous either, since private operators would be more willing to finance projects appearing as less risky and/or more profitable.

Second, there is an ex post moral hazard problem (the effect on the ν variable in our model), due to the fact that once the contract has been signed, the firm and the government would act strategically given the nature of this contract. Facing shorter contracts, firms might be induced to behave more efficiently to increase their chance to be awarded the contract again later on. Conversely, when protected by minimum income guarantee, they might make less effort. Price caps or private financing can also be expected to have incentive effects on the behavior of firms.

The problem we intend to tackle is to assess the real incentive effect of each specific aspect of the contract. We use a two-stage process to instrument each of the variables suspected to be endogenous. To do this, we need to find suitable instruments. We take as instruments: sectors, corruption, bureaucracy quality, rule of law, and existence of regulatory body, which are obviously exogenous in the sense that they are not determined by the risk of potential renegotiations. Nevertheless, finding instrumental variables that would not enter the equation explaining the probability of renegotiation appears very difficult[30]: virtually any contract characteristics and any aspects of the institutional and macroeconomic environment can be argued to have an impact on the probability of rene-gotiation.

We run probit estimates of the variables we want to instrument, using the static sample of the 307 concessions. Note that these first stage estimations are fairly satisfactory (see columns 1 to 4 in Appendix 1). We test for exogeneity of the variables under scrutiny, using the Rivers-Vuong (1988) approach, which simply consists in running the standard probit estimation augmented by the residuals of the first stage estimations (see also Wooldridge, 2002). Exogeneity is rejected for the price cap, the investment and the arbitration variables, while the test fails to reject it for the private financing variable. The p-values for the Rivers-Vuong test are in the last row of the table in Appendix 1.

We then take the predicted values of each of the variables found to be endogenous

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[30]Although the existence of one of these variable not entering the equation explaining renegotiation is doubtful, identification is still ensured by the non-linearity of the model.

and reintroduce them in the probit panel. Finally, we estimate the equations with these instrumented variables.[31] Furthermore, as we perform the two stages separately, we need to adjust the standard errors of the second stage. As computing the covariance matrix for a panel with several endogenous variables is not tractable, we present bootstrapped standard errors for the IV estimations. The results are in Table 8.

The price cap variable remains positive and significant once instrumented. Thus, despite the potential self-selection effect, the higher riskiness of price caps still leads to more renegotiation of the concessions under this regulatory scheme.[32]

The most striking difference with the previous table is the negative and significant sign of the investment requirements variable when instrumented. This seems to confirm that the incentive effects of the limited liability constraint more than compensate the direct cost effect (see section 2.5). In other words, the existence of investment requirements, because it decreases the firm's status quo payoff and thus its utility from renegotiation, induces the firm to behave more efficiently. This effect appears to outweigh the adverse effect on the cost that decreases the gain for the government to avoid renegotiating, so that the final probability of renegotiation is reduced. Finally, once the investment variable is instrumented, the prevalence of private finance loses significance, although it remains positive.

One aspect worth noticing is that the existence of a regulator loses significance when some contract clauses are instrumented. Technically, this may be related to the fact that this variable is used both in the instrumental first stage estimations and in the final specification. Intuitively, this could indicate that the influence of regulatory bodies precisely goes through their ability in selecting specific clauses adapted to the type and circumstances of the concessions.

The remaining results remain unaffected. The arbitration process variable is still positive but not significant, while the duration since award, bureaucratic quality, the lagged election and growth variables are all significant and with the same sign than in Table 7, with the election variable being more consistently significant.

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[31]In a simple probit model with an endogenous binary variable, a maximum likelihood estimation (MLE) would prove more efficient (see Wooldridge 2002). However, we are dealing with panel data and several endogenous variables, which makes this approach too difficult to apply. Support for the two-stage strategy we adopt can be found in Angrist (1991), who argues based on a Monte Carlo study of a bivariate probit model that in general IV estimates do not perform appreciably worse than estimates computed using the correct likelihood function.

[32]It must be noted however that since the instrumented variables are dummy variables varying in the range [0,1], their predicted values cover a reduced range. This induces a scale effect that explains the observed increases in the coefficients' sizes and does not allow for clear inferences on the magnitude of the effects. For example, the predicted value corresponding to the price cap variable has a mean very close to the actual variable (0.92 compared to 0.94) but varies only in the range [0.52,1]. For this reason, in what follows we only interpret marginal effects when no instruments are used.

3.5 Robustness Checks

Tables 9 and 10 present various robustness checks.

In Table 9, we introduce additional variables, not explicitly considered in our theoretical model, that could potentially affect the probability of renegotiation and alter the significance of our core variables. These are minimum income guarantee clauses, the existence of a bidding process previous to the award of the contract, and the duration of contract.

Minimum income guarantee is introduced in columns 1 to 3. In column 1, the coefficient is positive but not significant. Since exogeneity for this variable is rejected by the Rivers-Vuong test (Appendix 1, column 5), we instrument it in columns 2 and 3. When instrumented alone, it shows up positive and strongly significant, but this effect is again lost when price cap and investment requirements are instrumented simultaneously. At the very least, it means that this clause fails to reduce the incidence of renegotiation, and there is some evidence that it actually increases it, which confirms its inappropriateness (see for example Engel et alii, 2000). While minimum income guarantees do in principle protect holders of concession contract against shocks and other unforeseen contingencies, we thus conclude they might instead increase the probability of renegotiation by reducing incentives to behave efficiently and/or fostering strategic underbidding, as well as by making possible the realization of projects with negative social value.

In columns 4 and 5, the existence of a bidding process to award the concession is negative but not significant. This probably reflects the fact that bidding induces several potentially opposed effects: on the one hand, by allowing the selection of a more efficient operator, it should make the concession more robust; on the other hand, however, by reducing its prospective profits by this ex ante competition, it could also make it more sensitive to shocks. Finally, strategic bidding behavior can also generate an increase in subsequent renegotiations.

In columns 6 and 7, the duration of contracts is also negative but not statistically significant. More interestingly, Table 9 shows that our previous results with respect to price caps, investment, institutional quality and shocks, are robust to the introduction of these three variables, which advocates in favor of our basic theoretical specification. As for the marginal effects in columns 1, 4 and 6, there are basically unchanged, with average values around -5% for the existence of a regulator, 1% for the existence of a price cap scheme, 0.5% for one additional year since award, -1% for a one point increase in the index of bureaucratic quality and 1%, 0.2% to 0.4% respectively for elections and lagged growth shocks.

Table 10 offers some more robustness checks. Since our model is one of renegotiations

initiated by firms, we started by using firm-led renegotiations as our dependent variable. However, the fact that a renegotiation is profitable to the firm does not exclude the government from gaining too. This suggests using as a dependent variable the sum of renegotiations initiated by firms and those initiated by both parties.[33] The results in columns 1 and 2 again show that our central results remain robust in that case. It can be noticed that private financing becomes negative, although not significantly so, and that the significance of the lagged election variable is somewhat stronger. This could be a preliminary indication that political cycle are specially relevant for the renegotiations initiated or co-initiated by the government, but we leave a more precise analysis of this issue for a future paper on government led renegotiations. Marginal effects in column 1 are also larger than our base values from Table 8, but technically this is due to the fact that we consider more renegotiations (68 instead of 53), which shows up in the higher overall probability of renegotiation (2.4%).

In columns 3 and 4, we run estimations excluding from the sample the two countries, Brazil and Chile, in which they were no or few firm-led renegotiations. The general results are again robust. The marginal effects for the existence of a regulator in column 3 is now 13.1%, which again is probably a technical effect related to the reduced sample (222 concessions instead of 307, leading to 908 panel observations instead of 1132).

In columns 5 and 6, we exclude institutional variables and include instead a full set of country dummies. The main results remain unchanged, except the election variable that becomes not significant. The specific country dummies are very strongly significant, but this is not at the expense of the contract characteristics and the shocks, which are still statistically significant. As might be expected, in column 5 the marginal effects of most contract and environment variables are reduced, especially so for the election and growth shocks variables.

Finally in columns 7 and 8, we run our basic estimation with a dummy variable for the projects in the road sector, as concessions in this sub-sector seem to have been particularly prone to renegotiation (33 out of the 53 concessionaire-led renegotiations). Once more, the general results are robust, and the marginal effects in column 7 are in line with the base values from Table 7. The private financing variable is however positive and significant in both estimations, indicating that this dimension might be of more specific importance for other sectors.

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[33]Also, as discussed above, renegotiations initiated by the firm may have been classified as initiated by both parties when there was not full clarity about the initiator.

3.6 Relation to Theoretical Results

The empirical results presented above are broadly consistent with our theoretical model. We had first the prediction that better institutional quality (through our θ variable representing rule of law, non-corruption, or the quality of bureaucracy) should imply less renegotiations. This is indeed the case as the coefficients of the institutional variables are generally negative and significant. We also expected a higher cost of public fund (proxied by a lower efficiency of the bureaucracy) to raise the incidence of renegotiation, and this is again confirmed by the empirical analysis.

Political cycles have a positive effect, in that post-election years witness more renegotiations. This result can be related to the effect of the degree of state capture γ. Under this approach, it means that, as governments closer to the firms access to power, they are likely to tolerate more renegotiations.

Other results that we related to the degree of state capture γ, are corruption, with higher levels of corruption corresponding to more capture, and the existence of a regulator, expected to limit the potential for political capture. Again, in both cases the probit analysis yielded the expected sign and results were significant.

As anticipated, shocks have the expected effect and are significant determinants of the probability of renegotiation.

Relating the existence of arbitration rules to the cost of bargaining, the empirical results are consistent with our model, in that these rules increase the occurrence of renegotiation, although the coefficient are not statistically significant.

Finally, we have several variables for which the theoretical effect was ambiguous. For the price cap variable, the strong positive effect found shows that the riskiness and the fragility to shocks indeed dominates, which confirms the direct effect apparent in the model. Investment, on the other hand, appears to generate a strong incentive effect that reduces the probability of renegotiation. Finally, private financing appears to have a positive impact on the probability of renegotiation, although only weakly robustly so.

4 Conclusion: Policy Implications

There are a number of clear policy implications for the design of concession contracts, regulation and regulatory institutions aimed at facilitating the enforcement of those contracts, coming out from the results reported in this paper.

The first and perhaps foremost policy implication is about *the relevance of regulation and institutions: having regulatory institutions from the start and as autonomous as pos-*

sible matters. The findings reported in the paper argue for the key role of regulation and proper associated institutions as a signal and proxy for the quality of enforcement and as a filter and deterrent for costly opportunistic renegotiations. As it was shown, the existence of a regulatory body at the time the concession was awarded significantly reduces the occurrence of subsequent renegotiations. Overall, this result argues for the need to have a regulatory agency in place prior to the granting of any concession in the sector, which often was not the case in Latin American countries. There was a general or perhaps self-serving presumption that for the time being a contract was sufficient and the agency would be developed later, if at all. That has been shown to be very damaging. Additionally, granting a significant degree of operational and financial autonomy to regulatory institutions should be favored. That measure and others that reduce the probability of renegotiation through improving the governance environment, increasing predictability, reducing arbitrariness and reducing corruption in regulatory decisions, should be considered.

The second key policy implication is in regard to *the choice of the regulatory regime, arguing that rate of return regulation should be reconsidered as the salient choice.* Latin American countries adopted the price caps regime with a vengeance. Price caps, under a fairly volatile economic environment, regulate over 75% of the concessions.[34] Unfortunately, it appears that those countries merely swallowed rather than digested the concept, not anticipating its full range of implications. In particular they failed to account for the fact that price caps would increase the cost of capital. Moreover, the interaction of price caps and an increased cost of capital in high risk, weak governance environments had deep implications on the incidence of renegotiation. Price caps' greater riskiness and fragility to shocks led to more renegotiations as shown in this paper. Contracts were renegotiated very quickly, about two years on average, after the award of the concession (Guasch, 2001). Thus, there was little risk bearing for firms. They kept the efficiency gains when business was good and renegotiated when it was poor. In many instances, these renegotiations were aimed at increasing the rate of return to keep it consistent with the higher cost of capital.

Weak regulatory capacity and weak effective government commitment led to the fact that price caps alone did not yield the expected benefits for the users of the services. While price caps did provide incentives for operators to quickly secure efficiency gains, many of these gains were then captured by the governments or firms rather than shared with users. Moreover, these were in fact penalized twice, since the efficiency gains came at the cost of a higher cost of capital and thus higher tariffs to cover that increase. Finally, compounding the pain inflicted on the users is the fact that the adoption of price cap regime tended to delay or bring down investment levels, directly or through renegotiations, as firms did not

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[34]Including all Latin American countries. This figure goes up to over 90% in our empirical sub-sample.

get immediate rewards from those investments through tariff adjustments: the existing tariffs already accounted for expected investments or tariffs would be adjusted but only at the next tariff review period, usually a few years down the road.

Thus, not surprisingly, slowing down investment, reducing service obligations or increasing direct or indirect subsidies were part of the renegotiation outcomes (Guasch 2001). Ultimately, renegotiation tended to transform many price caps into hybrid regimes, de-legitimizing the price cap regime, both on grounds of the agreed terms' speed of change -less than three years- and of the outcome. All that argues, as a key policy implication, for reconsidering rate of return regulation or at least a hybrid regulatory scheme, as the salient choice for the regulatory regime, particularly in volatile environments and where there is weak regulatory capacity.

The mixed effects of *exclusive private financing and of minimum income guarantees* on the probability of renegotiation argue for a careful analysis of the tradeoffs involved before granting any guarantees or considering mixed financing. Minimum income guarantees do in principle protect holders of concession contracts against shocks and other unforeseen contingencies. However, the empirical analysis raises concerns about their effect and leads to think that such guarantees instead increase the probability of renegotiation by reducing incentives to behave efficiently and by leading the government/regulator to concede improved terms through renegotiation, in order to avoid calling in the guarantee.

Finally, there are two variables highly significant as determinants of renegotiation, for which policy implications are less clear and point out to implicit risk insurance. These variables are the *political cycle* and *macroeconomic shocks*. While the former is to some extent predictable, the latter is not. As shown here, political cycles are likely to have consequences on the occurrence of renegotiations. The policy implications here might be reduced to incorporating into the contract specific contingency clauses and guidelines for political cycle-led renegotiations, so as to reduce uncertainty and risk about the outcome. As for macroeconomic shocks, they are difficult to predict or to pre-empt, yet likely to happen during the life of a concession. The policy implications here are limited. This argues for the need to reduce uncertainty about their impact, for example by incorporating into the contracts contingency clause triggers and binding guidelines on the adjustment of tariffs and other elements with financial implications in the contracts.

In summary, accounting for all those factors in the design of concession contract, competitive allocation of concessions, and regulatory framework ought to have significant effects in reducing conflicts, wasteful and rent seeking renegotiations, and improving transparency and overall sector efficiency and welfare.

Appendix 1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable	Price cap	Investment requirements	Private financing	Arbitration process	Minimum Income guarantee	Bidding process	Duration of contract
Estimation method	Probit	Probit	Probit	Probit	Probit	Probit	OLS
Water sector	-0.58	-1.48*	-2.34*	-3.58*	-1.43*	2.36*	10.12*
	(0.55)	(0.28)	(0.40)	(0.51)	(0.39)	(0.57)	(3.75)
Existence of regulatory body	-0.48	0.21	-1.68*	-1.01*	0.52***	2.90*	13.10*
	(0.74)	(0.31)	(0.41)	(0.39)	(0.27)	(0.59)	(3.99)
Corruption	0.20**	0.25	-0.52*	-0.47*	-0.09	1.29*	3.50**
	(0.22)	(0.17)	(0.17)	(0.14)	(0.14)	(0.24)	(1.44)
Bureaucratic quality	-1.07*	-0.07	0.85*	1.52*	-0.22	-1.73*	0.67
	(0.21)	(0.19)	(0.20)	(0.31)	(0.15)	(0.42)	(0.81)
Rule of law	0.68*	-0.28**	-0.08	0.16	0.11	1.91*	2.31**
	(0.21)	(0.13)	(0.14)	(0.12)	(0.10)	(0.41)	(0.95)
Number of obs.	307	307	262	296	305	307	303
Pseudo/adj. R^2	0.31	0.27	0.28	0.53	0.16	0.63	0.22
Rivers-Vuong test: p-value	0.017	0.000	0.308	0.088	0.000	0.655	0.222

Robust standard errors in parenthesis. Coefficients significant at the 1% (*), 5% (**) and 10% (***) level.

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Table 7: Random effect probit panel
Dependent variable: Dummy variable indicating the occurrence
of renegotiation initiated by the firm

	(1)	(2)	(3)	(4)	(5)
Existence of regulatory body	-1.29* (0.21)	-1.09* (0.21)	-1.08* (0.21)	-1.51* (0.26)	-1.21* (0.21)
Price cap		0.55*** (0.33)	0.60*** (0.33)	0.81** (0.33)	0.54 (0.33)
Duration since award	0.20* (0.04)	0.19* (0.05)	0.20* (0.05)	0.15* (0.05)	0.20* (0.05)
Investment requirements		0.78** (0.39)	0.60 (0.39)	0.65*** (0.38)	0.62*** (0.37)
Private financing		0.51** (0.27)	-0.11 (0.48)	0.15 (0.29)	0.68* (0.27)
Bureaucratic quality	-0.28** (0.13)	-0.35** (0.14)	-0.39* (0.14)	-0.21 (0.15)	-0.70* (0.14)
Arbitration process			0.73 (0.55)		
Corruption				-0.43* (0.12)	
Election-1	0.30*** (0.18)	0.29 (0.19)	0.27 (0.19)	0.40*** (0.20)	0.34** (0.17)
GDP growth -1	-0.07* (0.02)	-0.06* (0.02)	-0.06* (0.02)	-0.07* (0.02)	
GDP growth -2	-0.14* (0.02)	-0.14* (0.02)	-0.14* (0.02)	-0.15* (0.03)	
Exchange rate -1					1.47** (0.65)
Exchange rate -2					4.60* (0.90)
Transport sector dummy	1.25* (0.25)	0.75** (0.34)	0.59 (0.39)	1.05* (0.36)	0.96* (0.34)
Number of obs.	1267	1132	1100	1132	1122
Log Likelihood	-143.59	-132.49	-130.97	-125.21	-144.92
Marginal effects (dy/dx)[a]					
Average predicted probability of renegotiation	0.011	0.010	0.011	0.008	0.011
Existence of regulatory body	-0.073	-0.050	-0.051	-0.075	-0.064
Price cap		0.009	0.011	0.009	0.010
Duration since award	0.006	0.005	0.006	0.003	0.006
Investment requirements		0.013	0.012	0.009	0.012
Private financing		0.012	-0.003	0.003	0.017
Bureaucratic quality	-0.009	-0.010	-0.011	-0.005	-0.020
Arbitration process			0.018		
Corruption				-0.009	
Election-1	0.010	0.009	0.009	0.011	0.012
GDP growth −1	-0.002	-0.002	-0.002	-0.001	
GDP growth −2	-0.004	-0.004	-0.004	-0.003	
Exchange rate −1					0.043
Exchange rate -2					0.135
Transport sector dummy	0.024	0.014	0.013	0.014	0.018

(a) For dummy variables, dy/dx is for discrete change from 0 to 1. For continuous variables, it corresponds to an increase by 1 unit.
Standard errors in parenthesis. Coefficients significant at the 1% (*), 5% (**) and 10% (***) level.

Table 8: Random effect probit panel
Dependent variable: Dummy variable indicating the
occurrence of renegotiation initiated by the firm

	(1)	(2)	(3)	(4)	(5)
Existence of regulatory body	-0.53 (0.47)	-0.54 (0.38)	-0.19 (0.57)	-0.10 (0.57)	-0.60 (0.64)
Price cap		0.75* (0.31)		4.62*** (2.91)	
Price cap (IV)	4.70** (2.14)		3.52 (2.15)		2.39 (3.31)
Duration since award	0.23* (0.06)	0.21* (0.06)	0.22* (0.06)	0.22* (0.05)	0.23* (0.07)
Investment requirements	0.78*** (1.89)				
Investment requirements (IV)		-9.49* (2.40)	-9.14* (2.38)	-8.51* (2.81)	-7.51* (3.84)
Private financing	0.77** (1.04)	0.14 (0.37)	0.31 (0.77)	0.26 (0.64)	0.44 (0.38)
Bureaucratic quality	-0.24** (0.18)	-1.15* (0.34)	-1.05* (0.32)	-1.18* (0.40)	-1.31* (0.50)
Arbitration process (IV)				1.41 (1.65)	
Election-1	0.17 (0.21)	0.45* (0.24)	0.36** (0.20)	0.36** (0.22)	0.39* (0.19)
GDP growth -1	-0.08* (0.03)	-0.08* (0.03)	-0.09* (0.03)	-0.09* (0.03)	
GDP growth -2	-0.15* (0.02)	-0.21* (0.05)	-0.22* (0.05)	-0.22* (0.06)	
Exchange rate -1					1.15*** (1.17)
Exchange rate -2					7.53* (4.94)
Transport sector dummy	0.32 (0.67)	5.34* (1.24)	4.86* (0.98)	3.57* (2.43)	4.42* (1.93)
Number of obs.	1132	1132	1132	1132	1122
Log Likelihood	-130.11	-112.76	-113.31	-112.81	-130.20

Marginal effects $(dy/dx)^{a}$

	(1)	(2)	(3)	(4)	(5)
Average predicted probability of renegotiation	0.007	0.003	0.002	0.002	0.005
Existence of regulatory body	-0.014	-0.006	-0.002	-0.001	-0.011
Price cap	0.096	0.003	0.025	0.033	0.033
Duration since award	0.005	0.002	0.002	0.002	0.003
Investment requirements	0.010	-0.081	-0.067	-0.060	-0.103
Private financing	0.014	0.001	0.002	0.002	0.005
Bureaucratic quality	-0.005	-0.010	-0.008	-0.008	-0.018
Arbitration process				0.010	
Election-1	0.004	0.005	0.003	0.003	0.007
GDP growth –1	-0.002	-0.001	-0.001	-0.001	
GDP growth –2	-0.003	-0.002	-0.002	-0.002	
Exchange rate –1					0.016
Exchange rate -2					0.104
Transport sector dummy	0.005	0.060	0.042	0.021	0.057

(a) For dummy variables, dy/dx is for discrete change from 0 to 1. For continuous variables, it corresponds to an increase by 1 unit.

Standard errors in parenthesis are bootstrapped estimates based on 100 replications. The significance level (1% (*), 5% (**) and 10% (***)) is assessed using the percentile confidence interval. For example, for the 95% interval, the bottom endpoint is the 2.5[th] percentile and the upper endpoint is the 97.5[th] percentile. If the confidence interval build in that way contains 0, the coefficient is not significant. Non-normality of the distribution may explain that coefficients are deemed significant while having relatively large standard errors.

Table 9: Random effect probit panel
Dependent variable: Dummy variable indicating the occurrence
of renegotiation initiated by the firm - Robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Existence of regulatory body	-1.10* (0.22)	-2.70* (1.16)	0.96 (1.42)	-1.15* (0.23)	-0.18 (0.46)	-1.07* (0.22)	-0.10 (0.57)
Price cap	0.45 (0.36)	0.73* (0.60)		0.63*** (0.33)		0.58*** (0.33)	
Price cap (IV)			3.73*** (2.12)		4.22** (2.50)		4.07** (2.36)
Duration since award	0.18* (0.05)	0.15* (0.07)	0.24* (0.06)	0.18* (0.05)	0.21* (0.05)	0.20* (0.05)	0.23* (0.08)
Investment requirements	0.79** (0.39)	0.95* (1.98)		0.74*** (0.29)		0.83** (0.40)	
Investment requirements (IV)			-11.27* (3.42)		-8.93* (2.32)		-9.08* (2.90)
Private financing	0.55** (0.27)	0.34 (0.42)	0.36 (0.37)	0.40 (0.29)	0.29 (0.38)	0.48*** (0.27)	0.31 (0.80)
Bureaucratic quality	-0.32** (0.15)	-0.22 (0.23)	-1.51* (0.55)	-0.29*** (0.16)	-0.98* (0.39)	-0.36** (0.14)	-1.04* (0.42)
Minimum income guarantee	0.16 (0.23)						
Minimum income guarantee (IV)		11.74* (5.45)	-6.89 (7.19)				
Bidding Process				-0.27 (0.30)	-0.22 (0.42)		
Duration of contract						-0.015 (0.015)	-0.02 (0.02)
Election-1	0.29 (0.19)	0.43* (0.18)	0.32*** (0.20)	0.30 (0.19)	0.35 (0.21)	0.28 (0.19)	0.33 (0.22)
GDP growth -1	-0.06* (0.02)	-0.08* (0.02)	-0.09* (0.03)	-0.06* (0.02)	-0.09* (0.03)	-0.06* (0.02)	-0.09* (0.03)
GDP growth -2	-0.14* (0.02)	-0.18* (0.05)	-0.21* (0.04)	-0.14* (0.02)	-0.22* (0.05)	-0.14* (0.02)	-0.22* (0.06)
Transport sector dummy	0.69*** (0.36)	-1.49*** (1.32)	7.30* (2.88)	0.80** (0.34)	4.72* (1.62)	0.70** (0.35)	4.73* (1.52)
Number of obs.	1127	1132	1132	1132	1132	1128	1128
Log Likelihood	-132.26	-125.09	-112.03	-132.08	-113.17	-131.95	-112.65
Marginal effects (dy/dx)[a]							
Average predicted probability of renegotiation	0.010	0.006	0.002	0.010	0.002	0.010	0.002
Existence of regulatory body	-0.051	-0.022	-0.006	-0.055	-0.001	-0.048	-0.001
Price cap	0.008	0.006	0.027	0.010	0.030	0.009	0.028
Duration since award	0.005	0.002	0.002	0.005	0.001	0.005	0.002
Investment requirements	0.013	0.009	-0.081	0.013	0.064	0.013	0.062
Private financing	0.013	0.005	-0.002	0.010	0.002	0.011	0.002
Bureaucratic quality	-0.009	-0.004	-0.011	-0.008	-0.007	-0.009	-0.007
Minimum income guarantee	0.005	0.188	0.049				
Bidding Process				-0.009	-0.002		
Duration of contract						-0.0004	-0.0001
Election-1	0.009	0.009	0.003	0.010	0.003	0.008	0.003
GDP growth -1	-0.002	-0.001	-0.001	-0.002	-0.001	-0.002	-0.001
GDP growth -2	-0.004	-0.003	-0.001	-0.004	-0.002	-0.004	-0.001
Transport sector dummy	0.013	0.081	0.121	0.015	0.039	0.013	0.037

(a) For dummy variables, dy/dx is for discrete change from 0 to 1. For continuous variables, it corresponds to an increase by 1 unit.

Standard errors in parenthesis. Standard errors in columns 3, 5 and 7 are bootstrapped estimates based on 100 replications. The significance level (1% (*), 5% (**) and 10% (***)) is assessed using the percentile confidence interval. For example, for the 95% interval, the bottom endpoint is the 2.5[th] percentile and the upper endpoint is the 97.5[th] percentile. If the confidence interval build in that way contains 0, the coefficient is not significant. Non-normality of the distribution may explain that coefficients are deemed significant while having relatively large standard errors.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample	Basic	Basic	without Brazil and Chile	Without Brazil and Chile	Basic	Basic	Basic	Basic
Dependent variable	Reneg. Initiated by firm or both	Reneg. Initiated by firm or both	Reneg. initiated by firm	Reneg. Initiated by firm	Reneg. Initiated by firm	Reneg. Initiated by firm	Reneg. initiated by firm	Reneg. Initiated by firm
Existence of regulatory body	-0.85* (0.19)	-0.19 (0.44)	-1.66* (0.26)	-0.22 (0.80)	-0.82** (0.36)	-0.23 (0.46)	-0.96* (0.20)	0.23 (0.45)
Price cap	0.33 (0.27)		0.65*** (0.34)		0.61*** (0.33)		0.06 (0.35)	
Price cap (IV)		2.13*** (1.65)		4.68** (2.92)		8.34*** (9.22)		6.49* (2.12)
Duration since award	0.15* (0.04)	0.15* (0.05)	0.27* (0.06)	0.27* (0.08)	0.23* (0.06)	0.27* (0.07)	0.18* (0.05)	0.25* (0.08)
Investment requirements	0.72** (0.36)		1.64 (0.48)	-8.49* (2.96)	1.14* (0.42)		0.99* (0.37)	
Investment requirements (IV)		-6.98* (2.04)				-0.043 (1.19)		-1.86** (0.98)
Private financing	-0.06 (0.19)	-0.10 (0.26)	-0.02 (0.27)	0.25 (1.14)	-0.25 (0.32)	0.23 (1.24)	0.73* (0.24)	1.21* (0.98)
Bureaucratic quality	-0.39* (0.12)	-0.91* (0.26)	-0.34** (0.14)	-0.96* (0.38)			-0.20* (0.15)	-0.15 (0.15)
Election-1	0.46* (0.15)	0.50* (0.17)	0.38*** (0.21)	0.32 (0.25)	0.27 (0.22)	0.14 (0.22)	0.27 (0.19)	0.11 (0.21)
GDP growth -1	-0.04** (0.02)	-0.05** (0.03)	-0.08* (0.02)	-0.11* (0.04)	-0.06* (0.02)	-0.06* (0.03)	-0.05** (0.02)	-0.07* (0.03)
GDP growth -2	-0.12* (0.02)	-0.16* (0.03)	-0.13* (0.02)	-0.22 (0.06)	-0.13* (0.03)	-0.15* (0.03)	-0.15* (0.02)	-0.18* (0.04)
Argentina dummy					7.25* (0.47)	6.04* (1.23)		
Chile dummy					5.50 (-)	4.37 (3.85)		
Colombia dummy					6.73* (0.61)	6.40*** (2.31)		
Mexico dummy					5.72* (0.57)	4.75*** (2.92)		
Transport sector dummy	1.19* (0.36)	4.29* (1.21)	0.27 (0.40)	4.46 (1.31)	-0.18 (0.42)	-0.21 (0.35)		
Road dummy							0.69 (0.20)	1.02* (0.27)
Number of obs.	1132	1132	908	908	1132	1132	1132	1132
Log Likelihood	-188.84	-173.07	-111.26	-102.43	-109.09	-108.79	-128.99	-123.66
Marginal effects (dy/dx)[a]								
Average predicted probability of renegotiation	0.024	0.012	0.008	0.003	0.001	0.001	0.009	0.005
Existence of regulat. body	-0.065	-0.006	-0.131	-0.002	-0.005	-0.001	-0.038	0.003
Price cap	0.014	0.067	0.009	0.037	0.001	0.026	0.001	0.094
Duration since award	0.008	0.005	0.006	0.002	0.001	0.0001	0.004	0.004
Investment requirements	0.027	-0.022	0.021	-0.068	0.002	-0.0001	0.014	-0.027
Private financing	-0.003	-0.003	-0.0004	0.002	-0.001	0.001	0.016	0.016
Bureaucratic quality	-0.022	-0.029	-0.008	-0.008			-0.005	-0.002
Election-1	0.031	0.020	0.011	0.003	0.001	0.0004	0.008	0.002
GDP growth −1	-0.002	-0.001	-0.002	-0.001	-0.0002	-0.0001	-0.001	-0.001
GDP growth −2	-0.007	-0.005	-0.003	-0.002	-0.0004	-0.0005	-0.004	-0.003
Argentina dummy					0.999	0.986		
Chile dummy					0.973	0.808		
Colombia dummy					0.986	0.972		
Mexico dummy					0.479	0.278		
Transport sector dummy	0.041	0.101	0.005	0.022	0.001	-0.001		
Road dummy							0.024	0.028

(a) For dummy variables, dy/dx is for discrete change from 0 to 1. For continuous variables, it corresponds to an increase by 1 unit.
Standard errors in parenthesis. Standard errors in columns 2, 4, 6 and 8 are bootstrapped estimates based on 100 replications. The significance level (1% (*), 5% (**) and 10% (***)) is assessed using the percentile confidence interval. For example, for the 95% interval, the bottom endpoint is the 2.5[th] percentile and the upper endpoint is the 97.5[th] percentile. If the confidence interval build in that way contains 0, the coefficient is not significant. Non-normality of the distribution may explain that coefficients are deemed significant while having relatively large standard errors.