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Renegotiation of concession contracts in Latin America ☆
Evidence from the water and transport sectors

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Abstract

High rates of contract renegotiation have raised serious questions about the viability of the concession model to attract private participation in infrastructure in developing countries. After extending in reduced form a standard regulation model, in which renegotiation occurs due to the imperfect enforcement of concession contracts, we use a unique data set of 307 concessions awarded in Latin America from 1989 to 2000, covering the sectors of transport and water, to analyze the determinants of this high incidence of renegotiations of infrastructure contracts. We look in details at 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. We then derive some policy implications of our work.

JEL classification: D7; L5; O54

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1. Introduction

Since the late 1980s, concession contracts have been widely used in the developing world to attract much needed private investment in infrastructure sectors (see Harris, 2003; Fay and Morrison, 2006). However, after more than a decade of experience with this model, its validity is being questioned, mostly because of the very high incidence of renegotiation (see Guasch, 2004). This paper examines a unique dataset of 307 concessions awarded in Latin American countries from 1989 to 2000 covering the sectors of transport and water, and analyzes the reasons for the high frequency of renegotiation of these contracts. We obtain results with important policy implications, among which the importance of having a

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Jean-Jacques Laffont left us, much too soon, in the spring of 2004. We learned a lot from him and miss him greatly.

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regulator in place when awarding the contract, the fragility of price caps, 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.

To guide the empirical analysis, we first propose a simple concession model that accommodates both renegotiations due to unanticipated events (Pareto improving renegotiations) and opportunistic behavior by the firms in anticipated events (rent-shifting renegotiations), and provides us with predictions consistent with the observed empirical results. Specifically, we extend the theoretical framework of Laffont (2003) and discuss briefly how the model can account, in reduced form, for a 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, specific clauses of the contract, exogenous shocks, as well as characteristics of the political cycle and of the institutional environment.

The model we develop is a model of renegotiations initiated by firms. Renegotiations initiated by governments raise technical issues, which need a different modeling and are dealt with in a companion paper (Guasch et al., in press, referred to hereinafter as GLS). 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.

This introduction starts by reviewing the context for and characteristics of infrastructure contracts in Latin America. It then discusses briefly the related theoretical literature.

1.1. Infrastructure concessions in Latin America: An overview

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 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 (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 sale of public infrastructure utilities to private parties, who quite often were foreign companies. Many countries, therefore, resorted to innovative strategies for attracting private firms 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 (Guasch, 2004).

Despite some improvements in infrastructure sector performance,[2] private sector participation by concession has often produced mixed results, raising, in a number of countries, questions about the concession model. Among

[1] See for example Sánchez and Corona (1993) and Harris (2003).

[2] See for example Chong and López-de-Silanes (2004) and Andres et al. (2005).

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 high incidence of renegotiation of contracts shortly after the award of the concession. 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. In particular, it might indicate excessive opportunistic behavior by the new operators, both during the bidding stage (strategic underbidding by firms skilled at renegotiations) and after it.[4]

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 as, possibly, 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 a better deal than the initial one.

It is therefore of significant policy relevance to determine what features of the contracts, the regulatory framework or the environment are likely to affect the probability of renegotiation, and consequently what levers are available to limit as much as possible the occurrence of such renegotiations.

1.2. Related theoretical literature

The procurement and regulation literature[5] 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

[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 et al., 2003).

[4] See Guasch (2004) for examples and a discussion of the welfare costs of renegotiations. Of course, 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 (see GLS).

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

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, 1997). 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 et al., 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 system, which are assumed in a rather ad hoc way.

Recently, Bondt (2001) 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 et al. (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 (2003) and Laffont and Meleu (2002) 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. The importance of enforcement of laws was stressed by the Chicago school,[6] but has been little addressed by modern contract theory. The modeling strategy of this paper can therefore be seen as an attempt to reconcile these two approaches.

Finally, the question we address is also related to the literature that has focused on the optimal form of procurement contracts along several dimensions: Optimal award mechanisms (auctions versus bilateral negotiations, Bajari et al., 2003), optimal reward mechanism (cost-plus versus fixed price, Bajari and Tadelis, 2001), or optimal degree of incompleteness (Crocker and Reynolds, 1993), to mention only a few. These papers analyze different trade-offs: between ex ante incentives to reduce costs and ex post transaction costs linked to renegotiation for the first two, between the ex ante cost of design and the mitigation of ex post opportunism for the last one. The relationship of our results with the insights from these papers is discussed in more details in the conclusion.

Section 2 discusses the potential effect of different variables on the probability of renegotiation in the context of a model of renegotiation. The full model is developed in Appendix A. Section 3 develops the empirical analysis. It presents the data set, discusses the methodology and addresses endogeneity issues, and presents the main results and several robustness checks. In the concluding Section 4, we derive some policy implications of our work.

2. Concession renegotiation: Theory

This section discusses some relevant aspects of the regulation model with renegotiation developed in Appendix A. Consider the concession of a natural monopoly, modeled along the line of Laffont and Tirole (1993). The regulator's objective function is utilitarian social welfare, given by the sum of consumers' surplus and the firm utility (U) with equal weight of 1 for both, and can be written (see Appendix for details of the derivation):

$$\widehat{W} = S(q) + \lambda p(q)q - (1+\lambda)((\beta - e)q + F + \Psi(e)) - \lambda U \equiv W(q, e, \beta) - \lambda U,$$

where

- $S(q)$ $(S' > 0,\ S'' < 0)$ is the utility consumers derive from the consumption of the natural monopoly's good;
- $p(.)$ is the inverse demand function;
- λ is the cost of public fund;
- $(\beta - e)\ q + F$ is the total cost of the firm, with β a private information cost parameter of the firm in $\{\underline{\beta}, \overline{\beta}\}$,$(\nu = \Pr\ (\beta = \underline{\beta}))$, e a decision variable of the firm, which decreases cost, but creates to the manager a disutility $\Psi(e)$ $(\Psi' > 0,\ \Psi'' > 0,\ \Psi''' \geq 0)$, and F a fixed cost.

As shown formally in the Appendix, when the regulator offers a contract before the firm discovers its type, the high cost firm obtains a negative utility ex post and therefore tries to renegotiate the contract. In this case, assuming that the regulator is able to invest in an imperfect enforcement mechanism, the contract is still enforced with an endogenously defined probability $\theta\pi(x)$, where θ proxies for the quality of existing institutions such as the judicial system and x is the level of expenses engaged by the regulator, while renegotiation occurs with probability $1 - \theta\pi(x)$. In this case, bargaining is costly, so the parties only share δW (q, e, β), with $0 \leq \delta < 1$.

[6] See Becker (1968), Stigler (1970), Becker and Stigler (1974), Posner (1972) and Polinsky and Shavell (2000) for a recent synthesis.

What are the main features of this model?

- 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 ($W(\overline{q}^*, \overline{e}^*, \overline{\beta})>\delta W(\overline{q}^*, \overline{e}^*, \overline{\beta})$), or because renegotiation may fail. This enforcement mechanism is imperfect and its quality is determined by Eq. (17). 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 that we are considering here.[7] An intuitive interpretation of λ is to relate it to the tightness of the government's budget constraint. In times of recession or more generally any adverse economic shock that affects the government's deficit, we expect λ to increase. Therefore, negative shocks (decrease in demand, cost shock) increase the probability of renegotiation, while positive shocks would reduce the probability of renegotiation.[8]

- Without limited liability, 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. In the case with limited liability, however, the effort and output levels of the bad type are now distorted because an expected rent is given up to the firm. Therefore, the strength of incentives is determined simultaneously with the level of enforcement. The direct effect is that 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.
- By introducing a weight γ applied to the firm's utility in the regulator's objective function, it is possible to analyze the consequence of the government being more or less captured by the firm's stakeholders.[9] This extension is pursued in Guasch et al. (2006), who show that a higher level of capture decreases the equilibrium level of enforcement, therefore making renegotiations more likely. Empirically, changes in γ can possibly be associated with political changes at election times.
- The direct effect of an increase in θ is 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.
- 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.
- 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 obvious effect of greater expertise in contracting.
- Another way to more explicitly link the existence or not of a regulatory agency to the model is to proxy it with the degree of capture γ, in the sense that a regulator distinct from the government itself is likely to limit the potential for political capture. Then, the existence of a regulator (lower γ) will result in less renegotiations.
- Finally, 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

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

[8] Guasch et al. (2006) consider an alternative way to model shocks in this model, in which an unanticipated shock affects the distribution of firm's types, with similar comparative statics.

[9] Note that we need to assume $\gamma<1+\lambda$, so the regulator still wants to minimize and not maximize the firm's rent.

Table 1
Concessions by country and sector

	Transport						Water				Total
	Air	Bus	Rail	Road	Port	Total	Potable water	Sewer	Composite	Total	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

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.

3. Empirical analysis

3.1. The data[10]

We use an original data set, developed by the World Bank, which describes the characteristics of nearly 1000 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.

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. Most of the renegotiations in our sample respond to these criteria in the sense that they have given rise to either tariffs adjustment not envisioned in the contract, rendering the bidding procedure almost meaningless (e.g. the 1993 water and sanitation concession in Buenos Aires), changes in the ownership share to be taken by the private operator or the shares of gross revenues/transfers corresponding to the government (e.g. the 1996 railway concession in Mexico; the Mexican toll roads program), or substantial changes in investment requirements (the airport concession in Lima, Peru; several water and toll roads concession, etc.).

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.

Restricting to the 5 countries (Argentina, Brazil, Chile, Colombia, and Mexico) where concessions were granted on a regular basis through the 1990s in these two sectors, we get a sample of 307 concessions. Table 1 shows the distribution by countries, sectors, and subsectors.

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.

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

[10] See Guasch (2001, 2004) for a more detailed description of the data and other aspects in this section.

Table 2
List of variables, source and summary statistics

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 3
Characteristics of the concessions by sector

	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 the government	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%

The time structure of the sample is also important. Table 4 presents the number of outstanding concessions by country, from 1989 to 2000, and 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 the table reveals the apparent importance of economic fluctuations and political shocks in determining renegotiations. Indeed, some of 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 in 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.

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 Argentina and Colombia, while in Brazil and Mexico renegotiations were almost always initiated by the government or both. In this paper, as mentioned before, we focus on these firm-led renegotiations, while government-led renegotiations are analyzed in GLS.

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 first estimate the following probit model, which allows us to take into account the specific characteristics

Table 4
Outstanding concessions and renegotiations by country and years

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Argentina													
Outstanding concessions	1	15	4	3	10	14	23	22	19	11	10	10	
Firm-led reneg.	0	12	2	1	0	0	1	3	10	3	0	0	32
Number of reneg.	0	12	2	1	0	0	1	3	11	3	0	0	33
Brazil													
Outstanding concessions						1	6	20	36	59	54	30	
Firm-led reneg.						0	0	0	0	0	0	0	0
Number of reneg.						0	0	0	1	5	24	6	36
Chile													
Outstanding concessions				1	1	3	6	9	16	19	20	24	
Firm-led reneg.				0	0	0	0	0	0	1	0	0	1
Number of reneg.				0	0	0	0	0	0	1	0	0	1
Colombia													
Outstanding concessions				1	6	18	22	29	37	42	45	43	
Firm-led reneg.				0	0	0	0	0	0	0	1	14	15
Number of reneg.				0	0	0	1	1	0	0	3	14	19
Mexico													
Outstanding concessions	9	23	34	45	61	67	66	52	48	56	58	58	
Firm-led reneg.	0	0	0	1	0	1	2	0	1	0	0	0	5
Number of reneg.	0	1	1	8	12	14	21	11	3	2	0	0	73
All countries													
Outstanding concessions	10	38	38	50	78	103	123	132	156	187	187	165	
Firm-led reneg.	0	12	2	2	0	1	3	3	11	4	1	14	53
Number of reneg.	0	13	3	9	12	14	23	15	15	11	27	20	162

of each individual concession contract, as well as aspects of the environment that evolve over time:

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

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. The output of these estimations is in Tables 5–7.

3.3. Results

The upper panel of Table 5 shows the results for our basic specification, including the characteristics of the contracts, the regulatory and institutional environment, a transport 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 a specification 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 macro-economic 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 prove consistently 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 positive but not significant, and in column 4, an index of corruption shows that a more corrupt environment increases renegotiations.[11] 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.

3.3.1. Existence of a regulator

The lower panel of Table 5 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.

Before discussing the estimates, it is important to make clear what this variable means. In our data set, it is considered that there is an existing regulator if the specific concession is regulated by an agency distinct from the (local) government itself. This happens to be the case for 13.5% of the water concessions and 77.1% of the transport concessions in the sample. It is also important to note that the regulatory structure in the two sectors under study differs. In particular, transport contracts are generally regulated at the state or federal level, while water concessions, due to their local nature, are more likely to be under the responsibility of local cities or states. Which of these agencies will be more efficient and/or more honest is however open to debate, as one needs to consider both their level of resources and training, but also the stakes involved.[12]

Looking more specifically at the concessions, we see that in the water sector the only ones with a regulatory body in place at the signing of the contract are composite potable and waste water treatment contracts in 3 Argentinean provinces (Tucuman, Saltas and Misiones), 2 Chilean cities (Valparaiso and Santiago), and 7 Colombian cities. In each case, a regulatory agency was in place and, despite being mostly appointed and funded by the executive power (although the Argentinean regulators receive part of the tax on bills), enjoyed some degree of independence from the government. Conversely, transport concessions awarded in the absence of a regulatory agency are the exception. A majority of cases is in the road sector, more specifically Argentinean and Chilean national roads, including part

[11] 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).

[12] This is an important question, but we do not pursue it here as it is beyond the scope of this paper. See for example Bardhan and Mookherjee (2006).

Table 5
Random effect probit panel

	(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 requirement		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 observations	1267	1132	1100	1132	1122
Log likelihood	−143.59	−132.49	−130.97	−125.21	−144.92
Marginal effects (dy/dx) [a]					
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

Dependent variable: Dummy variable indicating the occurrence of renegotiation initiated by the firm.
Standard errors in parenthesis. Coefficients significant at the 1% (***), 5% (**) and 10% (*) level.
[a] For dummy variables, d$y/$dx is for discrete change from 0 to 1. For continuous variables, it corresponds to an increase by 1 unit.

of the Panamerican highway. In Argentina, they correspond to contracts awarded at the beginning of the 1990s, before the creation of the regulatory agency in 1993, and in Chile to contracts regulated directly by the ministry of public works (MOP).

Note finally that the existence of a regulatory agency as defined above cannot be considered as a simple proxy for the implementation of a certain type of regulation like for example price cap. Indeed, the correlation between these two variables is negative in our sample (−0.19), and they retain explanatory power when introduced simultaneously.

Compared to a situation where no regulator is around when the concession contract is signed, the presence of such a regulator consistently implies an average reduction in the probability of renegotiation of between 5 and 7.3%. Note that marginal effects for individual variables may more than offset the average probability of renegotiation predicted by the model. This stems from the fact that the average probability of renegotiation is computed maintaining all variables equal to the sample mean, which of course does not correspond to any existing contract, and marginal effects are then computed by making one variable vary (by one unit if continuous, from 0 to 1 if binary) while maintaining all other variables equal to this sample mean.[13]

To better evaluate the marginal impacts, let us consider an experiment in which we estimate the change in the probability of renegotiation induced by changing

[13] An alternative measure, based on averaging across observations the probabilities predicted by the model (column 2), gives an average probability of renegotiation of 2.9%.

Table 6
Random effect probit panel

	(1)	(2)	(3)	(4)	(5)
Existence of regulatory body	−0.94*** (0.31)	−1.10*** (0.22)	−0.97*** (0.39)	−1.15*** (0.23)	−1.07*** (0.22)
Price cap	0.72** (0.62)	0.45 (0.36)	0.59** (0.35)	0.63* (0.33)	0.58* (0.33)
Duration since award	0.21*** (0.05)	0.18*** (0.05)	0.25*** (0.06)	0.18*** (0.05)	0.20*** (0.05)
Investment requirements	0.58 (1.68)	0.79** (0.39)	0.77** (1.72)	0.74* (0.29)	0.83** (0.40)
Private financing	0.16 (0.95)	0.55** (0.27)	0.40 (1.19)	0.40 (0.29)	0.48* (0.27)
Bureaucratic quality	−0.35*** (0.17)	−0.32** (0.15)	−0.41*** (0.16)	−0.29* (0.16)	−0.36** (0.14)
Arbitration process (IV)	1.15*** (26.33)				
Minimum income guarantee		0.16 (0.23)			
Minimum income guarantee (IV)			−0.99* (0.75)		
Bidding process				−0.27 (0.30)	
Duration of contract					−0.015 (0.015)
Election-1	0.30 (0.19)	0.29 (0.19)	0.31 (0.17)	0.30 (0.19)	0.28 (0.19)
GDP growth-1	−0.06** (0.02)	−0.06*** (0.02)	−0.06** (0.02)	−0.06*** (0.02)	−0.06*** (0.02)
GDP growth-2	−0.14*** (0.02)	−0.14*** (0.02)	−0.13*** (0.03)	−0.14*** (0.02)	−0.14*** (0.02)
Transport sector dummy	0.03 (1.40)	0.69* (0.36)	−1.01* (1.18)	0.80** (0.34)	0.70** (0.35)
Number of observations	1132	1127	1132	1132	1128
Log likelihood	−128.76	−132.26	−129.27	−132.08	−131.95
Marginal effects (dy/dx) [a]					
Existence of regulatory body	−0.037	−0.051	−0.037	−0.055	−0.048
Price cap	0.010	0.008	0.008	0.010	0.009
Duration since award	0.005	0.005	0.006	0.005	0.005
Investment requirements	0.010	0.013	0.011	0.013	0.013
Private financing	0.004	0.013	0.009	0.010	0.011
Bureaucratic quality	−0.009	−0.009	−0.010	−0.008	−0.009
Arbitration process	0.029				
Min income guarantee		0.005	−0.023		
Bidding process				−0.009	
Duration of contract					−0.0004
Election-1	0.009	0.009	0.009	0.010	0.008
GDP growth-1	−0.001	−0.002	−0.001	−0.002	−0.002
GDP growth-2	−0.003	−0.004	−0.003	−0.004	−0.004
Transport sector dummy	0.001	0.013	0.015	0.015	0.013

Dependent variable: Dummy variable indicating the occurrence of renegotiation initiated by the firm.
Standard errors in parenthesis. Standard errors in columns 1 and 3 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 2.5th percentile and the upper endpoint is the 97.5th 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.
[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.

just one characteristic of an existing contract. We consider three actual contracts from our sample.

- Contract 1 is the Buenos Aires Pacifico–San Martin rail cargo concession in Argentina. It was signed in 1993, in the absence of a regulator and was subsequently subject to a price cap. As of 1997, the date of renegotiation, the model predicted probability of renegotiation is 29.7%. The reason invoked was a combination of sharp decrease in demand and important reduction in competing truck transport tariffs that became cheaper than the train.
- Contract 2 is the potable and waste water treatment concession in Buenos Aires, Argentina. This concession contract was signed in 1993, again in the absence of a regulator and subject to a price cap scheme until its renegotiation at the initiative of the firm in 1997, due mostly to insufficient revenues and resulting in cuts in expansion targets, delays in investment and a new tariff system. In its last year, the model predicts a probability of renegotiation of 9.9%.
- Contract 3 is a sewage contract in Chihuahua Sur, Mexico, signed in 1992 and renegotiated in 1995. No regulator pre-existed that contract and regulation was a price cap. In 1995, the model predicts a probability of renegotiation of 3.1%. The peso crisis precipitated renegotiation, which eventually led to the suspension of the contract.

Table 7
Random effect probit panel

	(1)	(2)	(3)	(4)
Sample	Basic	Without Brazil and Chile	Basic	Basic
Dependent variable	Reneg. initiated by firm or both	Reneg. initiated by firm	Reneg. Initiated by firm	Reneg. initiated by firm
Existence of regulatory body	−0.85*** (0.19)	−1.66*** (0.26)	−0.82** (0.36)	−0.96*** (0.20)
Price cap	0.33 (0.27)	0.65* (0.34)	0.61* (0.33)	0.06 (0.35)
Duration since award	0.15*** (0.04)	0.27*** (0.06)	0.23*** (0.06)	0.18*** (0.05)
Investment requirements	0.72** (0.36)	1.64 (0.48)	1.14*** (0.42)	0.99*** (0.37)
Private financing	−0.06 (0.19)	−0.02 (0.27)	−0.25 (0.32)	0.73*** (0.24)
Bureaucratic quality	−0.39*** (0.12)	−0.34** (0.14)		−0.20*** (0.15)
Election-1	0.46*** (0.15)	0.38* (0.21)	0.27 (0.22)	0.27 (0.19)
GDP growth-1	−0.04** (0.02)	−0.08*** (0.02)	−0.06*** (0.02)	−0.05** (0.02)
GDP growth-2	−0.12*** (0.02)	−0.13*** (0.02)	−0.13*** (0.03)	−0.15*** (0.02)
Argentina dummy			7.25*** (0.47)	
Chile dummy			5.50 (−)	
Colombia dummy			6.73*** (0.61)	
Mexico dummy			5.72*** (0.57)	
Transport sector dummy	1.19* (0.36)	0.27 (0.40)	−0.18 (0.42)	
Road dummy				0.69 (0.20)
Number of observations	1132	908	1132	1132
Log likelihood	−188.84	−111.26	−109.09	−128.99
Marginal effects (dy/dx) [a]				
Existence of regulat. body	−0.065	−0.131	−0.005	−0.038
Price cap	0.014	0.009	0.001	0.001
Duration since award	0.008	0.006	0.001	0.004
Investment requirements	0.027	0.021	0.002	0.014
Private financing	−0.003	−0.0004	−0.001	0.016
Bureaucratic quality	−0.022	−0.008		−0.005
Election-1	0.031	0.011	0.001	0.008
GDP growth-1	−0.002	−0.002	−0.0002	−0.001
GDP growth-2	−0.007	−0.003	−0.0004	−0.004
Argentina dummy			0.999	
Chile dummy			0.973	
Colombia dummy			0.986	
Mexico dummy			0.479	
Transport sector dummy	0.041	0.005	0.001	
Road dummy				0.024

Coefficients significant at the 1% (***), 5% (**) and 10% (*) level.
[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.

Computing how these predicted probabilities would change if there had been a regulator at the time the contract was signed (while maintaining all other aspects unchanged), we gain a better insight into the huge impact of such an institutional development. Indeed, these probabilities would come down to 5.3%, 0.3% and 0.2% for contracts 1 to 3 respectively.

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.[14]

[14] See the example of the Buenos Aires water concession, running hundreds of pages and several volumes, mentioned in Klein (1998). In a different context (military procurement), Crocker and Reynolds (1993) argue that contracts are characterized by an optimal degree of incompleteness. We discuss the relevance of this concept for concession contracts in the conclusion.

However, there are limits to this approach. First, in a very complex 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.

3.3.2. Price regulation

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.

Conducting the same experiment as before with contracts 1 to 3, we find that had these concessions been regulated under a rate of return scheme, the predicted probabilities of renegotiation in their last year of existence would have been 13.8%, 3.3% and 0.8% respectively, to be compared with 29.7%, 9.9% and 3.1% for the actual contracts respectively.

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. We discuss it further in the last section.

3.3.3. Investment and financing

If, on top of basic performance requirements (service and quality) and price regulation, concession contracts include important investment requirements, they may end up being more sensitive to fluctuations in firm's productivity, shocks and wrong demand forecasts.[15] This may explain the positive effect of the investment variable in Table 5. As for the marginal effect, 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%.

3.3.4. Institutional and political context

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%. Going from the 1998 level of bureaucratic quality of Brazil or Colombia to that of Chile 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.[16]

3.3.5. Economic shocks

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% 2 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% 2 years later.

[15] Flyvberg et al. (2003) present systematic evidence of large forecasting errors for over 200 transport projects. In Latin America, 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 et al., 2000).

[16] See GLS for more on this.

Macroeconomic shocks can be thought of as exerting a negative effect on the 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 or decreasing net revenues if prices are in local currency and cannot be freely adjusted.

The contract characteristics introduced in columns 2 to 5 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 might thus be 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 may select specific clauses according to their (sometimes unobservable) characteristics or those of the projects. 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 are in general included as a mean to make risky concessions attractive to private agents.[17] A similar problem may apply to the type of tariff regulation chosen. A self-selection effect would suggest that more efficient firms prefer price cap regulation, which is more risky but allow them to get higher rents, but may also lead to think that riskier projects would be regulated by lower-powered (cost plus) schemes. The size of investment and type of financing that prevail might not be exogenous either, since private operators might 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 v 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. To do this, we need to find suitable instruments. The source of endogeneity is the correlation between explanatory variables (contract clauses) and the error term, because of omitted characteristics of the contracting parties (countries and operators) and of the projects. Country-specific unobserved factors are of a political and institutional nature (degree of political capture of regulatory institutions, general political culture), while operator-specific ones relate in particular to renegotiating skills and the tendency to indulge in strategic underbidding. To address this, we borrow the set of instruments developed in GLS, which are correlated with the prevailing contract clauses of interest, but not with the above unobserved effects.[18]

The instruments for each specific contract clause consist, for each project, of the average prevalence, at the time of contracting, of the same clause in the same sector and in different countries (Instrument1) and in different sectors and different countries (Instrument2). These instruments are valid because the correlation between the choice of a specific clause (say minimum income guarantee) for a project in a specific sector (say a road contract signed in 1998) of a given country (say Colombia) is only correlated to Instrument1 (1998 average prevalence of minimum income guarantees in road contracts outside Colombia) through aspects, which by construction are independent of country-specific aspects. Similarly this choice is only correlated to Instrument2 (1998 average prevalence of minimum income guarantees in sectors other than roads outside Colombia) through aspects, which by construction are independent of both country- and sector- (and hence operator-) specific effects. These aspects include for example global technological trends or global policy trends favoring certain types of contracts, both generating common shifts in contractual choices across countries. To take the example above, by 1998 the result of the widespread use of minimum income guarantees in Mexico and elsewhere in the early 1990s (for roads as well as other sectors) was starting to lead international institutions and practitioners to adopt a different point of view with respect to the convenience of such guarantees, and this in turn was likely to be correlated with the

[17] This has indeed been the case for example in the toll road programs in Chile and Colombia.

[18] This instrumental strategy follows insights from the IO literature and contributions on the empirical effect of public capital. See GLS for references and a more detailed discussion.

likelihood that new projects in Colombia would make use of them.

We run probit estimates of the variables we want to instrument, using the static sample of the 307 concessions.[19] Note that these first stage estimations are fairly satisfactory (see Appendix A). We test for exogeneity of the variables under scrutiny, using the Rivers and 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 clearly rejected for the minimum income guarantee and the arbitration variables, while the test largely fails to reject it for the price cap, the investment, the private financing and the bidding variables (see *p*-values in the last row of the table in Appendix B).

The rejection of endogeneity for the key variables in our analysis, namely price cap and the financing variables, gives confidence in the results discussed in the previous section.[20] Still, it is of some interest to see the behavior of the two variables deemed endogenous once they are instrumented. We take the predicted values of each of them and reintroduce them in the probit panel. Finally, we estimate the equations with these instrumented variables.[21] 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 boot-strapped standard errors for the IV estimations. The results are in Table 6.

Arbitration, in column 1, is now positive and significant, meaning that its presence in the original contract is likely to induce more renegotiation. This accords with our theoretical discussion that stressed that any mechanism making renegotiation less costly should increase its probability.

Minimum income guarantee is introduced in columns 2 and 3. In column 2, the coefficient is positive but not significant. We instrument it in column 3. It now shows up negative and marginally significant. While minimum income guarantees can be expected to reduce incentives to behave efficiently and/or foster strategic underbidding, they also in principle protect holders of concession contract against shocks and other unforeseen contingencies. We conclude that this second effect dominates here, therefore reducing the likelihood of firm-led calls for renegotiation. Note however that GLS show that this clause instead increase the probability of government-led renegotiation, in particular probably to limit the accumulation of liabilities when concessions are making losses.[22]

The remaining results remain unaffected. The duration since award, bureaucratic quality, the lagged election and growth variables are all significant and with the same sign than in Table 5.

3.5. Robustness checks

Table 6, columns 4 and 5, and Table 7 present various robustness checks. First, in Table 6 we introduce additional variables that could potentially affect the probability of renegotiation. These are the existence of a bidding process previous to the award of the contract and the duration of the contract.

In column 4, 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 that may cancel out: 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, since ex ante competition reduces the winning firm's prospective profits, it could also make it more sensitive to shocks. Finally, strategic bidding behavior can also generate an increase in subsequent renegotiations.

In column 5, the duration of contracts is also negative but not statistically significant. More interestingly, our previous results with respect to price caps, investment, institutional quality and shocks, are robust to the introduction of these variables. As for the marginal effects, they are basically unchanged, with average values around −5% for the existence of a regulator, 3% for the existence of a price cap scheme, 0.5% for one

[19] Following Laffont (2005), we complete first-stage estimations with a set of non-excludable, exogenous variables: per capita GDP, sector dummies, corruption, bureaucracy quality, rule of law, and existence of regulatory body.

[20] The existence of a regulator at the time of contracting is clearly exogenous as well.

[21] 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, 2001), 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. GLS also show in the case of government-led renegotiation that a linear probability model estimated by two-stage least square gives very similar results.

[22] In Colombia, the accumulated fiscal cost of such guarantees is estimated at nearly US$100 million (INCO, 2004).

additional year since award, −1% for a one point increase in the index of bureaucratic quality, 1% for elections, and, 0.2% to 0.4% for lagged growth shocks.

Table 7 offers some more robustness checks. Since we are focusing on 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.[23] The results in column 1 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. Marginal effects in column 1 are also larger than our base values from Table 5, but technically this is due to the fact that we consider more renegotiations (68 instead of 53).

In column 2, 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.[24]

In column 3, we exclude institutional variables and include instead a full set of country dummies. The main results remain unchanged, except the election variable that loses significancy. 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, the marginal effects of most contract and environment variables are reduced, especially so for the election and growth shocks variables.

In column 4, 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 are in line with the base values from Table 5. The private financing variable is however positive and significant, indicating that this dimension might be of more specific importance for the water sector.

Finally, in the light of the fact that the transport sector in particular has characteristics making it prone to renegotiation, it is worth mentioning that the focus on two sectors only and firm-led renegotiation only does not appear to lead to a selection bias. Indeed, in previous versions of this work we included the whole sample of nearly 1000 concessions in four sectors, and looked at the determinants of all renegotiations, regardless of the initiator. The main results discussed above (importance of a regulator and of the type of regulation, relevance of shocks) were unchanged.

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. Our findings 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 opportunistic renegotiations. As it was shown, the existence of a regulatory body at the time the concession was awarded dramatically 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, which often was not the case in Latin American countries. There was a general, self-serving presumption that initially a contract was sufficient and the agency would be developed later, if at all. Thus, measures that reduce the probability of renegotiation through improving the quality of contracting, increasing predictability and improving the governance environment, 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. Price caps regulate over 75% of Latin American infrastructure concessions. Unfortunately, it appears that the choice of price cap regulation being often the result of external advice, 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 (Alexander et al., 1996), and that the interaction of price caps and this increased cost of capital in high risk, weak governance environments would have implications on the incidence of renegotiation. Indeed, price caps' greater riskiness and fragility to shocks led to more renegotiations as shown in

[23] 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 originator.

[24] The marginal effects for the existence of a regulator in column 2 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).

this paper. As contracts were renegotiated very quickly, about 2 years on average, after the award of the concession (Guasch, 2004), 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. Ultimately, by endogenizing the review period, renegotiations tended to transform many price caps into rate of return regimes in bad times, delegitimizing the price cap regime.

All that argues, as a key policy implication, for reconsidering rate of return regulation or at least an hybrid regulatory scheme consisting of a cap and several cost pass-through clauses, as the salient choice for the regulatory regime, particularly in volatile environments and where there is weak regulatory capacity. Alternatively, some type of performance-based regulation, whereby risk-sharing mechanisms are introduced to differentially allocating the gains and losses resulting from different types of shocks, may be worth considering, especially in the light of the importance of macroeconomic shocks discussed below. In any case, the objective should be to retain some degree of incentives in the regulatory framework, while avoiding the major pitfalls of price cap regulation under a fairly volatile economic environment.

Note also that our conclusion with respect to the regulatory scheme are to be related with the approach of Bajari and Tadelis (2001), and Bajari et al. (2003). These papers posit that the procurement contracts prevailing in practice are the result of an efficient trade-off between the provision of incentive ex ante and ex post transaction costs linked to costly renegotiation. There, more incentives reduce cost but make ex post adaptation to unforeseen contingencies more difficult. In contrast, in the context of infrastructure concession contracts, our empirical results concerning the fragility of price cap regulation would seem to imply that at least some contracts have relied on a sub-efficient form of regulation. We believe that this difference can be readily explained by the fact that price cap regulation has very often been imposed by external advisory bodies on countries lacking experience with privatization of infrastructure, and is therefore more the result of historical circumstances than the optimal choice of agents faced with a trade-off such as the one mentioned above. In our view, the general prevalence of price cap in developed countries that led the way of privatization in the 80s, together with the institutional constraints faced by poor countries lacking previous experience with regulation, account for the fact that in most cases governments willing to quickly attract private investment in infrastructure were left with price caps as the only readily viable option.

Finally, the political cycle and macroeconomic shocks are both highly significant determinants of renegotiation. The policy implications revolve around 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. This is clearly an important policy question requiring further research. However, the potential adverse incentive effect of any type of implicit guarantees would have to be taken into account. Moreover, it is unclear how such guidelines, including for example the implication of arbitration bodies from outside the countries undertaking the projects, could be enforced in the face of large economic and political shocks, as the recent experience in Argentina shows.

Appendix A. A Model of concession renegotiation

A.1. Optimal regulation

This subsection simply restates an ex ante contracting version of the Laffont and Tirole (1993) regulation model, which is then extended to allow for renegotiations along the line of Laffont (2003). 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 $\{\underline{\beta}, \overline{\beta}\}$ with $\nu = \Pr(\beta = \underline{\beta})$ and e is a decision variable of the firm (moral hazard) which decreases cost, but creates to the manager a disutility $\Psi(e)$ with $\Psi' > 0$, $\Psi'' > 0$, $\Psi''' \geq 0$.

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

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

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:

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

where we make use of Eq. (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:

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

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

$$\widehat{W} = U + V = S(q) + \lambda p(q)q - (1+\lambda) \times((\beta - e)q + F + \Psi(e)) - \lambda U. \tag{5}$$

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 ($-\lambda U$ in Eq. (5)). This occurs as long as the weight of the firm's rent in social welfare is lower that $1+\lambda$.

Under complete information, the maximization of social welfare would lead to[25]:

$$S'(q^*) + \lambda(p'(q^*)q^* + p(q^*)) = (1+\lambda)(\beta - e^*) \tag{6}$$

$$\Psi'(e^*) = q^* \tag{7}$$

$$U = 0. \tag{8}$$

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 ($S'(q)=p$), Eq. (6), which says that social marginal utility equals social marginal cost, can be rewritten as a Lerner index formula:

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

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

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

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 Fig. 1 for the timing).

Eq. (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 $\{(\underline{t}, \underline{c})\}$, $(\overline{t}, \overline{c})$, 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. We know (see Laffont and Martimort, 2002) that the relevant incentive constraint is the one of type $\underline{\beta}$:

$$\underline{U} = \underline{t} - \Psi(\underline{\beta} - \underline{c}) \geq \overline{t} - \Psi(\underline{\beta} - \overline{c}) \Leftrightarrow \underline{U} \geq \overline{U} + \Phi(\overline{e}) \tag{9}$$

where $\underline{U}$ (resp. $\overline{U}$) represents at a truthful equilibrium the rent of type $\underline{\beta}$ (resp. $\overline{\beta}$), and $\Phi(e) \equiv \Psi(e) - \Psi(e-\Delta\beta)$, $\Phi'>0$, $\Phi''>0$.

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

$$v\underline{U} + (1-v)\overline{U} \geq 0. \tag{10}$$

Rewriting this program in terms of the variables (q, e, U) rather than (q, c, U) ,and denoting W (q, e, β) the complete information ex post social welfare[26] for a production level q and an effort level e when the efficiency parameter is β, the regulator's program becomes:

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

s.t. Eqs. (9) and (10).

The regulator makes the participation constraint binding and, substituting in the objective function,

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

[26] So $W(q, e, \beta) \equiv S(q) + \lambda p(q)q - (1+\lambda)((\beta-e)q + F + \Psi(e))$.

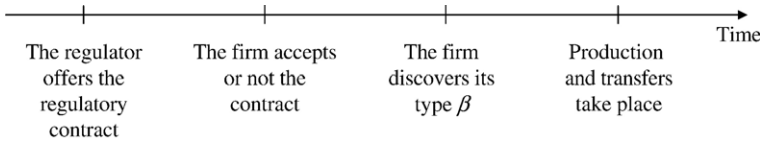

Fig. 1. Timing.

maximizes social welfare.[27] 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.[28]

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.[29]

A.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.[30] However, with a probability $\theta\pi(x)$, 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 $\pi(0)=0$, $\lim_{x\to\infty}\pi(x)=1$, $\pi_x>0$, $\pi_{xx}<0$. Moreover, 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.

With probability $1-\theta\pi(x)$ 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.[31] As made clear below, we are modelling a situation of ex ante contracting under symmetric albeit incomplete information, and because it is only the inefficient firm that seeks renegotiation after learning its cost parameter, the state of the world is common knowledge ex post. Therefore, costly bargaining takes place under complete information, only when $\beta=\overline{\beta}$. Its outcome solves:

$$\max_{\overline{q},\overline{e},\overline{U}^E}(\overline{U}^E-U_0)(\delta W(\overline{q},\overline{e},\overline{\beta})-\lambda\overline{U}^E-W_0), \tag{11}$$

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

$$\overline{U}^E=\frac{\delta W(\overline{q}^*,\overline{e}^*,\overline{\beta})+H}{2\lambda}-\frac{F}{2}, \tag{12}$$

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.

[27] See Laffont and Martimort (2002).

[28] This loss is minimized when Eq. (9) is binding.

[29] If, at the other extreme, the regulator anticipates that he will not be able to enforce a negative ex post utility level for the firm, he will choose a regulatory contract, which maximizes expected social welfare under the incentive constraints, but also the ex post participation constraints $\underline{U}\geq 0$ and $\overline{U}\geq 0$. This is similar to a model with ex-post contracting, i.e. offered to the firm at the interim stage, once it knows its type. In this case, 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 (see Laffont and Martimort, 2002).

[30] 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.

[31] See conditions in footnote 34 below.

The sequence of events is now the following. If the firm discovers to be a bad type $\overline{\beta}$, with probability $\theta\pi(x)$ it faces tough enforcement and carries out the project despite a negative utility. With probability $1-\theta\pi(x)$, 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.[32]

The resulting probabilities are:

$$\Pr(U=\underline{U}_1)=v$$
$$\Pr(U=\overline{U}_1)=(1-v)\theta\pi(x)$$
$$\Pr(U=\overline{U}^E)=(1-v)(1-\theta\pi(x))(1-P)$$
$$\Pr(U=-F)=(1-v)(1-\theta\pi(x))P.$$

We still need the offer of contracts to be incentive compatible (condition (9)) and the new ex ante participation constraint writes:[33]

$$v\underline{U}_1+(1-v)\theta\pi(x)\overline{U}_1+(1-v)(1-\theta\pi(x))(1-P)\overline{U}^E - (1-v)(1-\theta\pi(x))PF\geq 0. \quad (13)$$

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

$$\max_v v[W(\underline{q},\underline{e},\underline{\beta})-\lambda\underline{U}_1]+(1-v)\theta\pi(x)[W(\overline{q},\overline{e},\overline{\beta})-\lambda\overline{U}_1] + (1-v)(1-\theta\pi(x))(1-P)[\delta W(\overline{q}^*,\overline{e}^*,\overline{\beta})-\lambda\overline{U}^E] +(1-v)(1-\theta\pi(x))P[-H]-(1+\lambda)x. \quad (14)$$

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

$$\underline{q}^E=\underline{q}^*;\underline{e}^E=\underline{e}^* \quad (15)$$

$$\overline{q}^E=\overline{q}^*;\overline{e}^E=\overline{e}^* \quad (16)$$

$$(1-v)\theta\pi'(x^E)=\frac{1+\lambda}{(1-\delta)W(\overline{q}^*,\overline{e}^*,\overline{\beta})+P[\delta W(\overline{q}^*,\overline{e}^*,\overline{\beta})+H+\lambda F]} \quad (17)$$

With all these ingredients, the probability of renegotiation is given by:

$$\Pr(\text{renegotiation})=(1-v)(1-\theta\pi(x^E)) \quad (18)$$

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.

[32] This is indeed the case in practice for around 10% of the renegotiations.

[33] 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. $\underline{U}_1\geq\theta\pi(x)[\overline{U}_1+\Phi(\overline{e})]+(1-\theta\pi(x))(1-P)[\overline{U}^E+\Phi(\overline{e}^*)]+(1-\theta\pi(x))P[-F]$.

A.3. Limited liability

Although the presentation is more intuitive in the ex ante contracting case, the model can accommodate the fact that the firm be protected by limited liability. In particular, this allow us to consider the financing structure of the project. Without entering into details, the firm can rely on bank financing, but should be guaranteed enough profit to pay back its loan. Alternatively, the government may step in to second insufficient private financing. The relative shares of private and public financing then affect the tightness of the firm's limited liability constraint.

As shown in an extension of the present model,[34] the effect of limited liability is in essence to make the status quo payoffs, and therefore the ex post probability of renegotiation, dependent on the variables determining the stringency of the limited liability constraint, for example here the amount invested and the share of private financing. The direct effects are linked to the fact that an increase in investment and in the share of private financing increase cost to the firm, decreasing the regulator's gain from avoiding renegotiation and improving its bargaining power.

There is, however, an incentive effect of the limited liability constraint. Indeed, the expected utility of the firm is now strictly positive.[35] Therefore, it has incentives to invest to increase its expected profit. Suppose that with expenses $i(v)$ ($i'(v)>0$, $i''(v)\geq 0$) the firm increases the probability that $\beta=\underline{\beta}$. The firm chooses its investment level by solving:

$$\max_v v\Phi(\overline{e})+(1-v)(1-\theta\pi(x^L))((1-P)\overline{U}^E-PA)-i(v).$$

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

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

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. With this effect in mind, the effect of any variable affecting the statu quo payoff of the firm, such as investment and financing, on the probability of renegotiation becomes ambiguous and therefore an empirical question.

[34] This and other extensions discussed in Section 2 of the paper are presented in Guasch et al. (2006).

[35] Limited liability makes the model similar to the ex post contracting case in that a rent is left to the good type firm (see footnote 30).

Appendix B

Table A1
First stage estimations

	(1)	(2)	(3)	(5)	(6)	(7)
	Price cap (PC)	Investment requirements (IR)	Private financing (PF)	Arbitration process (AP)	Min. income guarantee (MI)	Bidding process (BP)
Constant	50.574	6.218	2.366	14.376	14.723	4.765
	(32.985)	(1.209)***	(1.415)*	(6.762)**	(3.502)***	(3.719)
Per capita GDP	0.000	−0.000	−0.000	0.002	−0.002	0.000
	(0.000)	(0.000)	(0.000)	(0.000)***	(0.000)***	(0.000)
Existence of regulatory body	−3.823	0.018	−1.584	−1.219	−2.215	0.940
	(1.585)**	(0.354)	(0.477)***	(0.668)*	(1.639)	(0.351)***
Corruption	1.192	0.332	−0.240	3.978	−0.095	0.844
	(0.450)***	(0.186)*	(0.200)	(1.223)***	(0.185)	(0.186)***
Bureaucratic quality	−3.084	−0.297	0.476	1.904	0.008	−1.541
	(0.767)***	(0.192)	(0.251)*	(0.467)***	(0.256)	(0.270)***
Rule of law	0.237	−0.099	0.140	−1.700	0.677	0.952
	(0.496)	(0.175)	(0.244)	(0.665)**	(0.616)	(0.241)***
Water sector dummy	−1.669	−2.505	−2.083	−38.847	−4.481	2.006
	(1.293)	(0.402)***	(0.402)***	(11.032)***	(1.548)***	(0.554)***
PC_instrument1	−63.268					
	(26.357)**					
PC_instrument2	22.522					
	(12.024)*					
IR_instrument1		−3.506				
		(0.589)***				
IR_instrument2		−0.563				
		(0.313)*				
PF_instrument1			−0.265			
			(0.459)			
PF_instrument2			−1.402			
			(0.512)***			
AP_instrument1				−35.900		
				(11.017)***		
AP_instrument2				−1.649		
				(0.779)**		
MI_instrument1					−3.865	
					(1.817)**	
MI_instrument2					0.115	
					(0.418)	
BP_instrument1						−7.045
						(1.226)***
BP_instrument2						2.069
						(2.368)
Observations	307	307	262	296	305	307
Rivers–Vuong test: *p*-value	0.27	0.75	0.55	0.01	0.00	0.70

Probit estimations. Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.
Specific instruments are averages of same variable (denoted by the variable abbreviation, e.g. PC: price cap, IR: Investment requirements, etc.) in different countries, for the same sector (_instrument1) and other sector (_instrument2).

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