Contractual flexibility or rigidity for public private partnerships? Theory and evidence from infrastructure concession contracts

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Contractual Flexibility or Rigidity for Public Private Partnerships? Theory and Evidence from Infrastructure Concession Contracts [1]

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Abstract: In this article, we explore the contractual design of toll infrastructure concession contracts. We highlight the fact that the contracting parties try to sign not only complete rigid contracts in order to avoid renegotiations but also flexible contracts in order to adapt contractual framework to unanticipated contingencies and to create incentives for cooperative behavior. This gives rise to multiple toll adjustment provisions and to a tradeoff between rigid and flexible contracts. Such tradeoff is formalized with an incomplete contract framework, including *ex post* maladaptation and renegotiation costs. Our model highlights the fact that trade-offs are complex and do not correspond to previous propositions coming from a transaction cost framework. More precisely, those previous works argue that a rigid contract is to be preferred as soon as specific assets are high. We highlight the fact that this proposition may be true, but only if other conditions concerning maladaptation costs, renegotiation costs and the probability to see the contract enforced are met. Furthermore, our results stress the fact that the institutional environment in which the contract is embedded matters. Propositions are tested using an original database of 71 concession contracts. Our results suggest an important role for economic efficiency concerns, as well as politics, in designing toll road concession contracts. In this perspective, our work complements other empirical studies on contractual price provisions (Masten-Crocker 1991, Crocker-Reynolds 1993, Bajari-Tadelis 2001, Bajari & al 2006), by considering the case of public-private contracting, as well as other studies on public-private partnerships, by focusing on toll adjustment provisions and documenting the effect of reputation and political ideology.

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0. Introduction

The "infrastructure gap" in Europe has been recognised for many years and its negative impact on economic growth, job creation and social cohesion is felt across every country within the region. However, governments have limited financial resources to devote to increased capital expenditure and improving public services, and they face restrictions (including those of the Maastricht Treaty) on their ability to raise debt. In order to bridge the gap between the cost of the infrastructure needed and the resources available, and to ensure that the infrastructure is delivered as efficiently and cost-effectively as possible, Public Private Partnerships (PPPs) are seen as one possible solution. The defining feature of a PPP is that the government buys services whereas in a conventional arrangement the government buys a physical asset. The fact is that in the last couple of decades, PPPs have become increasingly popular in many countries, and a variety of administrative arrangements have been used (see Grout and Stevens 2003).

Nevertheless, even in the UK where there is significant resort to PPPs, still 85% of public investment is delivered through conventional forms of procurement (HM Treasury 2003). At the same time, there is a bad feedback on experience in Latin American countries (Guasch 2004, Estache 2006,) but also in developed countries (Gomez-Ibanez and Meyer 1993, Engel & al 2006). This mixed context may be explained by significant contractual costs and difficulties to design such contractual agreements between a public authority and a private operator, especially concerning the way price should evolve in such long-term contracts. For example, it is often noted that "A key concern with long-term PPP contracts is the level of flexibility that they offer to authorities to make changes either to the use of assets or to the level and type of services offered" (PWC 05) but at the same time huge concerns have been raised regarding the high incidence of renegotiation of such contracts in practice (Guasch 2004, Estache 2006, Engel&al 2006, Martimort and Straub 2006).

In this paper, we address this issue by focusing on the question of *how* parties adjust prices – tolls – in toll road concession contracts (highways, bridges, tunnels). In these contracts, concessionaires undertake the design, building, financing and operation of the relevant facility and their main source of revenue are the tolls that they can charge to users for the whole length of the concession. We can find in these contracts a Toll Adjustment Provision (TAP), which consists in determining *ex ante* the tolls that can be charged to users *ex post*. While there have been some empirical studies of how the contracting parties choose among alternative pricing processes in private commercial contracts or in procurement contracts (Masten-Crocker 1991, Crocker-Reynolds 1993, Bajari-Tadelis 2001), there has been, to our knowledge, no such analysis in toll infrastructure concession contracts whereas these contracts are special agreements in numerous ways and should deserve a special attention.

First, they are very long-term contracts (often over 30 years) involving a degree of uncertainty that is much greater than in most ordinary contracts. Indeed, forecasting errors and associated risks are characteristics of infrastructure projects. Second, the likelihood of opportunism in concession contracts is not any more to be proved (Gomez-Ibanez and Meyer 1993, Engel & al. 2003, Bajari and al. 2004, Guasch 2004, Engel and al. 2006, Estache 2006). Third, the context of infrastructure concessions is frequently characterized by imperfect verifiability of the investments. Fourth and finally, the stakes involved in toll adjustment provisions are huge since they have a direct impact on users. Political considerations may therefore interfere in the design of toll road concession contracts. For all of these reasons, the necessity to shape efficient toll adjustment processes is crucial.

In order to highlight trade-offs between contractual flexibility and rigidity in the design of this price provision, we develop a simple model mixing incomplete contract theory (Hart 1995) and transaction cost theory. More precisely, we propose an incomplete contract theory model *with* renegotiation and maladaptation costs, permitting us to study alternative contract forms in a refined incomplete contract framework[2].

Besides, we argue it is crucial to introduce in the analysis a particular characteristic of such public-private contracts, namely the potential for renegotiation even if toll adjustment provisions are completely rigid and well designed. This problem, highlighted by our data, begins to be studied for less developed countries (Guasch 2004, Laffont 2005, Guasch-Laffont-Straub 2006) and also for developed countries (Gomez-Ibanez and Meyer 1993, Engel & al. 2006, Martimort and Straub 2006, Athias and Saussier 2007), and clearly contributes to the inefficiency of PPPs. Renegotiation is thus seen, in our model, more like a political decision than a way to avoid maladaptation costs of a rigid contract. We therefore consider the likelihood of contractual renegotiation as an independent dimension, not connected to the design of the contract that is signed. This is a way for us to insist on the fact that a more rigid contract is not a more complete (optimal) contract and thus a contract that is less probably renegotiated (Saussier 2000). This is in stark contrast to previous empirical studies on this topic, which consider that rigidity and completeness are synonyms, both reflecting a lower probability of renegotiation (Masten-Crocker 1991, Crocker-Reynolds 1993, Bajari-Tadelis 2001).

In deciding how to design the contract, contracting parties face a choice between a flexible contract, in which parties plan to renegotiate price once uncertainty unfolds, and a rigid contract, in which parties cannot commit not to renegotiate but attempt to prevent renegotiation. This leads to predictions about how contractual choices will vary across projects. Contracts for which uncertainty is low and hold-up severe are more likely to be rigid.

[2] Incomplete contract theory (a la Grossman and Hart), despite its name, is actually a theory of ownership rather than contracting. In restricting feasible contract forms, incomplete contract theory assumes what a theory of contracting seeks to explain (Masten-Saussier 2002).

We also argue that the trade-off identified in the model will play out differently across contracting parties' characteristics. As renegotiation will inevitably occur when contracting parties decide to devise a flexible contract, they have to account for with whom they sign the contract. Reputation is therefore an important dimension. The model suggests that lower reputational capital of the contracting parties will more likely lead to rigid contracts.

The model also leads to predictions about how contractual choices will vary across institutional frameworks. For instance, if the institutional framework of a country is such that the reliability of contract enforcement is weak, it will more likely lead to flexible contracts.

To test our propositions, we constructed an original database consisting of 71 worldwide toll road concession contracts. We show, in contrast to many papers that often assume the rigidity of such contractual relationships, that this rigidity seems to be the exception rather than the rule regarding toll adjustment provisions. Indeed, we observe in our sample a great variety of toll adjustment provisions, from very rigid ones such as firm-fixed price provision in which tolls are fixed for the whole length of the concession, to very flexible ones with the so-called renegotiation provisions, which consist in determining *ex ante* periodic *ex post* negotiations of the toll adjustment provision initially chosen.

We complement the data on the design of toll adjustment provisions with data gathered from contracts and other sources that describe the type of concessionaires, the traffic uncertainty and the complexity surrounding each project, the number of bidders, the country institutional framework, the experience of the public authority, the number of repeated interactions between the concessionaire and the public authority, political leanings, and so forth.

Our main empirical findings can be summarized as follows. First, results indicate a strong negative correlation between traffic uncertainty and the rigidity of the toll adjustment provision actually chosen, so that contracts for which traffic uncertainty is high are more likely to be flexible. Second, our data also reveals a substantial variation in contract design across contracting parties' characteristics. For instance, when the public authority and the concessionaire have contracted repeatedly before, contracts are more likely to be flexible. The presumption is that both had behaved reliably so that they both now have a better reputation with the other. This is consistent with previous empirical studies that document the effect of reputation on the choice of contracts (Crocker-Reynolds 1993, Banerjee-Duflo 2000) and with many recent studies (Bajari-McMillan-Tadelis 2003, Doni 2005, Schugart 2005) that insist on the fact that reputation particularly matters in PPPs. In addition, we also find strong evidence of political effects. Contracts signed with left leaning public authorities, rather than with right leaning public authorities, appear to be more likely rigid. This seems to corroborate the conjecture that private concessionaires have a better reputation among right wing public authorities. Finally, we find strong evidence that the institutional framework impacts on the rigidity of the toll adjustment provision chosen. In particular, our measure of the reliability of contract enforcement negatively correlates with the rigidity of the contract, so that stronger institutional frameworks will more likely lead to flexible contracts.

We believe the contribution of our article is twofold. At the theoretical level, by proposing an incomplete contract theory model with renegotiation and maladaptation costs and hence by making new propositions on the design of price provisions in contracts in a formalized way, in contrast to the previous papers on this topic (Masten-Crocker 1991, Crocker-Reynolds 1993). At the empirical level, by focusing on concession contracts and toll adjustment provisions, both never addressed before, with an original database.

The article is organized as follows. We begin in Section 1 with a discussion on the economic tradeoffs involved in designing public private contracts. We then propose in Section 2 a model of these tradeoffs leading to propositions that are to be tested. Section 3 describes the empirical implications of the model. In Section 4, we describe the contractual toll adjustment processes observed in our sample of contracts and in Section 5, we present the original data used in the empirical section. Section 6 contains the econometric results, and a final section provides concluding remarks.

1. Economic Tradeoffs in Contract Design of Public-Private Contracts

In order to develop their infrastructure, public authorities (States or local authorities) may decide to resort either to traditional procurement contracts or to PPPs. The key difference between PPPs and traditional procurement is that under PPPs the private sector delivers over the contract length services, not assets, although providing assets is often integral to the services. They are therefore not only responsible for asset delivery, but also for overall project management and implementation, and successful operations for several years thereafter. Thus, PPPs are complex long-term agreements, involving non-verifiable investments, usually for delivering complex services or at least services in which uncertainty is high.

The imperfect verifiability of the services in public private contracts has been largely emphasized.[3] We are thinking, for example, of how difficult it can be to demonstrate (and sanction) that amendments to the terms are required by the concessionaire's inability, rather than by unexpected external factors. Furthermore, the public authority often does not sue a

[3] In the literature, a contractual aspect is called perfectly verifiable when 1/ a third party can verify the case occurred in relation to this aspect; 2/ the cost of litigation that falls upon the Principal is not greater than the benefit which it can obtain from a sentence in its favour; 3/ the extent of the penalties is not subject to any limitation. When one of these three requisites is not satisfied, there is a risk of not being able to obtain the full enforcement of the contract (Doni 2005).

concessionaire for partial non-fulfillment of obligations, because litigation can require very long times and produce uncertain results, while it surely worsens the relationship with the counter-party. Lastly, the risks discharged on the contracting party cannot be unlimited. For this reason, the extent of the penalties cannot always be proportioned to the damage caused by imperfect fulfillment.

Such characteristics of the transaction impede the crafting of complete contracts (Hart 1995). These non-verifiable investments may result in higher surplus or better service quality delivered by the private operator. In this paper, we focus on concession contracts in which the private operator has residual control rights over the way the service is provided. We suppose that, after the initial contract has been agreed, the provider may underinvest or come up with innovative ways of providing the service. Since such innovations could not be foreseen when the initial contract was designed, bargaining may take place over the splitting of the surplus from implementation of the innovations. The private operator's anticipation of the outcome of such bargaining affects its incentive to research possible innovations, and its anticipation will depend on the contractual design (flexible or rigid).

The framework proposed by the incomplete contract theory seems therefore to fit well with public-private contracts. However the incomplete contract theory narrowed the focus on one type of transaction cost – the hold-up problem. Thus, in this theoretical framework *ex post* bargaining is always efficient. This paper focuses also attention on two different kinds of transaction cost: maladaptation costs due to misalignment of the contract with states of nature, and renegotiation costs, namely haggling and friction due to *ex post* changes and adaptations when contracts are incomplete. This focus is motivated by a careful examination of public-private contracts (Gomez-Ibanez and Meyer 1993, Engel and al. 2002, 2003 and 2006, Bajari and al. 2004, Guasch 2004, Estache 2006).

Besides, as noted above, in contrast to the previous literature on this topic (Masten-Crocker 1991, Crocker-Reynolds 1993, Bajari-Tadelis 2001), we assume that renegotiation costs are not a function of the contractual design. In other words, we believe that a contract in which contracting parties aim at covering *ex ante* most contingencies that may arise *ex post* is not always less renegotiated than a contract in which contracting parties do not have this goal.

2. The Model

2.1. Structure of the Model

We consider two contracting parties. One is the State or a representative (local public authorities). The other is a private operator. The contract is such that essentially the private party supports investments. This is coherent with what we observe in many PPPs. This is also what is considered by Hart (2003) as a specificity of such relationships.

A part of the investments performed by the private investors is non-verifiable (but not necessarily specific). Thus we make the assumption that it would be impossible or too costly for the State or a third party to check investments made by the private operator (see Part 1 of this paper for a discussion on this topic). We note these investments *i*. They generate a surplus noted *R(i)*.[4] We make the classical assumptions that $R'>0$, $R''<0$ and $R'''<0$.

To realize the transaction, the parties may sign two kinds of incomplete contracts:

- On the one hand a rigid contract, in which the contracting parties are trying to specify the way to coordinate according to future states of nature. In other words, in such a contract, the parties try to prevent renegotiation, essentially by deciding the price that will be charged by the private operator for the whole length of the contract.
- On the other hand a flexible contract, in which parties do not try to avoid renegotiation and plan to renegotiate price once uncertainty unfolds.

We note $f \in]0,1]$, where $\underline{f}$ ($\overline{f}$) represents the impact on the *ex post* surplus of a rigid (flexible) contract. Thus we make the assumption that the *ex post* realized surplus of the transaction is a function not only of the investments but also of the adequacy of the contract to states of nature. f measures this adequacy level. A rigid contract generates maladaptation costs (*i.e.* a realized surplus for the private operator $\underline{f}R(i) \leq R(i)$). A flexible contract generates renegotiation costs (*i.e.* a realized surplus $\overline{f}R(i) \leq R(i)$ to be shared between the contracting parties).

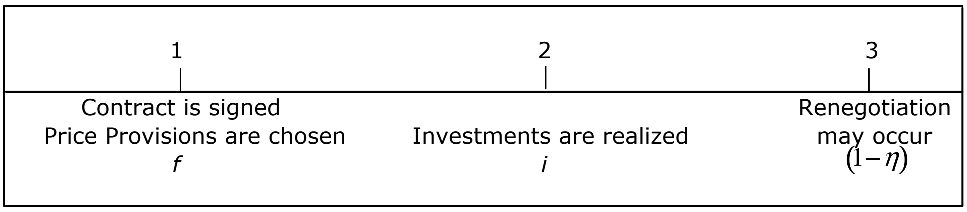
We note *r(i)* the value of the outside option of the private operator in the case of an *ex post* contract breach. We make the assumption that $r(i) = \alpha \cdot R(i)$ with α the level of investment specificity. When $\alpha \rightarrow 0$ then investments made by the private operator do not generate any surplus when used outside of the contractual relationship. Investments are therefore totally specific to the relationship.

Finally, as already explained, we consider the likelihood of contract renegotiation exogenous and we note $(1-\eta)$ the probability to see a rigid contract be renegotiated. This is another dimension of our model reflecting the specificity of public private partnerships. More precisely, the contracting parties are often in an asymmetric position and such contracts are often linked to political decisions so that such arrangements might be renegotiated independently of what has been decided initially in the contracts (Guasch 2004; Laffont 2005).

The timing of the model is standard.

[4] In many cases, operators face well defined investment obligations. Without loss of generality, we normalize the size of this contractible and verifiable investment to zero. The investment *i* must therefore be understood as any additional "efficiency investment", which we assume is non-verifiable although observable by both parties (See Schmidt 1996 for similar arguments).

Figure 1. Timing of The Model



2.2. Investment Levels and Contract Design

First Best

As a benchmark, it is useful to specify the first-best solution, which would obtain if investments were verifiable. Contracting parties would then choose investment level in a way to maximize the total economic surplus *S* generated by the contractual relationship given by

$$S = Bo - Co + R(i^*) - i^* \tag{1}$$

where *Bo* and *Co* are positive constants and respectively the social benefit and cost of providing the basic service without any investment.

Thus, the optimal level of investment is i^* such that

$$i^* \,|\, R'(i^*) = 1 \tag{2}$$

Flexible Contracting

When parties decide to sign a flexible contract, they accept the fact that they will have to renegotiate after investments have been made. Since the private operator is now entrenched as the provider, its bargaining power is not eroded by competition from other potential operators (given that it provides the service at, at least, the basic level specified in the initial contract). We therefore assume that the private operator and public authority (the government G) have equal bargaining powers and hence consider a renegotiation where the surplus generated by the non verifiable investments, R(*i)*, is shared between the parties through a Nash-bargaining solution.[5]

Private operator's objective function is profit π_c, where[6]

$$\pi_c = P_0 - C_0 + \frac{1}{2}\left[fR(i) + r(i)\right] - i \tag{3}$$

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[5] Thus, following Hart-Shleifer-Vishny (1997), we assume that the public authority does not maximize the global surplus during renegotiations: its utility function is given by the welfare of the rest of society, excluding the private operator. A justification for this is that the political process aligns the public authority's and society's interests (since the private operator has negligible voting power, his interests receive negligible weight). Of course, if the government placed the same weight on the private operator's utility as on the rest of society, the first-best could be achieved.

[6] The way the surplus is shared is nevertheless impacted by the outside options of each party.

where Po is the payment that the private operator would obtain if service provision were to be at its basic level. He chooses a level of investment i^f such as

$$i^f \left| R'(i^f) = \frac{2}{(\bar{f} + \alpha)} \right. \tag{4}$$

When the parties sign a flexible contract, the first best is not attainable, at the exception of a particular case where $\bar{f} = 1$ (*i.e.* there are no renegotiation costs) and $\alpha = 1$ (*i.e.* there are no specific investments). Surplus generated by such a contract is sub-optimal because of the low incentives for the operator to invest since he anticipates that he will have to let a part of the surplus generated by his investments to the State when renegotiation occurs ($i^f \leq i^*$).

Consumer surplus is then given by CS^f, where

$$CS_f = B_0 - P_0 + \frac{1}{2}\left[\bar{f}R(i^f) - r(i^f)\right] \tag{5}$$

The social surplus S^f, which is the sum of consumer surplus and the profit of the private operator is:

$$S^f = B_0 - C_0 + \bar{f}R(i^f) - i^f \tag{6}$$

Rigid Contracting and Parties Can Commit not to Renegotiate

When the contracting parties devise a rigid agreement and pledge that they will not renegotiate then the profit of the private operator is given by:

$$\pi_c = P_0 - C_0 + \underline{f}R(i) - i \tag{7}$$

The private operator only receives a part of the surplus generated by its investments, which depends whether the contract matches states of nature. He chooses a level of investment i^r such that

$$i^r \left| R'(i^r) = \frac{1}{\underline{f}} \right. \tag{8}$$

Consumer surplus is then given by CS^r, where

$$CS^r = B_0 - P_0 + (1 - \underline{f})R(i^r) \tag{9}$$

The *ex post* maladaptation of the contract results in the recovery by the consumers of a part of the surplus generated by the private operator's investments. This simply means that if the private operator thinks of investments in order to improve quality or other dimensions of the provided service, he anticipates that, because renegotiation is not an option, he will retain only a part of the generated surplus, depending on whether the initial agreement matches with states of nature. The other part is considered as a positive externality for consumers.

The total surplus is then given by S^r, with

$$S^r = B_0 - C_0 + R\left(i^r\right) - i^r \tag{10}$$

It can be noticed that, for a given level of investment, a flexible contract leads to a lower total surplus than a not renegotiated rigid contract. This is due to the fact that a flexible contract, in contrast to a rigid one, induces renegotiation costs that constitute deadweight losses. However, this does not imply that rigid contracts are always to be preferred to flexible ones since the global surplus is also a function of the investments realized by private operators. More precisely, under rigid contracting, private operators might underinvest for fear of contractual maladaptation, leading to a lower surplus compared to the flexible contracting case. This will be analyzed later.

Rigid Contracting and Parties Cannot Commit not to Renegotiate

Nevertheless, as discussed above, when parties sign a rigid contract, there is always a risk that this contract will not be applied *ex post* and will be renegotiated – thus leading to the case of an initial flexible agreement. Then, if we consider that a rigid contract might be renegotiated, the profit generated by such contract for the private contractor is given by

$$\pi_c = \eta\left[P_0 - C_0 + \underline{f}.R(i) - i\right] + (1-\eta)\left[P_0 - C_0 + \frac{1}{2}\left[\overline{f}.R(i) + r(i)\right] - i\right] \tag{11}$$

where (1-η) is the probability to see the *ex ante* rigid contract be renegotiated. The optimal level of investment is then given by

$$i^{rr} \middle| \; R'(i^{rr}) = \frac{2}{\alpha + \overline{f} + \eta(2\underline{f} - \alpha - \overline{f})} \tag{12}$$

We observe that when η = 1 (*i.e.* the probability to renegotiate a rigid contract is zero), we find the results that would occur when the government can credibly commit not to renegotiate (equations 8 and 12 are the same).

Consumer surplus is then given by

$$CS^{rr} = \eta\left[B_0 - P_0 + (1-\underline{f})R(i^{rr})\right] + (1-\eta)\left[B_0 - P_0 + \frac{1}{2}\left[\overline{f}.R(i^{rr}) - r(i^{rr})\right]\right] \tag{13}$$

It follows that the total surplus is

$$S^{rr} = B_0 - C_0 + (1-\eta)\overline{f}R(i^{rr}) + \eta R(i^{rr}) - i^{rr} \tag{14}$$

2.3. Comparisons

As discussed in the first part, we do not consider the case of rigid contracting without any renegotiation as a plausible one. Thus, in this part, we will always compare and contrast flexible and renegotiated rigid contracts.

Contractual Choices and Global Surplus

To be able to generate propositions about efficient contractual choices, and thus to be able to rank rigid and flexible contracting, we have to compare the generated total surplus under the two types of contracting.

More precisely, a rigid contract – but renegotiated with a probability $(1-\eta)$ – will be preferred to a flexible one when

$$S^{rr} > S^{f} \Leftrightarrow B_0 - Co + \overline{f}R(i^f) - i^f < B_0 - Co + (1-\eta)\overline{f}R(i^{rr}) + \eta R(i^{rr}) - i^{rr} \qquad (15)$$

Which leads to the following condition

$$\overline{f}R(i^f) - i^f \prec \overline{f}R(i^{rr}) - i^{rr} + \eta \underbrace{\left[R(i^{rr})(1-\overline{f})\right]}_{\substack{loss \quad of \quad surplus \\ due \quad to \quad renegotiation}} \qquad (16)$$

Because both investment levels i^{rr} and i^f are increasing in $\overline{f}$ but at different rates, it is not straightforward to find out clear propositions focusing on surplus comparison (*i.e.* a change in the level of $\overline{f}$ has a direct impact and an indirect impact through investment levels). [7] This is also true for the other parameters in our model. The partial derivatives in order to disentangle direct effect and indirect effects (*i.e.* through investment levels) of each of our parameters are presented in Appendix 0. They lead us to the following propositions.

<u>PROPOSITION 1</u>. (1) Suppose $\overline{f} \succ \alpha$.

Then, the higher the maladaptation costs (*i.e.* the lower $\underline{f}$), the more efficient a flexible contract compared to a rigid one.

Proof. (See Appendix 0)

The assumption $\overline{f} > \alpha$ is, in our case, a realistic assumption. Investments made in road infrastructures, because they are non removable, are completely specific to the relationship (*i.e.* $\alpha \to 0$). Furthermore, such contracts signed between private operators and the State,

[7] It is one striking difference between our model and standard incomplete contract models, in which renegotiation under symmetric information ensures that all organization choices yield an *ex post* efficient outcome (*i.e.* the only difference between the organizational choices concerns the choice of *ex ante* investment levels). This is not the case in our framework because we postulated renegotiation costs.

when they lead to renegotiation, are characterized by conflicts and renegotiation costs (*i.e.* $\overline{f} \succ\succ 0$).

Proposition 1 is intuitive. Signing a flexible contract is a way to avoid maladaptation costs. The higher the maladaptation costs, the more interesting it is to avoid them through a flexible contract.

Other trade-offs highlighted by our derivatives depend crucially on the investment level considered under each contractual form.

<u>PROPOSITION 2.</u>
(1) Suppose $\overline{f} > \alpha$
(2) Suppose $\eta \succ 0$
(3) $i^{rr} \succ i^{f} \Leftrightarrow \left(2\underline{f} - \overline{f}\right) \succ \alpha \Rightarrow \underline{f} \succ \frac{\overline{f} + \alpha}{2}$.

Then, the higher the probability to renegotiate a rigid contract, the more efficient a flexible contract compared to a rigid one.

<u>PROPOSITION 3.</u>
(1) Suppose $\overline{f} > \alpha$
(2) Suppose $\eta \succ 0$
(3) $i^{rr} \succ i^{f} \Leftrightarrow \left(2\underline{f} - \overline{f}\right) \succ \alpha \Rightarrow \underline{f} \succ \frac{\overline{f} + \alpha}{2}$.

Then, the higher the level of asset specificity (*i.e.* the lower α), the less efficient a flexible contract compared to a rigid one.

Proof. (See Appendix 0)

Condition (3) constrains maladaptation costs to be bounded compared to renegotiation costs. This is likely to be the case in our contracts since they include guarantees for the private operator in cases maladaptation costs are too high (like guarantees against *force majeure* risks).

Proposition 2 highlights the fact that rigid contracts might be useful only as long as contracting parties believe that it has a fairly good probability to be enforced. In fact, there is no point in signing a rigid contract if one knows that it will be renegotiated.

Proposition 3 stresses the fact that rigid contracts, by defining *ex ante* the way the surplus (generated by the investments made by the operator) is to be shared, might secure the operator.

<u>PROPOSITION 4.</u>
(1) Suppose $\overline{f} > \alpha$
(2) Suppose $\eta \succ \frac{R(i^{rr}) - R(i^{f})}{R(i^{rr})}$
(3) Suppose $i^{rr} \succ i^{f} \Leftrightarrow \left(2\underline{f} - \overline{f}\right) \succ \alpha \Rightarrow \underline{f} \succ \frac{\overline{f} + \alpha}{2}$.

Then, the lower the renegotiation costs, the more efficient a flexible contract compared to a rigid one.

Proof. (See Appendix 0)

Proposition 4 is intuitive. As soon as you consider the case when maladaptation costs are bounded compared to renegotiation costs (condition (1)), then the lower the renegotiation costs, the more efficient a flexible contract compared to a rigid one only if the probability not to renegotiate a rigid contract is high enough (condition (2)). If the probability to renegotiate the contract was nearly one, then there is no advantage of using flexible contracts compared to rigid one, because rigid and flexible contracts become similar devices.

Those propositions are intuitive. Nevertheless, we would like to point out the fact that they differ from previous incomplete contract theory models. As we already noticed, previous works using an incomplete contract framework focused on the make or buy issue, opening the way for critics saying that the incomplete contract theory is only a property right theory and has nothing to say about alternative contractual choices. Furthermore, our results highlight the fact that trade-offs are complex and do not correspond to previous propositions coming from a transaction cost framework (Masten-Crocker 1991; Crocker-Reynolds 1993). More precisely, those previous works argue that a rigid contract is to be preferred as soon as specific assets are high. We highlight the fact that this proposition may be true, but only if other conditions concerning maladaptation costs, renegotiation costs and the probability to see the contract enforced are met. Lastly, our results stress the fact that the institutional environment in which the contract is embedded matters. In fact, the probability to see the contract enforced is clearly part of this institutional framework.

3. Relating The Model To Data

Our model points out the costs and benefits of two types of contractual design. In this section, we describe the empirical implications of this model.

Our model yields one elementary prediction about how contractual choices will differ across institutional frameworks. As highlighted before, we assume that the likelihood of unanticipated renegotiation is exogenous, *i.e.* disconnected from the contractual design. Renegotiation is thus considered, in our model, as a political decision. The probability of renegotiation is therefore correlated with the institutional and regulatory environment in which the contract takes place. To the extent that it is useless to devise a rigid contract if one knows that it will be renegotiated, a first prediction is therefore that weak institutional frameworks (e.g. the reliability of contract enforcement is weak) will more likely lead to flexible contracts.

Our model also yields two predictions about how the contractual design will differ across project characteristics. First, the theory suggests that contracting parties are less likely to design rigid contracts for which the uncertainty is higher (proposition 2). The intuition is that maladaptation costs are a function of uncertainty, so that the higher the uncertainty, the higher the probability that the rigid contract will be badly specified. Second, following directly from proposition 3, the theory predicts that contracting parties are more likely to devise rigid contracts for which the degree of investment specificity is high.

A further set of predictions that emerges from the theoretical framework concerns the magnitude of the renegotiation costs. The model suggests that the higher the renegotiation costs, the more likely contracts will be rigid. The straightforward empirical implications of this proposition involve differences in contracting parties' characteristics as well as differences in institutional environments. In fact, on the one hand, costs of *ex post* adaptation are a function of the willingness of the contracting parties to enter or not in conflicts, haggling and friction. Thus, when parties decide to devise a flexible contract, they have to account with whom they sign the contract, as renegotiation will inevitably occur. Reputation is therefore an important dimension, reducing the probability of high *ex post* renegotiation costs. To this extent, it is possible that differences in political ideology (e.g. left or right leaning public authorities) might affect contractual choices. On the other hand, the institutional framework might also impact on the contracting parties opportunism to the extent that it impacts on the probability of success of an opportunistic behavior. Thus, weak institutional frameworks, in which the probability of success of an opportunistic behavior is high, imply the possibility of important renegotiation costs and then will more likely lead to rigid contracts. The overall impact of the institutional environment on the contractual rigidity is therefore ambiguous (it has a positive impact through η but a negative one through $\overline{f}$)

To test our propositions, we now turn to the case of toll adjustment provisions in infrastructure concession contracts.

4. Toll Adjustment Processes in Infrastructure Concession Contracts

4.1. The Particular Case of Infrastructure Concessions

The degree of complexity and uncertainty and the likelihood of opportunism come directly to bear in the design of infrastructure concession contracts. By its nature, infrastructure concession, as long-term contracts, involves a high degree of uncertainty. Some might therefore say that there is nothing new here and that most business decisions are taken in the face of uncertainty. But it is a matter of degree, and uncertainty in infrastructure decision is generally much greater than in most ordinary business decisions (Prud'homme 2004). As a matter of fact, forecasting errors and associated risks are characteristics of infrastructure projects. Studies of such errors show that construction costs are generally underestimated and traffic overestimated, by large amounts. Errors of 50% or more seem to be the rule rather than the exception (Pickrell 1990; Flyvbjerg 1997, 2002, 2003; Odeck 2004).

The likelihood of opportunism in concession contracts is not any more to be proved as well. The related literature to concession contracts, empirical (Gomez-Ibanez and Meyer 1993, Guasch 2004, Bajari and al. 2006, Engel and al. 2006, Estache 2006) as well as theoretical (Williamson 1976), points out that these contracts between a public authority and a private entity are particularly pervasive renegotiations prone. In a study on more than 1,000 concession contracts awarded during the 1990s in Latin America, Guasch (2004) found that, within three years, terms had been changed substantially in over 60% of the contracts. According to him, the frequency of renegotiation is troubling because the contractual changes often are not desirable. In some cases, renegotiations allow governments to expropriate concessionaires after they have sunk their investments. In other cases, concessionaires renegotiate contracts in order to shift losses to taxpayers.

The design of contractual compensation processes in infrastructure concession contracts is not regulated, *i.e.* there are no rules that determine the set of allowable toll adjustment processes. This is another particular feature of infrastructure concession contracts and this complete freedom in determining the contractual compensation arrangement explains their great diversity and complexity, highlighted in the next part. This strengthens the relevance of the analysis of the choice of the toll adjustment process.

Finally, concession contracts are most often awarded under an open bidding procedure, usually in two stages; in the first stage, private consortiums submit their technical qualifications, following the rules defined by the public authority. In the second stage, qualified consortiums, *i.e.* the consortiums selected after the first step, are allowed to bid. The concession is then awarded to the consortium with the best bid (sometimes there is an additional stage between the second stage and the selection of the best bid, which consists in selecting the two best bidders and asking them to submit in a third stage their Best and Final Offer). Most of toll road concession contracts are awarded via low-bid auctions with adjudication criteria going from the lowest toll, to the lowest public subvention required, or to the shorter length of the concession. Once the best offer is selected, there is the so-called "preferred bidder phase", during which the public authority negotiates with the preferred bidder the final terms of the contract. Thus, during this phase, the public authority and the private operator, through negotiation, have the opportunity to make the contract more rigid or more flexible. Although this preferred bidder phase is nowadays questioned because of transparency problems, leading to more and more adhesion contracts, all the contracts of our database are concerned by this phase. This feature of the award process of toll infrastructure concessions introduces reputational considerations in the choice of contractual terms, making the study of such a choice even more interesting.

4.2. Toll Adjustment Types

The toll adjustment processes that we have found in our sample, which we now address in detail, are summarized in the following Table 1. Toll – or price – adjustment processes can be divided into two categories, automatic processes and renegotiation processes, except for the most stringent possibility, the “firm-fixed price” contract (FFP), in which price is specified to be independent of future events. The FFP contracts are however very scarce in infrastructure concessions because of their high uncertainty, as discussed above.

Automatic Adjustment Processes

Automatic provisions adjust tolls periodically according to predefined formula. The most extreme, rigid form of this category is a definite escalator (DE) that adjusts tolls according to an explicit, predefined schedule, increasing tolls at a stipulated rate, for example. While the toll that applies at a particular date is easily determined by reference to the contract, definite escalators have the obvious disadvantage of failing to make use of information arising over the course of the relationship and thus suffer many of the deficiencies of firm-fixed price contracts. Parties have then devised DE contracts that provide more flexibility, by allowing the concessionaire a predefined margin around the adjusted price (DE/MARG). Still, even these contracts may miss cost or demand changes specific to a particular transaction and thus adjust tolls imperfectly. On the other hand, contracting parties are ensured of the sharing of the surplus.

In contrast, fixed-price with economic price adjustment (EPA) contracts attempt to relate contract tolls to market conditions as they unfold. The process of compensation is formulaic and the equation ties toll to market data such as the consumer price index or specific labor or materials indices. In practice, the flexibility of such a contract depends upon the number and importance of the indexed categories. This is the reason why we have distinguished the fixed-price with partial economic price adjustment contract, which uses the consumer price index to determine tolls according to an agreed-upon compensation formula (FP/CPI), from the fixed-price with economic price adjustment contract, which uses cost indices (FP/COST). Implementation remains thus straightforward, while tolls become more flexible. But the requirement that the contingencies and the compensation formulas must be explicitly prespecified constrains the flexibility of such contracts. Besides, the practicality of indexing is limited by the relationship-specific nature of many of the assets developed that isolates the parties from market alternatives. The possibility for the concessionaire to be ensured of a fixed minimum increase of the fixed-price through a definite escalator (FP/EPA/DE), or to have a predefined margin around the adjusted price (FP/EPA/MARG), or a traffic variation indexation (FP/EPA/TRAFFIC) in the compensation formula, even if it provides more flexibility, does not remove these drawbacks.

Parties have also devised adjustment provisions such as not-to-exceed price (NTEP) clauses, which afford more flexibility while constraining seller opportunism. The not-to-exceed price (NTEP) has been specified initially and the concessionaire has to negotiate with the public authority the determination of a firm price at or below the ceiling. Thus, NTEP contracts are not pure automatic adjustment processes insofar as the final price is the result of a negotiation but they are also not renegotiation provisions inasmuch as the contracting parties do not specify *ex ante* periodic negotiation of the toll adjustment process. In addition, in all the contracts resorting to this NTEP adjustment, the toll ceiling is loosened by indexing those tolls to the consumer price index (NTEP/CPI) or to prespecified cost indices (NTEP/COST). This approach entails less prespecification than FP/CPI or FP/COST, as contingencies that may influence the final toll are not enumerated. Nevertheless, the not-to-exceed-price specified initially may turn out to be unsuitable (due to forecasting errors on construction costs or traffic). Thus, to protect concessionaires from unsuitable compensation adjustment, parties have devised not-to-exceed-price with economic price adjustment contracts – CPI or COST or both – that either ensure the concessionaire a fixed minimum increase of the NTEP through a definite escalator (NTEP/DE/EPA), or an indexation to traffic variation (NTEP/TRAFFIC/EPA), or a margin of prices (NTEP/EPA/MARG). Still, even these contracts do not totally protect the concessionaire from an unsuitable ceiling toll. In addition, the need to check and validate traffic variation makes the provisions with indexation to traffic variation more costly to implement than mere index formulas and, being less definite, introduce a somewhat greater prospect of strategic behavior. The most flexible option, as an automatic adjustment process, affords the concessionaire total freedom in determining and imposing tolls during ten years and then establishes a NTEP with indexation to cost indices adjustment for the rest of the concession (FREE/NTEP/COST).

Renegotiation Adjustment Processes

Parties have also devised in our sample of contracts renegotiation provisions (RENEG), which consist in determining *ex ante* periodic *ex post* negotiations of the initial adjustment process. Thus, periodically, parties take into account the full range of relevant information before reaching agreement on toll. These provisions afford therefore the transaction a considerable degree of flexibility. Nevertheless, the parties may structure the negotiation process by, for example, defining in the contract the sequence of offers and acceptances or specifying the defaults if agreement cannot be reached. The advantage of renegotiation adjustment processes is obvious. They permit the parties to take full advantage of current information in adjusting tolls. Hence, they provide a high degree of flexibility. But they also expose the parties to the costs of having to negotiate mutually acceptable terms. Under these arrangements, there is a considerable scope for exercising subtle bargaining strategies.

The following table summarizes toll adjustment process. The first eight price adjustment processes are rigid enough to work without any external intervention. They clearly are rigid toll adjustments, accepting maladaptation costs in order to avoid *ex post* renegociation. The last seven price adjustment processes explicitly open the room for *ex post* negotiation as the final price is the result of a negotiation between the private operator and the public authority.

Table 1: Toll Adjustment Types

Type	Negotiated *Ex Ante*	Negotiated *Ex Post*
Firm-fixed price (FFP)	Price	No negotiation ex post
Definite escalator (DE)	Price , escalator	Only adjustment to price according to an explicit predefined schedule
Definite escalator with a margin (DE/MARG)	Price , escalator, margin	Only adjustment to price according to an explicit predefined schedule with the flexibility afforded by a predefined margin
Fixed price with partial economic price adjustment (FP/CPI)	Price, Economic price adjustment formula based on the consumer price index	Only formulaic adjustment to price as specified ex ante
Fixed price with economic price adjustment (FP/COST)	Price, Economic price adjustment formula based on specific labor or materials indices	Only formulaic adjustment to price as specified ex ante
Fixed price with EPA and with a definite escalator (FP/EPA/DE)	Price, Economic price adjustment formula, definite escalator	Only formulaic adjustment to price as specified ex ante and according to an explicit predefined schedule
Fixed price with EPA and with a margin (FP/EPA/MARG)	Price, Economic price adjustment formula, margin	Only formulaic adjustment to price as specified ex ante with the flexibility afforded by a predefined margin
Fixed price with EPA and with traffic variation indexation (FP/EPA/TRAFFIC)	Price, Economic price adjustment formula, traffic indexation	Only formulaic adjustment to price as specified ex ante and to traffic variation
Not-to-exceed price with partial economic price adjustment (NTEP/CPI)	Ceiling price, Economic price adjustment formula based on the consumer price index	A firm price at or below the ceiling
Not-to-exceed price with economic price adjustment (NTEP/COST)	Ceiling price, Economic price adjustment formula based on specific labor or materials indices	A firm price at or below the ceiling
Not-to-exceed price with a definite escalator and an economic price adjustment (NTEP/DE/EPA)	Ceiling price, definite escalator, Economic price adjustment formula	A firm price at or below the ceiling
Not-to-exceed price with a traffic variation indexation and an economic price adjustment (NTEP/TRAFFIC/EPA)	Ceiling price, Traffic variation indexation, Economic price adjustment formula	A firm price at or below the ceiling
Not-to-exceed price with economic price adjustment and with a margin (NTEP/EPA/MARG)	Ceiling price, Economic price adjustment formula, Margin	A firm price at or below the ceiling
Freedom during ten years and then NTEP/COST (FREE/NTEP/COST)	Ceiling price, Economic price adjustment formula based on specific labor or materials indices	A firm price at or below the ceiling after ten years
Renegotiation Adjustments (RENEG)	Initial automatic adjustment process, Frequency of renegotiation	A firm price

4.3. Toll Adjustment Types and Contractual Rigidity

The description of the toll adjustment processes found out in our sample of contracts, points out that contracting parties do not determine future prices with the same degree of rigidity. As already discussed, the choice between the various adjustment types will reflect the relative costs of governing relationships under the respective arrangements. On the one hand, renegotiation provisions generally offer wider latitude to respond to changing conditions but subject the parties to the need to negotiate prices on a regular basis. On the other hand, automatic adjustment processes avoid the expense of negotiations but are less sensitive to relationship-specific events.

As a consequence, we may rank the contract types encountered in infrastructure concessions according to a qualitative index of rigidity. The following tables 2 and 3 indicate the ranking of price adjustment processes that are used in the empirical part, where lower numerical values correspond to less rigid contracts[8]. The most specific contract in this regard is clearly the FFP, which permits no toll adjustment at all. When escalated by a definite adjustment or by an economic price adjustment tied to the consumer price index or the realized costs of important inputs, the contract is less rigid, yet more rigid than NTEP contracts, and their different variations, which afford the concessionaire more flexibility in determining tolls according to the actual context, but also substantial scope for opportunism. Nevertheless, the upper bound restrains the most opportunistic redistributive strategies, in contrast to renegotiation adjustments, which however permit the parties to take full advantage of current information.

Table 2: Dependent Variable Used in the Ordered Logit Estimations (11 groups)

	Frequency	Mean
TYPE = 1 if RENEG	3	6,28
= 2 if FREE/NTEP/COST	10	
= 3 if NTEP/EPA/MARG	10	
= 4 if NTEP/TRAFFIC/EPA	3	
= 5 if NTEP/DE/EPA	3	
= 6 if NTEP/COST or NTEP/CPI	4	
= 7 if FP/EPA/MARG	10	
= 8 if FP/EPA/TRAFFIC	2	
= 9 if FP/EPA/DE	12	
= 10 if FP/COST or FP/CPI	6	
= 11 if DE or DE/MARG or FFP	8	

[8] In order to perform econometric tests on toll adjustment processes, we have decided to make two classifications of our contracts. One classification reduces the number of observed processes from 15 to 11; the second one from 15 to 5. Using the two classifications is a way to see how robust our results are according to the way adjustments are classified.

Table 3: Dependent Variable Used in the Ordered Logit Estimations (5 groups)

	Frequency	Mean
TYPE = 1 if RENEG	3	3,42
= 2 if FREE/NTEP/COST	10	
= 3 if NTEP	20	
= 4 if FP	30	
= 5 if DE or FFP	8	

Our hypothesis is that the degree of contractual rigidity chosen by the contracting parties is influenced by the factors discussed in section 2.

5. Infrastructure Concession Contracts: Data

5.1. Description of the Dataset of Contracts

We have constructed a panel dataset consisting of 71 toll road concession contracts (highways, bridges, tunnels). These 71 contracts refer to 45 original contracts and to 26 renegotiated contracts, referred to as "supplemental agreements". These supplemental agreements correspond to non-anticipated agreed-upon modifications to the original contract[9], and the fact that they create new and different arrangements between the parties make it possible to consider them as new contracts (See Crocker-Reynolds 1993 for a similar methodology). Most projects in the sample (76%) are French, the rest concerns contracts from Greece, United Kingdom, Canada, Portugal, Benin, Chile and Thailand. Tables 4 and 5 show the distribution of the toll adjustment provisions according to their classification by country. The contracts have been devised with different operators. The oldest contracts in the sample were implemented in 1970, whereas the latest in 2005.

Table 4: Distribution of the Toll Adjustment Provisions (11 Groups) by Country

	COUNTRY								
TYPEADJUSTREGROUP 11	Benin	Canada	Chile	France	Greece	Portugal	Thailand	UK	Total
1				3					3
2				10					10
3				10					10
4				3					3
5		1		1				1	3
6					4				4
7				10					10
8			2						2
9				12					12
10		1	1	2		2			6
11	1			3			4		8
Total	1	2	3	54	4	2	4	1	71

[9] In contrast to Crocker-Reynolds (1993), these supplemental agreements are not contract renegotiations due to the presence of NTEP or renegotiation provisions in the initial contract. These supplemental agreements follow from the willingness of the contracting parties to change some contractual terms, including in some cases the initial toll adjustment process.

Table 5: Distribution of the Toll Adjustment Provisions (5 Groups) by Country

	COUNTRY								
TYPEADJUSTREGROUP 5	Benin	Canada	Chile	France	Greece	Portugal	Thailand	UK	**Total**
1				3					3
2				10					10
3		1		14	4			1	20
4		1	3	24		2			30
5	1			3			4		8
Total	1	2	3	54	4	2	4	1	71

5.2. Contractual Record

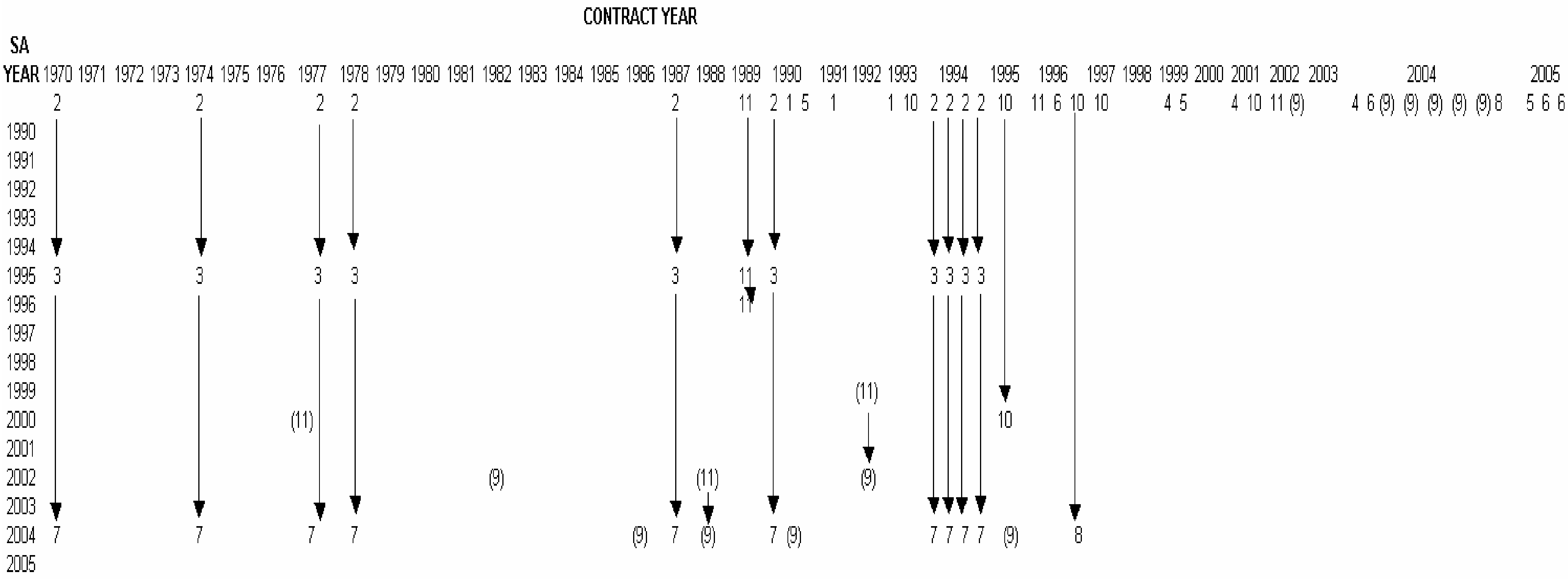
Using the convention for contractual rigidity from Table 2 (11 groups), we present the contractual record in Table 6. The horizontal axis identifies the year in which the contract was negotiated, and the vertical axis indicates the year in which an amendment to the original contract, *i.e.* a supplemental agreement, was implemented. Entries correspond to contractual observations, where contracts with private operators (semi-public companies) are those without (with) parentheses. For example, the concession contract originally negotiated in 1970 as a FREE/NTEP/COST contract was renegotiated in 1995 to establish a NTEP/EPA/MARG contract, and then in 2004, resulting in the more complete FP/EPA/MARG contract. Some contracts, such as the one negotiated in 1991, were never renegotiated.

Several aspects of this contractual record draw immediate attention. The first is the extensive use of contract renegotiation (34% of the original contracts were renegotiated at least once, and 57% of the original contracts signed before 2000 were renegotiated at least once). Contracts tend to be less rigid initially, anticipating renegotiation to a more rigid form at some future date.

A second important characteristic of the data is that road concession contracts have become substantially more rigid over time. Whereas the mean of adjustment types observed for the road concession contracts initially negotiated between 1970 and 2000 is 4,6, the mean of those signed between 2000 and 2005 is 7,6.

A final point worth noting is the apparent asymmetry between semi-public and private concessionaires. Contracts with totally private concessionaires are quite systematically less rigid than those with semi-public concessionaires. The contract year 2004 is, in this respect, very revealing. This is a counter-intuitive observation as one might expect contracts with semi-public concessionaires to be more flexible since they are supposed to behave less opportunistically, having quite the same interests as the State or its representative. In fact, in France, the State holds more than 90% of these semi-public concessionaires' capital (Cour des Comptes 1998). As a result, they may be considered as not-for-profit firms (Bennett-Iossa 2005).

Table 6 : Contractual Observations



5.3. Explanatory variables

The model developed in section 2 suggests several factors that are likely to influence the contractual degree of flexibility chosen by the parties.

Regarding variables affecting the marginal costs of contractual rigidity, the most prominent consideration is the extent to which the environment associated with the transaction is complex and uncertain. One of the primary sources of uncertainty facing parties during contractual negotiations over a road concession contract is the difficulty of forecasting future traffic with any confidence. This uncertainty on the future demand may be more or less important according to the context of the project. To quantify this traffic uncertainty, we surveyed a set of managers of a French private concessionaire, asking them to rate the traffic uncertainty surrounding each project (more information about the data collection process about traffic uncertainty is presented in Appendix 1). As a matter of fact, when negotiating a contract**,** the parties have expectations about the degree of traffic uncertainty likely to be experienced in the course of the exploitation phase. We capture this uncertainty in the explanatory variable *TRAFFIC,* which corresponds to the average rating between 1 and 5 given by managers regarding the traffic uncertainty for every contract. We made sure that the respondents gave consistent answers to all the questions, probing them if there was an inconsistency.[10] The hypothesis is that increasing traffic uncertainty, as reflected by an increase in the rate given by CEOs, should lead to more flexible arrangements.

This traffic uncertainty is accompanied moreover by uncertainty on construction costs. Indeed, the project may take more effort than estimated either because the conditions of construction are not those envisioned (discovery of an archaeological site, bad soil, soil contaminated…), or the project requires the use of innovative and untested technologies in the design and construction of infrastructure (it is mainly the case for bridges and tunnels). As for traffic uncertainty, data on construction costs uncertainty have been obtained from the rating by managers, on a scale from 1 to 5, of projects' complexity. To capture this effect, we include as an explanatory variable *COMPLEXITY*. We are confident that the figure we have obtained for the traffic uncertainty as well as for construction cost uncertainty are reliable. The hypothesis is that increasing project's complexity, as reflected by an increase in the average rate, should lead to more flexible arrangements.

Another important source of uncertainty stems from the difficulty of predicting future economic conditions with any confidence. We capture the increasing uncertainty associated with long time horizons in the variable *DURATION*, defined as the number of months between the completion of the infrastructure construction and the end of the concession. The hypothesis is that longer duration increases uncertainty and the costs of implementing more

[10] For each contract, we obtained at least three managers notations. Very few contracts have given rise to different notations.

rigid contracts, leading to more flexible arrangements. Because contract duration is an endogenous variable, we correct for the possibility of endogeneity bias by substituting predicted value *DURATION** from reduced-form estimations of this variable[11] and using two-stage least square method (2SLS).

Regarding now the magnitude of renegotiation costs, the reputation of the contracting parties may serve as a useful guide. Indeed, as explained above, the public authority has the opportunity to take the concessionaire's reputation into account and consequently modify the contractual terms during the preferred bidder phase. In the same way, the concessionaire might not propose the same offer according to the procuring authority with which the concessionaire is dealing with.

There are several mechanisms by which reputation can evolve (Banerjee and Duflo 2000). First, in those cases where the public authority and the concessionaire[12] have contracted before, the presumption is that both had behaved reliably so that they both now have a better reputation with the other. We capture this effect in the variable *REPEATED CONTRACT*.

Second, as explained above, it is possible that differences in political ideology (e.g. left or right leaning public authorities) might affect contractual choices. In fact, on the one hand, left leaning public authorities are generally more skeptical than right leaning public authorities about the delegation of public services to private operators. This means that private concessionaires are supposed to have a better reputation among right wing public authorities. On the other hand, private operators anticipate that they will more likely be expropriated when the procuring authority is a left leaning authority. Thus, we expect that contracts negotiated with left wing authorities will be more rigid. We capture this effect in the variable *LEFT*.

Our model also yields one prediction about how contractual choices will differ across institutional and regulatory frameworks, which should reflect the likelihood of contractual renegotiation. In recent years, international institutions have developed numerous aggregate governance indicators. To capture the reliability of contract enforcement, we used the aggregate indicator *REGULATORY QUALITY* developed by the World Bank.[13] In fact, this

[11] In addition to the exogenous variables already used in the estimations, we included the country concerned by the contract and institutional variables reflecting corruption and quality of the bureaucracy in the country concerned by the contract. We obtained a $R^2 = 0,68$.

[12] The term concessionaire, regarding reputation issues, refers to the leader of the consortium.

[13] Kaufmann, Kraay and Mastruzzi (2004) constructed indicators of six dimensions of governance: *Voice and Accountability* – measuring political, civil and human rights; *Political Instability and Violence* – measuring the likelihood of violent threats to government, including terrorism; *Government Effectiveness* – measuring the competence of the bureaucracy and the quality of public service delivery; *Regulatory Quality* – measuring the incidence of market-unfriendly policies; *Rule of Law* – measuring the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence; *Control of Corruption* – measuring the exercise of public power for private gain. We performed the regressions with all these indicators and results were always similar. We introduced the indicator *Regulatory Quality* in our analysis because interviews with French managers of a private concessionaire indicated that the relative ratings of this indicator match up best to their expectations.

indicator measures the capacity of the government to formulate and implement policies. More precisely, it includes measures of the incidence of market-unfriendly policies such as price controls or inadequate bank supervision, as well as perceptions of the enforceability of contracts and the burdens imposed by excessive regulation in areas such as business development. The hypothesis is that stronger institutional frameworks will more likely lead to rigid contracts. Nevertheless, this variable might reflect not only the probability to see the contract renegotiated but also the fact that a renegotiation will be less costly ($\overline{f} \rightarrow 1$), all things being equal. Therefore, the expected sign might be positive or negative, depending of which of these effects is dominating.

In addition, we include in the regressions several control variables. First, in our sample of contracts, we have 71 contracts that refer to 45 original contracts and to 26 renegotiated contracts, referred to as "supplemental agreements". As pointed out before, we consider these supplemental agreements as new contracts (following Crocker-Reynolds 1993). We control for the possibility that these contracts are specific by using a dichotomous variable *SUP AGREEMENT*.[14]

Besides, the ability of the procuring authority to negotiate price provisions depends on the number of bidders. The hypothesis is that the availability of alternative suppliers increases the negotiation power of the public authority during the preferred bidder phase, leading to the adoption of more rigid contracts. Thus, we include as an explanatory variable *NUMBER OF BIDDERS*.

Furthermore, in our sample of contracts, there are private and semi-public concessionaires. We use the dichotomous variable *SEMCA*[15] as an additional control variable.

Finally, it has been emphasized in Section 5.2. that agreements tend to become more rigid over time. This may be a consequence of the reduction of traffic uncertainty out in time, but also of an evolution of the contractual practices due to a learning effect of the procuring authorities. Thus, to capture this effect, we incorporate in the estimates the variable *LEARNING EFFECT,* defined as the number of former contracts of the public authority with private concessionaires.

The variables used in our estimations are summarized in the following Table 7 and their distribution by country is given in Appendix 2. The correlation matrix is given in Appendix 3.

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[14] The main econometric results are not affected when considering only the sub sample without any supplemental agreements. Partial results are presented in section 7. More is available on request.

[15] SEMCA for semi-public companies concessionaires of highways.

Table 7: Data Definitions and Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Definition
TYPE OF ADJUSTEMENT (5 GROUPS)	71	3.42	1.01	1	5	Ranking of toll adjustment types in 5 groups (See Table 3)
TYPE OF ADJUSTEMENT (11 GROUPS)	71	6.28	3.28	1	11	Ranking of toll adjustment types in 11 groups (See Table 2)
COMPLEXITY	71	2.19	1.29	1	5	Average rating on uncertainty on construction costs
TRAFFIC	71	2.39	1.13	1	5	Average rating on traffic uncertainty
LEFT	71	.31	.46	0	1	1 if the procuring authority is a left wing authority; 0 otherwise
REPEATED CONTRACT	71	5.26	4.20	0	11	Number of former interactions between the concessionaire and the public authority
SUP AGREEMENT	71	.46	.50	0	1	1 if the contract is a supplemental agreement; 0 otherwise
NUMBER OF BIDDERS	69	1.66	1.24	1	5	Number of bidders for the contract
DURATION	68	396.44	183.06	60	1164	Number of months between the completion of the infrastructure construction and the end of the concession
DURATION*	66	401.18	149.41	213.72	853.63	Predicted values for the variable DURATION using instrumental variables technic
LEARNING EFFECT	71	6.78	4.59	0	16	Number of former contracts of the public authority with private concessionaires
REGULATORY QUALITY	71	1.02	.30	-.48	1.82	Rating obtained by the country in question regarding this governance dimension (*Source*: World Bank)
SEMCA	71	.21	.41	0	1	1 if the concessionaire is a semi public company; 0 otherwise

6. Econometric Results

In order to study the way toll adjustment processes are chosen in public private partnerships, we have performed two set of estimates using ordered logit models.[16] The first set of estimates is concerned by our classification of toll adjustment types in 11 groups. The second set of estimates is concerned by our classification in 5 groups. Using the two classifications is a way to see how robust our results are according to the way adjustment types have been classified. Furthermore, we also add in a last regression for each classification (models 6 & 12) results we would obtain if our dependent variable was a continuous one instead of a qualitative one - to check the robustness of our results - using two-stage least square method.

Results are reported in Table 8. Models 1 and 7 contain only the exogenous variables *COMPLEXITY* and *TRAFFIC*. Models 2 and 8 take into account the reputation effect. Control variables have been then included in Models 3 and 9. They have fewer observations (69) because the number of bidders was not available for two contracts. Finally, we have included in Models 4 and 10 the variable *DURATION*. We use a two-steps ordered logit procedure in

[16] In our case, it is not possible to use an OLS or 2SLS models because it imposes cardinality on the ordinal variables *TYPEADJUST5* and *TYPEADJUST11*. Using an ordered logit model, we consider the relationship $Y_i = \beta X_i + \varepsilon_i$ (i=1,2 ,..*n*), where *Y* is an unobserved latent variable, *X* is a set of explanatory variables and ε is a random disturbance. If we consider *Y* is in our case the price provision rigidity level, we cannot observe *Y* directly, but we can observe a category *j*, if $\mu_{j-1} \leq Y \leq \mu_j$. The use of an ordered logit model results in estimates of the thresholds μ as well as the distance between them. The use of an OLS model exogenously assigns both. Nevertheless, we provide the two types of estimates for checking how robust our results are.

order to correct for the potential endogeneity problem we have with duration. Results are given in Models 5 and 11. Again, there are fewer observations because *DURATION* data are not available for concession contracts that have been awarded through Present-Value-of-Revenue auctions[17].

[17] These auctions differ from auction mechanisms where the public authority sets a fixed concession term and firms bid tolls. Indeed, under a Present-Value-of-Revenue auction, bidders compete on the present value of toll revenue they require to finance the project. Thus, the concession ends when the present value of toll revenue is equal to the concessionaire's bid, *i.e.* the concession term is undefined. For a precise description of such an auction mechanism, see Engel-Fischer-Galetovic (1997).

Table 8: Estimation Results

	TYPEADJUST5						TYPEADJUST11					
	model1	model2	model3	model4	model5	model6	model7	model8	model9	model10	model11	model12
	Ordered Logit	Ordered Logit	Ordered Logit	Ordered Logit	Two Stage Ordered Logit	2 SLS	Ordered Logit	Ordered Logit	Ordered Logit	Ordered Logit	Two Stage Ordered Logit	2SLS
TRAFIC	-1.673*** (-4.993)	-2.617*** (-5.581)	-2.416*** (-4.424)	-2.800*** (-4.257)	-2.813*** (-4.328)	-0.635*** (-5.817)	-1.362*** (-4.718)	-2.561*** (-6.264)	-2.153*** (-4.802)	-2.429*** (-4.743)	-2.470*** (-4.782)	-2.133*** (-6.398)
COMPLEXITY	0.068 (0.303)	-0.184 (-0.755)	0.057 (0.178)	0.209 (0.588)	0.074 (0.204)	0.070 (0.752)	0.287 (1.336)	0.145 (0.683)	0.211 (0.722)	0.272 (0.873)	0.215 (0.668)	0.281 (0.993)
REPEATED CONTRACT		-0.278** (-3.113)	-0.461** (-3.288)	-0.254 (-1.576)	-0.209 (-1.302)	-0.061 (-1.596)		-0.366*** (-4.409)	-0.460*** (-3.738)	-0.254+ (-1.816)	-0.235+ (-1.727)	-0.329** (-2.838)
LEFT		1.764** (2.833)	1.336+ (1.849)	1.195 (1.545)	0.940 (1.250)	0.288 (1.582)		1.776** (3.198)	1.639* (2.483)	1.649* (2.411)	1.455* (2.204)	1.332* (2.392)
NUMBER OF BIDDERS			0.149 (0.454)	0.675+ (1.688)	0.467 (1.202)	0.187* (2.061)			0.406 (1.333)	0.979* (2.568)	0.833* (2.225)	0.805** (2.908)
SUP. AGREE			1.964* (2.285)	1.966* (2.125)	2.073* (2.259)	0.390+ (1.815)			1.331+ (1.827)	1.229 (1.636)	1.351+ (1.790)	0.473 (0.719)
REGULATORY QUALITY			-3.980** (-3.099)	-8.069*** (-4.007)	-8.207*** (-4.139)	-1.622*** (-4.698)			-2.963** (-2.829)	-6.155*** (-3.879)	-6.559*** (-4.096)	-4.087*** (-3.874)
LEARNING EFFECT			0.090 (1.001)	-0.063 (-0.476)	-0.173 (-1.189)	0.006 (0.158)			0.034 (0.435)	-0.115 (-1.020)	-0.161 (-1.374)	-0.012 (-0.113)
SEMCA			1.643+ (1.717)	1.593 (1.533)	1.977+ (1.823)	0.231 (0.940)			2.409** (2.917)	2.290** (2.714)	2.462** (2.848)	2.289** (3.054)
DURATION				-0.004+ (-1.840)						-0.003 (-1.477)		
DURATION*					-0.000 (-0.007)	-0.001 (-1.647)					-0.001 (-0.242)	-0.006* (-2.274)
Intercept	8.460*** (6.698)	13.181*** (6.268)	16.260*** (5.130)	22.850*** (5.199)	22.195*** (5.278)	6.606*** (12.789)	6.591*** (6.547)	12.267*** (7.062)	13.547*** (5.727)	18.221*** (6.138)	18.316*** (6.161)	16.529*** (10.475)
McFadden r2 / Pseudo R2	0.22	0.34	0.42	0.50	0.48	0.753	0.09	0.20	0.30	0.30	0.31	0.786
Log Likelyhood	-76.02302	-64.1877	-54.12007	-45.28638	-46.97244		-144.6992	-126.8796	-115.5318	-98.70075	-99.84397	
N	71	71	69	66	66	66	71	71	69	66	66	66

Significance levels: + 0.10 * 0.05 ** 0.01 *** 0.001; t-stats in parentheses.

The first striking result we observe is that the traffic uncertainty is clearly an important variable, driving the choice of toll adjustment type. More precisely, the higher the traffic uncertainty, the more flexible the toll adjustment provisions will be. This confirms our proposition 1, whatever the econometric model (1‰ significance level). In particular, a one standard deviation increase in our "traffic uncertainty" measure is associated with a decrease in the numerical value of the toll adjustment provision of 2 in our classification in 11 groups (Model 11), e.g. a shift of a toll adjustment provision of type 9 to type 7.

However, the complexity of the project is not significant. This might be explained by the fact that project's complexity concerns the construction phase and thus may not have an impact on the toll adjustment processes which in turn concern only the exploitation phase. Besides, in concession contracts, construction cost uncertainty is most often completely supported by the concessionaire.

Contracts of longer *DURATION* appear to favor more flexible toll adjustment processes in our estimates but this effect is not always significant according to the econometric specifications. This result could corroborate the prediction of our theoretical model: the longer the duration of the contract, the more uncertain the future economic conditions of the transaction, the more difficult it is to draft a rigid contract.

When we incorporate in the regressions variables reflecting contracting parties reputation (contracting parties' connivance), we observe that they all have a significant impact on price provisions, confirming our prediction 4. First, the *REPEATED CONTRACT* variable has a significant negative effect on the choice of the rigidity of the toll adjustment process, especially when considering our 11 groups classification: an increase in the number of former interactions between the contracting parties will decrease the rigidity of the toll adjustment provision chosen. This effect is significant in nearly all our specification models. In particular, the fact that the contracting parties already signed 10 previous contracts together is associated with a decrease in the numerical value of the toll adjustment provision of 2 in our classification in 11 groups (Model 11), e.g. a shift of a toll adjustment provision of type 9 to type 7. In addition, results indicate that left leaning procuring authorities are much more likely to provide rigid contracts than right leaning authorities. This finding, especially significant when considering our 11 groups classification, complements previous works on optimal contracting (Bajari-McMillan-Tadelis 2003) and runs against a recent study of Levin-Tadelis (2005) in which the authors find that there is little correlation between voters' broader political preferences and contracting practices.

Table 6 also shows that in addition to finding a relationship between the rigidity of the toll adjustment provision and projects and contracting parties characteristics, we found a significant correlation between the rigidity of the toll adjustment provision and institutional frameworks. In particular, our measure of the reliability of contract enforcement negatively correlates with the rigidity of the contract. In other words, the stronger the institutional framework, the more flexible the toll adjustment provisions will be. This result suggests that it is the second effect of strong institutions (See Section 5.3.) that prevails, *i.e.* strong institutions constitute an important impediment to contracting parties opportunism.

Finally, if we now turn to the effect of our control variables, we observe that the *NUMBER OF BIDDERS* variable is sometimes, depending on the specifications, significant and of the predicted sign, so that the availability of alternative suppliers increases the rigidity of contractual agreements. Supplemental agreements do not seem to be specific agreements as the dichotomous variable *SUP AGREEMENT* is not always significant, at least in our 11 group classification. We come back on this issue in the next section. This is partly consistent with the results obtained by Crocker-Reynolds (1993). In the same way, results indicate the absence of impact of a learning effect of the procuring authorities on the design of toll adjustment provisions. Finally, results show that we observe an impact of the type of the concessionaire, *i.e.* private or semi-public, on the toll adjustment provision chosen. The fact that the concessionaire is a semi-public company seems to rigidify the contract (especially regarding the classification in 11 groups). A simple explanation here is that semi-public concessionaires do not try to negotiate more flexible contractual terms since they have the same interests as the public authority (the semi-public companies in question are indeed quite completely public). Thus, if there is a renegotiation, there won't be haggling or friction, in contrast to renegotiations with private concessionaires.

7. ROBUSTNESS ANALYSIS

The econometric results are interesting and in line with our model. Nevertheless, they are also fragile for several reasons.

One possible limitation of our results would arise from ignoring a temporal evolution of the contractual practices regarding the design of the toll adjustment provisions. Indeed, as it has been emphasized in Section 5.2., agreements tend to become more rigid over time. This may be a consequence of the reduction of traffic uncertainty out in time, but also of an evolution of the contractual practices due to a learning effect or a change in political views. Thus, to capture this effect, we incorporate in the estimates the variable *TREND* (Models 13 to 15 of Table 9). Results show that such a trend does not exist and remain unchanged.

Another possible limitation lies in the fact that we considered supplemental agreements as original contracts. Even if we already incorporated a dummy variable to correct for the potential bias, we now perform our estimations on the sub sample composed only of original contracts (Models 14 and 16 of Table 9). Even if the number of observation decreases significantly, results are not at all affected.

However, the main limitation of our results, as already mentioned, stems from the fact that we have an unbalanced sample. To feel confident with our results and to be sure that the overrepresentation of French contracts does not drive our results (as the Appendix 2 seems to show), we performed our estimates using a dummy variable FRENCH for contracts signed in France (Models 17 to 20). Our main results still remain unaffected: we still observe strong political, institutional and uncertainty effects on contractual choices. Nevertheless, we also observe a “French effect”, leading to more flexible contract compared to foreign agreements. Furthermore, introducing cross effects between on the one hand, our variables *FRENCH* and *REPEATED CONTRACT* and on the other hand, the variables *FRENCH* and *LEARNING EFFECT*, we observe both a repeated contract effect and a learning effect for our whole sample but only a repeated contract effect for the sub sample of French contracts. This is an interesting result calling for a better understanding of institutional differences that might explain such results. We also performed our estimates on the French contracts sub sample (Models 21 and 22 of Table 9) confirming those results.

Finally, whereas in our model we consider that the contracting parties make a dichotomous choice (*i.e.* they sign either a rigid contract or a flexible one), we allow for a continuous choice in our empirical analysis. To correct for this lack of adequation between the model and our empirical part, we propose a logit estimate, using *RENEGOTIABLE CONTRACT* as explained variable (dummy variable taking the value 1 if the type of the TAP actually chosen is between the types 7 and 11, included, of our classification in 11 groups). Doing this, we look at the willingness of the parties to sign a contract that stipulates *ex ante* some *ex post* renegotiations. Results are presented in the Model 23 of Table 9; our main results still apply.

Table 9: Estimation Results

	TYPEADJUST5		TYPEADJUST11		TYPEADJUST5		TYPEADJUST11		TYPEADJUST5	TYPEADJUST11	RENEGOTIABLE
	model13	model14	model15	model16	model17	model18	model19	model20	model21	model22	model23
	Two Stage Ordered Logit	Two Stage Ordered Logit	Two Stage Ordered Logit	Two Stage Ordered Logit	Two Stage Ordered Logit	Two Stage Ordered Logit	Two Stage Ordered Logit	Two Stage Ordered Logit	Two Stage Ordered Logit	Two Stage Ordered Logit	Logit
TRAFIC	-3.081*** (-4.461)	-4.383*** (-3.922)	-2.546*** (-4.671)	-4.020*** (-4.345)	-2.737*** (-3.399)	-1.657+ (-1.959)	-2.363*** (-3.911)	-1.219* (-2.070)	-2.584* (-2.261)	-1.399* (-2.019)	22.859* (2.168)
COMPLEXITY	0.191 (0.510)	-0.282 (-0.506)	0.247 (0.750)	-0.231 (-0.487)	0.331 (0.678)	-0.098 (-0.214)	0.591 (1.432)	0.213 (0.541)	0.283 (0.506)	0.195 (0.447)	1.167 (0.987)
REPEATED CONTRACT	-0.183 (-1.130)	-0.088 (-0.465)	-0.230+ (-1.683)	-0.092 (-0.571)	0.062 (0.325)	-4.718* (-2.430)	-0.029 (-0.201)	-5.764** (-2.760)	-0.130 (-0.543)	-0.100 (-0.561)	2.087+ (1.815)
LEFT	1.063 (1.371)	0.297 (0.305)	1.474* (2.233)	0.384 (0.459)	2.270* (2.462)	2.387* (2.513)	2.187** (3.116)	2.692*** (3.434)	3.267** (2.810)	3.371*** (3.502)	-9.453* (-2.221)
NUMBER OF BIDDERS	0.739+ (1.650)	1.083* (2.116)	0.907* (2.221)	1.053* (2.378)	1.067* (1.962)	0.132 (0.303)	1.265** (2.649)	0.377 (0.923)	-0.594 (-0.827)	-0.431 (-0.684)	-3.677* (-2.323)
SUP. AGREE	2.142* (2.309)		1.381+ (1.818)		2.262* (1.997)	1.938+ (1.849)	1.102 (1.395)	0.743 (0.991)	1.915 (1.606)	-0.253 (-0.340)	3.505 (0.614)
REGULATORY QUALITY	-9.526*** (-4.173)	-8.259** (-3.059)	-6.866*** (-3.936)	-6.776** (-2.982)	-10.541*** (-4.190)	-8.245** (-3.099)	-8.823*** (-4.261)	-7.648** (-3.055)	-8.235+ (-1.922)	-7.169* (-2.132)	8.832* (2.135)
LEARNING EFFECT	-0.096 (-0.605)	0.051 (0.305)	-0.142 (-1.143)	-0.039 (-0.265)	0.983** (3.244)	0.285 (0.704)	1.186*** (4.573)	0.541 (1.619)	0.629+ (1.959)	0.971** (3.209)	-1.038* (-1.967)
DURATION*	-0.000 (-0.085)	-0.001 (-0.518)	-0.001 (-0.269)	-0.002 (-0.931)	0.000 (0.052)	-0.003 (-0.937)	-0.001 (-0.537)	-0.005 (-1.565)			0.035* (2.330)
SEMCA	2.013+ (1.816)	-3.069 (-1.163)	2.482** (2.862)	-3.971+ (-1.662)	3.007* (2.056)	1.864 (1.500)	3.077*** (3.403)	2.326** (2.600)			
TREND	-0.096 (-1.219)	-0.106 (-1.072)	-0.029 (-0.436)	-0.060 (-0.696)	-0.421** (-2.958)		-0.394*** (-3.325)				
FRENCH					-10.473*** (-4.239)	-10.022*** (-3.319)	-12.384*** (-5.656)	-14.018*** (-4.387)			
REPEATED CONTRACT * FRENCH						4.645* (2.372)		5.659** (2.694)			
LEARNING EFFECT*FRENCH						0.196 (0.357)		0.279 (0.626)			
Intercept	213.849 (1.358)	239.615 (1.210)	76.845 (0.572)	144.991 (0.846)	865.441** (3.025)	27.464*** (4.958)	809.491*** (3.381)	27.765*** (5.558)	19.832** (2.832)	12.807** (2.689)	-77.795* (-2.193)
McFadden r2	0.49	0.50	0.30	0.35	0.63	0.59	0.44	0.42	0.63	0.41	0.82
Log Likelyhood	-46.21246	-24.4971	-99.74914	-42.86556	-33.61508	-37.17431	-79.68973	-82.81771	-26.10998	-60.51498	-8.108938
N	66	34	66	34	66	66	66	66	53	53	66

Significance levels: + 0.10 * 0.05 ** 0.01 *** 0.001; t-stats in parentheses.

8. Conclusion

This paper has studied the contractual design of price provisions in toll infrastructure concession contracts. We develop a simple incomplete contract theory model *with* renegotiation and maladaptation costs that emphasizes trade-offs between contractual flexibility and rigidity. Propositions derived from the model differ from previous incomplete contract theory models. Furthermore, our results highlight the fact that trade-offs are complex and do not correspond to previous propositions coming from a transaction cost framework (Masten-Crocker 1991; Crocker-Reynolds 1993) that generally assume a monotonic relationship between asset specificity and the use of rigid contract. We highlight the fact that this proposition may be true, but only if other conditions concerning maladaptation costs, renegotiation costs and the probability to see the contract enforced are met. Our model also stresses the fact that the institutional environment in which the contract is embedded matters. It explains why uncertainty, weak connivance between the contracting parties, or lack of a strong institutional environment would lead to the design of more rigid contracts.

We use this model to interpret our empirical findings about the determinants of the contractual design of toll adjustment provisions in worldwide toll road concession contracts. Using data gathered from a variety of sources, we find that toll adjustment provisions in infrastructure concession contracts exhibit a wide diversity contrary to what is often written. But more interestingly, we find that contracts characterized by high traffic uncertainty are likely to be less rigid and we provide strong evidence that contracting parties characteristics impact on the contractual design. In particular, an increase in the number of former interactions between the contracting parties will decrease the rigidity of the toll adjustment provision chosen. In the same way, we find that contracts designed with left leaning procuring authorities are likely to be more rigid. These results confirm and emphasize the importance of trust in such agreements between a public authority and a private operator. Finally, we provide strong evidence that institutional environments impact on contract design, so that contracts designed in a strong institutional environment are likely to be more flexible.

Our analysis leaves many questions open. For instance, it would be interesting to study if a difference between the predicted and the observed type of toll adjustment provision translates in difference in performance. In addition, our results suggest that further studies are needed to shed lights on the concessionaires selection process in public-private contracts. Indeed, the efficiency of observed contractual agreements are also connected to the way concessionaires are selected (Bajari-McMillan-Tadelis 2003).

References

Athias L. and S. Saussier, [2007], “Un Partenariat Public Privé rigide ou flexible ? Théorie et application aux concessions routières à péage”, forthcoming in Revue Economique, May 2007.

Bajari P., Houghton, Tadelis S., [2006], “Bidding for Incomplete Contracts”, *Working Paper*.

Bajari P, McMillan R. and Tadelis S, [2003], “Auctions versus Negotiations in Procurement: An Empirical Analysis”, *NBER Working Papers,* 9757.

Bajari P, Tadelis S, [2001], “Incentives versus Transaction Costs: a Theory of Procurement Contracts”, *Rand Journal of Economics*, 32(3), 387-407.

Banerjee A.V., Duflo E., [2000], “Reputation Effects and the Limits of Contracting: A Study of the Indian Software Industry”, *Quarterly Journal of Economics*, 115(3), 989-1017.

Bennett J., Iossa E., [2005], “Contracting Out Public Service Provision to Not-For-Profit Firms”, *CMPO Working Paper No. 05/124*.

Cour des Comptes, [1998], "La politique autoroutière française", *rapport de la Cour des Comptes*, politique autoroutière -2-.

Crocker K.J., Masten S.E., [1991], "Pretia ex Machina?: Prices and Process in Long Term Contracts", *Journal of Law and Economics*, 34, 64-69.

Crocker K.J., Reynolds K.J., [1993], "The Efficiency of Incomplete Contracts: An Empirical Analysis of Air Force Engine Procurement", *Rand Journal of Economics*, 24, 126-146.

Doni N., [2005], “The Importance of Reputation In Awarding Public Contracts”, *Working Paper*.

Engel E., Fisher R., Galetovic A., [1997], “Highway Franchising: Pitfalls and Opportunities“, *American Economic Review*, 87, 68-72.

Engel E., Fischer R., Galetovic A., [2002], “A New Approach to Private Roads”, *Regulation,* Fall 2002, 18-22.

Engel E., Fisher R., Galetovic A., [2003], “Privatizing Highways in Latin America: Fixing What Went Wrong?”, *Economia, The Journal of LACEA*, 4, 129-158.

Engel E., Fisher R., Galetovic A., [2006], “Privatizing Highways in the United States”, *Review of Industrial Organization, 29, 27-53*.

Engel E., Fisher R., Galetovic A., [2006], “Renegotiation Without Holdup: Anticipating Spending and Infrastructure Concessions”, *Working Paper*.

Estache A., [2006], “PPI partnerships vs. PPI divorces in LDCs” *Review of Industrial Organization*, 29, 3-26.

Flyvberg B., Bruzelius N. and Rothengatter W., [2003], “Megaprojects and Risk – An Anatomy of Ambition”, *Cambridge: Cambridge University Press*, 207p.

Flyvbjerg B., Skamris M. and Buhl S.L., [2002], “Underestimating Costs in Public Works Projects: Error or Lie?”. *Journal of the American Planning Association,* 68, 279-95.

Flyvbjerg B. and Skamris M., [1997], “Inaccuracy of Traffic Forecasts and Cost Estimates on Large Transport Projects”, *Transport Policy,* 4(3), 141-6.

Goldberg V.P., [1985], “Price Adjustment in Long-Term Contracts”, *Wisconsin Law Review*, 527-543.

Goldberg V.P., Erickson J.E., [1987], "Quantity and Price Adjustment in Long Term Contracts: A Case Study of Petroleum Coke", *Journal of Law and Economics*, 30, 369 398.

Gomez-Ibanez J.A. and Meyer J. R., [1993], “Going Private: The International Experience with Transport Privatization”, *The Brookings Institution*, Washington, D.C.

Grout P. and Stevens M., [2003], “The Assessment: Financing and Managing Public Services”, *Oxford Review of Economic Policy*, 19, 215-234.

Guasch J.L., Laffont J.J., Straub S., [2006], “Renegotiation of Concession Contracts: A Theoretical Approach”, *Review of Industrial Organization*, 29, 55-73.

Guasch J. Luis, [2004], “Granting and Renegotiating Infrastructure Concessions: Doing it Right”, *World Bank Institute*.

Hart O.D., [1995], “Firms, Contracts, and Financial Structure”, *Oxford and New York: Oxford University Press, Clarendon Press*.

Hart O.D., [2003], “Incomplete Contract and Public Ownership: Remarks, and an Application to Public-Private Partnerships”, *The Economic Journal*, 113, 69-76.

Hart O. D. and Holmstrom, B., [1987], “The Theory of Contracts,” in Advances in Economic Theory, T.R. Bewley (ed.). Fifth World Congress. *Cambridge: Cambridge University Press*, 369-98.

HM Treasury, [2003], “PFI: meeting the investment challenge”, The Stationery Office, London, UK.

Holmstrom B. and Milgrom P., [1991], “Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design”, *Journal of Law, Economics, and Organization*, 7, 24-52.

Jolls C., [1997], “Contracts as Bilateral Commitments: A New Perspective On Contract Modification”, *Journal of Legal Studies*, 26, 203-237.

Kaufmann D., Kraay A., Mastruzzi M., [2004], “Governance Matters III: Governance Indicators for 1996, 1998, 2000, and 2002”, *World Bank Economic Review,* 18, 253-287.

Klein, B. [1992], ”Contracts and Incentives” in L. Werin and H. Wijkander (eds.), Contract Economics. Cambridge, MA: Basil Blackwell, 149-172.

Laffont, J.J., [2005], “Regulation and Development”, *Cambridge University Press*, 292p.

Levin J., Tadelis S., [2005], “Contracting for Government Services: Theory and Evidence from U.S. Cities”, *Working Paper*.

Martimort D. and S. Straub [2006], “Privatization and Changes in Corruption Patterns: The Roots of Public Discontent”, *Working Paper*.

Masten S.E., Saussier S. [2002], "Econometrics of Contracts : An Assessment of Developments in the Empirical Literature of Contracting", in Economics of Contracts: Theories and Applications, Brousseau E. & Glachant J-M Eds, Cambridge University Press, 273-293.

Odeck, James, [2004], "Cost Overruns in Road construction – What Are their Sizes and Determinants?", *Transport Policy,* 11 (1), 43-53.

Pickrell, D., [1990], "Urban Rail Transit Projects: Forecasts Versus Actual Ridership and Cost". Washington, D.C.. Department of Transportation.

Prud'homme R., [2004], "Infrastructure and Development", *Annual Bank Conference on Development Economics*, Washington, May 3-5, 2004.

PWC [2005], "Delivering the PPP promise", Price Waterhouse Coopers Study.

Saussier S., [2000], "Transaction Costs and Contractual Completeness", *Journal of Economic Behavior and Organization*, 42, 189-206.

Schmidt, K. [1996], "The Costs and Benefits of Privatization: An Incomplete Contract Approach", *Journal of Law, Economics and Organization*, 12, 1-24.

Schugart C., [2005], "The Selection of Concessionaires In the Urban Water Sector: Does the Standard Procurement Paradigm Fit ?", *Working Paper*.

Tirole J., [1999], "Incomplete Contracts: Where Do We Stand ?", *Econometrica*, 67, 741-781.

Williamson O.E., [1976], "Franchise Bidding for Natural Monopolies – In General and with Respect to CATV", *Bell Journal of Economics,* 7, 73-104.

Williamson O.E., [1985], "The Economic Institutions of Capitalism", *New-York Free Press*.

Williamson O.E., [1996], "The Mechanisms of Governance", Oxford University Press.

Appendix 0: Proof for propositions 1 to 4

Looking at equation (16) we have the following condition for a rigid contract to be preferred to a flexible one:

$$\left[(1-\eta)\overline{f}+\eta\right]\cdot R(i^{rr})-i^{rr}-\overline{f}R(i^{f})+i^{f}\succ 0 \qquad \text{(16bis)}$$

We define $\rho(.)$ by the following equivalence

$$y=\rho(x)\Leftrightarrow x=\frac{2}{R'(y)}$$

In other words, for every x we have

$$R'\left[\rho(x)\right]=\frac{2}{x} \qquad \text{(A1)}$$

Then we have:

$$i^{f}=\rho(\alpha+\overline{f}) \text{ and } i^{rr}=\rho(\alpha+\overline{f}+\eta(2\underline{f}-\alpha-\overline{f})) \qquad \text{(A2)}$$

Differentiating in x the two members of equation (1), we obtain the derivative of $\rho(.)$:

$$\rho'(x)\cdot R''\left[\rho(x)\right]=-\frac{2}{x^{2}}\Leftrightarrow \rho'(x)=-\frac{2}{x^{2}\cdot R''\left[\rho(x)\right]}\succ 0$$

Thus function $\rho(.)$ is strictly increasing because $R(.)$ is supposed strictly concave.

Our problem boils down to study the mathematical properties of the function $\phi(\overline{f},\underline{f},\alpha,\eta)$ defined as:

$$\phi(\overline{f},\underline{f},\alpha,\eta)\equiv\left[(1-\eta)\overline{f}+\eta\right]\cdot R\left\{\rho\left[\alpha+\overline{f}+\eta\left(2\underline{f}-\alpha-\overline{f}\right)\right]\right\}$$
$$-\rho\left[\alpha+\overline{f}+\eta\left(2\underline{f}-\alpha-\overline{f}\right)\right]-\overline{f}\cdot R\left\{\rho\left[\alpha+\overline{f}\right]\right\}+\rho\left[\alpha+\overline{f}\right]$$

Studying the partial derivatives of function ϕ we obtain:

$$\phi'_{\overline{f}}=(1-\eta)R(i^{rr})-R(i^{f})+\left\{\left[(1-\eta)\overline{f}+\eta\right]\cdot R'(i^{rr})-1\right\}\frac{\partial i^{rr}}{\partial\overline{f}}$$
$$-\left\{\overline{f}\cdot R'(i^{f})-1\right\}\cdot\frac{\partial i^{f}}{\partial\overline{f}}$$

$$\phi'_{\underline{f}}=\left\{\left[(1-\eta)\overline{f}+\eta\right]\cdot R'(i^{rr})-1\right\}\frac{\partial i^{rr}}{\partial\underline{f}}$$

$$\phi'_{\eta}=(1-\overline{f})R(i^{rr})+\left\{\left[(1-\eta)\overline{f}+\eta\right]\cdot R'(i^{rr})-1\right\}\frac{\partial i^{rr}}{\partial\eta}$$

$$\phi'_{\alpha}=\left\{\left[(1-\eta)\overline{f}+\eta\right]\cdot R'(i^{rr})-1\right\}\frac{\partial i^{rr}}{\partial\alpha}-\left\{R'(i^{f})-1\right\}\cdot\frac{\partial i^{f}}{\partial\alpha}$$

The first term of each derivative is capturing the direct effect holding i^f and i^{rr} constant. The second term is the indirect effect that is coming through the variation of i^{rr}. The third term is the indirect effect that is coming through the variation of i^f. We can note that there is no direct effect for $\underline{f}$ and α. There is also no indirect effect transiting through i^f for $\underline{f}$, neither for η.

Knowing that from equation (2):

$$\frac{\partial i^f}{d\overline{f}} = \rho'\left[\alpha + \overline{f}\right] \succ 0 \qquad \frac{\partial i^{rr}}{\partial \overline{f}} = (1-\eta)\cdot \rho'\left[\alpha + \overline{f} + \eta\left(2\underline{f} - \alpha - \overline{f}\right)\right] \succ 0$$

$$\frac{\partial i^f}{d\underline{f}} = 0 \qquad \frac{\partial i^{rr}}{\partial \underline{f}} = 2\eta \cdot \rho'\left[\alpha + \overline{f} + \eta\left(2\underline{f} - \alpha - \overline{f}\right)\right] \succ 0$$

$$\frac{\partial i^f}{d\eta} = 0 \qquad \frac{\partial i^{rr}}{\partial \eta} = \left(2\underline{f} - \alpha - \overline{f}\right)\cdot \rho'\left[\alpha + \overline{f} + \eta\left(2\underline{f} - \alpha - \overline{f}\right)\right]$$

$$\frac{\partial i^f}{d\alpha} = \rho'\left[\alpha + \overline{f}\right] \succ 0 \qquad \frac{\partial i^{rr}}{\partial \alpha} = (1-\eta)\cdot \rho'\left[\alpha + \overline{f} + \eta\left(2\underline{f} - \alpha - \overline{f}\right)\right] \succ 0$$

We can also note that because

$$R'(i^f) = \frac{2}{\alpha + \overline{f}} \qquad R'(i^{rr}) = \frac{2}{\alpha + \overline{f} + \eta\left(2\underline{f} - \alpha - \overline{f}\right)} = \frac{2}{(1-\eta)\left(\alpha + \overline{f}\right) + 2\cdot\eta\cdot\underline{f}}$$

We have

$$\overline{f}\cdot R'(i^f) - 1 = \frac{2\cdot\overline{f}}{\alpha + \overline{f}} - 1 = \frac{\overline{f} - \alpha}{\alpha + \overline{f}}$$

And similarly

$$\left[(1-\eta)\overline{f} + \eta\right]\cdot R'(i^{rr}) - 1 = \frac{2\cdot\left[(1-\eta)\overline{f} + \eta\right] - (1-\eta)\left(\alpha + \overline{f}\right) - 2\cdot\eta\cdot\underline{f}}{(1-\eta)\left(\alpha + \overline{f}\right) + 2\cdot\eta\cdot\underline{f}}$$

$$= \frac{(1-\eta)\overline{f} - (1-\eta)\alpha + 2\cdot\eta\cdot\left(1 - \underline{f}\right)}{(1-\eta)\left(\alpha + \overline{f}\right) + 2\cdot\eta\cdot\underline{f}}$$

$$= \frac{(1-\eta)\left(\overline{f} - \alpha\right) + 2\cdot\eta\cdot\left(1 - \underline{f}\right)}{(1-\eta)\left(\alpha + \overline{f}\right) + 2\cdot\eta\cdot\underline{f}}$$

Proof of proposition 1.
If we assume that

- $\overline{f} > \alpha$

We know

$$\overline{f} \cdot R'(i^f) - 1 = \frac{2 \cdot \overline{f}}{\alpha + \overline{f}} - 1 = \frac{\overline{f} - \alpha}{\alpha + \overline{f}} \succ 0$$

and $$\left[(1-\eta)\overline{f} + \eta\right] \cdot R'(i^{rr}) - 1 = \frac{(1-\eta)\left(\overline{f} - \alpha\right) + 2 \cdot \eta \cdot \left(1 - \underline{f}\right)}{(1-\eta)\left(\alpha + \overline{f}\right) + 2 \cdot \eta \cdot \underline{f}} \succ 0$$

It is then obvious that

$$\phi'_{\underline{f}} = \left\{\left[(1-\eta)\overline{f} + \eta\right] \cdot R'(i^{rr}) - 1\right\} \frac{\partial i^{rr}}{\partial \underline{f}} \geq 0$$

Proof of proposition 2.
If we assume that

- $\overline{f} > \alpha$
- $\eta \succ 0$
- $i^{rr} \succ i^f \Leftrightarrow \left(2\underline{f} - \overline{f}\right) \succ \alpha \Rightarrow \underline{f} \succ \frac{\overline{f} + \alpha}{2}$.

Then we have

$$\frac{\partial i^{rr}}{\partial \eta} = \left(2\underline{f} - \alpha - \overline{f}\right) \cdot \rho' \left[\alpha + \overline{f} + \eta\left(2\underline{f} - \alpha - \overline{f}\right)\right] \succ 0$$

And thus

$$\phi'_{\eta} = (1 - \overline{f}) R(i^{rr}) + \left\{\left[(1-\eta)\overline{f} + \eta\right] \cdot R'(i^{rr}) - 1\right\} \frac{\partial i^{rr}}{\partial \eta} \succ 0$$

Proof of proposition 3.

If we assume that

- $\overline{f} > \alpha$
- $\eta \succ 0$
- $i^{rr} \succ i^f \Leftrightarrow \left(2\underline{f} - \overline{f}\right) \succ \alpha \Rightarrow \underline{f} \succ \frac{\overline{f} + \alpha}{2}$.

Then we have

$$\phi'_{\alpha} = \left\{\left[(1-\eta)\overline{f} + \eta\right] \cdot R'(i^{rr}) - 1\right\} \frac{\partial i^{rr}}{\partial \alpha} - \left\{R'(i^f) - 1\right\} \cdot \frac{\partial i^f}{\partial \alpha}$$

Because of our assumptions concerning function $R(.)$ and our parameters η and $\overline{f}$, we know that

$$R'(i^f) \succ R'(i^{rr}) \text{ and } (1-\eta)\overline{f} + \eta \leq 1$$

Then

$$[(1-\eta)\overline{f} + \eta] \cdot R'(i^{rr}) - 1 \prec R'(i^f) - 1 \quad \text{and} \quad \frac{\partial i^{rr}}{\partial \alpha} \prec \frac{\partial i^f}{\partial \alpha}$$

Thus we have

$$\phi_\alpha' = \{[(1-\eta)\overline{f} + \eta] \cdot R'(i^{rr}) - 1\} \frac{\partial i^{rr}}{\partial \alpha} - \{R'(i^f) - 1\} \cdot \frac{\partial i^f}{\partial \alpha} \prec 0$$

Proof of proposition 4.

If we assume that

- $\overline{f} > \alpha$
- $\eta \succ 0$
- $i^{rr} \succ i^f \Leftrightarrow (2\underline{f} - \overline{f}) \succ \alpha \Rightarrow \underline{f} \succ \frac{\overline{f} + \alpha}{2}$.
- $\eta \succ \frac{R(i^{rr}) - R(i^f)}{R(i^{rr})}$

We have

$$(1-\eta)R(i^{rr}) - R(i^f) \prec 0$$

Following the same reasoning as in proof of proposition 3, we obtain

$$\phi_{\overline{f}}' = (1-\eta)R(i^{rr}) - R(i^f) + \{[(1-\eta)\overline{f} + \eta] \cdot R'(i^{rr}) - 1\} \frac{\partial i^{rr}}{\partial \overline{f}}$$
$$- \{\overline{f} \cdot R'(i^f) - 1\} \cdot \frac{\partial i^f}{\partial \overline{f}} \prec 0$$

Lastly, we can find some values of our parameters for our inequality (16) to be respected. To show this, note that

$$\phi(\overline{f}, \underline{f}, \alpha, 0) \equiv 0$$

Suppose $\underline{f} \succ \frac{\overline{f} + \alpha}{2}$, and let choose values for $\underline{f}, \overline{f}, \alpha$ such that this condition is met, then:

$$\phi(\overline{f},\underline{f},\alpha,\eta)=\underbrace{\phi(\overline{f},\underline{f},\alpha,0)}_{=0}+\int_0^{\eta}\phi'(\overline{f},\underline{f},\alpha,x)dx$$

Indeed, if $\underline{f}\succ\frac{\overline{f}+\alpha}{2}$ we have $\phi'_{\eta}(\overline{f},\underline{f},\alpha,\eta)\succ 0$ so $\phi(\overline{f},\underline{f},\alpha,\eta)\succ 0$

Appendix 1: Data Collection about Traffic Uncertainty

Some of the data used in this paper (*TRAFFIC*, *COMPLEXITY* and *NUMBER OF BIDDERS*) were collected by interviews with three different persons of a French private concessionaire: the CEO and two other senior persons. The interviews were conducted separately and the respondents did not have any idea of the purpose of the project. Most of the projects were negotiated or renegotiated over the last ten years, and the persons we interviewed have more than 15 years of seniority in the firm. They therefore had no difficulty answering the questions. Regarding very old contracts, at least one of the three interviewees was able to answer us for each of the contracts since the firm keeps contracts' memory green. Thus, cross-checking of information was not always possible for every old contract but data was available.

For every contract, respondents were asked to rate between 1 and 5 the traffic uncertainty likely to be experienced in the course of the exploitation phase that they expected at the time of contract negotiation (rating 1 corresponding to a contract in which the traffic uncertainty is very low, *i.e.* the respondents have a good idea of future traffic, and 5 the opposite). Nevertheless, to facilitate the interviews and obtain comparable answers from respondent to respondent as we were conducting the interview we used a structured questionnaire so as to recall the respondent the general background of each project. This questionnaire (not exhaustive) is the following one:

1/ Regarding the tolling culture of the country in question: are toll roads well established or are there no toll roads in the country? (So as to estimate uncertainty over toll acceptance)

2/ Regarding toll-facility details:

- Is the infrastructure in question an extension of existing roads or a Greenfield site?
- Is the infrastructure in question a stand-alone facility or does it rely on other, proposed improvements?
- Are there few competing roads or many alternative roads?
- Is there only road competition or multimodal competition?

3/ Regarding the users:

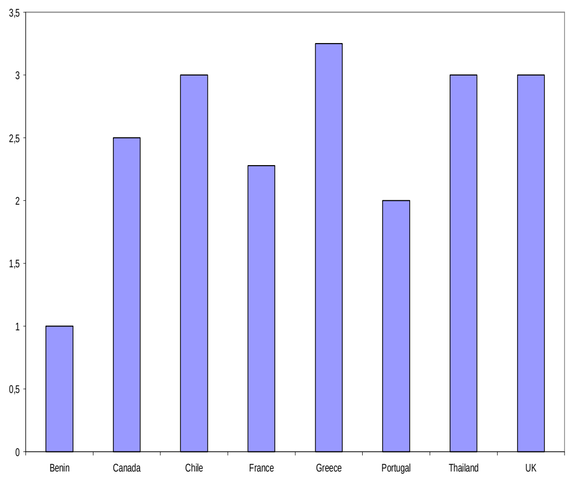
- Are there few, key origins and destinations or multiple origins and destinations?
- Is the demand profile flat or highly seasonal and/or "peaky"?
- Is the income, time sensitive market high or low?

4/ Is the local/national economy strong or weak?

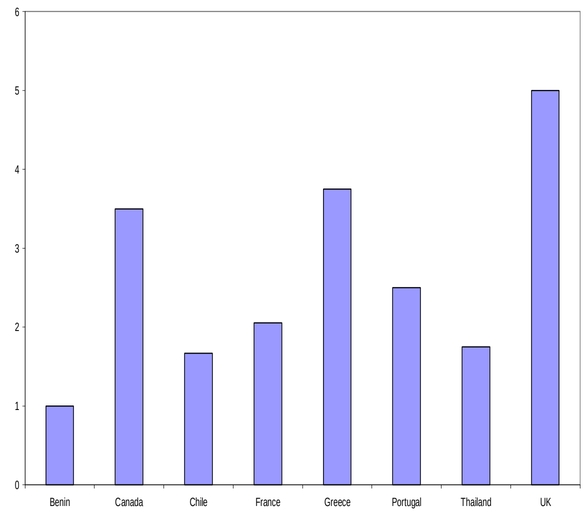
Once the respondent answered to these questions, he was more able to give an accurate rating of the traffic uncertainty of the project in question on a scale between 1 and 5.

Furthermore, when we did not obtain comparable answers from senior to senior, we probed until we reached consistency (which was usually easily done).

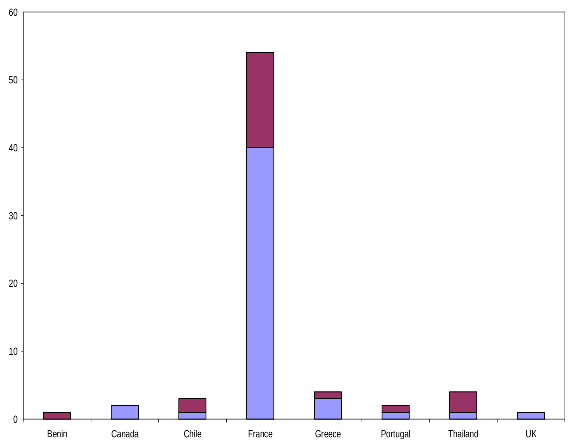
Appendix 2: Explanatory Variables Distribution by Country



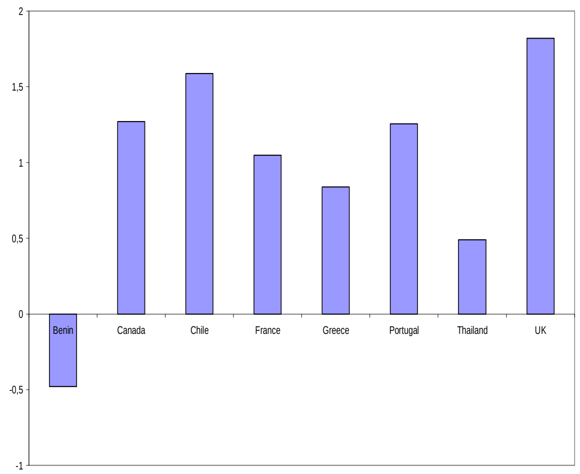
(a) Average of Traffic Uncertainty



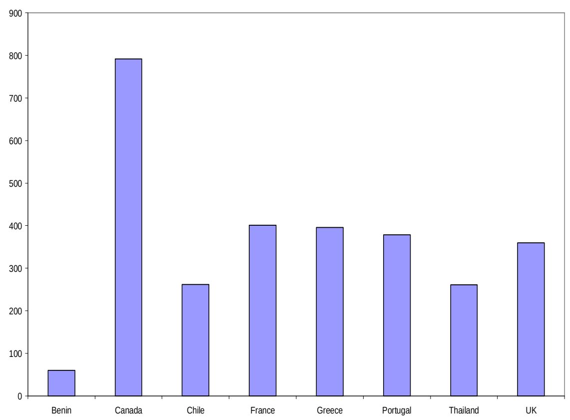
(b) Average of Complexity



(c) LEFT (Blue : 0 ; Red : 1)



(d) Regulatory Quality



(e) Average of Duration

Appendix 3: Correlation Matrix

	TYPEADJUST11	TYPEADJUST5	TRAFFIC	COMPLEXITY	REPEATED CONTRACT	LEFT	NUMBER OF BIDDERS	SUP. AGREEMENT	LEARNING EFFECT	REGULATORY QUALITY	DURATION	DURATION*	SEMCA
TYPEADJUST11	1.0000												
TYPEADJUST5	0.9229	1.0000											
TRAFFIC	-0.5446	-0.6776	1.0000										
COMPLEXITY	-0.2628	-0.4335	0.6536	1.0000									
REPEATED CONTRACT	0.0280	0.2394	-0.6896	-0.5242	1.0000								
LEFT	0.2390	0.1080	0.2088	0.2439	-0.2780	1.0000							
NUMBER OF BIDDERS	0.0173	-0.1682	0.4611	0.5702	-0.6644	0.0443	1.0000						
SUP. AGREEMENT	0.1781	0.4218	-0.5771	-0.6279	0.6032	-0.0812	-0.5161	1.0000					
LEARNING EFFECT	0.2195	0.3918	-0.7328	-0.5370	0.7770	-0.2267	-0.4439	0.5239	1.0000				
REGULATORY QUALITY	-0.4438	-0.4993	0.1270	0.1730	0.0977	-0.1549	0.0930	-0.0913	-0.0776	1.0000			
DURATION	-0.3452	-0.3761	0.3954	0.5095	-0.3393	0.0778	0.4850	-0.3743	-0.1436	0.1048	1.0000		
DURATION*	-0.3506	-0.4105	0.4791	0.6174	-0.4111	0.0942	0.5877	-0.4535	-0.1740	0.1270	0.8254	1.0000	
SEMCA	0.5228	0.4291	-0.5234	-0.2834	0.4446	0.1343	-0.2885	0.1250	0.4953	-0.0799	-0.3175	-0.3847	1.0000