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RENEGOTIATION OF DEFENSE PROCUREMENT CONTRACTS

Jean-Michel OUDOT[♣]

Centre ATOM

University of Paris I Panthéon – Sorbonne

106-112 boulevard de l'Hôpital

75647 Paris cedex 13 - France

Phone: +33 1 44 07 83 21

Fax: +33 1 44 07 83 20

E-mail: oudot@univ-paris1.fr

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Abstract:

Ex ante contract terms are not always enforced *ex post*. Through the analysis of enforcement conditions of outsourcing contracts in the French defense procurement sector, I identify the determinants of renegotiations. I demonstrate that analyzing formal arrangements is not enough to account for renegotiations. Informal decision-making plays a major role in that perspective. Determinants of renegotiations are focused on uncertainty associated to implicit decision rules prevailing in this sector. Besides, I show that probity transactions can be regarded as a transactional environment that favors renegotiations.

Introduction

"Contractual relationships, especially long-term ones, are rarely implemented in the mechanical way typically envisioned in economic theory but are characterized instead by an ongoing process of negotiations over the terms of trade" (Crocker & Masten, 1991 p.72). The defense procurement sector provides an illustration for this assertion. French data detailed in this article show that 56% of contracts are renegotiated. In those contracts, enforcement conditions of contracts changed substantially from what was initially planned. Those renegotiations cause increases in prices by 4.64% on average per contract. In some contracts, prices increase by 30% while amounts of those contracts may exceed several hundreds of million euros. In addition, renegotiations may valid decreases in quantity ordered without any price reductions. Thus, both the frequency of renegotiations and their impacts cannot be neglected. Beyond economic consequences of renegotiations, the latter causes a switch from fixed-price contracts to cost-reimbursement contracts in the French defense procurement sector[1]. This switch modifies substantially a major feature of the governance structure of contracts (Williamson, 1991). Understanding motivations for such a switch appears as an interesting task. Since renegotiations are frequent, cause huge financial consequences and may modify the choice of the contract type, their analysis can be regarded as crucial. That is why I devote this article to the analysis of the determinants of renegotiations. Why renegotiations occur? I aim at identifying contingencies in which *ex ante* contract clauses are not enforced *ex post*.

[1] Cost-reimbursement contracts include cost contracts, cost-sharing contracts, cost-plus-incentive-fee contracts, cost-plus-award-fee contracts and cost-plus-fixed fee contracts. Fixed-price contracts include firm-fixed-price contracts, fixed-price contracts with economic price adjustment, fixed-price incentive contracts, fixed-price contracts with prospective price redetermination, fixed-ceiling-price contracts with retroactive price redetermination, firm-fixed-price with level-of-effort term contracts.

I focus on defense procurement contracts in France. Those contracts govern the acquisition of equipment to be included into the organization of the national defense (missiles, air craft fighters, helicopters, warships,…). Analyzing such contracts is particularly relevant since the French department of defense is the first buyer and the first public investor in France, with spending of € 14.3 billions in 2005 (French department of defense, 2006 p.33). In addition, renegotiations turn out as an acute matter in this sector, as developed previously.

To my knowledge, no empirical analysis has investigated motivations for renegotiations in this sector. However, some empirical articles address renegotiations from an empirical perspective. While Guasch (2004), Guasch, Laffont & Straub (2003, 2005, 2006, 2007) and Engel, Fisher & Galetovic (2006) focus on renegotiations of concession contracts in Latin America; Cai, Li & Zhou (2003) are interested in the Chinese banking industry, Gil (2004, 2006) in the Spanish movie industry and Filson, Switzer & Besocke (2005) in the US movie industry. These articles point out both economic and political factors explaining renegotiations. By adopting a transactional approach, I emphasize in this article economic explanations for unexpected renegotiations. Along with the usual transaction characterization developed by transaction cost economics, I remind the role of uncertainty in the explanation of contract choices. However, I show that uncertainty is not enough to justify renegotiations. Indeed, uncertainty must be associated to decision rules establishing the link between uncertainty and renegotiation to justify the latter in defense procurement contracts. Those decision rules may be explicit or implicit. I show that explicit contract terms do not allow for renegotiations in face of uncertainty. That is why the explanation of renegotiation calls for an analysis of implicit contract terms. In that perspective, I identify implicit decision rules and a specific transactional environment that favor renegotiations in the defense procurement sector.

I document the developments detailed in this article with an extensive dataset constructed in the French defense procurement sector. I investigate 48 outsourcing procurement contracts signed by the French department of defense, through its division devoted to the procurement of defense equipment (the Délégation Générale pour l'Armement), and a set of 18 contractors. Contract terms and their precise enforcement conditions are accurately analyzed. This original dataset allows to disentangle the role of explicit and implicit contractual design, of adverse events occurring during the contract life and impacts of specific transactional environments in the determination of unexpected renegotiations.

This article is composed of three sections. The first section is devoted to a detailed analysis of renegotiations of defense procurement contracts. Frequencies and financial impacts of renegotiations are assessed, which settles the matter investigated in this article. In the second section, I explain the occurrence of those renegotiations. I observe that uncertainty and renegotiations occur simultaneously. Despite this simultaneity, I show that uncertainty is not enough to justify renegotiations since contract terms do not allow renegotiations in face of uncertainty. Explaining renegotiations call for analyzing contracts beyond formal agreements by identifying informal decision rules that establish the link between uncertainty and renegotiations. I identify such a decision making process in the French defense procurement sector. In the third section, I discuss results displayed in this article. I start by introducing variables explaining renegotiations in defense procurement contracts into the model developed by Guasch, Laffont & Straub (2007). Such an extension of their model is likely to favor an inter-industry analysis of renegotiations determinants. Last, I interpret contract choices in the French defense procurement sector. In particular, I examine consequences of renegotiations in terms of contract type choice.

1. Renegotiations of defense procurement contracts

This first section is devoted to the documentation of renegotiations of French defense procurement contracts. After a brief presentation of the dataset constructed in this sector, I detail the frequency and impacts of renegotiations.

1.1 Data on French defense procurement contracts

Defense procurement contracts are signed by the department of defense (represented in France by the Délégation Générale pour l'Armement, henceforth DGA) and contractors. Whereas the latter develops and produces defense equipment, the former pays for equipment delivered. Then, equipment are transferred to armed forces for use.

The dataset I rely on in this article is composed of 48 outsourcing procurement contracts signed by the DGA and 18 contractors. Those contracts have been selected by the DGA with the purpose to make the dataset as much representative of its overall activity as possible. Statistics on this dataset are detailed in the following table.

	Nb of obs.	Average	Standard deviation	Min.	Max.
Year of signature	48	2002	2.3	1994	2005
Year of termination	48	2007	2.5	2000	2013
Initial price (€ million)	48	134.7	446.6	0.2	3000

Table 1: descriptive statistics on the dataset

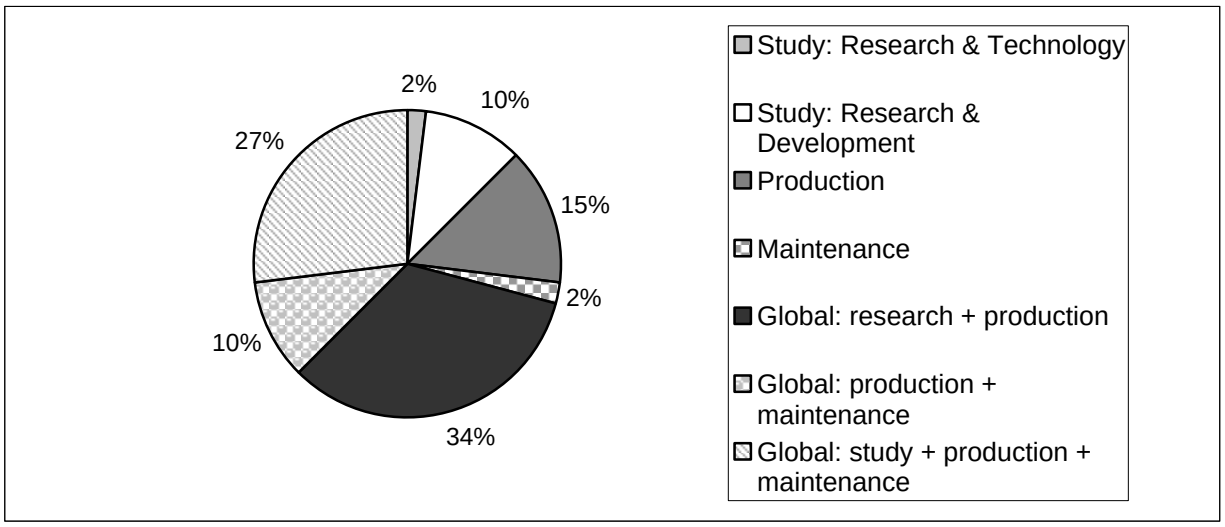
Contracts included in the dataset have been signed between 1994 and 2005 (2002 on average) with termination dates spread between 2000 and 2013 (2007 on average)[2]. The mean duration of contracts is 5.1 years. Thus, I deal with medium-term contracts. The average value of these contracts is € 134.7 million, ranging from €0.2 million to €3 billion. The high value of

[2] While most of contracts analyzed are completed, some of them are still implemented. Contracts that are not terminated are either maintenance contracts, *i.e.* concern low-uncertain activities, or deal with equipment whose realization is very close to be completed. Thus, the knowledge on adverse events occurring during the implementation of contracts is relatively complete.

standard deviation of prices shows that prices are diversified in the dataset, along with the DGA's overall activity.

Contracts included in the dataset were attributed through a competitive tendering in 23% of cases, while 23% of contracts were attributed by applying a mixed process (negotiation with competition) and 54% through negotiation without competition (26 observations). Thus, most of contracts are bilaterally negotiated. 75% of contracts were signed by only one contractor and 25% were enforced by two or more co-contractors. Besides, the DGA was the only buyer in 92% of cases; 8% of contracts were managed with an international cooperation process.

Equipment procured with the implementation of contracts (electronic systems, missiles, vehicles,…) and types of activities involved in the dataset are diversified, as detailed in the following graph.



Graph 1: types of activities in contracts

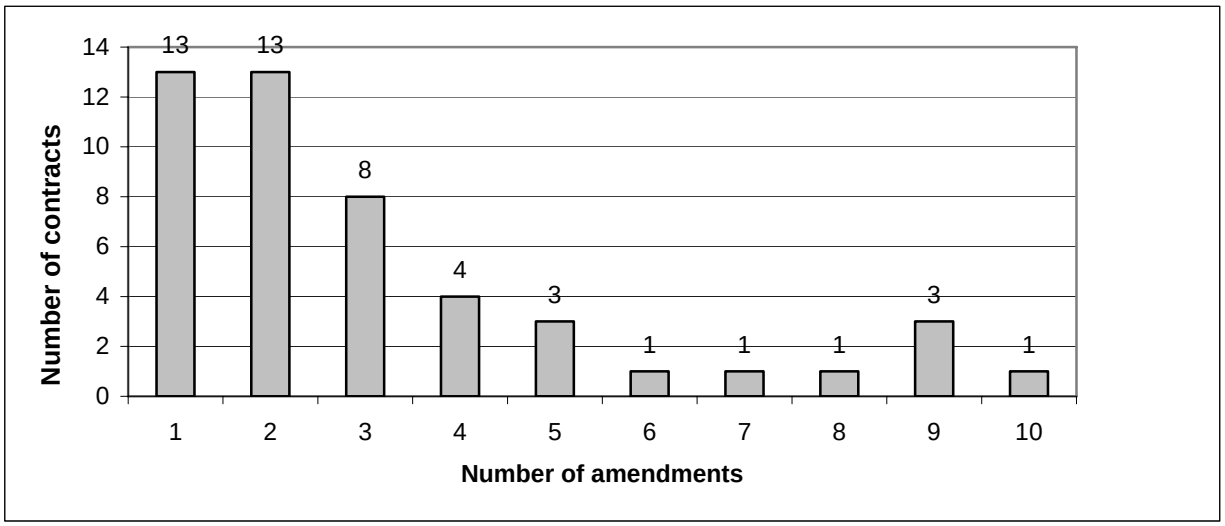
Whereas 2% of contracts are focused on research & technology activity (1 observation), 34% of contracts includes both research and production (16 observations). In 27% of cases, a global contract with research, production and maintenance was signed (13 observations).

For each of these 48 contracts, I have obtained the original version of the contract, which served as the reference, as well as their amendments. Moreover, I have systematically sent a detailed questionnaire to the persons within the DGA in charge of monitoring these contracts.

The central goal of this questionnaire was to assess the overall performance of each contract and to collect detailed information on the various events that occurred during the implementation and enforcement of contracts. More generally, the objective was to understand the logic underlying the implementation of these contractual arrangements. Answers to questionnaires were systematically checked through phone interviews with respondents. Thus, both *ex ante* contractual choices and their *ex post* modifications are identified, while the motivations for these changes have been accurately acknowledged.

1.2 Renegotiations

Changes in enforcement conditions of contracts are realized through the signature of amendments. In the dataset analyzed, 104 amendments have been signed concerning 35 contracts. 2 amendments are signed per contract on average[3]. The following graph details their repartitions. It is shown that no amendment was signed in 13 contracts and that one contract had 10 amendments.



Graph 2: number of amendments per contract

[3] Since all contracts in the dataset are not completed, all expected amendments have not been signed yet. Thus, the average number of amendments signed per contract is likely to be higher than that suggested here.

All these amendments do not mean renegotiation. Indeed, amendments have two functions: adjusting the monitoring of contracts and renegotiating enforcement conditions of these contracts. Whereas the first function can be regarded as incremental, the second represents a more radical change of enforcement conditions. Examples of adjustments necessary in the defense procurement sector are the rectification of mistakes in original contracts, changes of management clauses, indices of prices, the rate of value-added tax, the contractor's name, or changes in the account plan. These minor agreements are addressed by what I call adjustment-amendments.

As opposed to adjustment-amendments, renegotiation-amendments valid substantial changes in enforcement conditions of contracts. Such changes regard delays, technical specifications of equipment to deliver, quantities to produce and/or prices. The following table differentiates these two functions of amendments and provides related statistics.

Amendments	Number of observations	% / total	Mean price (€ million)	Standard deviation of price	Min of price (€ million)	Max of price (€ million)
Adjustments	59	**57**	**0.06**	0.2	-0.1	1.1
Renegotiations	45	**43**	**2.27**	**4.7**	-4.3	27.3
Total	**104**	100	1.02	3.3	-4.3	27.3

Table 2: amendments in the French defense procurement sector

57% of amendments are adjustments of minor contract clauses (59 observations). The mean price of these adjustments is close to zero with a low standard deviation.

Besides, 43% of amendments are clear renegotiations of contracts since substantial departures from original contracts can be noted. The mean price of these renegotiations is € 2.27 million, with a standard deviation of 4.7. Prices of these renegotiations vary from – € 4.3 million to + € 27.3 million[4]. In addition of these financial impacts, renegotiations may valid decreases in the quantity delivered without any price reduction. In one contract for instance, quantities

[4] Renegotiation with negative prices means that the DGA eventually reduces the quantity ordered, and pays less accordingly.

were reduced by 30% with a constant financial perimeter. Thus, the DGA may support both financial and technical impacts from renegotiations. In the following developments, I focus on financial impacts of renegotiations because technical consequences of adverse events are less significant than financial impacts in the French defense procurement sector. Indeed, whereas excess costs concern 87% of contracts, reductions in the technical performance is observed in only 27% of procurement contracts in the dataset analyzed.

These renegotiation-amendments concern 27 contracts in the dataset. Thus, the frequency of renegotiations is 56% in the French defense procurement sector. Total excess prices validated by these renegotiation-amendments are € 102.15 million in the dataset analyzed. The purpose of the following section is to explain both occurrences of renegotiation-amendments and related excess prices.

2. Determinants of renegotiations

In this section, I present and justify determinants of renegotiations of defense procurement contracts. A basic principle in transaction cost economics is that contract terms are aligned with transaction features to minimize costs (Williamson, 1985). This alignment principle is supposed to prevail both *ex ante* and *ex post* since these both periods are important in the explanation of performance. Thus, during the implementation of contracts, the alignment principle still applies: when contract terms become misaligned with transaction features, partners engage renegotiations, at least as long as they expect gains higher than costs (Klein, 1980). Three variables characterize transaction features: asset specificity, uncertainty and frequency. Here, I focus on uncertainty. When expected uncertainty differs from what occur in practice, transaction cost economics suggests that parties engage in renegotiations to keep enforcement conditions of contracts aligned with transaction features. In the dataset analyzed, I observe that *ex post* uncertainty and renegotiations occur simultaneously (section 2.1).

However, this simultaneity is not enough to justify renegotiations since formal contract terms do not justify renegotiations in face of uncertainty, while any renegotiation should be justified for administrative reasons (section 2.2). That is why I go deeper into the analysis of contracts by focusing on informal arrangements to explain renegotiations. I show that implicit decision rules establish the relation between uncertainty and renegotiations in the French defense procurement sector (section 2.3). I also identify a specific transactional environment that favors renegotiations (section 2.4).

2.1 Simultaneousness between uncertainty and renegotiations

In the dataset analyzed, events whose probability of occurrence or impacts are incompletely known, and whose anticipation or occurrence causes, directly or indirectly, adverse effects on the completion of the project, in terms of time, cost or quality occurred in 96% of contracts. Thus almost all contracts are characterized by some forms of *ex post* uncertainty.

So as to document uncertainty in the defense procurement sector, I develop in this section adverse events occurring during the implementation of contracts. I gathered the different adverse events according to the type of their sources[5]. I identified four main sources of uncertainty in the defense procurement sector: contractual events, technical or technological events, industrial and direct financial events. Each of these sources gives rise to a category of uncertainty[6]. Thus, I resort to four categories of uncertainty. Thanks to empirical

[5] From a methodological point of view, the number of categories of uncertainty should be minimized (to favor assessment of their impacts) and should be based on a single variable (so that each adverse event cannot be introduced in different categories). Three variables can be used to structure categories of uncertainty: the period at which events occur (useful in management of projects), impacts of events or according to sources of events. I have chosen the third opportunity.

[6] *Technological uncertainty* gathers technical or technological events that had significant impact on the performance of contracts. *Contractual uncertainty* is composed of events related to the characteristics of the contract per se, that is, its negotiation, its drafting, notification of its attribution (which can be delayed), and conditions of its enforcement. Typically, opportunism shows in this category. *Industrial events* represent for instance cases in which one contractor or one or several of its subcontractors were not able to meet their commitments because they overestimated their capabilities. *Direct financial uncertainty* is composed of events that directly modify the initial equilibrium between revenues and expenses, either because revenues are inferior

investigations that I have undertaken with the DGA, the different categories of uncertainty were ranked according to their impacts in terms of time, cost and technical specification. The contractual uncertainty turned out as the most significant category, followed by technological, industrial and direct financial uncertainty. Indeed, contractual events cause most of excess costs, delays and reductions in technical performance. For each of the categories of uncertainty, people responsible for managing procurement contracts identified their most critical events. The combination of the ranking of categories and the knowledge of their critical determinants allow me to determine the list of the 10 most critical determinants of uncertainty in the French defense procurement sector. This list is detailed in the following table.

Categories of uncertainty	Critical determinants of these categories
Contractual	1. Failure of government furnished equipment
	2. Change in the demand ordered by the Army after the signature of the original contract
	3. Matters related to the non independence of several contracts
Technological	4. Underestimation of the complexity of equipment to realize
	5. Complexity of equipment to realize
	6. Sub-contractors' insufficient technical abilities
Industrial	7. Contractor's insufficient organizational abilities
	8. Sub-contractors' insufficient organizational abilities
Direct financial	9. Reduction in financial resources by Army's decision
	10. Freezing of financial resources by Army's or DGA's decision

Table 3: the 10 most critical adverse events in the defense procurement sector

The most critical event is the failure of government furnished equipment. The latter is composed of defense equipment to retrofit, intermediary consumptions, test facilities, infrastructures and carrier vehicles. These equipment can be regarded as specific assets introduced in the realization process of procurement contracts. Government furnished equipment are delivered by armed forces or other public organizations exterior to the DGA. The latter is unable to control them, that is why failures of their delivery can be regarded as an

to what was expected or suffered from delays, or because costs seriously exceeded financial resources initially planned.

environmental uncertainty. 73% of procurement contracts analyzed include government furnished equipment (35 observations). During the enforcement of contracts, failures of government furnished equipment are observed in 22 contracts (63% of contracts including these equipment). They were delivered in late, and/or with a different specification from what was expected, and/or they were not delivered at all. In table 3, let us also note the importance of the complexity of equipment to realize. The purpose of a large part of these contracts is to procure defense systems, and sometimes a system of systems[7]. Therefore, the number of variables that must be taken into account in the determination of the governance structure is high, which reveals a certain complexity of both equipment to deliver and of the procurement organization. This complexity is source of uncertainty on the completion of objectives pursued.

The occurrence of those events caused excess costs, delays and/or reduction in the technical performance. I focus here on excess costs, *i.e.* on differences between the expected (production and transaction) costs and realized costs. Excess costs occurred in 87.5% of contracts (42 observations). The mean excess cost was assessed as of € 6.03 million per contract. Excess costs are assessed as percentage of prices of each contract so as to account for the economic importance of contracts. The following table details statistics on excess costs in the dataset analyzed.

	Nb of obs.	Average in %	Standard deviation	Min.	Max. in %
Excess cost / initial price	48	9.96	10.40	0	45.68

Table 4: Excess costs in defense procurement contracts

Excess costs represent 9.96% of prices of contracts on average. This percentage reaches 45.68% in the dataset analyzed. Besides, let us note that 100% of contracts in which

[7] A defense system realizes a function of defense by itself. A system of systems is composed of several systems that are interconnected and interoperable (*e.g.* an antimissile defense system connects command, control, communication computers, surveillance and intelligences systems -C4ISR- with missiles platforms).

renegotiation-amendments have been signed are characterized by some forms of *ex post* uncertainty on costs. Thus, renegotiations and uncertainty occur simultaneously in the dataset analyzed.

However, I show, in the following section, that this simultaneity is not enough to explain renegotiations. As a matter of fact, formal contract terms do not justify renegotiations in face of uncertainty, while any excess prices should be justified for administrative reasons.

2.2 Formal contract terms: no relation between uncertainty and renegotiations

Formal contract terms do not justify renegotiations in face of uncertainty in the French defense procurement sector. All contracts (but one which is a cost-reimbursement contract) in the dataset are fixed-price contracts with economic price adjustments. Prices can be revised downwards or upwards according to input prices. Price adjustments are first a function of cost indexes of labor and of various products or services. For instance, the building cost index is used in that perspective. Second, price adjustments are based on cost indexes of raw materials (*e.g.* energy, aluminum and copper). All indexes of inputs introduced within the price formula are specifically identified in French official reports[8]. In 21% of contracts (10 observations), fixed-price contracts with economic price adjustments are completed with a cap. These contracts become then fixed-ceiling-price contracts with economic price adjustment under the cap. The fixed price, that may be completed with a cap, reveals the *ex ante* DGA's high protection in face of adverse contingencies.

This protection is reinforced *ex ante* by the clear contractor's responsibility in realizing contractual commitments, in terms of schedule and technical performances in particular. As far as the schedule performance is concerned, let us note that penalties for delays are very

[8] This is the « bulletin officiel de la concurrence, de la consommation et de la répression des fraudes » (BOCCRF) and various reports of the « Institut National de la Statistique et des Etudes Economiques » (INSEE) (especially the « bulletin mensuel de la statistique » (BMS)).

similar from one contract to another[9]. They all allocate the financial consequences of delays to the contractor, regardless the parties' responsibility for adverse contingencies. In addition, penalties are also provided in 13 contracts in case the contractor does not complete technical objectives stipulated in original arrangements (speed, autonomy, resistance to shocks,…). When such penalties are not formulated in contracts, it is stipulated that the contractor is subject to a result constraint. In this perspective, the classical formula used in contracts is the following: "the contractor has the responsibility to deliver equipment completing all the demands of the contract. He should get the expected results with the means he has chosen".

In addition, no "rendez-vous clauses"[10] are stipulated in original contracts, except in one case. The latter corresponds to long delays of government furnished equipment. In this perspective, long delays are regarded as being comprised between 6 and 12 months, depending on contracts. Long delays of government furnished equipment represents only one specific case of a source of uncertainty, among many others sources of uncertainty, as detailed in table 3. Thus, rendez-vous clauses do not justify the bulk of renegotiations observed in the French defense procurement sector.

To sum up, the price paid by the buyer is apparently definitely fixed at the start of the contract. Prices are expected to vary only according to macroeconomic data clearly specified in original contracts through cost indexes with references to official reports. Prices indexation is not subject to renegotiations. In addition, contractors have a result constraint to comply with. Besides, rendez-vous clauses do not explain the high frequency of renegotiations. Thus, formal contract terms do not justify renegotiations in face of uncertainty. Contractors are supposed to support financial consequences of adverse events occurring during the contract

[9] The penalty formula for delays is equal to the value of assets delivered times the number of days of delays, out of 3000 in 62% of contracts. In the other contracts, the denominator varies between 1,000 and 6,000.

[10] Rendez-vous clauses specify conditions under which talks between transaction parties can attend to renegotiate contract terms.

implementation. Although formal arrangements do not explain renegotiations, associating uncertainty and renegotiations implies to analyze contract terms beyond formal agreements by investigating informal arrangements.

2.3 Informal contract terms justify renegotiations in face of uncertainty

In this section, I identify two implicit decision rules establishing the link between uncertainty and renegotiations. Those two decision rules are focused on the responsibility principle enounced by Holmström & Milgrom, 1991 p.27. This principle stipulates that transaction parties are expected to support the financial consequences of events that are under their control. The motivation for applying this principle is to encourage parties to prevent occurrences of adverse events they can control. The application of this principle has distinct consequences according to information assumptions. Here, I distinguish a world with full information and complete rationality from a world with incomplete information and bounded rationality (Simon, 1986).

When transaction parties have complete information on sources of uncertainty and on their relative responsibilities, they decide to allocate financial consequences of uncertainty according to their relative responsibilities. In that perspective, sharing rule positioned anywhere on the [0;1] continuum, according to each one's responsibility, is possible[11]. Oudot (2006) has tested this hypothesis in the defense procurement sector and has shown that the responsibility principle applies when parties have complete information on the sources of uncertainty and on their relative responsibilities. This principle directly influences *ex post* contractual decisions about the sharing of the financial consequences of adverse events occurring during the contract life. Here, I observe that this sharing rule is not specified in original contracts nor in regulations. Thus, the responsibility principle appears as an implicit

[11] A (0-1) allocation of financial consequences of uncertainty means that party # A does not support any financial consequences while party # B supports 100% of those consequences. Conversely, a (1-0) allocation puts the entire burden on party # A.

decision rule governing the enforcement of procurement contracts in the French defense procurement sector.

Since the realization of defense equipment implies inputs from contractors, subcontractors, and also from the DGA, the department of defense (through the government furnished equipment in particular) and the department of finance, all these partners may be responsible for adverse events. Realization costs being partly determined by those events, the DGA pays for financial consequences of events that it, or other public organizations, controls. In practice, the application of the responsibility principle leads to exemptions of penalties and renegotiations. The following table details the number of contracts in which the DGA is responsible for adverse events and excess prices associated.

Responsibility for adverse events	Number of contracts impacted	Excess prices associated (€ million)
DGA	9	7.25
DGA or department of defense	27	25.25
DGA, or department defense, or DGA & contractor, or DGA & contractor & exogenous forces	34	64.5

Table 5: financial consequences of the responsibility principle application

This table details financial consequences coming from the application of the responsibility principle[12]. Three main degrees of DGA's responsibility can be noted. The first line of table 5 concerns adverse events whose responsibility belongs only to the DGA. Changes in technical specifications ordered without any changes of demand from the department of defense fall in this category for instance. € 7.25 million of excess prices are caused by the sole DGA's responsibility. The second level of the DGA's responsibility is detailed in line 2. The department of defense is also responsible for adverse events when government furnished equipment fail for instance. 27 contracts are impacted by such responsibilities, causing €

[12] The method I used to determine those amounts consists in a very accurate investigation of procurement contracts: for each category of uncertainty materialized, I know events causing this occurrence and responsibilities for those events. I am also aware of decisions on the sharing of financial consequences coming from materialized uncertainty. I have compiled information and get results detailed in this table.

25.25 million as excess prices. Line 3 widens the analysis to events whose DGA's responsibility is shared with contractors and exogenous forces. The DGA supported part of financial consequences of events whose responsibility is shared with contractors, or belongs to the department of defense or to exogenous forces. € 64.5 million of excess prices are explained by this widened DGA's responsibility. Thus, the application of the responsibility principle explains 63% of excess prices validated by renegotiation-amendments in the dataset analyzed.

The second explanation of renegotiations in face of *ex post* uncertainty regards situations in which transaction parties are unable to establish clear and accurate responsibilities for adverse events. This is a particular case of the responsibility principle. Masten (1988) has shown that parties have strong incentives to share the financial consequences of events occurring during the contract life in an equitable way, 50-50, when they are in a symmetric position concerning specific assets and reputation effects. This is what Masten called the "hazard equilibration principle". Oudot & Ménard (2006) have tested this hypothesis in the defense procurement sector, in a context of ambiguous responsibilities regarding the origins of adverse events. They concluded on the non rejection of this hypothesis. Parties want to avoid costly renegotiations and guarantee the continuity of their contractual relationships by enforcing equitable contractual arrangements. Partners regard that enforcing original contract terms may sometimes cause an inequitable outcome, leading to high renegotiation costs.

Bounded rationality of partners associated to the complexity of defense procurement equipment and to incomplete information explains why some sources of events may appear as ambiguous (*e.g.* 40-60 or 60-40). In those specific circumstances, parties decided to share 50-50 the financial consequences of adverse events. This contingency corresponds to 8 contracts in the dataset analyzed, causing € 7.5 million as price overruns. 7% of excess prices validated

by renegotiation-amendments are explained by the inability to establish clear responsibilities for adverse events.

Responsibility and hazard equilibration principles are two implicit decision rules that govern decisions on the sharing of financial consequences caused by uncertainty materialized *ex post*. These two implicit decision rules explain why uncertainty can be regarded as an explanatory factor of renegotiations in the French defense procurement sector. Whereas formal contracts could not justify such a relation, informal arrangements explain why uncertainty causes renegotiations. In the following section, I identify a transactional environment that favors renegotiations.

2.4 Probity transactions as a transactional environment favoring renegotiations

The concept of "probity transaction" has been introduced by Williamson (1999). In this article, the author emphasizes the specificity of some extreme transactions including sovereign tasks: "foreign affairs, the military, foreign intelligence, managing the money supply, and, possibly, the judiciary" (p.321). Williamson (1999) adds that "what distinguishes probity transactions are their needs for loyalty (to the leadership and to the mission) and process integrity" (p.324). In such transactions, the public authority needs a large confidence and professional excellence from the contractor. The former is highly dependent on the latter. Indeed, any failure in the realization of the technical or schedule objectives may cause very large losses to the public buyer. Probity transactions are characterized by stakes that exceed the strict perimeter of the transaction.

In the defense procurement sector, probity transactions correspond to cases related to either nuclear defense systems or to equipment that are due to be introduced into major or crucial defense systems whose realization is in progress. In these two situations, any failure in the realization of original technical or schedule objectives would impose a cost to the public

authority that goes far beyond project's costs. For instance, let us think of the potential social, economic and political consequences of any failure (explosion, leak,…) of a nuclear equipment. The second situation can be regarded as a probity transaction because of technical and organizational interdependences of several contracts. Indeed, the defense procurement process is organized as a nexus of contracts[13] aiming at the realization of complex equipment whose final performance depends on the weakest performance of its components (weakest-link good). The failure of one component (or contract) leads to the failure of the whole program whose realization is in progress, causing huge troubles (excess costs in particular).

At the same time, if the contractor declares *ex post* not to be able to complete expected schedule and/or technical performances, then he hold-ups the DGA. Simply by deciding to wait for a contractual arrangement or, in an extreme case, to breach the contract by putting forward technical impossibilities for instance[14], the contractor threatens the DGA from considerable excess costs. This strategy has been identified by Goldberg (1985) who stipulates that "the costs can arise directly from the effort to renegotiate or indirectly through strategic bargaining. That is, the loser might threaten to engage in acts which impose costs upon the other party but do not constitute a legal breach" (p.532). By delaying one contract of the program aiming at the realization of the defense system, the contractor delays the entire program. Such a "waiting strategy" is likely to succeed since the DGA has invested in sunk-type assets (the other related-contracts or nuclear facilities), which creates a high quasi-rent. Here, the seller can undertake an opportunistic behavior aiming at capturing the buyer's quasi-rent. When the amount of this quasi-rent is much higher than the price of the contract

[13] The network organization is illustrated by spillovers from one contract to others during the implementation of procurement contracts. In the dataset analyzed, 44 contracts suffered from delays. The delays of these contracts caused delays in the program in which the contract was a part of in 23% of cases, and also delays in contracts exterior to this program in 11% of cases. These spillovers explain partially why interdependences between several contracts have been identified as the third most critical event in the French defense procurement sector.

[14] In one of the contracts analyzed, it was specified that the contractor had the opportunity to breach the contract in case of "important technical or economic difficulties", without any other precisions. In this contract, the contractor had another opportunity to renegotiate, along with pretending technical impossibilities.

considered, the latter is likely to be renegotiated. The DGA absolutely needs the realization of the expected technical and schedule performances in probity transactions, which constraints him to find a contractual solution in face of a waiting strategy.

In the dataset analyzed, two transactions are characterized by probity[15]. One of them has caused large contractual difficulties. The purpose of this contract was to develop and produce one equipment that was due to be introduced into a major defense system whose realization is in progress. *Ex post*, the contractor declared that he was unable to complete the expected technical performance for technical reasons that belong to its sole responsibility. Excess costs induced by this difficulty were of € 40 million, for a contract price of € 350 million. The contractor adopted a waiting strategy. Since the DGA absolutely needed the expected technical performance within the prescribed delays, it accepted to pay for half of this cost overrun (€ 20 million) to unlock the situation. Such a behavior is qualified by the DGA as a "participative action". If the DGA would not have supported these financial consequences, the contractor would have waited for a contractual solution before carrying on with this project. Delays would have been high, causing delays in the entire program of the major defense system in which the equipment was due to be introduced. Induced excess costs for this program were estimated at more than € 100 million, *i.e.* more than initial excess costs, which justified the DGA's participative action.

Although probity transactions are not frequent in my dataset, they cause huge financial consequences. This contract has the highest excess price in the dataset analyzed. Price overruns caused by the opportunistic behavior in this probity transaction explains 20% of total excess prices validated by renegotiation-amendments.

3. Discussion

[15] This dataset does not include any equipment related to the nuclear defense system. The inclusion of these special equipment in the dataset is likely to cause an increase in the number of probity transactions observed.

In this section, I detail the model developed by Guasch, Laffont & Straub (2007). I suggest an extension of this model to account for renegotiations in the French defense procurement sector by introducing in their model stylized facts identified previously (section 3.1). Such an extension is likely to favor an inter-industry analysis of determinants of renegotiations. Then, I interpret contractual choices made in France. In particular, I emphasize consequences of renegotiations on choices of the contract type (section 3.2).

3.1 Extending the Guasch, Laffont & Straub's model

Guasch, Laffont & Straub (henceforth GLS) have published several articles focused on the determinants of renegotiations of concession contracts in Latin America (GLS, 2006, 2007; Guasch & Straub, 2006). GLS formalize empirical observations by Guasch (2004). GLS point out that renegotiations may be government (GLS, 2005; 2006) or firm-led (GLS, 2003)[16]. While government-led renegotiations are mostly explained by political cycle considerations (the government expropriating the contractor), firm-led renegotiations come from factors detailed in the following equation.

$$\mathbf{Pr(renegotiation) = (1 - \upsilon - \varepsilon)\,(1 - \pi(x^E))} \qquad \mathbf{(1)}$$

Equation (1) stipulates that the probability of renegotiation is a function of three variables:

υ: probability that contractor is efficient (exogenous variable in the model[17]). If the contractor is efficient, then he will never ask to renege on its contract. On the other hand, an

[16] Here, I do not reproduce this dichotomy since it is not relevant in the defense procurement sector. Indeed, whereas joint-led renegotiations are relatively rare in concession contracts (GLS, 2005), they are very common in the defense procurement sector. This may be explained by the partnership that exists between the buyer and the seller. In addition, as opposed to Guasch & Straub (2006) that regard that the "outcome of renegotiations depends on who initiated them", previous analysis on the defense procurement sector shows that the outcome of renegotiations depends on the responsibility of adverse events occurring during the contract life (Oudot, 2006).

[17] In the defense procurement sector, I have observed that the contractor's type is endogenous to the transaction. Indeed, potential contractor pretend to be able to comply with the schedule and calendar objectives so as to get the contract. At the same time, contractors anticipate renegotiations of contracts *ex post*. In their model, GLS assume that contractors do not know their type and discover it when contracts are implemented.

inefficient contractor will ask for a renegotiation, since its *ex post* utility level is lower than its status-quo payoff.

ε : shocks. While positive shocks (increases in demand) reduce the probability of renegotiation, negative shocks (*e.g*. macroeconomic shocks affecting costs) increase the probability of renegotiation. Negative shocks can be regarded as environmental uncertainty in their model.

$\pi(x^E)$: probability that the regulator is able to impose the implementation of the agreed contract. This probability depends on the expenses x^E incurred to finance the functioning of the enforcement mechanism. With probability $(1 - \pi(x^E))$ the regulator is forced to accept a renegotiation. Opportunistic behaviors are presented as exploiting weaknesses of the institutional environment.

Thus, GLS allow for two main determinants of renegotiations: incompleteness of contracts and enforcement failures. Whereas the former comes from the need to adapt to environmental uncertainty, the latter is explained by weaknesses of the regulatory framework in face of opportunistic behaviors. Thus, renegotiations are expected to come from both environmental uncertainty (ε in the equation above**)** and behavioral uncertainty associated to institutional weaknesses.

In previous developments detailed in this article, I have demonstrated that renegotiations are mostly determined by uncertainty (shocks in the GLS's model) associated to implicit decision rules. From a formal point of view, I extend the Guasch, Laffont & Straub's model by introducing decision rules establishing the link between uncertainty and renegotiations. I suggest the following equation in that perspective:

$$\mathbf{Pr(renegotiation) = (1 - \upsilon - \varepsilon.\gamma)\,(1 - \pi(x^E))} \qquad \mathbf{(2)}$$

With **γ:** explicit and/or implicit decision rules allowing renegotiations in face of adverse shocks. While explicit rules may be associated with rendez-vous clauses, implicit rules refer

to the responsibility principle in the French defense procurement sector. γ takes 1 if such rules prevail in contracts; 0 otherwise.

Along with environmental uncertainty (shocks) and decision rules allowing renegotiations, the third factor explaining renegotiations in the French defense procurement sector relies on the behavioral uncertainty. Opportunistic behaviors aim at exploiting the DGA's dependence concerning the realization of technical or schedule objectives in probity transactions. As opposed to concession contracts in Latin America, contractors do not directly exploit weaknesses of enforcement mechanisms but rather weaknesses of the procurement process organization (as a nexus of contracts, when the realization of major defense systems is in progress). From a formal point of view, I complete again equation (1) so as to introduce the procurement organization (ρ).

$$\mathbf{Pr(renegotiation) = (1 - \upsilon - \varepsilon.\gamma)\ (1 - \pi(x^E;\rho))} \qquad \mathbf{(3)}$$

The probability $\pi(.)$ that the DGA is able to impose the implementation of the agreed contract is a positive function of the enforcement expenditures (Guasch, Laffont & Straub's model) and also a negative function of the procurement organization. The latter is mainly determined by a dummy variable taking 1 if the transaction is characterized by probity; 0 otherwise. Probity transactions reduce $\pi(.)$ and increase the probability that the regulator is forced to accept a renegotiation $(1- \pi(.))$.

3.2 Interpreting contractual choices in the French defense procurement sector

I suggest in this section to interpret contract choices in the French defense procurement sector as *hybrid* and *implicit*. Let us analyze these two features successively.

Part of fixed-price contracts are enforced as cost-sharing contracts in the French defense procurement sector. Whereas 98% of contracts are of fixed-price type, 56% of those contracts

are renegotiated which switched them from fixed-price to cost-sharing contracts[18]. Indeed, contractors reimbursed for an agreed-upon portion of their costs by the DGA. These contractual practices can be interpreted as *hybrid* between two polar possibilities: firm-fixed-price contracts and cost-plus-fixed-fee contracts. I assimilate this hybrid choice to the stability/flexibility trade-off pointed out by transaction cost economics. Whereas the purpose followed by the stability of contract enforcement conditions is to encourage parties to respect their commitments (Williamson, 1993), flexibility aims at avoiding the lock-in effect so that maladaptation costs are minimized (Bajari & Tadelis, 2001). Here, fixed-price contracts were initially chosen to incite contractors to perform[19], and these contracts are enforced as cost-sharing contracts to adapt enforcement conditions in face of uncertainty.

This French hybrid strategy can be compared with choices of the contract type in the US. The American defense procurement sector is the reference because of huge defense spending in equipment. Such a comparison is detailed in the following table.

	France 1994-2005 Dataset analyzed		**USA 1998-2003 All contracts - *Ex ante* choices**				
	18 companies		**Lockheed Martin**	**Boeing**	**Raytheon Co.**	**Northrop Grumman**	**General Dynamics**
	Ex ante	***Ex post***					
Fixed-price	97.92%	42%	46.77%	70.25%	57.94%	49.55%	60.02%
Cost-reimbursement	2.08%	58%	49.68%	27.42%	37.53%	42.48%	38.87%
Amounts awarded	€ 6.46 billion		$ 94 billion	$ 82 billion	$ 40 billion	$ 34 billion	$ 33 billion

Table 6: a France-US[20] comparison on the choice of contract types

[18] 58% of the 48 contracts analyzed are enforced as cost-sharing arrangements: 27 fixed-price contracts are enforced as cost-sharing contracts *ex post*, and 1 contract is signed and enforced as a cost-sharing contract.

[19] This was the initial motivation for resorting to fixed price contracts in the French defense procurement sector. However, the frequency of renegotiations drastically reduces incentives in that sector. This observation may lead DGA's decision makers to reconsider their contractual strategy concerning the choice of contract type.

[20] The source of the American data is the think-tank "center for public integrity". http://www.publicintegrity.org/pns/

This table points out important differences in the type of contracts chosen in France and in the US. Whereas French authorities favor almost systematically fixed-price contracts at the start of transactions, American decision-making reveals a much higher rate of cost-reimbursement contracts. This difference cannot be explained by differences in regulation. Indeed, French and American regulations allow cost-reimbursement contracting. In the French defense procurement sector, the acquisition regulation of public markets[21] allows public authorities to resort to cost-reimbursement contracts in many different contingencies: negotiation, complex equipment, new technology or no price comparator, among other reasons. These contingencies are regularly observed in the defense procurement sector. Cost-reimbursement contracts may not have any cap in those cases. In the US, the Federal Acquisition Regulation (section 16) clearly recommends to align the contract type with the degree of complexity or uncertainty of the transaction.

Differences in the choice of contract types between France and the US may be explained by differences in other aspects of the institutional environment. In the US, authorities rely on both law (the Truth In Negotiations Act[22]) and on large and powerful audit controls (through the Government Accountability Office) to monitor procurement contracts. This institutional environment favors the public authorities' accurate knowledge on contractors' realization costs. In France, no law demands a revelation of information by contractors and, above all, efficiency of audit controls is relative, although efforts are currently run in that perspective (Beaufils et al., 2004). In the 1980s, those weaknesses, associated to the revelation of obvious contractors' abuses on the costs declared for military equipment and intermediary consumptions, triggered the switch from cost-reimbursement contracts to almost systematic

[21] The « code des marchés publics » and the « décret spécifique au secteur de la défense ».

[22] Under the Truth in Negotiations Act (TINA) an American government's contractor or subcontractor is required to submit "cost or pricing data". The latter comprises all facts that prudent buyers and sellers would reasonably expect to affect price negotiations significantly. Contractors or subcontractors should certify that submitted data are accurate, current and complete.

fixed-price contracts. Here, contract choices are constrained by the institutional environment, which makes *ex ante* cost-reimbursement contract *a priori* inefficient in France.

Beyond formal types of contracts used in the French defense procurement sector, let us note that parties rely on relational contracts[23] (Baker, Gibbons & Murphy, 2002; Poppo & Zenger, 2002). Indeed, both explicit and implicit rules govern the enforcement of procurement contracts in this sector. Whereas explicit rules are written in original agreements (rendez-vous clauses), implicit rules apply during the enforcement of contracts and are not written nor in original agreements, nor in regulations. Resorting to such relational contracts remind that parties are embedded in a partnership in the defense procurement sector. This analysis also suggests that implicit and explicit terms are complementary, rather than substitutable, to govern transactions (Poppo & Zenger, 2002).

Conclusion

Using a sample of 48 French defense procurement contracts, I have identified *ex ante* contract choices and their modifications. The frequency and financial impacts of renegotiations have been accurately analyzed. In addition, determinants of renegotiations were identified. In that perspective, I emphasized the simultaneity of uncertainty and renegotiations. However, the sole analysis of formal contract terms was not enough to establish the relation between uncertainty and renegotiations. I have shown that implicit arrangements must be identified and analyzed to account for renegotiations in the French defense procurement sector. Furthermore, I have thoroughly detailed the specific case of probity transactions. The latter represents a favorable transactional environment for renegotiating enforcement conditions of contracts. I extended the model developed by Guasch, Laffont & Straub (2007) by introducing

[23] Baker, Gibbons & Murphy (2002) point out that relational contracts are sometimes called "self-enforcing" (Telser, 1980; Klein, 1996), implicit (MacLeod & Malcomson, 1989), or both (Bull, 1987). Here, I focus the developments on the implicit dimension of relational contracts.

decision rules establishing the link between uncertainty and renegotiations and also the procurement organization, from which probity comes, so as to account for observations in the French defense procurement sector.

Although I interpret contract choices in the French defense procurement sector as hybrid and relational, I cannot conclude on their relevancy. Concluding on this matter was not the purpose of this article and implies a specific methodology, based on the alignment principle in transaction cost economics. It will be addressed in a future work.

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