

Competitive Bidding, Renegotiation and Relational Contracting: Evidence from French Defense Procurement.

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Abstract

Well-established theories of contract procurement posit that the more complex a transaction, the higher the probability the buyer will find a seller through bilateral negotiation (rather than competitive bidding). This result yields two separate implications such that contracts awarded through auctions are less likely to be renegotiated ex-post; and that more complex projects will be more likely to experience ex-post renegotiation, holding everything else constant. In this paper, we empirically test both of these implications using a unique data set of 48 contracts from French defense procurement sector. Consistent with predictions from the theory, our empirical findings suggest that there is a negative relation between the use of competitive bidding and the frequency of ex-post renegotiation. We also find evidence that more complex projects are also more likely to be renegotiated ex-post. Finally, we emphasize the role of relational contracting between buyer and sellers as well as regulation and institutions in our findings within this particular empirical example.

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1 Introduction

Pervasive anecdotal evidence has challenged the view that ex-post contractual renegotiation may result in efficiency losses (see Macaulay (1963) and Asanuma (1989) for instance). This evidence fostered the emergence of a new literature that emphasizes the trade-off between the design of ex-ante formal contracts and the use of ex-post adjustment mechanisms in the presence of contractual incompleteness and relational contracting (see Hart and Moore (2007); Baker, Gibbons and Murphy (2009); or Wernerfelt (2007)). At the same time as this new theoretical literature develops, a stream of empirical papers has documented new evidence on the causes and consequences of ex-post renegotiation in a wide variety of settings (see Engel, Fischer and Galetovic (2006); Estache, Guasch, Iimi and Trujillo (2007); and Guasch, Laffont and Straub (2007)).

This paper contributes to this emerging literature in that, first, it provides evidence of the relation between competitive bidding (as opposed to bilateral negotiation) on ex-post contractual renegotiation in the French defense procurement sector. Second, it highlights the importance of accounting for the impact of relational contracting when studying the relation between competitive bidding and ex-post renegotiation. This means that when examining the data and discussing our results we explicitly take into account the fact that buyers and sellers have long-standing relationships that may shift their trade-off between ex-ante contracting design and ex-post costly renegotiation.

We start off relying on well-established ideas in Goldberg (1977) that compare the benefits of mediating a transaction through bilateral negotiation or competitive auction. He observes that transactions of goods carry along a transfer of information. In other words, the relative importance of non-price related information for the outcome of a transaction determines whether the transaction should be mediated through bilateral negotiation or competitive auction. These ideas are formalized in Bajari and Tadelis (2001) and Bajari, McMillan and Tadelis (2003) [hereafter BT and BMT respectively] which derive testable implications that the latter tests indirectly with a sample of private construction contracts in Northern California during years 1995-2000. These testable implications mainly specify that a more competitive contract award process (mainly competitive bidding as opposed to bilateral negotiation) combined with a higher project complexity may lead the bidding firms to hide information and therefore we may be more likely to observe ex-post contractual renegotiation. Therefore, we should find that more complex projects, holding award mechanism constant, should observe higher incidences of ex-post renegotiation. Similarly, holding

project complexity constant, we should observe that projects awarded through more competitive mechanisms (competitive bidding) are less likely to observe ex-post renegotiation.

In the second part of this paper we examine the factors driving ex-post renegotiation in the French defense procurement sector. We describe the institutions and norms governing transactions in this industry and complement this with an empirical test of the implications presented previously. For this purpose, we use a unique data set that contains information on a sample of 48 defense contracts from the French defense procurement sector and their ex-post renegotiation outcomes. In particular, we are able to examine renegotiation in two different dimensions. The first dimension is project cost and in our sample cost is renegotiated 56% of the time. The second dimension is the deadline to finish the project. This dimension appears to be renegotiated 89% of the time.

We can divide our empirical findings in two categories. First, we provide evidence that contracts for more complex projects are more likely to be renegotiated ex-post. This finding is stronger for deadline renegotiation than it is for price renegotiation. Second, we show that there is a priori no relation between ex-post renegotiations and whether the contract is awarded through competitive bidding in the French defense procurement sector. This correlation turns negative and significant as predicted after controlling for the (unobservable) specific buyer-seller relation of each contractor with the French governmental agency through bidder fixed effects. We interpret the impact of including bidder fixed effects as evidence of the importance of relational contracting on the trade-off between ex-ante contract design and ex-post costly renegotiation. We take these results as supporting evidence for testable implications derived in BMT (2003).

Our findings also relate to results in other papers that analyze contractual renegotiation such as Estache, Guasch, Iimi & Trujillo (2007) or Guasch, Laffont & Straub (2007). This paper contributes to that empirical literature on formal and informal contracting. This literature is rather scarce and has mainly focused on the description of government procurement contracts. Private firms rarely share information regarding their private agreements with others and even less so information on the ex-post departures from the initial formal agreements.¹ For this reason, it

¹Even though there is not as much evidence on the use of informal agreements in the private sector as in procurement, the first set of evidence goes back to Macaulay (1963) and Asanuma (1989) already mentioned in the introduction. A more recent stream of papers have added substance to this early evidence. The focus of these papers is the study of renegotiation and informal agreements in private contracting in a variety of industries such as the US motion picture industry (Filson, Switzer and Besocke, 2005), the construction industry (Chakravarty and MacLeod, 2004), oil drilling (Corts and Singh, 2004), the airline industry (Benmelech and Bergman, 2007), the Chinese banking industry (Cai, Li and Zhou, 2003) and strategic alliances of small Spanish firms (Ariño, Ragozzino and Reuer (2008)).

is hard to find empirical papers on private contracting outside of government procurement. A few examples of papers documenting contractual renegotiation in procurement are Joskow (1988) for the US coal industry, Bajari, Houghton and Tadelis (2006) for California Highway procurement, Joskow and MacAvoy (1975) for electrical power companies in the US, and Guasch, Laffont and Straub (2003, 2006, 2007) and Estache, Guasch, Iimi and Trujillo (2007) for procurement contracts in South America.

Finally, the active role that relational contracting and institutional norms play in the analyses differentiates this paper with those above. Our results become supporting evidence for arguments in Corts (2007). In that paper, Corts show how relational contracting may supplement incentives in formal contracts and therefore attenuating the empirical relation between competitive bidding and ex-post renegotiation. The goal of our paper is not only to understand further the use of ex-post contractual renegotiation in procurement but also shed some light on the impact of relational contracting on the design of contracts and ex-post contractual outcomes. To do so, we provide evidence that is consistent with traditional results regarding the role of competition in procurement with the use of ex-post renegotiation in arm's length transactions.

The paper is structured as follows. Section 2 presents the ideas in Goldberg (1977) and the theoretical framework in BT (2001) and BMT (2003). In section 3, we describe the institutional norms of the French defense procurement sector and our data set. Section 4 presents our empirical methodology and results. Finally, in section 5 we offer concluding remarks.

2 Theoretical Framework

We completely borrow here the model in BMT (2003). In their model, different award mechanisms (auctions versus negotiations) entail different types of contracts that have embedded different degrees of incentives. In particular, they differentiate between fixed price contracts (auctions) and cost plus contracts (negotiations) noting that the former type provides stronger incentives for cost reductions than the latter. In the same way that they borrow the main underlying concept from Goldberg (1977) and their earlier work in BT (2001), we first proceed to introduce the work of Goldberg and then lay out their model in BMT (2003) and present the testable implications that we will take to the data in the following section.

2.1 Conceptual Framework: Goldberg (1977)

The idea that competitive auctions may be the best way to find a seller for a project in procurement has been around for many years. Clear advantages of this allocation process (as opposed to bilateral negotiation) is that the sellers incur most of the search costs and that price may be lowest due to competition among sellers. This appealing idea has been challenged by many studying government procurement of public services. One example is Goldberg (1977).

Goldberg (1977) emphasizes two main factors that condition the buyer's choice between competitive auctions and bilateral negotiation as a way to find a seller and mediate the corresponding transaction. On one hand, Goldberg explains that competitive bidding is just one of many mechanisms to transmit information across organizations (in this case, between the buyer and the potential sellers). He follows up this by stating that the complexity of the project at stake is a key factor to determine whether competitive auctions are the optimal information transmission device between buyer and seller. In other words, in projects that are easy to specify the buyer is only left to specify the price of the project and may decide to use competitive bidding when the costs of setting up the auction are low enough. As the complexity of the project increases, the importance of information on non-price dimensions increases and therefore the buyer will need to find a transaction mechanism that provides flows of information on dimensions other than price. Otherwise, the buyer risks that the seller fails to provide the project at the specified price and conditions. Therefore as complexity increases the buyer may consider to use other mechanisms such as bilateral or multilateral negotiations instead of competitive bidding.

On the other hand, Goldberg (1977) also frames these transactions within their institutional environment and the particular commercial law around them. This law may put legal constraints to the information that can be transmitted in the transaction and therefore may shift the relative benefit of using competitive bidding versus bilateral negotiation. This relative benefit may also change in government versus private contracts and therefore may affect the importance of complexity presented in the previous paragraph. Therefore it is important to understand the institutions and legal framework surrounding a transaction before examining the impact of the mode of procurement (auctions versus negotiations) on the project outcomes.

In conclusion, the established notion that competitive auctions may be the best device to allocate a contract may be biased if we underplay the role of project complexity and the legal environment. Next, we remind the reader of the model in BMT (2003) and the two testable implications that we

take to the data later on.

2.2 Testable Implications

BT (2001) shows that there is a trade-off between the provision of ex-ante incentives and the occurrence of ex-post transaction costs. In particular, they show that strong incentives save costs ex-ante but are likely to increase ex-post renegotiation costs. On the other hand, soft incentives may increase ex-ante costs but prevents the parties from engaging in costly ex-post renegotiation. BMT (2003) extends the model in BT (2001) and derives testable implications that they test using a data set of private construction contracts in Northern California between 1995 and 2001.

Here we repeat the model in BMT (for the sake of exposition) before enumerating the testable implications that we are going to take to the data. Consider a buyer and a seller. The buyer has a value \bar{v} of a given project. Each project is characterized by a degree of complexity T and each contract is characterized mainly by its degree of completeness τ and its provision of incentives y . Both τ and y take values between 0 and 1. τ represents the share of possible contingencies included in the contract taking value 1 when the contract is complete. Following BMT (2003), low values of y are associated with stronger incentives and higher values with softer incentives.²

Therefore, each project/contract has τ probability of including the state of the world realized ex-post and $(1 - \tau)$ probability of not including it and therefore causing renegotiation. If renegotiated, the project loses value for the buyer such that takes value $\underline{v}(y)$ and this depends on the intensity of incentives y such that $\underline{v}'(y) > 0$. The cost that the buyer must pay for the project is $C(y, N)$ and depends on both the intensity of incentives and the number of sellers N offering the project to the buyer. Again following assumptions in BMT such as $\frac{\partial C}{\partial N} < 0$, $\frac{\partial C}{\partial y} > 0$ and $\frac{\partial^2 C}{\partial N \partial y} < 0$, there is a weak complementarity between competition and incentive intensity.³ Finally, there is a cost of designing a contract that is incurred by the buyer. We call the cost $d(\tau, T)$ and it depends on the complexity of the project T and the completeness of the contract τ such that $\frac{\partial d}{\partial \tau} > 0$, $\frac{\partial d}{\partial T} > 0$ and $\frac{\partial^2 d}{\partial \tau \partial T} > 0$.⁴

²In their framework, BMT allows for two contracts indexed by $y \in \{0, 1\}$ where $y = 0$ represent fixed price contracts and $y = 1$ represent cost plus contracts. They implicitly assume that incentives and award mechanism are bundled.

³The complementarity between competition and incentives only exists for $N > 1$ and this is stronger for fixed price contracts than it is for cost plus contracts. There is no complementarity for the case when $N = 1$.

⁴See Bajari and Tadelis (2001) for more details on $d(\tau, T)$.

Given all these conditions, the buyer will maximize a profit function such as

$$\max_{y, \tau} \tau \bar{v} + (1 - \tau) \underline{v}(y) - C(y, N) - d(\tau, T)$$

where the two choice variables are the intensity of incentives y and the contractual completeness τ . Taking FOCs with respect to τ and y , we find

$$[\tau] \quad \bar{v} - \underline{v}(y) - \frac{\partial d}{\partial \tau} = 0 \tag{1}$$

$$[y] \quad (1 - \tau) \frac{\partial \underline{v}}{\partial y} - \frac{\partial C}{\partial y} = 0 \tag{2}$$

See comparative statics in BT (2001) and BMT (2003) for more detail. Essentially, the complexity of a project naturally conditions the trade-off between ex-ante contractual completeness and the expected ex-post renegotiation costs. Moreover, this trade-off is also affected by the number of sellers and the competitive nature of the contract awarding process, the intensity of incentives embedded in the contract and the legal constraints that condition the buyer's actions. From the interaction of these variables in the model, we can then replicate the two testable implications from BMT (2003) such that,

- H1: Holding the number of bidders constant, more complex projects are more likely to be governed by contracts with softer incentives. This means that more complex projects are more likely to be negotiated (softer incentives, higher y), while simpler projects are more likely to be procured using auctions (stronger incentives, lower y). In other words, more complexity will be associated with more renegotiation ex-post.

- H2: Holding the project complexity constant, an increase in the number of available bidders makes awarding processes with stronger incentives (auctions versus negotiations) more attractive. In other words, more competition will be associated with less renegotiation ex-post.

We now proceed to describe institutional details and our data before testing the two implications here in this section.

3 Institutional Details and Data Description

In this section we first describe relevant institutional details of the French defense procurement sector since this is different than the usual procurement contracts studied in the literature (mainly highway construction and repair contracts) and the legal environment is unique to the country of origin France. French defense procurement contracts are signed agreements between the French Department of Defense and contractors, private most of them. While the latter develop, produce and maintain in operation capability defense systems, the former pays for equipment delivered. Once the systems are produced, they are transferred to armed forces for use. The Department of Defense delegates the procurement of defense systems to a specialized agency: the Délégation Générale pour l'Armement in France (DGA hereafter).⁵ Within the procurement process, the DGA is a public organization positioned between the military forces and the government.

Since the defense procurement sector is very significant from economic and strategic perspectives, the implementation of procurement contracts is subject to strict enforcement processes. As a result, its control is delegated to the Commission des Marchés Publics de l'Etat, the Comité des Prix de Revient des fabrications d'Armements and the Cour des Comptes in France.⁶ These auditing and control bodies check and enforce the compliance of procedures within the acquisition regulations (the Code des Marchés Publics in France⁷) and the relevance of management procedures regarding performances in terms of time, cost and quality. Despite of regulation accuracy, different countries are different in the intensity of public controls and while we may observe that the US and England are characterized by almost systematic and huge audit procedures, France is rather subject to very unsystematic controls auditing partly informal agreements (Oudot, 2006).

Beyond the impact of institutional features, the defense procurement sector is also characterized by a relative low number of contractors which increases monopoly power in auctions of certain types of defense projects and the frequency of future transactions among the parties involved. For this reason, implicit and relational agreements may play an important role when structuring formal agreements and this may be a reason why public authorities rely so often in bilateral negotiations as opposed to competitive bidding. In addition, both the complexity of transactions and the public authorities' objective aiming at supporting the development of national contractors may also

⁵Similarly, the equivalent to the DGA in France would be the Defense Procurement Agency in England, and a few different organizations within the Department of Defense in the US.

⁶This agency has its equivalent in the US in the Government Accountability, and in England in the National Audit Office.

⁷In the US, this would be the Federal Acquisition Regulation and the Truth In Negotiation Act.

increase the frequency of bilateral negotiation procedures as awarding criterion in this sector. The economic importance of defense procurement contracts in the economy associated to the predominance of negotiation procedures make the study of the relation between award mechanism (auction versus negotiation) and renegotiation in this sector interesting.

In this sector, the formal contracts transfer all risks to the contractor regardless the ex-post events. Despite the content of the formal contract, the contractor may ask for the renegotiation of one contractual clause when an adverse event may cause costs go over what was expected when the project was first settled. The DGA usually accepts to change the contract terms ex-post when it feels to be responsible for the adverse events that caused the cost increase, when the responsibility of the cost increase is ambiguous or when the cost increase is caused by exogenous factors that are nobody's fault. These renegotiations may take two forms, price and deadline renegotiation. The former transforms cost overruns into price overruns and the latter allows extensions of the realization schedules.

We now elaborate on the role of legal constraints in ex-post renegotiation. Take the following case as a hypothetical example. Imagine that DGA feels responsible for a cost overrun in a given project/contract X and this determines a first set of ex-post adjustments in such contract. If a related project Y also needs of ex-post adjustments, this may cause further adjustments on project X due to the delay and higher urgency on Y. These negative externalities may be innocuous if X and Y have been contracted through bilateral negotiation and a Cost Plus type of contract. If an auction was used, the French legal system may allow losing bidders to sue DGA since these may argue that they would have been able to produce the project at a higher quality at the ex-post realized cost. Given the suing threat, French officials face certain pressure to contain ex-post renegotiation that is difficult to justify to outsiders. This additional pressure has two effects: one is cross-subsidization among projects performed by the same seller through renegotiation if renegotiation is more easily justifiable in one project than the other. The second consequence is that deadline renegotiation may be more prevalent than price renegotiation. We will have this in mind when analyzing the prevalence of renegotiation in this sector within our sample.

3.1 The Data

Our data set on French defense procurement contracts is composed of 48 outsourcing agreements signed between the DGA and 18 French and European contractors whose purpose was to realize

various armaments (air strike fighters, helicopters, missiles, electronic systems and the like). The sample of contracts in our data set was selected by the DGA with the purpose to make the data set as representative as possible of the DGA overall activity.⁸ Summary statistics of the variables that we use in our empirical analysis are detailed in Table 1.

The contracts in the data set were signed between 1994 and 2005 (2002 on average) with termination dates between 2000 and 2013. The mean duration of a contract is 5.1 years. The average price of these contracts is €134.7 million, ranging from €0.2 million to €3 billion. The goal of these contracts varies greatly and they can be for research and technology activity (2% of the contracts), research and production (34%) or research, production and maintenance (27%) among others.

For each of these 48 contracts, we obtained the original version of the contract, which served as the reference, and its amendments. In addition to this, a detailed questionnaire was sent to the persons within the DGA in charge of monitoring these contracts. This questionnaire allowed us 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. Answers received for the questionnaires were systematically checked through qualitative analysis and phone interviews with respondents. Thus, both ex-ante contractual choices and their ex-post modifications are identified. From Table 1, we show that 2% of the contracts were cost reimbursement contracts ex-ante and 56% were cost reimbursement contracts ex-post.

Contract renegotiation is observed often. In particular, 56% of the contracts have their price renegotiated ex-post and 89% have their length extended. In addition, three different award mechanisms are used in the French defense procurement sector: bilateral negotiation (54% of cases), mixed process (23%) and through competitive auctions (23%). To account for complexity of agreements, we construct two measures of complexity. The first variable measures complexity by compiling information from ex-ante variables. This measure is a non-linear measure of transaction complexity that combines information on the number of contractors and the number of buyers involved,⁹ and whether the contract is for a defense system or a simple armament. The underlying assumption here is that the more people involved in the project ex-ante the higher the complexity since it will be more difficult to specify ex-ante what the end product needs to be like. Similarly,

⁸Systems related to nuclear defense were withdrawn from the sample.

⁹See that there will be always one intermediary in the buyer's side which is the DGA. The ultimate number of buyers may be more than one because more than one corp of the French army as well as other allied European nations may be involved in the project.

defense systems are more complex to produce than simple armaments. Table 1 shows summary statistics for these three variables. On average, a contract has 1.4 contractors and 1.1 buyers, and 40% of the contracts are for the realization of defense systems. Our index of ex-ante complexity takes values between 0 and 3. It equals 0 if the number of contractors equals 1, the number of buyers equals 1 and the contract is not for a defense system. It takes value 1 if it has more than 1 contractor or more than 1 buyer or it is for a defense system. It takes value 2 if two of the three variables suggest complexity and takes value 3 if all three suggest complexity. Over the whole sample, this measure of complexity averages 0.75.

The second measure of complexity that we use captures the number of adverse events realized ex-post in any given project. More complex ex-ante projects are more likely to suffer more adverse events ex-post. We construct this second measure of complexity by multiplying two separate variables that measure the number of risk categories realized ex-post and the number of adverse events that the contract faced ex-post. The number of risk categories materialized ex-post ranges from 0 to 4 and averages 1.94 in the sample.¹⁰ On the other hand, the number of adverse events ranges between 0 and 30 and averages 8.44 in the sample. The ex-post complexity measure ranges then between 0 and 112 and its average is 22.19 for all 48 contracts in the sample. Notice that the ex-ante and ex-post complexity measures are just proxies for the degree of complexity of any given project in the sample and we should not interpret them literally.

4 Empirical Methodology and Results

The testable implications out of this framework are supported by evidence in different pieces of the empirical literature on renegotiation. BMT (2007) provide evidence from private construction in contracts between 1995 and 2000. They document the fact that more complex projects use cost reimbursement contracts more often than fixed price contracts. This relates to the two first testable implications above and from BMT (2003). Our paper adds to the evidence in BMT (2007) in that they do not observe renegotiation per se but whether the parties use fixed price or cost plus contract, whereas we provide direct evidence in renegotiation outcomes.

In a different scenario, Guasch, Laffont and Straub (2007) provide evidence of renegotiation in Latin American concession contracts. In their evidence, they focus on the effect of institutional

¹⁰The variable of the number of risk categories realized ex-post was constructed by grouping realized ex-post adverse events into four different categories such as technological, contractual, industrial and financial risk.

factors on the frequency of ex-post renegotiation. They find that the presence of a public agency lowers the probability of ex-post renegotiation. As part of a robustness check, they test for the impact of competitive awarding process on ex-post renegotiation and find that they are negatively correlated even though this result is not statistically significant. We now proceed to test whether the same relation prevails in the French defense procurement sector.

4.1 Methodology and Results

In this subsection we examine the validity of the first two testable implications from BMT (2003) presented in section 2. The first testable implication establishes that more complex projects will use softer incentives and therefore more renegotiation will be observed holding the number of competitors constant. The second testable implication states that, holding project complexity constant, an increase in the number of bidders should strengthen incentives and decrease the amount of observed renegotiation. Our empirical evidence comes from a cross-section of projects with no apparent exogenous variation. Therefore we are left to explore whether the correlations specified in the two testable implications are present. In particular, we will examine whether in our sample of French procurement contracts more complex projects are more likely to experience renegotiation and whether those contracts procured through competitive bidding are less likely to experience renegotiation. We do these for both price renegotiation and project deadline delay.

We run OLS regressions of both types of renegotiation on the different measures of project complexity and whether the project contract was awarded through competitive bidding and other controls such that

$$\text{Renegotiation?}_i = \alpha_0 + \alpha_1[\textit{Competitive Auction}]_i + \alpha_2\textit{Complexity}_i + \alpha_3X_i + \epsilon_i$$

where X_i represents other variables controlling for whether the contract used is a cost reimbursement contract or a fixed price contract, the initial price or contractor fixed effects. To control for project complexity, we use information on the number of agents involved in the transaction (both the number of buyers and sellers), whether the project involves a defense system, the contractual form after amendment renegotiations and other variables that control for ex-post events such as the number of risk categories realized and the number of adverse events realized. The variable $[\textit{Competitive Auction}]$ takes value 1 if contract was awarded by competitive bidding and 0 otherwise. Remember that other options where bilateral negotiation and mixed processes. Competitive

bidding is assumed to be a more competitive process than the other two alternative options and therefore provide stronger incentives, all other factors equal. In our empirical exploration, we are only looking for uncovering empirical correlations between the variables of interest and therefore coefficients reported below should not be interpreted causally.

Table 2 shows results from OLS regressions where the dependent variable is “Price Renegotiation?” This variable takes value 1 if the price of the project is renegotiated after awarding the project to a contractor or a team of contractors, and 0 otherwise. We first examine the relation between project complexity and renegotiation. On this regard, we observe partial supporting evidence since only column (4) provides a statistical positive correlation between our measure of ex-post complexity and ex-post renegotiation. Surprisingly, not even when we break our composite measures of complexity into their components we observe a statistically significant coefficient that will support the first testable implication consistently. We believe that part of this disappointing result is due to the fact that we control for whether the type of contract used is a cost reimbursement contract (cost plus) and therefore the unobservable measures of complexity are already controlled for giving almost no additional explanatory variable to the complexity measures. Our evidence on the correlation between these variables and ex-post renegotiation shows that projects using cost reimbursement contracts are also more likely to be renegotiated. This table also shows that contracts with initial higher prices are also more likely to experience ex-post price renegotiation. To this result, we can imagine that more costly projects may be also more complex and therefore we should not be surprised to observe that those projects with higher initial prices are also more likely to see their prices renegotiated up.

Note that the first 5 columns in Table 2 show that the *Competitive Auction* variable has no statistically significant correlation with the dependent variable “Price renegotiation”. In the second part of Table 2 (columns (6), (7) and (8)) we introduce contractor fixed effects and this result changes drastically. The introduction of these fixed effects control for any idiosyncratic characteristic of the individual contractor-buyer relationship (since buyer does not change ultimately) that may drive ex-post renegotiation. In these three columns, the *Competitive Auction* variable is negatively correlated with ex-post renegotiation and this result is consistently statistically significant as predicted by testable implications in BMT (2003).

Table 3 shows results from OLS regressions where the dependent variable is “Project Delay.” Note from Table 1 that the dependent variable takes value 1 for 89% of the observations in the sample. This variable takes value 1 if the project deadline is changed after awarding the project

contract and 0 otherwise. Due to the lack of variation in the dependent variable, results from examining the empirical validity of both testable implications in project delay are rather disappointing. Following the first testable implication, most of our measures of complexity are correlated positively with “Project Delay.” Our measure of ex-ante complexity, the number of buyers involved and the number of ex-post risk categories occurred increase the probability of project delay. Surprisingly enough the number of adverse events is associated with lower probability of delay holding everything else equal.

On the other hand, the evidence here shows no relation between ex-post renegotiation on contract length and whether competitive bidding was used. If anything, we observe that once we include contractor fixed effects (that proxy for relation specific factors) the coefficient on *Competitive Auction* switches sign from positive to negative but still remains statistically non-significant. The other variables do not seem to have much explanatory power and, if anything, we find some evidence that more expensive projects are also more likely to be delayed. This is consistent with findings in Table 2. In summary, even though the evidence in Table 3 may support the first testable implication, it does not support the second testable implication (but it does not go against it either). After all, the testable implications examined here may be only relevant for price renegotiation since these are politically costly for French officials while deadline extensions are not.

In summary, we find partial supporting evidence for both testable implications in our sample of French defense procurement contracts. This partial support comes from the fact that defense procurement is a highly regulated sector and political pressures may not allow agents adjust in the margin their trade-offs between ex-ante contract design and ex-post renegotiation. We also need to clarify that statistically significant coefficients must not be interpreted as causal parameters since endogeneity of the variable *Competitive Auction* in Tables 2 and 3 is a pervasive problem. The government does not choose at random the way it procures contractors for different projects. In particular, the government will be more likely to procure projects through bilateral negotiations the higher the complexity of projects. In this case, we hope that after controlling for project complexity the unobservable factors driving the use of competitive bidding are weakly correlated with *Competitive Auction* and therefore the bias in our results is minimal.

4.2 Discussion of results

So far we have presented evidence on support of the first two testable implications coming out of BMT (2003). More specifically, we have shown evidence that higher complexity and softer incentives (less competition) are associated with higher levels of ex-post renegotiation. This evidence is robust to the effect of relational contracting and institutions. In our results, it turns out that it is important to control for relational specific factors (through contractor and distributor fixed effects) to observe the correlations predicted by the model.

This paper directly studies the effect that repeated interactions between buyers and sellers may have on the impact of incentives and complexity on ex-post renegotiation. As mentioned earlier, the repeated interactions between buyer and sellers in the framework of BMT (2003) may contaminate the testable implications coming out of that model.¹¹ As a matter of fact, most of the evidence that does not account for repeated interactions between buyer and seller in this paper shows no relation between complexity, competitive bidding and ex-post renegotiation. Only after introducing contractor fixed effects we find evidence consistent with BMT (2003) in the French procurement defense contracts. These findings challenge evidence provided in BMT (2007) and GLS (2007) but it is consistent with Corts (2007). In his paper, Corts (2007) examines the consequences for opportunistic behavior of relational contracting in cost reimbursement contracts versus fixed price contracts. His discussion highlights the role of future interactions for the provision of effort in otherwise apparently low incentive provision scenarios. Future interactions between buyer and sellers may deter any informational abuse as described in BMT (2007), Goldberg (1977) or GLS (2007) and may allow buyers to minimize transaction costs.

Finally, our results here are a contribution to the scarce empirical procurement literature because it provides evidence on actual renegotiation outcomes. This differs from BMT (2007) in that they implicitly assume that cost reimbursement contracts experience more ex-post renegotiation than fixed price contracts but cannot demonstrate so because they lack information on ex-post payments. Here we provide evidence of ex-post renegotiation outcomes and show that even after controlling for the type of contract used ex-ante, contracts for less complex projects and contracts awarded through competitive bidding are less likely to experience renegotiation ex-post.

¹¹See for example the implications in Baker, Gibbons and Murphy (2002) regarding the impact of relational contracting on contracts within and between firms. It is not quite clear how results from a one-time interaction contracting scenario will be affected.

5 Concluding Remarks

In this paper, we have examined the empirical relation between competitive bidding and contract complexity and ex-post renegotiation in the French defense procurement sector. To do so, we used well-established theories of procurement by Goldberg (1977), BT (2001) and BMT (2003) to formulate testable implications that we can take to the data.

The evidence documented in the paper yields partial support for the testable implications from BMT (2003) once we introduce controls for buyer-seller (contractor) specific relations. We find evidence that more complex projects require more ex-post renegotiation and that projects awarded through competitive bidding are less likely to observe price renegotiation ex-post. In addition to this, our evidence supports results in Corts (2007) who shows that relational contracting can strengthen incentives in cost plus construction contracts and therefore soften or even reverse the predicted relation in BMT (2003) between Fixed Price (versus Cost Plus) contracts and ex-post renegotiation.

Finally, as we focus in this paper on the correlation between transaction complexity and incentive strength (competitive bidding versus bilateral negotiation) on the likelihood of ex-post renegotiation, we leave open different future lines of research such as the study of the impact of legal constraints and institutions on renegotiation and the ultimate impact of these on the project final outcomes. Furthermore, this paper concentrates in the occurrence of price and length renegotiation in French defense procurement contracts and does not examine the impact of changes and amendments to the initial conditions of the French defense contracts. These amendments may modify enforcement conditions of a contract and shift decision rights between buyer and seller as the time of project completion approaches. This resembles the framework of Arruñada, Garicano and Vázquez (2001) or Zanmarone (2007) in the European auto retailing sector and more generally provides further evidence in support of the motivation behind Baker, Gibbons and Murphy (2009).

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Table 1. Summary Statistics of French Procurement Defense Contract Renegotiation Data Set

| Variable | No. Obs. | Mean | Std. Dev. | Min | Max |
|--------------------------------------|-----------------|-------------|------------------|------------|------------|
| Price Renegotiation? | 48 | 0.56 | 0.5 | 0 | 1 |
| Project Delay | 48 | 0.89 | 0.31 | 0 | 1 |
| Competitive Auction | 48 | 0.23 | 0.42 | 0 | 1 |
| Initial Price (€ millions) | 48 | 134.66 | 444.60 | 0.2 | 3000 |
| Ex-Ante Cost Reimbursement? | 48 | 0.02 | 0.14 | 0 | 1 |
| Ex-Post Cost Reimbursement? | 48 | 0.56 | 0.50 | 0 | 1 |
| Ex-Ante Complexity | 48 | 0.75 | 0.84 | 0 | 3 |
| Number Contractors | 48 | 1.42 | 0.85 | 1 | 5 |
| Number Buyers | 48 | 1.10 | 0.37 | 1 | 3 |
| Defense System? | 48 | 0.40 | 0.49 | 0 | 1 |
| Ex-Post Complexity | 48 | 22.19 | 27.55 | 0 | 112 |
| Ex-post Risk Categories | 48 | 1.94 | 0.95 | 0 | 4 |
| Ex-post Adverse Events | 48 | 8.44 | 7.7 | 0 | 30 |

This table provides summary statistics for all the variables that we use in our empirical analysis of renegotiation in French procurement defense contracts. "Price Renegotiation?" takes value 1 if the price initially agreed is changed ex-post and 0 otherwise. "Project Delay" takes value 1 if project is delayed from its original deadline and 0 otherwise. "Ex-Ante Cost Reimbursement?" and "Ex-Post Cost Reimbursement?" are variables that take value 1 if ex-ante/ex-post the contract is a cost reimbursement contract and 0 if it is a price fixed contract. Finally "Ex-Ante Complexity" is a synthetic index of ex-ante complexity made of the variables "Number of Contractors", "Number of Buyers" and "Defense system?". This variable takes value 0 if Number of contractors=1 and if Number of Buyers=1 and if Defense system=0; takes value 1 if Number of contractors>1 or if Number of buyers>1 or if Defense system?=1; takes value 2 if two of the three variables suggest complexity; takes value 3 if all three suggest complexity. "Ex-Post Complexity" is an index of ex-post realized complexity and it is the result of the product of the number of ex-post risk categories realized and ex-post adverse events realized.

Table 2. OLS Regressions of "Price Renegotiation?" on Competitive Auction in French defense procurement

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---------------------|-----------------------|------------------------|-----------------------|---------------------|-------------------------|----------------------|----------------------|
| Competitive Auction | -0.022 (0.173) | -0.004 (0.167) | 0.067 (0.182) | 0.042 (0.187) | -0.029 (0.201) | -0.491 (0.289)* | -0.564 (0.271)** | -0.539 (0.259)** |
| Initial Price (million Euros) | | 0.0002 (0.0001)*** | 0.00025 (0.0001)*** | -0.000003 (0.0001) | 0.00005 (0.0001) | 0.00011 (0.00001)*** | 0.00001 (0.00001) | 0.000232 (0.0002) |
| Ex-Ante Cost Reimbursement? | | | 0.287 (0.095)*** | 0.031 (0.121) | -0.055 (0.210) | -0.411 (0.309) | -0.54 (0.286)* | -0.543 (0.326) |
| Ex-Post Cost Reimbursement? | | | 0.422 (0.139)*** | 0.319 (0.164)* | 0.291 (0.183) | 0.586 (0.229)** | 0.485 (0.242)* | 0.497 (0.251)* |
| Ex-Ante Complexity | | | | 0.083 (0.099) | | | 0.128 (0.101) | |
| Ex-Post Complexity | | | | 0.005 (0.002)** | | | 0.005 (0.003) | |
| Number Contractors | | | | | -0.003 (0.128) | | | -0.047 (0.129) |
| Number Buyers | | | | | -0.084 (0.198) | | | 0.185 (0.144) |
| Defense System? | | | | | 0.181 (0.168) | | | 0.136 (0.161) |
| Ex-post Risk Categories | | | | | 0.055 (0.152) | | | 0.100 (0.195) |
| Ex-post Adverse Events | | | | | 0.013 (0.021) | | | 0.007 (0.028) |
| Constant | 0.568 (0.083)*** | 0.536 (0.087)*** | 0.27 (0.114)** | 0.189 (0.113) | 0.213 (0.253) | -0.058 (0.006)*** | -0.037 (0.015)** | 0.266 (0.367) |
| Contractor FE | No | No | No | No | No | Yes | Yes | Yes |
| Observations | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 |
| R-squared | 0.00 | 0.03 | 0.22 | 0.28 | 0.31 | 0.61 | 0.66 | 0.67 |

Note: The dependent variable of all 8 regressions is "Price Renegotiation?". Number in parentheses are standard errors.

* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3. OLS Regressions of "Project Delay" on Competitive Auction in French defense procurement

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---------------------|---------------------|-----------------------|---------------------|---------------------|----------------------|----------------------|---------------------|
| Competitive Auction | 0.017 (0.102) | 0.023 (0.106) | 0.048 (0.103) | 0.027 (0.101) | 0.036 (0.097) | 0.046 (0.127) | -0.054 (0.121) | -0.021 (0.144) |
| Initial Price (million Euros) | | 0.0001 (0.0001) | 0.0001 (0.00004)** | 0.00004 (0.0001) | 0.00014 (0.0001) | 0.00001 (0.00001) | 0.00001 (0.00003) | 0.00016 (0.0002) |
| Ex-Ante Cost Reimbursement? | | | 0.049 (0.048) | 0.048 (0.106) | 0.229 (0.146) | -0.126 (0.235) | -0.093 (0.244) | -0.022 (0.198) |
| Ex-Post Cost Reimbursement? | | | 0.163 (0.101) | 0.146 (0.118) | 0.096 (0.114) | 0.223 (0.234) | 0.149 (0.243) | 0.156 (0.183) |
| Ex-Ante Complexity | | | | 0.063 (0.045) | | | 0.172 (0.095)* | |
| Ex-Post Complexity | | | | -0.0001 (0.0008) | | | 0.0001 (0.0008) | |
| Number Contractors | | | | | -0.008 (0.047) | | | -0.028 (0.100) |
| Number Buyers | | | | | 0.151 (0.079)* | | | 0.425 (0.237)* |
| Defense System? | | | | | 0.019 (0.082) | | | 0.042 (0.111) |
| Ex-post Risk Categories | | | | | 0.26 (0.096)** | | | 0.272 (0.112)** |
| Ex-post Adverse Events | | | | | -0.029 (0.014)** | | | -0.024 (0.014) |
| Constant | 0.892 (0.052)*** | 0.882 (0.057)*** | 0.782 (0.103)*** | 0.761 (0.111)*** | 0.389 (0.227)* | 0.981 (0.011)*** | 0.998 (0.144)*** | 0.469 (0.320) |
| Contractor FE | No | No | No | No | No | Yes | Yes | Yes |
| Observations | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 |
| R-squared | 0.00 | 0.01 | 0.08 | 0.10 | 0.27 | 0.38 | 0.47 | 0.65 |

Note: The dependent variable of all 8 regressions is "Project Delay". Number in parentheses are standard errors.

* significant at 10%; ** significant at 5%; *** significant at 1%.