Pre- and Post-award outsourcing:

Temporary Partnership *vs* Subcontracting in public procurement[1]

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ABSTRACT - This paper studies the impact of qualification rules to entry public procurement auctions on firm bids and contract execution, contributing to the debate about which regulations may foster the efficient participation of SMEs. Using rich and detailed microdata on all public work contracts awarded by the Regional Government of Valle d'Aosta from 2000 to 2008, we investigate the differences between *ex-ante* outsourcing by Temporary Partnerships (TPs) and *ex-post* outsourcing by firms in optional or mandatory subcontracting. We find that both outsourcing status and firm size affect bids (hence price) and the probability of time and cost overrun. TPs bid lower prices to execute contracts than both large "optional" and "mandatory" firms and also do well in contract execution, similar to small optional firms; mandatory firms are more likely to exceed expected cost and no better in timely delivery. Evidence holds when we disentangle horizontal and vertical subcontracting. Our results highlight TPs advantage of being free to choose the economic size and the technical boundaries before entering the auction. (169 words)

Keywords: public procurement, regulation on entry, firm strategy, firm boundaries, firm size, SMEs, supply chain, vertical and horizontal subcontracting, temporary consortium, outsourcing.

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1. Introduction

Public procurement accounts for a significant part of taxpayers' money - about 29% of government expenditure and 12% of GDP in developed countries [OECD, 2016] - and governments are expected to carry it out efficiently to safeguard public interest. As such, public procurement is not only an important leverage to gain *value for money* in purchasing services, goods and furniture, but also drives resources towards innovation and sustainability (*i.e.* programs for procuring innovative and/or green solutions; and programs addressed to increase disadvantaged and small businesses' participation in procurement, *etc.*).[4]

When it comes to its implementation, however, public procurement turns out to be a very complex process, consisting typically of at least two main phases - the contract's awarding and the contract's execution. These two stages are usually managed as separated, but they are tightly interrelated since the supplier that wins the contract by bidding the "best price" according to the auction's rules, should then deliver the contracted tasks and quality in the execution stage. In this two-stage process, the firm's decision on whether and when to outsource part of the contract's execution is crucial because it directly impacts on a) the allocation of resources to perform the contractual tasks/quality, and b) the efficiency of the supply-chain in production, which, in turn, also determines the procurement cost for the government.

Notice that, in public procurement, the firm's make-or-buy decision for the awarded public work's execution is also typically affected by regulations on the firm's qualification required to enter the tender. Such qualifications are typically implemented both in the aim to prevent favoritism/corruption by keeping public officers accountable in the allocation of public funds, and reduce the supplier's default risk in contract execution by screening and selecting potential suppliers with the appropriate characteristics (*i.e.* technology, size, experience, financial status, etc.).[5]

[4] Tirole and Saussier (2015) contributed to the recent debate on the use of public procurement for policy goals; they highlighted that pursuing innovation or social/environmental goals could lead to inefficient outcomes, being public procurement driven by efficiency in costs and optimal quality in performance.

[5] As highlighted in Spagnolo (2011), these regulations are absent in private procurement where, differently, the supplier can take advantage of reputational forces, relational contracts and implicit incentives in designing outsourcing.

The goal of this paper is to empirically investigate the impact of the qualification rules on the firm's outsourcing decision and, in turn, how this affects the cost and performance of public procurement works. We do this by exploiting the Italian regulation on firms' qualification for public works and an original dataset containing bids of all the participants in each awarding auction, information both about each firm's ability to run the tasks included in the auctioned contract and about the winning firm's performance. In this setting, all the tasks in each auctioned contract have to be executed by *qualified* firms. Accordingly, for each awarded contract, qualification(s) required determines whether each firm can enter the auction and, in so doing, if it might or must subcontract/outsource part(s) of the work. Specifically, if it wins the tendered contract, a fully qualified firm might proceed for *ex-post* outsourcing, *i.e.* for *optional* subcontracting; differently, a partially qualified firm must proceed for *ex-post* outsourcing, *i.e.* for *mandatory* subcontracting.

As an alternative, considering the tasks in each awarded contract, partially qualified firms can join in a Temporary Partnerships (TPs) with other firms *before* participating in the tender to collect the required qualifications. Moreover, according to the Italian regulation on public procurement, a *TP* can also be formed to meet the economic value required to execute the awarded contract. This latter option is usually adopted by small and medium firms to entry relative large value awarded contracts and, in our dataset, it is straightforward for in presence of *TP* bidding for only one work category contracts.

In our analysis, for each auctioned contract, we thus disentangle firms that join to set an *ex-ante* outsourcing in the form of *Temporary Partnerships* (TPs) by firms that *ex-post* proceed for *mandatory* or *optional* subcontracting agreements. We accordingly investigate the differences – if any - in their bids (*i.e.* procurement prices). Moreover, focusing on the winning firms, *i.e.* the contractors which proceed for the tasks' execution, we study their performance in terms of the probability of time and cost overruns in contract's delivery, also taking into account the contract's complexity. In order to gauge the differences in terms of scale of firms' activities, we compare bids and performance by *TP*s and by firms in a position of *optional* subcontracting as disentangled by size. Finally, we investigate effects from the contract complexity by focusing on the subsample of one work category contracts as separated from the subsample of more than one work categories contracts (*i.e.* horizontal vs vertical subcontracting)..

Our results show that bidding rebates by *ex-ante* outsourcing in the form of *TP*s are higher (i.e. leading to lower prices) than those by firms in a position to proceed *ex-post* for both *Mandatory* and *Optiona*l subcontracting. More specifically, when we account for the size of firms in the position of *Optional* subcontracting, we find that *TP*s' rebates are significantly higher than *large* firms, but close to medium and small ones'. When we disentangle firms' rebates by complexity of the contract, our results show that *TP*s bid significantly larger rebates than large firms in the position of *Optional* subcontracting both in one category work and in more than one categories works.

Considering performance in the contract's execution, our empirical analysis shows that *TP*s are less likely to exceed execution costs than firms in a position of *Mandatory* subcontracting, but equally likely to incur in time overruns. Moreover, *TP*s' are also less likely to report cost overruns than medium-sized firms in *Optional* subcontracting status; and firms that have to proceed for *Mandatory* subcontracting appear as the worst performers in this default. And the probability of cost overruns is always significantly lower when *TP*s performs contracts with more than one works categories, i.e. with complex works. When we turn to the ability to deliver the contract on time, *TP*s do significantly better than medium-sized firms in *Optional* subcontracting status, and do not differ from both large firms that have the option to outsource and firms in status of *Mandatory* subcontracting. Considering contracts with more than one works categories, i.e. complex works, the *TP*s' probability of cost overruns is always significantly lower than for the other firms; and *TP*s' probability of cost overruns is close to *mandatory* firms and *large optional* firms, and lower than *small* and *medium*-sized optional firms.

All these results suggest that, on average, *TP*s not only succeed in planning and performing production at efficient costs as compared to firms that have to ex-post proceed for *Mandatory* subcontracting, but also manage to comply with the contract's timely execution showing similar or lower probability of delay than the other investigated organization forms.

Our findings contribute to inform about the cost arising from the regulatory constraints on the suppliers' choice of the organizational form to participate in the public procurement process. Specifically, our focus on Temporary Partnerships is motivated by the policy debate

about how to foster entry by SMEs in procurement auctions.[6] Regulation on entry qualification for procurement auctions which allow for *TP*s, can indeed improve SMEs' ability to match both public contract size and complexity: we mainly contribute to the debate by providing evidence that *TP*s operates efficiently as compared to firms in a position to proceed for *Mandatory* subcontracting, and to large firms in position of *Optional* subcontracting.

The rest of the paper is organized as follows. Section 2 discusses existing literature and presents our research question. Section 3 describes the institutional features of the Italian public procurement setting. Section 4 presents the dataset and preliminary descriptive evidence. Section 5 illustrates our empirical strategy and discusses the econometric results. Section 6 concludes with policy implications.

2. Background and research questions

Since the seminal paper by Ronald Coase (1937) on firm boundaries, many theoretical contributions have addressed the determinants of contract outsourcing as being based on transaction costs (Williamson, 1971 and 1985), property rights (Grossman and Hart, 1986) and the knowledge-based view of the firm (Kogut and Zander, 1992 and 1996). Holmstrom and Roberts (1998) highlighted how the interest on firms' boundaries has progressively moved from their role in coordination problems to their weight in rising incentives (i.e. hold-up issues). Empirical research has documented how and when firms adopt outsourcing to efficiently organize production in different economic sectors (Novak and Stern, 2008; Macher, 2006; Quinn and Hilmer, 1994). Joskow (1988) proposed a seminal empirical survey on firms' vertical arrangements *vs.* spot market transactions and long-term contracts in different sectors; more recently, Lafontaine and Slade (2007) have provided a thoughtful review of the empirical literature on backward/forward vertical integration and Gibbons and Roberts (2013) collect updated contribution to relevant issues in the within firm's organization.

[6] On the EU debate about SME's participation in public procurement, see *SMEs' access to public procurement markets and aggregation of demand in the EU* (2015), downloadable from: http://ec.europa.eu/DocsRoom/documents/15459/attachments/1/translations/

All these theoretical and empirical contributions all assume the firm's *voluntary* choice of internal or external sourcing, in different timings and formats. Our paper differs from the above literature on outsourcing in that it specifically focuses on public procurement contracts, where firms are constrained by many rules and procedures that, on the one hand, limit their decision-making, and on the other, affect the efficiency (i.e. cost) of the public-private transaction and the overall social welfare.

The motivation to regulate procurement procedures on the firm's qualification and entry to the auction is twofold (OECD, 2007). On the one hand, public authorities have to maintain fairness in procurement transactions in order to prevent favoritism and corruption; on the other, they have to minimize poor performance in the execution of these contracts financed by public resources.[7] In particular, frameworks for firms' qualification screening are adopted all over the world to implement the verification of a firm's financial status, references, technical/product/process and surge capacity, but the literature examining the cost and benefits of "rules vs. discretion" in public procurement and the consequences on bidding behavior and contract performance is still scarce.

Moretti and Valbonesi (2015) using a newly assembled dataset on qualification rules for public procurement auctions in Italy, found that firms in a position to choose whether to subcontract part of the work (i.e. *Optional* subcontracting) offer significantly lower prices to execute the contract than firms obliged to subcontract part of the work (i.e. *Mandatory* subcontracting). Their results highlight the direct effect of the regulatory burden on procurement costs showing, on the one hand, that firms' voluntary arrangements tend to improve market performance while on the other, that any imposed arrangements that either prohibit or mandate relationships tend to worsen it. Their findings are consistent with evidence reported in Lafontaine and Slade's (2008) survey on vertical restraints, concluding that when manufacturers choose to impose vertical restraints, their impact on market performance is positive by implication, whereas the impact is negative if vertical restraints are prohibited.

[7] Such regulatory burdens could be even higher when these procurement contracts are specifically intended to be the core of affirmative action policies that indirectly enhance the participation of disadvantaged business enterprises (DBEs). See also Marion (2007 and 2009) and Krasnokutskaya and Seim, (2011), De Silva *et al.* (2012), Athey, Coey and Levin (2013) for other examples of these policies.

In this paper, exploiting the same dataset on Italian public procurement investigated by Moretti and Valbonesi (2015), we test if there are significant differences in both bids and performance of firms proceeding to *pre*- and *post*-award outsourcing. According to the Italian qualification system, all parts of the awarded contracts should be completed by qualified firms; this means that, for each auctioned contract, a firm would enter the tender as:

i) *Fully qualified firm, i.e.* firm in a position to complete the contracted work by itself that, if it wins the auction, can freely decide whether or not to outsource part of the work (i.e. firm in an *ex-post* position of *optional* subcontracting);

ii) *Partially qualified firm, i.e.* firm which, after bidding in the auction, is mandated to outsource if it wins the contract (i.e. firm in an *ex-post* position of *mandatory* subcontracting);

iii) *Temporary Partnerships* (TPs), *i.e.* two or more partially qualified firms that set up an *ex-ante* binding agreement in order to obtain fully – economic and technical - qualification to bid for and execute the awarded contract. [8]

Box 1 below classifies the above organizational forms according to the firm's status and the timing about outsourcing. Considering the bid as a *proxy* for the firm's expected cost to execute the tendered contract, our purpose is to empirically investigate differences, if any, in such expected costs for firms adopting different such outsourcing formats in the execution of awarded public contracts.

- Box 1 about here -

Furthermore, in this paper we investigate *TPs*' performance in the execution of public procurement as measured by time and cost overruns in delivering the contracted project. We thus compare the probability of *TP*s' overruns with those incurred by firms in a position of either *Optiona*l or *Mandatory* subcontracting.

[8] In Moretti and Valbonesi (2015), TPs have been included in the analysis as fully qualified firms (i.e. firms in an *ex-post* position of *optional* subcontracting): this is because TPs manage to enter the auction and bid having covered all the qualifications required to execute the contract. Accordingly, TPs would have the option to subcontract whenever they win the contract. Findings of their analysis are robust excluding TPs.

Finally, we investigate the *ex-ante* and *ex-post* firm's outsourcing status as related to the number of work categories in each awarded contract, a good proxy for contract complexity. This last analysis allows us to investigate horizontal outsourcing which occurs in one work category contract where delegation of task is between/among similarly qualified firms - and vertical outsourcing adopted in more than one work categories contract - where delegation of tasks is spread on differently qualified firms.

Our paper contributes to three strands of economic literature. First, we add to the extensive economic literature on firm boundaries and vertical restraints with new empirical results to the limited evidence on Temporary Partnerships. In this field, it has been highlighted that make-or-buy decisions can be driven by cost structures (Spiegel, 1993; Shy and Stenbacka, 2003; Kamien and Li, 1990; Van Mieghem, 1999; Marechal and Morand, 2003), technology spillover (Van Long, 2005), learning by doing (Chen, 2006), hold-up (Rey and Tirole, 2007; Miller, 2014) and strategic motives (Arya *et al.* 2008). In our setting, we find that outsourcing through TPs, where liabilities are distributed *ex-ante* among the consortium's participants and thereby hold-up issues are reduced, can effectively increase efficiency in the procurement production chain as compared to *ex-post* subcontracting.

Second, our paper contributes to the empirical literature assessing entry and subcontracting in public procurement. Branzoli and Decarolis (2016) show how different auctions format (i.e. average bid auctions vs first price auctions) can differently affect the number of participants in the tender and their subcontracting behavior. In a setting where participants to a public work auction should provide, along with the bid, information both about which tasks will be outsourced and to who (i.e. the identity of subcontractors), Gil and Marion (2013) empirically show how the stock of past subcontractors affect firms' bidding behavior. The work by Moretti and Valbonesi (2015), particularly close to the present one because it uses the same dataset, highlights that limiting the discretion of firms in terms of their supply-chain choices represents a cost (i.e., higher price) in the public procurement process. Our paper differs from the previous ones as it provides evidence that widening the scope for *ex-ante* award outsourcing by participants in the auction (i.e. allowing for TP) leads to higher efficiency in terms of lower public contract prices and better performance in terms of cost overruns than when implementing *ex-post* mandatory rules to subcontract.

Third, the economic literature explores mechanisms and procedures to support small and medium-sized enterprises' (SMEs) participation in public procurement (and, more generally, to implement the so-called "affirmative policies" for disadvantaged businesses). Loader (2013) and Flynn and Davis (2015) provide empirical evidence that i) contract size is commonly regarded as the main impediment to SME involvement in public procurement; and ii) regulations which promote contracting authorities' action to reduce the issue, *i.e.* dividing contracts into lots and/or encouraging consortium bidding, are not often implemented. Marion (2007) empirically evaluates the effect of bid preferences in public procurement California auctions for highway construction contracts where small businesses receive a five percent bid preference in their offers;[9] he founds that procurement costs are 3.8 percent higher on auctions using preferences.[10] Our paper contributes to this literature on SMEs' participation in procurement for public works by providing empirical results on prices and performance by *TPs*, an organizational option typically adopted – whenever allowed - by SMEs to entry procurement auctions and match the required technical and economic value of the awarded contracts: in this regard, to the best of our knowledge, we are the first to compare – ceteris paribus - *TPs* and *ex-post* traditional subcontracts, also controlling in our analysis for horizontal vs vertical features in outsourcing contractual tasks.

3. Institutional Setting

In this Section, we describe the regulations on the supply and supply side of the Italian public procurement market in more detail.

[9] On affirmative actions toward minority owned firms and SME's employment, see also Marion (2009) and Farlie and Marion (2012) respectively.

[10] The higher procurement cost in preference auctions is explained by the reduced participation by lower cost large firms, see Marion (2009). Krasnokutskaya and Seim (2006), also using data from Caltrans highway auctions to estimate a structural model and investigating bidder participation in bid preference auctions, find that bid preferences increase the probability of small firms winning; however their simulations do not suggest a significant effect on procurement costs. Differently, Corns and Schotter (1999) suggest, with an experimental investigation, that bid preferences for disadvantaged agents could lower the equilibrium winning bid if it forces nondisadvantaged agents to bid more aggressively. Athey, Coey and Levin (2013) studying the US Forest Service timber sale program, highlight that bid preferences for SMEs could be more effective means than set-aside in auctions.

The Supply side. The aim of the Italian system regarding firms' qualification is to restrict participation to the call for bids to those firms capable – i.e. technical and economic capacity - of efficiently executing all aspects of the awarded project. In the period our data refer to, the Italian qualification system was operated by 37 private companies - called SOA (Società Organismo di Attestazione) - accredited and monitored by AVCP (Autorità per la Vigilanza dei Contratti Pubblici)[11], the national authority in charge of regulating and monitoring the national market for public works, supplies and services. Firms' qualifications refer to: i) *general requirements* for the firm's financial standing and criminal records (e.g. anti-Mafia); and ii) *technical and economic requirements* for the specific technical skills needed to perform certain works and which are usually assessed on the firm's documented expertise, economic size and observable items (i.e. number of employees, invested capital in technological assets, etc.).[12] The qualification for each category and size (i.e. value) of work is a costly process for the firm (i.e. different fees for different categories of works/size), and remains valid for 3 or 5 years, after which it must be renewed. Firms must be qualified to bid in these auctions and all the contract's parts should be executed by qualified firms: information on the firms' qualification status and tasks for each awarded contract enables us to classify suppliers into three outsourcing positions (i.e. TPs, *mandatory* and *optional* subcontracting) and to run our empirical analysis on their bid and performance comparisons, also keeping into account firm size and contract complexity.

The Demand side. When awarding a public works contract, the Contracting Authority (CA) specifies all the tasks (i.e. the work categories and their economic value) involved in the project and indicates the "main category" as well as the "secondary category(ies)" of work to be executed in the contract's completion. For example, consider a contract for the building of a road in a new residential area; the fulfilment of this contract contains three tasks: t_A (road works), t_B (water works), t_C (sewage works). Accordingly, in the requests for tenders, let's assume that the CA will present the former task t_A as the main work category and the remaining two (t_B and t_C) as secondary work categories. Such a distinction is relevant since participation

[11] AVCP has formed part of the Italian National Anti-Corruption Authority (ANAC) since August 2014. Regulations on firms' qualification and regulations on the awarding of public contracts have not changed.
[12] Specifically, 46 "categories of works" have been defined in Italian public works over which firms can obtain qualifications accordingly, also with an assessment about the allowed contracts' economic value.

in tenders is restricted to firms qualified for the main work category. Differently, the bidding firm may or may not be qualified for the secondary work categories involved in a public contract up for tender. In particular, we can have the following cases. If the bidding firm is fully qualified when it wins the contract, it can choose to either complete all the works itself or to horizontally subcontract parts of the works to other similarly qualified firms (i.e. rival firms with comparable qualifications), thus giving rise to *optional subcontracting*. If the winning firm is not qualified for one or more secondary categories, it has to declare that it will vertically subcontract the works for which it lacks qualifications to other qualified firms, and if it wins, it is required to subcontract (i.e. *mandatory subcontracting*). Alternatively, if a firm lacks the qualification (and/or the required economic value) can entry the auction by setting a Temporary Partnerships (TP)[13]: these partnerships are established *ad hoc* to bid for a given contract, and involve firms that pool their qualifications together to address the main and the secondary categories required to execute the awarded contract.

As soon as the CA announces in the call for bid procedure the qualification categories to enter the auction and their size, the potential position of each bidder concerning any outsourcing/subcontracting becomes clear, and each firm is ex-ante aware (i.e. before bidding) of its qualification status. Therefore, each firm willing to participate in that auction can ex-ante verify whether it is fully qualified to bid – a status which permits to proceed for *optional* subcontracting - and, if not, can alternatively choose whether to organize a TP or to proceed for *mandatory* subcontracting. [14]

Having the CA verified the bidders' legal, fiscal, economic, financial and technical requirements, the winner is then identified according to the rules governing the competitive auction, and the contract is finally awarded. The procurement setting here investigated adopts either Average Bid Auctions (ABA) or Average Bid Auctions with Lottery (ABA with Lottery).[15] As shown by Galavotti, Moretti and Valbonesi (2014) empirically investigating the

[13] In Italy, the name for this organization of firms bidding jointly is "Associazione Temporanea d'Impresa", ATI.
[14]Notably, each firm's "full" or "partial" qualification status is not granted forever, but it may change at any procurement auction, depending on the contractual tasks that have to be executed in each awarded contract.
[15] These mechanisms work as follows. Within the ABA framework, given the distribution of all bids received in the auction, a first average (A1) is computed by averaging all the bids, except those located in the first and last deciles. A second average (A2) is then computed by averaging all of the bids above A1 (again, excluding those bids located in the last decile). The winning bid is the one immediately below A2. Within the ABA with lottery scheme, given A2 computed as above, a random integer R between 1 and 9 is extracted. The R-th number among

same dataset we are adopting for the present analysis, these auction formats are beauty context auctions, the bidding behavior is quite similar in both formats and the mean rebate is lower in the ABA with Lottery than in the simple ABA.[16]

4. Data and Descriptive Statistics

Our dataset collects public works worth more than 150,000 Euros that the Regional Government of Valle d'Aosta awarded in the period 2000-2008 by means of open tenders where firms participate by offering a rebate (i.e. a percentage reduction on the reserve price set by the CA). Differently from many other datasets on public procurement where – often - only the winning bid is collected along with the name of the winner in each competitive tender, our dataset contains all the bids submitted and the winner in each auction, along with detailed information both on each auction and the participating firms. Specifically, for each participant firm, our dataset includes its name (identity), the rebate it has offered in all auctions in which it participated, its size and location, its distance from the CA awarding the contract (the city of Aosta), the number of pending public procurement projects at the time of bidding (i.e. the backlog), the work categories for which it qualifies and, accordingly, , its (optional or mandatory) outsourcing position in each auction, i.e., whether they may or must rely on outsourcing. However, for fully qualified firms that have the option to subcontract, we have no information as to whether they did so, while for TPs, we have no information on the identity of all the individual firms that form the TP because all each TP forms and dissolves at every single auction. Therefore, TPs enter the dataset with a separate identification number that differs in every auction.

For each auction, we have information on the reserve price (i.e. the price over which each participating firm has to bid a rebate) and on the contractual duration of the public work, as both defined by the CA; on the auction's format (Average Bid or Average Bid with Lottery), , and on the tasks to be covered within the tendered project ("category of work"). In addition, we have some information on the contract's execution, such as the final cost of the project and

the nine equidistant numbers between the bid just above the first decile and the bid just below A2 is averaged with A2 to obtain the winning threshold. The winning bid is the one immediately above this winning threshold.

[16] For further investigations on these auction formats see Albano *et al*. (2006), Decarolis (2009).

whether the winning firm has completed the project on time, which allows us to observe whether the contract was complied with defaults in the form of cost and/or time overruns.[17]

Crucially, for each contract, we know the qualifications required for the completion of the contract and all the qualifications held by the bidding firms. This information enables us – auction by auction - to identify for each bidding firm if it is fully or partially qualified, i.e. whether the firm - if it wins the auction - has the option to subcontract *ex-post (optional* subcontracting*),* or it is required to outsource part of the works *ex-post* (*mandatory* subcontracting).

Finally, by disentangling projects that include one work category from projects with more than one work categories, we distinguish contracts where subcontracting can only be horizontal from contracts where outsourcing will typically be vertical. This feature helps with the identification in the econometric analysis. For example, when focusing on horizontal subcontracting, we can investigate SMEs that enter procurement auctions for public works by setting up TPs to overcome the contract's economic capacity requirement (i.e. the economic size).

Our dataset consists of 269 auctions awarding public contracts for road works (37.2%), river and hydraulic works (29.7%), and buildings (14.9%) awarded by the Regional Government of Valle d'Aosta. In these auctions, a total of 13,331 bids were offered by 892 firms and 1,777 through Temporary Partnerships.

- Table 1 about here – Summary statistics: Full Sample

As highlighted in Table 1, the average reserve price is about 1.18 million euro (min 155,000 euro, max about 5.25 million euro), and the average expected duration of completion is 322 days. The market is essentially a local one, being the average distance between the bidder's location (i.e. the closest capital city) and the CA location (i.e. the city of Aosta) about 310 kilometers, with a standard deviation of about 399 kilometers). The average number of firms and TPs participating in auctions is 49. On average, each firm in the sample participated in

[17] Following Moretti and Valbonesi (2015), we define time overruns as the probability of completing the project after the expected (contracted) deadline and cost overruns as the probability that the final cost of the project is greater than the winning bid.

about 13 auctions (by definition, TPs participate only in one auction). 12% of the bids are by small firms, 53% by medium-sized firms; and 22% from large companies; TPs cover about 13% of the bids. Considering firm performance in executing the contract, we note that the probabilities of cost and time overruns are quite high (0.850 and 0.919, respectively).[18] Finally, 83% of the open tenders are in the form of Average Bid Auctions and 17% in the form of Average Bid Auctions with Lottery.

Table 2 shows the descriptive statistics by the firms' outsourcing positions. In our sample, about 73.8% of the bids were offered by firms in an *optional* subcontracting position (of which 26.6% by large firms); 12.86% by firms in a *mandatory* subcontracting position; and 13.32% of the bids were offered by firms organized as TPs. In what follows, we consider each bid as a *proxy* for the firm's expected costs to execute the contract and we investigate differences across the different outsourcing positions of the firms, in particular: i) *ex-ante* outsourcing in the form of TPs, and ii) *ex-post* outsourcing in the form of either *mandatory* or *optional* subcontracting. Indeed, in the firm's supply chain for production, TPs and *optional* subcontracting are planning alternatives *ex-ante* and *ex-post*, respectively; while *mandatory* subcontracting is an *ex-post* planning constraint driven from entry qualification rules.

Finally, we also consider differences in bids by firm size, the idea being that large firms could result better equipped and more efficient, in particular for complex contract (i.e. for large value and/or more than one work category contracts) and hence may bid more aggressively and/or record differences in contractual performance as compared to small and medium firms.

- **Table 2 about here - Summary Statistics by form of organization (sub-samples)**

In Table 2, we observe that – on average – TPs offer larger rebates (i.e. lower prices) than firms in both the *mandatory* and the *optional* subcontracting position. TPs also appear to bid lower prices than large and small fully qualified firms. Finally, TPs record a slightly higher probability to incur cost and time overruns than *Optional* firms while, with respect to firms in

[18] These high percentages in overruns are consistent with other empirical investigations on Italian procurement for public works; see, for example, Moretti and Valbonesi (2015); Guccio et al. (2012); Decarolis and Palumbo (2015); Decarolis, (2009); Coviello et al. (2016).

a *mandatory* subcontracting position, TPs seem to deliver later, but at a lower cost.

-Table 3 about here - Mean comparisons

In Table 3, we test the significance of mean differences for rebates and probability of winning. In Panel A, we find that average rebates by TPs are significantly higher than those by firms in *mandatory* subcontracting positions and similar to rebate by firms in an optional subcontracting position. However, if we separate *optional* firms by size, we find that TPs bid significantly higher rebates than both *large* and *small* firms in optional subcontracting position, but also significantly lower than rebates by *medium*-sized firms.

In Panel B of Table 3 we compare the mean probabilities of being successfully awarded a contract by outsourcing status and by firm size. For each outsourcing position (TPs, firms in the position of *Optional* and *Mandatory* subcontract*ing*) and size category, we compute the mean probability as the ratio between the number of contracts awarded (i.e. the winning outcomes) and the total number of bids by firms in that position or size category. Our findings show that TPs have a significantly higher probability of being awarded a contract than Large and Medium-sized firms in the position of *optional* subcontracting, but not with respect to either Small-sized *optional* firms or firms in a *mandatory* subcontracting status. Results from this table suggest that not only do TPs tend to bid aggressively but they are also quite successful when they do so. To confirm the descriptive evidence, in the next section we turn to multivariate regression analysis.

5. Empirical Models and Results

In the previous sections, we have explained how the qualification system to entry public procurement auctions affects firms' outsourcing status. Now, we empirically investigate how the firms' outsourcing status affects firms' bids (*i.e.* rebates offered in the auction) and winning firms' performance in contract execution (*i.e.* the probability of time and cost overruns in delivering the public works). Moreover, we extend the analysis by relating firms' bids and performance to firm size and contract complexity; note that contract complexity is here

measured by the number of work categories in the projects, allowing us to add a focus on the differences between horizontal and vertical subcontracting.

5.1 The firms' bidding behavior and outsourcing status: a close-up on TPs

Our empirical model of firm bidding investigates the differences in the rebates offered by Temporary Partnerships and by firms that proceed with *ex-post* outsourcing in the form of either *mandatory* subcontracting or *optional* subcontracting. Fully qualified firms that optionally subcontract are further disentangled by size. The results are in Table 4.

We assume that the firm's bid is a *proxy* for its expected costs to complete the tendered contract. We estimate the following specification of the rebate of firm i in each auction for project j in year t:

$$Rebate_{ijt} = \alpha + \beta\, TP_{ijt} + \varphi\, OF_{ijt} + \gamma\, Q_{jt} + \theta X_{it} + \delta Z_{ijt} + \lambda_t + \varepsilon_{ijt} \qquad (1)$$

where *TP* is a binary variable that takes value 1 when the bidder i in the auction for project j in year t is a Temporary Partnership, and 0 otherwise, *OF* is a set of dummies that covers for the other *n-1 Organizational Forms* that we control for when we want to compare the bidding rebates of TP vis-à-vis the n*th* organizational form. For example, if we aim at testing the difference between the *TPs* and the *Mandatory* firms' rebates, *OF* will be a dummy equal to 1 when the bidder is a fully qualified firm that can optionally decide *ex-post* whether to subcontract (*Optional*), as in Column (2) of Table 4. Correspondingly, when we move on to test the difference with respect to *Optional* firms, *OF* will be a dummy equal to 1 when the bidder is a partially qualified firm that has to proceed to mandatory subcontracting (*Mandatory*), as in Column (3). Finally, when we explore the size-related issues, *OF* will be a set of dummies that covers sub-sampled by size (small, medium, large), as in Columns (4)-(6).

Q_{jt} is a set of variables that controls for the characteristics of the project and the nature of the auction. This includes the size of the project as measured by the *reserve price*, its length in terms of *expected duration*, the toughness of competition (i.e. the *number of participants* in each auction), the tasks to be executed (i.e. a set of dummies to control for sixteen *categories of work*), the *type of auction* (either Average Bid Auction or Average Bid Auction + Lottery), and a dummy

indicating whether the auctioned contract is a project that implies only one or more work categories.

X_{it} is a set of variables that measures the characteristics of the bidder, such as its size (as measured by a set of dummies for small, large and medium-sized firms) and the distance between its location (i.e. the closest capital city) and the CA's location.

Z_{ijt} controls for the bidder's capacity constraints as measured by the firm's backlog when it bids for the project *j*. In addition, we include a dummy denoting the winning firm in the auction and, λ_t, the year dummies, since the auctions were held from 2000 to 2008. ε_{ijt} is the error component.

Because we don't know the identity of the firms in each TP, and TPs form and enter every auction with a different identification code and composition (and split after the auction, or after the contract's execution in case they win), we cannot estimate (firm) fixed effects regressions, since we do not have continuous (or repeated) observations for TPs. For identification, however, we rely on control firm- and auction-specific control and, in Appendix Table A1, we also report estimates with auction fixed effects.

Robust standard errors are clustered by firm, to account for the fact that bidders may contemporarily participate in more than one auction, and their bids may be influenced by the current status of their business (e.g. backlog, distance, etc.). In addition, we control whether the results hold when we cluster the standard errors by auction, to account for possible correlation of firms' bids across auctions.

In Table 4, our variable of interest is the β coefficient on TP, which indicates whether bids by temporary partnerships significantly differ from those by firms having the status of *optional* or *mandatory* subcontracting.

- **Table 4 about here –**

In Column (1), we find that TPs' rebates are significantly higher, i.e. the bid price is on average lower than the rebates by both *optional* and *mandatory subcontracting* firms (i.e. the default). Turning to the control variables, we find that the *number of participants*, and the dummy variables indicating the *winning firm* and the auctions with *only one work category* enter

significantly in all columns. The positive coefficient on the number of participants suggests that the tougher the competition in the bidding process, the higher is the bidding rebate, and the lower the final price, with a benefit for the public buyer. The positive coefficient on the winning firm's dummy indicates that winning firms bid higher rebates, while the positive coefficient on the *only one work category* dummy suggests that competition for this type of projects, relatively less complex to execute and maybe easier to monitor, is probably tougher, thus leading firms to bid lower prices.

In Column (2), we focus on the comparison between TPs and partially qualified firms that have to proceed to *mandatory subcontracting* once they win the contract. We find that TPs' bidding rebates are significantly higher, suggesting that the expected execution costs by partially qualified firms that choose (and negotiate with) their partners *ex-ante* are lower than the expected costs by partially qualified firms that *ex-post* must look for subcontractors if they win the auction. In contrast, the insignificant coefficient on *optional subcontracting* shows indicates that rebates by fully qualified firms do not differ from those by partially qualified firms in a status of *mandatory subcontracting*.[19] When we turn to Column (3), we find that TPs' bidding rebates are significantly larger than *optional* firms' (i.e. the default after controlling for *mandatory subcontracting*), thus suggesting that ex-ante outsourcing leads to lower prices. This result - suggesting a potential higher efficiency or planning capacity of TPs with respect to fully qualified firms - is somewhat surprising, thus leading us to further investigate the differences between TPs and *optional* firms. We do so by disentangling their bids by firm size in Columns (4)-(6). The new estimates reveal that the above result was driven by the lower rebates of *large optional* firms, since the TP's coefficient is significant only in Column (4), where the default is the *large optional* category, and insignificant in the remaining two columns, where we directly compare TPs' bids with those *medium* and *small optional* firms, thus suggesting that TPs' bids do not differ from theirs. Moreover, looking at the coefficients of optional firms of different size, we note that *small* firms bids significantly higher rebates than both *large* and *medium optional* firms (see Columns (4) and (5)) and firms in a status of *mandatory subcontracting* (Column (6)), while mandatory firms' rebates do not significantly differ from the others

[19] Notice that in the paper by Moretti and Valbonesi (2014) such coefficient is significant: this difference with the present paper is explained by the fact that here, focusing precisely on temporary partnership, we consider optional subcontracting firms as not including TPs.

(medium, large optional firms and TPs).

Overall, our findings show that, along with the outsourcing status, also firm size matters for the outcome of the bidding process, suggesting that TPs are able to choose the optimal size to entry and match the size of the auctioned contracts similarly to *small* fully qualified firms and more efficiently than *large* optional firms and firms in *mandatory* subcontracting.[20] Considering the firm's bid as a *proxy* for self-estimated cost in executing the contract, these results suggest that TPs, which in advance choose their partners, boundaries and size, have a better ex-ante planning ability than *large* and *mandatory* subcontracting firms that outsource parts of the contract ex-post.

5.2 – Cost and Time overruns in contract execution

In this Section, we investigate the performance of firms winning the auction, disentangling by outsourcing status and firm size. Time and cost overruns in contract execution are the typical measures of defaults in procurement contract performance. They are defined, respectively, as the extra-time on the contractual duration and the extra-cost on the winning bid; both time and cost overruns are usually leading to a costly renegotiation of the contract, which in some way could waste the advantages from the competitive tender.

In the literature on procurement auctions, cost and time overruns have attracted much attention and different explanations. Spulber (1990) considering a setting where bidders can renege on their bids and on contractual terms and production cost is identical for all bidders but uncertain at the bidding stage, shows that such overruns will occur as a result of an adverse selection of the successful bidder. Ganuza (2007), focusing on large contracts, highlights that overruns may originate from the procurer's attempt to minimize the information rent left to the suppliers: specifically, the procurer underinvests in the initial project design and renegotiates both the price and the project specifications with the winning bidder. Both cost and time overruns have relevant effects on social welfare in terms of direct and indirect costs for taxpayers. Lewis and Bajari (2011), for instance, empirically estimate the negative externalities for commuters (i.e. congestion effects) generated by contractors' slow completion times in the case of Californian highway procurement.

[20] Results with the alternative clustering by auction are very similar and available on request.

Specifically referring to Italian public procurement, time and cost overruns in the execution of contracts have been empirically investigated along different directions by a number of papers.[21] To the best of our knowledge, this paper is the first to investigate cost and time overruns in public procurement performance with a focus on Temporary Partnerships and mandatory subcontracting. Indeed, cost and time overruns depend partly on the firm's ability to plan and bid wisely, and partly on the firm's ability to minimize the risk of hold-up whenever it chooses, or has to rely on, subcontractors for some contractual tasks. Within the TP, the participating firms delivering different parts of the public works chose to form the partnership *before* entering the procurement process, and have then planned the production, estimated the cost and accordingly offered the rebate. TP is thus a contractual agreement by which firms pre-commit to collaborate and, in this vein, it can be argued that the risk of hold-up by partners in a TP (instead of subcontractors) should be lower.

To investigate cost and time overruns in public procurement performance, we estimate probit regressions of the probability that the project's final cost for the winning firm is greater than the winning bid, and of the probability of completing the project after the expected (contracted) deadline, respectively. The estimating sample consists only of the winning firms and the specification is the following:

$$Prob[ExtraCost/Delay=1]_{ijt} = \alpha + \beta\, TP_{ijt} + \varphi\, OF_{ijt} + \gamma\, Q_{jt} + \theta X_{it} + \delta Z_{ijt} + \varepsilon_{ijt} \qquad (2)$$

where all the variables are defined as in Section 5.1. Before turning to the results in Table 5, we calculate the correlation between the probability of time and cost overruns in the sample of winning firms, considering that delayed delivery may lead to penalties with potential higher costs. However, we find that the correlation is as low as 0.01.

[21] By using different dataset extensions and periods in which Italian regulators allowed the adoption of both average bid auctions and first price auctions, Decarolis (2014) empirically finds that cost overruns are lower in the former auction format than in the latter. Bucciol, Chillemi and Palazzi (2014) confirm this result but only when the entry in the former auction is restricted by the procurer. Moretti and Valbonesi (2015) refer overruns to optional and mandatory subcontracting. Coviello, Moretti, Spagnolo and Valbonesi investigate time-overruns as contractors' opportunistic behavior under weak local courts' enforcement of contractual rules (2016). Coviello and Mariniello (2014) address the effects of tender publicity on renegotiations and overruns. Decarolis and Palumbo (2015) study overruns as referred to the projects' design stage.

- **Table 5 about here -**

In Table 5, the β coefficient on *TP* is negative in all columns, thus suggesting that the probability of TPs completing the contract with *cost* overruns is always lower with respect to firms in a different outsourcing status, but the coefficient is statistically significant only in Columns (2) and (5), that is, with respect to firms in a position of *mandatory* subcontracting and *optional* firms of *medium* size. Turning to the probability of cost overruns of other outsourcing forms, we note that *large* and *small optional* firms are similar to TPs in their ability to conform to the expected costs while *mandatory* firms are the most likely to default (see the results in Columns (4) and (6)).

When we look at the estimation of the probability of time overruns in Table 6, we find that TPs report mixed results. On the one hand the β coefficients on the TP dummy are insignificant in Columns (1)-(3), suggesting that the probability to delay the completion of the contract is similar across all organizational forms. On the other hand, breaking up *optional* firms by size, *TPs* result significantly less likely to incur in time overruns than both *medium* and *small* fully qualified *optional* firms (Columns (5) and (6)). Focusing on large firms, the results also tell us that l*arge optional* firms are definitely less likely to deliver late than any other form, except TPs. Apparently, large optional firms, which appear less aggressive in the bidding stage according to Table 4, appear more efficient in the execution stage, as they are less likely than other firms to incur in either time or cost default (see Table 5).

- **Table 6 about here -**

The result that *TPs* are significantly less likely to exceed the project's expected cost than firms in the position of *mandatory subcontracting* (with a similar probability to deliver on time) indicates that voluntary, *ex-ante* agreements among firms lead to a lower probability of default than a forced *ex-post* subcontracting relationship. This evidence seems to suggest that pre-commitment by firms in the consortium is affected by a lower risk of hold-up as compared to ex-post subcontracting relationships in the mandatory status. Moreover, with respect to small firms in an *optional* position to subcontract, *TPs* do not differ in the (lower) probability to exceed costs, but are more efficient in timely delivery.

5.3 A focus on vertical and horizontal outsourcing

In this section, we repeat the above analyses on two subsamples of auctioned contracts, i.e. one including contracts with only one work category, and the other including contracts with more than one work categories. This analysis enables us to distinguish horizontal (i.e. one category) from vertical (i.e. more than one categories) subcontracting and to evaluate the bidding and performance differences between firms in the *ex-ante* and *ex-post* outsourcing status in a homogeneous environment (i.e. in a ceteris paribus condition). Indeed, if the project includes only one work category, all firms entering the bidding stage must be qualified for that category and both *ex-ante TP*s and *ex-post optional* subcontracting will outsource to similarly qualified firms, hence *horizontally* subcontracting. In this case, TPs are set up only to comply with economic, size-related requirements[22] (not technical ones), and the mandatory firms' type is not present (see the entry qualification rules in Section 3). In this analysis, we therefore compare TPs and optional firms that horizontally outsource.

In contrast, projects with more than one work categories imply that partially qualified firms will outsource parts of the contract to firms with different qualifications, thus *vertically* subcontracting. In this case, partially qualified firms engaging in TPs will comply with such technical requirements *ex-ante* (i.e. before bidding in the auction) while partially qualified, *mandatory* firms will outsource the work categories for which they are not qualified by vertically subcontracting to other firms *ex-post*, i.e. after bidding and winning the auction. This allows us another ceteris paribus identification of the differences between TPs and both *mandatory* and *optional* firms within vertical relationships (more-than-one work category).

Table 7 reports the estimates of the bidding rebates model, while Tables 8 and 9 present the probit estimates for the probability of cost and time overruns, respectively.

- Table 7 about here -

[22] Notice that for SMEs that wish to bid for one-work-category contracts, setting a TP may be the only way to enter the auction procedure and bid to win contracts of large economic value. In other words, by setting a TP small firms can reach the economic value required for the qualification included in the awarded contract.

In Table 7, Column (1), we find that the bidding rebates by TPs and by optional firms in auctions for projects with only one work category do not significantly differ. This is an important result that states the ability of (probably small) firms that overcome an economic, size-related constraint by setting up a temporary partnership and bidding like fully qualified firms. Even more so, when we disentangle by size, we find that TPs bid more aggressively than *large optional* firms (Column (2)), and similarly to *small* and *medium optional* firms.

Looking at control variables, we note that the larger the size of the project (as measured by the contract value, i.e., *reserve price*) the lower the rebate; and the longer the contractual execution period, the higher the rebate. Contract value is usually understood in the procurement literature as a *proxy* for the project complexity: in this perspective, the negative relationship between contract size and rebates is consistent as large value contracts will be also more difficult/complex to be executed. On the other hand, the contractual time to execute the awarded project is usually perceived as a constraint for the firm: ceteris paribus, the longer the contractual execution time, the higher the firm's flexibility to allocate simultaneously its capacity over different projects and the larger the rebate offered.[23]

When we turn to more complex projects that imply more than one work categories, we find that TPs, on average, tend to bid significantly higher rebates than all the other firms. However, looking further, we find that this results is driven by the significantly higher rebates that TPs bid with respect to *optional* firms (Column (7)), specifically *large optional* firms (Column (8)). The comparison with firms in a position of *mandatory* subcontracting reveals that TPs' rebates do not statistically differ.

In Table 8, we test differences in the probability of cost overruns in horizontal and vertical subcontracting. We find that the results for the one work category in Column (1) suggest that there are no differences between *TPs* and *optional* firms in this type of default, regardless of size.[24] In contrast, in contracts with more than one work category, hence in vertical subcontracting, TPs appear as always less likely to exceed the expected costs. Conversely,

[23] For a theoretical and empirical analysis on contracted time to execute procurement contract, flexibility and option value, see D'Alpaos et al (2013).

[24] Due to multicollinearity problems in the probabilistic model, the only way to estimate this specification was to leave the dummy for TPs as the default and estimate the differences with firms in the Optional regime separated by size.

results in Columns (3)-(5) suggest that firms in a status of *mandatory* subcontracting are significantly more likely to incur in cost overruns than both *TPs* and *optional* firms.

- **Table 8 about here -**

Finally, we look at time overruns in Table (9). Our results in Column (1) show that, within projects that imply horizontal subcontracting, TPs tend to deliver significantly later than firms in a status of *optional* outsourcing, regardless of the size. When we turn to contracts with more than one work category, i.e. vertical outsourcing, the results confirm previous evidence in Table 6 whereby TPs are similar to both *mandatory* firms and *large optional* firms in the probability to deliver late, and less likely than *small* and *medium*-sized optional firms to exceed the expected project's duration. Finally, *large Optional* firms appear as the most efficient in terms of timely delivery, significantly outperforming both small and medium fully qualified *optional* and *mandatory* firms.

- **Table 9 about here -**

Overall, if we combine the evidence for cost and time overruns to compare the TPs vs. firms in a status of mandatory outsourcing (i.e. ex-ante and ex-post subcontracting within vertical relationships), we can observe that TPs appear to comply with the contractual terms better than firms that have to mandatorily outsource ex-post, which do worse in terms of cost overruns and no better in terms of timely execution. Finally, *large optional* firms appear quicker to execute the contracted works, but their costs rise also faster.

6. Conclusion

We empirically investigate an Italian dataset on procurement auctions for the awarding of public works with the aim of identifying the effects of different types of outsourcing used to comply with the firms' qualification system there adopted. Such system allows contracting authorities to award public contracts through tenders in which a precise description of work

category(ies) the contractor should be qualified for is advertised. Thus, if firms are fully qualified for such advertised work-category(ies), they can enter such awarding auctions and bid individually; if firms are partially qualified, in the aim to cover the qualifications required by the awarded contract, they can choose i) to bid and opt for *ex-post* subcontracting or ii) to set an *ex-ante* outsourcing as Temporary Partnership (*TP)* with other firms, and bid accordingly. Notice that, given this qualification system, the same firm can be fully qualified for an awarded contract and partially qualified for another one: this is an interesting feature of our database that permits us to investigate the firms' outsourcing status with a dynamic perspective.

We empirically find that *TP*s offer lower prices than those by firms which *ex-post* proceed with *Mandatory* or *Optional* subcontracting. When run such comparison by disentangling by firm size in the subsample of fully qualified firms, we find that *TP*s bid significantly lower than *large firms* but on a similar level to *small and medium-sized firms* in a status of *Optional* subcontracting. This suggests that i) the firm's size matters in the expected cost of procurement supply-chain; and ii) *TPs* can derive positive efficiency effects from their discretion in deciding *ex-ante* on their size for each auctioned contract.

Taking contract performance into consideration, we found that: i) *TP*s execute contracts with a lower probability of cost overruns than firms in a position of *mandatory* subcontracting, and ii) with a higher probability of time overruns of both firms in a position of *mandatory* and *optional* subcontracting.

Once we repeat the above analyses disentangling two subsamples of auctioned contracts to consider horizontal and vertical relationships between/among firms, we find that *TP*s show not significant differences with other outsourcing forms in one work category contracts; and higher rebates (i.e. lower execution price) and better performance in more than one work categories contracts.

All these findings together highlight that *TP*s, being free to choose their boundaries for each awarded contract, enter the auction with an efficient economic and technical size, and this efficiency advantage is particularly evident with respect to large fully qualified firms that have the option to subcontract.

Our the empirical evidence highlights that *TP*s, being free to choose their boundaries for each awarded contract, enter the auction with an efficient economic and technical size, and

perform with a lower (or similar) probability of cost overruns than firms in *ex-post* outsourcing status. This suggests that regulations for efficient and effective public procurement should provide incentives to encourage firms to enter procurement auctions in the form of *ex-ante* temporary partnerships. However, our results also show that coordination among firms in *TP*s may lead to time overruns: in this perspective, the inclusion of explicit (i.e. bonus and penalty) and implicit (i.e. relational contracts) incentives in the awarded contract for timely execution should be carefully addressed by the regulator.

References – to be checked

Albano, G., Bianchi, M, Spagnolo, G. (2006). Bid Average Methods in procurement, *Rivista di Politica Economica*, 1-2, 41-62.

Albano GL, Spagnolo G, Zanza, M, (2009),"Regulating joint bidding in public procurement", *Journal of Competition Law Econom,* 5(2), 335–360.

Athey, S, Coey, D, Levin, J, (2013), Set-Asides and Subsidies in Auctions, *American Economic Journal: Microeconomics,* 5, 1-27.

Arya, A, Mittendorf, B, Sappington, DEM, (2008), The make-or-buy decision in the presence of a rival: Strategic outsourcing to a common supplier, *Management Science,* 54(10), 1747–175.

Branzoli, N. and F. Decarolis, (2015), Entry and Subcontracting in Public Procurement Auctions, *Management Science*, 61(12), 2945-2962.

Chen,Y . (2005), Vertical disintegration,. *J.Econom. Management Strategy*, 14, 209-229.

Coase, R. (1937): The Nature of the Firm, *Economica,* 4 (16), 386–405

Coviello, D., Moretti, L., Spagnolo, G. and P. Valbonesi (2016): Court Efficiency and Procurement Performance, *The Scandinavian Journal of Economics*, *forthcoming*.

Decarolis, F, 2009, "When the Highest Bidder Loses the Auction: Theory and Evidence from Public Procurement," *Economic working papers 717, Bank of Italy, Economic Research Department.*

Decarolis, F. (2014), "Awarding price, contract performance and bids screening: Evidence from procurement auctions", *Amer. Econom.J.: Appl. Econom.* 6(1):108–132.

Decarolis. F. & G. Palumbo (2015): Renegotiation of Public Contracts: An Empirical Analysis, *Economic Letters*, 132, 77-81.

De Silva, D. G., Dunne, T., Kosmopoulou, G., & C. Lamarche, (2012), Disadvantaged Business Enterprise Goals in Government Procurement Contracting: An Analysis of Bidding Behavior and Costs, *International Journal of Industrial Organization*, 4**,** 377-388

Fairlie, R. & Marion J, (2012), Affirmative action programs and business ownership among minorities and women, *Small Business Economics*, 39: 319–339.

Flynn R, Davis P, 2015, "The policy–practice divide and SME-friendly public procurement", *Environment and Planning C: Government and Policy* **20** 1–20.

Ganuza, J.J., 2007. Competition and cost overruns in procurement. The Journal of Industrial Economics 55, 633-660.

Galavotti, S, Moretti, L, and Valbonesi, P, 2014, "Sophisticated Bidders in Beauty Contest Auctions" *Marco Fanno Working Paper 187, Department of Economics and Management, University of Padova*.

Grossman, S, Hart, O, 1986, "The Costs and Benefits of Ownership: a Theory of Vertical and Lateral Integration," *Journal of Political Economy* **94** 691-719.

C. Guccio, G. Pignataro, and I. Rizzo (2012): "Determinants of adaptation costs in procurement: an empirical estimation on Italian public works contracts", *Applied Economics* Vol. 44, (15).

Holmstrom, B, Roberts, J, 1998, "The boundaries of the firm revisited", *Journal of Economic Perspective,* **12** 73–94

Joskow, P.L. 1988. "Asset Specificity and the Structure of Vertical Relationships: Empirical Evidence" *Journal of Law, Economics and Organization* **4** 95-117.

Krasnokutskaya, E, Seim, K, 2011, "Bid Preference Programs and Participation in Highway Procurement Auctions", *American Economic Review* **101** 2653-2686

Kamien, M, Li. L, 1990, "Subcontracting, Coordination, Flexibility and Production Smoothing in Aggregate Planning," *Management Science,* **36** 1352-1363.

Kogut, B, Zander, U, 1992, "Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology" *Organization Science* **3** 383-397.

Kogut, B, Zander, U, 1996, "What Firms Do? Coordination, Identity, and Learning", *Organization Science* **7** 502-518.

Lafontaine, F, Slade, M, 2007, Vertical Integration and Firm Boundaries: The Evidence" *Journal of Economic Literature* **45** 629-685

Lafontaine, F, Slade, M, 2008. "Exclusive Contracts and Vertical Restraints: Empirical Evidence and Public Policy," in P. Buccirossi, ed., *Hanbook of Antistrust Economics,* Cambridge MA: MIT Press, 391-414

Lewis, TR, Sappington, DEM, 1991, "Technological Change and the Boundaries of the Firm," *American Economic Review* **81** 887-900.

Lewis, G, P, Bajari, 2011, "Procurement Contracting with Time Incentives: Theory and Evidence", *Quarterly Journal of Economics* **126** 1173-1211.

Loader K, 2013, "Is public procurement a successful small business policy support? A review of the evidence" *Environment and Planning C: Government and Policy* **31** 39–55

Macher, J T, 2006, "Technological Development and the Boundaries of the Firm: A Knowledge-Based Examination in Semiconductor Manufacturing," *Management Science* **52** 826-843.

Marechal F, Morand P-H, 2003, Pre vs. post-award subcontracting plans in procurement bidding. *Economic Letters* **81**(1) 23–30.

Marion, J.J. 2007, "Are Bid Preferences Benign? The effect of Small Business Subsidies in Highway Procurement Auctions" *Journal of Public Economics* **91** 1591-1624.

Marion, J. J. (2009a) "Firm Racial Segregation and Affirmative Action in the Highway Construction Industry", *Small Business Economics* 33:4, p. 441-453

Marion, J.J. 2009b. "How Costly is Affirmative Auction? Government Contracting and California's Proposition 209," *Review of Economics and Statistics* 91 503-522.

Miller, D. 2014. "Subcontracting and Competitive Bidding on Incomplete Procurement Contracts," *The Rand Journal of Economics* **45** 705-746.

Moretti, L, Valbonesi, P, 2015, "Firms' Qualifications and Subcontracting in Public Procurement: An Empirical Investigation" *Journal of Law Economics and Organization* **31** 568-598

Novak, S, Stern, S, 2008, "How Does Outsourcing Affect Performance Dynamics? Evidence from the Automobile Industry", *Management Science* **54** 1963-1979

OECD. 2007. Integrity in Public Procurement, available at: www.oecd.org/development/aide_ectiveness/38588964.pdf

Quinn, J B, Hilmer, F G, 1994, "Strategic Outsourcing", *Summer Sloan Management Review* 43-55.

Rey, P, Tirole, P, 2007, "A primer on vertical foreclosure" in M, Armstrong, Porter, R, eds. *Handbookof Industrial Organization*, Vol.3, Elsevier Science, Amsterdam, 21 45-2220.

Saussier, S, Tirole, J, 2015. "Renforcer l'efficacité de la commande publique", *Les notes du conseil d'analyse économique*, n° 22, download from:
http://www.cae-eco.fr/IMG/pdf/cae-note022v2.pdf

Spagnolo, G. 2012. "Reputation, Competition, and Entry in Procurement" *International Journal of Industrial Organization* **30** 291-296.

Spulber, D.F., 1990. Auctions and contract enforcement. Journal of Law, Economics and Organization 6, 325-344.

Spiegel, Y, 1993, "Horizontal Subcontracting", Rand Journal of Economics **24** 570-590.

Van Mieghem, J.A. 1999. "Coordinating Investment, Production and Subcontracting", 45 *Management Science* 954-971.

Van Long, N, 2005, "Outsourcing and technology spillovers", *International Review of Economic Finance*, **14** 297-3

Williamson, O. 1971. "The Vertical Integration of Production: Market Failure Considerations" *American Economic Review* **63** 316-325.

Williamson, O. 1985. *The Economic Institutions of Capitalism*, New York: The New Press.

TABLES

Box 1: Firm's qualification status and timing of outsourcing

		Firm's Qualification Status (for each awarded contract)	
		Fully Qualified	*Partially Qualified*
Firm's Timing of outsourcing	*Ex-Ante bidding in the auction*	Ready to bid and perform the contract	Temporary Partnerships (TPs)
	Ex-Post bidding in the auction	Optional Subcontracting	Mandatory Subcontracting

Table 1 – Summary statistics: Full Sample

	No. Obs.	Mean	*Std. Dev*	Min	Max
Rebates (%)	13331	17.210	*4.831*	0.00	43.00
Winning Rebates (%)	13331	17.996	*4.360*	3.62	32.25
Reserve price (euro)	13331	1182926	*833891*	155526	5267860
Expected Duration (days)	13331	322.575	*155.176*	79	1440
Distance (km)	13331	310.398	*398.783*	30	1762
No. of Participants	13331	74.848	*31.842*	3	155
Average Bid Auction	13331	0.831	*0.375*	0	1
Average Bid Auction+Lottery	13331	0.169	*0.375*	0	1
Firm Size Dummy: Large	13331	0.220	*0.414*	0	1
Firm Size Dummy: Medium	13331	0.529	*0.499*	0	1
Firm Size Dummy: Small	13331	0.118	*0.323*	0	1
Temporary Partnership Dummy (TP)	13331	0.133	*0.340*	0	1
Prob. of Cost Overrun (winners)	227	0.850	*0.358*	0	1
Prob. of Time Overrun (winners)	234	0.919	*0.274*	0	1

Table 2 - Summary Statistics by outsourcing status (sub-samples) and size

	Temp Partnerships (TPs)			Optional			Mandatory		
	No. Obs.	Mean	*Std. Dev.*	No.Obs	Mean	*Std. Dev.*	No. Obs.	Mean	*Std. Dev.*
Rebates	1777	17.396	*4.708*	9839	17.339	*4.847*	1715	16.272	*4.759*
Winning Reb	1777	18.139	*4.390*	9839	18.164	*4.838*	1715	16.889	*4.006*
Reserve Price	1777	1663345	*993998*	9839	1104538	*764945.3*	1715	1134852	*865321*
Exp. Duration	1777	377.454	*175.068*	9839	312.019	*143.152*	1715	326.266	*184.702*
Pr. Cost Over.	38	0.842	0.370	157	0.828	0.379	32	0.969	0.177
Pr. Time Over.	41	0.976	0.156	161	0.907	0.292	32	0.906	0.296
	Small-sized Optional			Medium-sized Optional			Large-sized Optional		
	No. Obs.	Mean	*Std. Dev.*	No. Obs	Mean	*Std. Dev.*	No. Obs.	Mean	*Std. Dev.*
Rebates	1193	17.051	*4.493*	6011	17.617	*4.833*	2635	16.836	*4.986*
Winning Reb	1193	17.763	*3.965*	6011	18.315	*4.448*	2635	18.000	*4.410*
Reserve Price	1193	885956	*612177*	6011	1021262	*694929*	2635	1141587	*726060*
Distance (km)	1193	288.223	*130.81*	6011	304.347	*139.862*	2635	340.296	*151.565*
Pr. Cost Over.	26	0.846	*0.368*	95	0.916	*0.279*	40	0.925	*0.267*
Pr. Time Over.	26	0.731	*0.452*	92	0.848	*0.361*	39	0.846	*0.366*

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Table 3 - Mean differences by outsourcing status and firm size

	Temporary Partnerships	Mean difference	Other outsourcing forms
Panel A: *Mean Rebates*			
Temporary Partnership (TP)	17.396		
Mandatory		> ***	16.272
Optional (excl. TPs)		~	17.339
Large-sized Optional (excl. TPs)		>***	16.836
Medium-sized Optional (excl. TPs)		<*	17.617
Small-sized Optional (excl. TPs)		>**	17.051
Panel B: *Mean Probability of Winning Outcomes*			
Temporary Partnerships (TPs)	0.0231		
Mandatory		~	0.0186
Optional (TPs excluded)		> **	0.0164
Large-sized Optional (TPs excl.)		> *	0.0151
Medium-sized Optional (TPs excl.)		> **	0.0158
Small-sized Optional (TPs excl.)		~	0.0218

- Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: TPs *vs*. other outsourcing forms: analysis of bidding rebates (Full sample)

	TPs *vs.* All	TPs *vs.* Mandatory	TPs *vs.* Optional	TPs *vs.* Large Optional	TPs *vs.* Medium Optional	TPs *vs.* Small Optional
	(1)	(2)	(3)	(4)	(5)	(6)
Temporary Partnership (TP)	0.440**	0.497**	0.429**	0.453***	0.280	-0.288
	(0.176)	(0.198)	(0.176)	(0.175)	(0.311)	(0.403)
Mandatory Subcontracting			-0.069	0.180	0.006	-0.561**
			(0.103)	(0.234)	(0.124)	(0.274)
Optional Subcontracting		0.069				
		(0.103)				
Small-size Optional				0.740**	0.567*	
				(0.367)	(0.309)	
Medium-size Optional				0.173		-0.567*
				(0.259)		(0.309)
Large-size Optional					-0.173	-0.740**
					(0.259)	(0.367)
Log (1+Backlog)	-0.058	-0.060	-0.060	-0.059	-0.059	-0.059
	(0.063)	(0.063)	(0.063)	(0.063)	(0.063)	(0.063)
Log (Distance)	0.005	0.006	0.006	0.004	0.004	0.004
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Log (Reserve Price)	0.119*	0.119*	0.119*	0.114*	0.114*	0.114*
	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)
Log (No. of Participants)	1.227***	1.230***	1.230***	1.236***	1.236***	1.236***
	(0.137)	(0.137)	(0.137)	(0.137)	(0.137)	(0.137)
Log (Expected Duration)	-0.098	-0.100	-0.100	-0.096	-0.096	-0.096
	(0.083)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)
Winning Firm Dummy	0.722***	0.720***	0.720***	0.720***	0.720***	0.720***
	(0.167)	(0.167)	(0.167)	(0.167)	(0.167)	(0.167)
one-work-category-contract	0.275***	0.256***	0.256***	0.251***	0.251***	0.251***
	(0.059)	(0.061)	(0.061)	(0.061)	(0.061)	(0.061)
Constant	4.042**	4.005**	4.073**	3.971*	4.145**	4.712**
	(2.023)	(2.022)	(2.029)	(2.043)	(1.995)	(2.010)
Dummies						
Firm size	Yes	Yes	Yes	Yes	Yes	Yes
Categories of work	Yes	Yes	Yes	Yes	Yes	Yes
Type of Auction	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.521	0.521	0.521	0.521	0.521	0.521
No. of Observations	13,331	13,331	13,331	13,331	13,331	13,331

OLS estimates on the full sample. The dependent variable is the bidding rebate. Robust standard errors in parentheses are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.10

Table 5: TPs *vs*. other outsourcing forms: Probability of *Cost Overrun* in contract execution (Winning firms)

	TPs *vs.* All	TPs *vs.* Mandatory	TPs *vs.* Optional	TPs *vs.* Large Optional	TPs *vs.* Medium Optional	TPs *vs.* Small Optional
	(1)	(2)	(3)	(4)	(5)	(6)
Temporary Partnership (TP)	-0.589	-1.501**	-0.424	-0.360	-4.378***	-0.111
	(0.452)	(0.646)	(0.465)	(0.471)	(0.714)	(0.640)
Mandatory Subcontracting			1.077**	4.731***	0.713	4.980***
			(0.525)	(0.434)	(0.574)	(0.400)
Optional Subcontracting		-1.077**				
		(0.525)				
Small-size Optional				-0.249	-4.267***	
				(0.574)	(0.652)	
Medium-size Optional				4.018***		4.267***
				(0.668)		(0.652)
Large-size Optional					-4.018***	0.249
					(0.665)	(0.572)
Log (1+Backlog)	-0.088	-0.088	-0.085	-0.085	-0.069	-0.069
	(0.164)	(0.164)	(0.167)	(0.167)	(0.169)	(0.169)
Log (Distance)	-0.128	-0.128	-0.113	-0.113	-0.104	-0.104
	(0.084)	(0.084)	(0.083)	(0.083)	(0.083)	(0.083)
Log (Reserve Price)	0.330	0.330	0.372*	0.372*	0.377*	0.377*
	(0.223)	(0.223)	(0.214)	(0.214)	(0.214)	(0.214)
Log (No. of Participants)	-0.332**	-0.332**	-0.375**	-0.375**	-0.368**	-0.368**
	(0.163)	(0.163)	(0.164)	(0.164)	(0.168)	(0.168)
Log (Expected Duration)	0.307	0.307	0.291	0.291	0.284	0.284
	(0.304)	(0.304)	(0.297)	(0.297)	(0.299)	(0.299)
One Work Category Contract	0.018	0.018	0.270	0.270	0.278	0.278
	(0.222)	(0.222)	(0.243)	(0.243)	(0.245)	(0.245)
Dummies						
Firm size	Yes	Yes	Yes	Yes	Yes	Yes
Type of Auction	Yes	Yes	Yes	Yes	Yes	Yes
Wald $\chi 2$ (p-value)	0.184	0.178	0.178	0.000	0.000	0.000
Pseudo R-squared	0.068	0.100	0.100	0.109	0.109	0.109
No. of Observations	227	227	227	227	227	227

Probit analysis on the sub-sample of winning firms. The dependent variable is the Probability of Cost Overrun. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10

Table 6: TPs *vs*. other outsourcing forms: Probability of *Time Overrun* in contract execution (Winning firms)

	TPs *vs.* All	TPs *vs.* Mandatory	TPs *vs.* Optional	TPs *vs.* Large Optional	TPs *vs.* Medium Optional	TPs *vs.* Small Optional
	(1)	(2)	(3)	(4)	(5)	(6)
Temporary Partnership (TP)	0.890	0.662	0.934	1.001	-2.928***	-2.626**
	(0.604)	(0.646)	(0.620)	(0.628)	(0.758)	(1.030)
Mandatory Subcontracting			0.272	4.008***	0.078	0.381
			(0.379)	(0.385)	(0.463)	(0.679)
Optional Subcontracting		-0.272				
		(0.379)				
Small-size Optional				3.627***	-0.303	
				(0.761)	(0.803)	
Medium-size Optional				3.930***		0.303
				(0.572)		(0.803)
Large-size Optional					-3.930***	-3.627***
					(0.572)	(0.761)
Log (1+Backlog)	0.149	0.140	0.140	0.145	0.145	0.145
	(0.201)	(0.197)	(0.197)	(0.199)	(0.199)	(0.199)
Log (Distance)	-0.061	-0.055	-0.055	-0.050	-0.050	-0.050
	(0.104)	(0.104)	(0.104)	(0.106)	(0.106)	(0.106)
Log (Reserve Price)	0.463	0.471	0.471	0.457	0.457	0.457
	(0.301)	(0.293)	(0.293)	(0.288)	(0.288)	(0.288)
Log (No. Of Participants)	-0.422	-0.431	-0.431	-0.434	-0.434	-0.434
	(0.271)	(0.266)	(0.266)	(0.271)	(0.271)	(0.271)
Log (Expected Duration)	-0.539	-0.531	-0.531	-0.506	-0.506	-0.506
	(0.418)	(0.410)	(0.410)	(0.416)	(0.416)	(0.416)
One Work Category Contract	0.363	0.455	0.455	0.460	0.460	0.460
	(0.258)	(0.279)	(0.279)	(0.281)	(0.281)	(0.281)
Dummies						
Firm Size	Yes	Yes	Yes	Yes	Yes	Yes
Type of Auction	Yes	Yes	Yes	Yes	Yes	Yes
Wald $\chi 2$ (p-value)	0.004	0.006	0.006	0.000	0.000	0.000
Pseudo R-squared	0.128	0.132	0.132	0.138	0.138	0.138
No. of Observations	234	234	234	234	234	234

Probit analysis on the sub-sample of winning firms. The dependent variable is the Probability of Time Overrun. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10

Table 7 TPs *vs.* other outsourcing forms: bidding rebates by number of work categories in the contract

	Sample of contracts with one work category				Sample of contracts with more than one work category					
	TPs vs. Optional	TPs vs. Large Optional	TPs vs. Medium Optional	TPs vs. Small Optional	TPs vs. All	TPs vs. Mandatory	TPs vs. Optional	TPs vs. Large Optional	TPs vs. Medium Optional	TPs vs. Small Optional
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Temporary Partnership (TP)	0.052	0.544**	-0.026	0.049	0.323*	0.157	0.403**	0.420**	-0.019	-0.124
	(0.176)	(0.234)	(0.176)	(0.232)	(0.198)	(0.212)	(0.196)	(0.193)	(0.133)	(0.168)
Mandatory							0.247**	0.600***	0.161	0.055
							(0.096)	(0.159)	(0.105)	(0.148)
Optional						-0.247**				
						(0.096)				
Small-size Optional		0.494**	-0.076					0.544***	0.105	
		(0.230)	(0.174)					(0.193)	(0.143)	
Medium-size Optional		0.570***		0.076				0.439***		-0.105
		(0.160)		(0.174)				(0.160)		(0.143)
Large-size Optional			-0.570***	-0.494**					-0.439***	-0.544***
			(0.160)	(0.230)					(0.160)	(0.193)
Log (1+Backlog)	-0.130*	-0.027	-0.027	-0.027	-0.078	-0.061	-0.061	-0.064	-0.064	-0.064
	(0.069)	(0.073)	(0.073)	(0.073)	(0.076)	(0.076)	(0.076)	(0.073)	(0.073)	(0.073)
Log (Distance)	-0.034	-0.009	-0.009	-0.009	0.039	0.034	0.034	0.036	0.036	0.036
	(0.033)	(0.033)	(0.033)	(0.033)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)
Log (Reserve Price)	-0.515***	-0.468***	-0.468***	-0.468***	0.296***	0.286***	0.286***	0.278***	0.278***	0.278***
	(0.085)	(0.087)	(0.087)	(0.087)	(0.091)	(0.091)	(0.091)	(0.093)	(0.093)	(0.093)
Log (Participants)	1.549***	1.560***	1.560***	1.560***	1.731***	1.729***	1.729***	1.728***	1.728***	1.728***
	(0.236)	(0.234)	(0.234)	(0.234)	(0.146)	(0.145)	(0.145)	(0.146)	(0.146)	(0.146)
Log (Exp. Dur.)	0.299**	0.287**	0.287**	0.287**	-0.429***	-0.407***	-0.407***	-0.403***	-0.403***	-0.403***
	(0.118)	(0.117)	(0.117)	(0.117)	(0.118)	(0.119)	(0.119)	(0.119)	(0.119)	(0.119)
Winning Firm	0.661**	0.660**	0.660**	0.660**	0.825***	0.833***	0.833***	0.832***	0.832***	0.832***
	(0.272)	(0.271)	(0.271)	(0.271)	(0.204)	(0.205)	(0.205)	(0.206)	(0.206)	(0.206)
Dummies										
Firm size	No	No	No	No	Yes	Yes	Yes	No	No	No
Type of Auction	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Category of Work	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	7,450	7,450	7,450	7,450	5,881	5,881	5,881	5,881	5,881	5,881
R-squared	0.500	0.500	0.500	0.500	0.573	0.574	0.574	0.573	0.573	0.573

OLS estimates. The dependent variable is the bidding rebate. Robust standard errors in parentheses are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.10

Table 8: TPs *vs*. other outsourcing forms: Probability of *Cost Overrun* by number of work categories in the contract (Winning firms)

	Contracts with one work category	Contracts with more than one work category			
	Optional *vs.* TPs.	TPs *vs.* All	TPs *vs.* Mandatory	TPs *vs.* Optional	TPs *vs.* Large Optional
	(1)	(2)	(3)	(4)	(5)
Temporary Partnership (TP)	-	-5.509***	-7.341***	-6.138***	-5.643***
	-	(1.035)	(1.427)	(1.424)	(1.299)
Mandatory Subcontracting	-			1.204**	-4.036***
	-			(0.552)	(1.139)
Optional Subcontracting	-		-1.204**		
	-		(0.552)		
Small-sized Optional	0.005				-6.091***
	(0.653)				(1.149)
Medium-sized Optional	-0.534				-5.105***
	(0.772)				(1.015)
Large-sized Optional	-0.195				
	(0.716)				
Log (1+Backlog)	-0.066	-0.161	-0.287	-0.287	-0.257
	(0.239)	(0.335)	(0.338)	(0.338)	(0.329)
Log (Distance)	-0.115	-0.167	-0.144	-0.144	-0.135
	(0.122)	(0.133)	(0.128)	(0.128)	(0.128)
Log (Reserve Price)	0.473	0.202	0.295	0.295	0.380
	(0.320)	(0.308)	(0.295)	(0.295)	(0.303)
Log (No. of Participants)	-0.286	-0.392**	-0.421**	-0.421**	-0.400**
	(0.328)	(0.186)	(0.188)	(0.188)	(0.189)
Log (Expected Duration)	0.365	0.328	0.182	0.182	0.046
	(0.423)	(0.428)	(0.394)	(0.394)	(0.419)
Dummies					
Firm size	No	Yes	Yes	Yes	No
Type of Auction	Yes	Yes	Yes	Yes	Yes
Wald $\chi 2$ (p-value)	0.462	0.000	0.000	0.000	0.000
Pseudo R-squared	0.108	0.136	0.203	0.203	0.203
No. of Observations	108	119	119	119	119

Probit analysis on the sub-sample of winning firms. The dependent variable is the Probability of Time Overrun. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10

Table 9: TPs *vs*. other outsourcing forms: Probability of *Time Overrun* by number of work categories in the contract (Winning firms)

	Contracts with one work category	Contracts with more than one work category					
	Optional *vs.* TPs	TPs *vs.* All	TPs *vs.* Mandatory	TPs *vs.* Optional	TPs *vs.* Large Optional	TPs *vs.* Medium Optional	TPs *vs.* Small Optional
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Temporary Partnership (TP)	-	0.840	0.706	0.856	0.959	-3.007***	-2.972**
	-	(0.818)	(0.824)	(0.828)	(0.832)	(0.761)	(1.216)
Mandatory Subcontracting	-			0.150	4.035***	0.069	0.105
	-			(0.386)	(0.519)	(0.495)	(0.885)
Optional Subcontracting	-		-0.150				
	-		(0.386)				
Small-sized Optional	-4.315***				3.931***	-0.036	
	(0.404)				(1.027)	(1.047)	
Medium-sized Optional	-3.860***				3.966***		0.036
	(0.415)				(0.713)		(1.047)
Large-sized Optional	-4.225***					-3.966***	-3.931***
	(0.648)					(0.713)	(1.027)
Log (1+Backlog)	-0.066	0.434	0.418	0.418	0.410	0.410	0.410
	(0.285)	(0.317)	(0.303)	(0.303)	(0.292)	(0.292)	(0.292)
Log (Distance)	0.032	-0.083	-0.079	-0.079	-0.081	-0.081	-0.081
	(0.147)	(0.136)	(0.135)	(0.135)	(0.138)	(0.138)	(0.138)
Log (Reserve Price)	1.071**	0.107	0.116	0.116	0.102	0.102	0.102
	(0.455)	(0.360)	(0.347)	(0.347)	(0.352)	(0.352)	(0.352)
Log (No. Of Participants)	-0.919*	-0.356	-0.358	-0.358	-0.385	-0.385	-0.385
	(0.493)	(0.272)	(0.267)	(0.267)	(0.269)	(0.269)	(0.269)
Log (Expected Duration)	-0.268	-0.692	-0.689	-0.689	-0.659	-0.659	-0.659
	(0.680)	(0.565)	(0.557)	(0.557)	(0.577)	(0.577)	(0.577)
Dummies							
Firm size	No	Yes	Yes	Yes	No	No	No
Type of Auction	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald $\chi 2$ (p-value)	0.000	0.011	0.016	0.016	0.000	0.000	0.000
Pseudo R-squared	0.249	0.158	0.159	0.159	0.165	0.165	0.165
No. of Observations	111	123	123	123	123	123	123

Probit analysis on the sub-sample of winning firms. The dependent variable is the Probability of Time Overrun. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10