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What explains delays in public procurement decisions?☆

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ABSTRACT

Delays in contractor selection are widespread and often costly in public procurement. This paper is the first thorough empirical examination of a common view held by practitioners and in the theoretical literature that negotiation as a selection process causes delay. We adapt an established framework of decision-making process in the wider organisation literature to identify the determinants of decision speed in public procurement. Employing data for all UK public procurement contracts during 2009-2015, our results using both logit models and duration analysis suggest that organisational factors (e.g. the centralisation of procurement) and contract features (e.g. contract complexity) account better for delay. We also find that the choice of simpler procurement procedures, whether these involve negotiation or not, can reduce the decision time. Such time efficiency further justifies the use of negotiation for complex contracts, where this procedure has been proved cost-efficient.

1. Introduction

Public procurement represents on average 13% to 20% of a country's GDP.[1] However, delays in awarding public procurement contracts are pervasive. For example, our results reveal delays of on average 2.5 months in the awarding of almost half of the UK public contracts during 2009–2015.

Existing literature tends to suggest that such delays can increase the cost of services and inhibit investment. The National Audit Office (NAO) reveals in its report that the perception of slow procurement decision discourages suppliers from bidding.[2] This is important for public finance because weakened competition leaves more room for bidders to charge a higher price (Bulow and Klemperer, 1996, 2009; McAfee and McMillan, 1987a). Delay in more complex projects can lead to substantial cost increases. For instance, 18 months delay, of which 9 months due to protracted procurement decision, added £660 million to the cost of the 2009 award for maintaining and widening the M25 in London.[3] It is arguable that delay may also have a positive economic impact, for example, associated with better post-award contractor performance, but it is clear that delay in the award of public procurement contracts is under-researched.

This study investigates the determinants of delay in the award process. A prominent view amongst practitioners is that negotiations between public bodies and potential suppliers is the key reason for delays in the awarding of procurement contracts (Yescombe, 2007; Ahsan and Gunawan, 2010). The same NAO report suggests that negotiation causes the lengthy award period for public private partnership (PPP) contracts. It uncovers that public procurers on average took 34 months to make a contract award decision during 2004–2006 and since 2000–2003 the duration of negotiations to finalise deals with a single

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[1] According to a Word Bank article "Global Public Procurement Database: Share, Compare, Improve!" published in 2020: https://www.worldbank.org/en/news/feature/2020/03/23/global-public-procurement-database-share-compare-improve.

[2] See the report "Improving the PFI tendering process": https://www.nao.org.uk/reports/improving-the-pfi-tendering-process/.

[3] See the NAO report "Procurement of the M25 private finance contract": https://www.nao.org.uk/reports/procurement-of-the-m25-private-finance-contract/.

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preferred bidder has increased to an average of over one year with some cases of five years.

Negotiation facilitates the working out of contract terms in the presence of contractual incompleteness and asymmetric information (Tadelis and Bajari, 2006). A theoretical literature modelling contracting arrangements finds that information asymmetries and bargaining strategies may result in sequential negotiation with associated delay in reaching a contractual outcome (Möller, 2007; Kennan and Wilson, 1993). We identify only four empirical studies of decision speed in public procurement. Reeves et al. (2015, 2017) and Palcic et al. (2022) examine how certain factors might affect the speed of contractor selection decision. These three studies examine only PPP contracts but do not evaluate other more usual forms of public procurement. Decarolis (2014) briefly compares the decision speed under two sub-categories of auctions. We have found no previous empirical study of decision speed comparing negotiation-based with auction-based award mechanisms.

This shows that the literatures on award mechanism and public procurement lacks comprehensive empirical study on procurement decision speed. Previous studies on award mechanisms have focused on the contract cost (Bajari et al., 2008; McAfee and McMillan, 1987a; Tadelis, 2012; Yao and Tanaka, 2020; Huang and Li, 2015). Several studies in public procurement literature have discussed the speed of contract execution (Lewis and Bajari, 2011, 2014; Love et al., 2013; Gori et al., 2017; Decarolis, 2014).[4]

Our contribution to the award mechanism and public procurement literatures is twofold. First, we investigate the relationship between two sub-categories of both auction- and negotiation-based award mechanisms and the speed of public procurement decisions. Second, we build upon the organisation literature to provide a broader framework (illustrated in Fig. 1) for identifying the factors affecting delays in public procurement. Our framework incorporates additional organisational, environmental and decision-specific factors to those already highlighted in the literature on award mechanism. Our work thus parallels other studies in the economics literature, highlighting the role of organisational factors in determining economic outcomes.[5] Overall, our results suggest that negotiation is a more time-efficient contractor selection process for complex projects and justify the approach taken in the EU legal framework for public procurement, which allows for a range of different negotiation-based as well as auction-based award mechanisms.

Section 2 sets out our research questions and reviews relevant organisation literature and award mechanism literature. Section 3 introduces our data obtained from the European Union Tenders Electronic Daily (TED) database and describes the empirical methods. Section 4 discusses the results. In contrast to the existing literature that highlights decision specific factors such as contract complexity, we find that organisational factors, notably the bureaucratic processes required for organising the more complicated award processes rather than the negotiation mechanism itself better account for delay in public procurement decisions. Section 5 concludes.

2. Research questions and related literature

In order to assess a fuller range of potential determinants of delay in contract award decision, we locate our own and other economic research within the wider organisation literature on decision making, as summarised by the framework illustrated in Fig. 1.[6] In this framework, organisational, environmental and decision-specific factors affect the whole decision process; decision process characteristics affect the process and economic outcomes; and the process outcomes, among which is the decision speed, in turn affect the economic outcomes.

As is shown by arrow (2) in Fig. 1, award mechanism may affect the speed of award decisions. Auctions are designed to arrive at procurement decisions in a more straightforward way. In an auction, bidders submit sealed bids to a public buyer before a prescribed deadline and the public buyer evaluates bids collectively and announces the decision of contractor to the public. While auctions prohibit discussions between bidders and the public buyer, negotiations facilitate such communication. Put more technically, auctions transmit signals (e.g. price) only from bidders to the procurer but not in the opposite direction and negotiations allow interactions of signals transmitted from both sides.

The award mechanism literature is developed in two settings: (1) the single-seller-many-buyers context,[7] a monopolist designs a selling mechanism and sells goods, services or franchises to potential buyers; (2) the single-buyer-many-sellers context, i.e. procurement[8]: a monopsonist designs a purchasing mechanism to buy goods or services from many potential sellers. The two contexts share similar attributes, because the principal in both settings aims to maximise its expected utility, e.g. to maximise its expected profit, minimise its expected cost, or maximise the social surplus. Therefore, studies developed in one context are informative about studies in the other context (McAfee and McMillan, 1987a,b).

Auctions are suitable for simple contracts (e.g. stationary purchasing) because auctions accommodate price competition and buyers of simple contracts tend to focus on price. For simple contracts, competition in auctions automatically forces bidders to offer bids close to their true valuation without compromising the quality of the product (Bulow and Klemperer, 1996, 2009).[9] This is the relationship represented by arrow (1) in Fig. 1: decision-specific factors affect the choice of award mechanism. However, auctions, which transit signals only from bidders to the buyer, cannot convey buyers' preference on quality (Goldberg, 1977; Williamson, 1976). Although scoring auction can incorporate more quality characteristics and extract a significant proportion of bidders' surplus in some circumstance (Asker and Cantillon, 2008, 2010), the cost of designing scoring rules for complex projects can be prohibitively expensive because of buyers' inability to clearly specify their needs (Albano et al., 2017; Dellarocas et al., 2006) and better-qualified bidders are still likely to withdraw to avoid price competition due to their prior commitment to quality (Yao and Tanaka, 2020).

Negotiations are more efficient than auctions when contracts are complex and incomplete, buyers care about non-contractible quality and the risk of ex-post renegotiation is high (Manelli and Vincent, 1995; Tadelis, 2012; Tadelis and Bajari, 2006). Negotiations facilitate communication that enhances mutual understanding of what is purchased and therefore improve contract design and reduce disputes in renegotiation. Negotiations also lend themselves to cost-plus compensation

[4] A larger project management literature investigates the delivery time in procurement with most studies using a qualitative or survey-based approach (Ahsan and Gunawan, 2010; Assaf and Al-Hejji, 2006; Aibinu and Odeyinka, 2006; Flyvbjerg et al., 2004). This literature focuses on works contracts but not the more common supplies or services contracts.

[5] For example, Ben-Yashar and Nitzan (1998), Decarolis (2014) and Kocher and Sutter (2006).

[6] This literature focuses on decision process and decision speed in corporate decision making (Forbes, 2005; Baum and Wally, 2003; Eisenhardt, 1989; Judge and Miller, 1991).

[7] Notable studies include Bulow and Klemperer (1996, 2009) and McAfee and McMillan (1987b).

[8] While there is relatively little prior work on decision speed in procurement, there is an extensive literature examining many aspects of award mechanisms for procurement, including, for example, Manelli and Vincent (1995) and Tadelis and Bajari (2006) and three papers in this journal (Huang and Li, 2015; Liu et al., 2013; Zhang et al., 2013).

[9] Duncombe and Searcy (2007) show that simple procurements conducted by New York schools has greater cost savings when auctions were used. Bajari et al. (2008) and Baldi et al. (2016) find a negative correlation between the adoption of auction and measures of contract complexity.

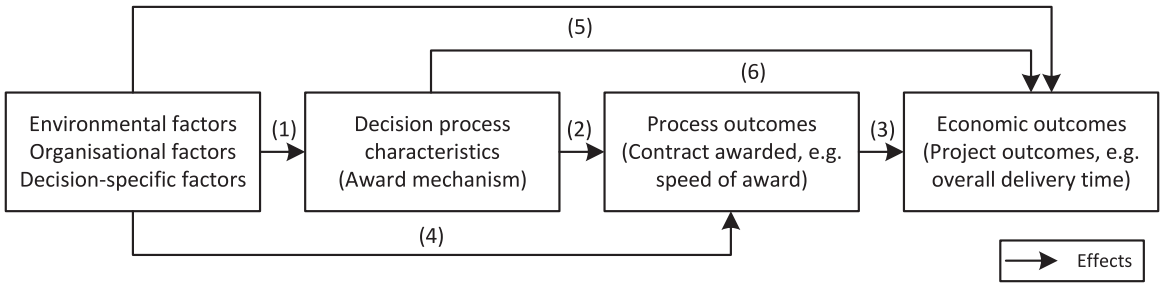

Fig. 1. Decision Making Process.

Notes. This figure provides a framework of decision making process, based on the organisation literature (Rajagopalan et al., 1993), for analysis of decision speed. It shows a sequential flow of the decision process with examples of public procurement in brackets. Decision speed is defined as "how quickly organisations execute all aspects of the decision-making process, spanning from the initial consideration of alternative courses of action to the time at which a commitment to act is made" (Forbes, 2005, p. 355). The framework shows that organisational factors (e.g. nature of decision makers), environmental factors (e.g. competition among bidders) and decision-specific factors (e.g. complexity of contracts) fundamentally influence all aspects of the decision process; the decision process characteristics affect the process and economic outcomes; and the process outcomes also affect the economic outcomes. The award mechanism defines award process characteristics and belongs to the category of decision process characteristics. Process outcomes, such as decision speed and contractual price, relate to the status of a contract when it is awarded. In the context of public procurement, economic outcomes are the final payment for the contract, quality of the product and the overall delivery time.

rules, which allow for and accommodate the need for renegotiating unavoidable incomplete contracts (Bajari and Tadelis, 2001).[10]

The award mechanism theory suggests that negotiation can take a long time. Dealing with uncertainty and non-contractible quality requires the buyer to collect information sequentially from bidders (Manelli and Vincent, 1995). This iterative communication may evolve into haggling, with several rounds of negotiations with each bidder, one after another, before a contract is awarded (Riley and Zeckhauser, 1983). Bargaining strategies can lead the principal to choose sequential negotiations and delay the final decision, in order to, for example, reduce bidders' outside options (Möller, 2007) or to make credible the threat of offering the contract to a competing bidder (Jehiel and Moldovanu, 1995). It is though abrupt to rush to conclude that negotiation is practically lengthier than auction to arrive at a procurement decision, because theoretical studies tend to simplify the institutional environment in which award mechanisms are implemented.

Adopting the framework of Fig. 1 leads us to distinguish two research questions, where the second question focuses on the institutional environment:

1. Compared to auction-based award mechanisms, whether and to what extent are negotiation-based award mechanisms related to the speed of procurement?

2. Whether and to what extent does the speed of procurement decisions relate to other factors, environmental, organisational and decision-specific?

We use different metrics of decision speed, i.e. the duration of award process, the probability of delay and the duration of delay, to investigate both research questions.

The most left box in Fig. 1 represents the factors in our second research question. The award mechanism literature has discussed some of these factors, i.e. competition, buyers' experience and contract complexity, through arguments on asymmetric information and moral hazard (Laffont and Tirole, 1993; Bulow and Klemperer, 1996, 2009; Bajari and Tadelis, 2001). We focus on the roles of these factors in the award process as represented by arrows (1) and (4) in Fig. 1.

Organisational Factors. The organisational factors include buyer's experience, whether the ultimate public buyer runs the award process directly, and the authority type. Buyer's experience may affect both decision speed and the choice of award mechanism. Experienced people are likely to decide faster because they have already possessed prior knowledge and can gather and process information more efficiently (Forbes, 2005; Lord and Maher, 1990). With more experience, a public buyer is likely to implement auctions at a lower cost and become more skillful in extracting rents in negotiation (Bajari et al., 2008). However, the importance of experience is weakened in a competitive environment which allows a public buyer to extract surplus without acquiring much knowledge or negotiation skills (Bulow and Klemperer, 2009).

Authority type is relevant to access to information and organisational size, which in turn affect decision speed. For example, the central government possesses more human, financial and technical resources and can acquire information more easily than the local authorities. Having access to more complete information may speed up decision making (Duhaime and Schwenk, 1985; Galbraith, 1977). A country's central government is usually much larger than its local authorities.[11] A large organisation size tends to indicate a complex organisation structure (Pugh et al., 1968) and a comprehensive but inflexible decision process (Fredrickson and Iaquinto, 1989; Papadakis et al., 1998), both encourage organisational inertia (Wally and Baum, 1994; Fredrickson and Mitchell, 1984).

A public procurement decision is centralised when a central purchasing body rather than the ultimate buyers takes charge of contractor selection. The organisation literature covers rich discussions on centralised decision making under different scenarios, all lending credence to the impact of (de)centralisation on decision outcomes. Generally, centralisation in decision process exhibits a positive relationship with decision speed (Wally and Baum, 1994; Eisenhardt, 1989; Baum and Wally, 2003), because skilful top decision makers process information more efficiently. Such advantage of in processing information is more evident in complex situations when more profound analysis is required; in simpler but fast-changing environments, decentralisation facilitates speedier responses to changes (Siggelkow and Rivkin, 2005).

Environmental Factors. Since we focus on the UK, a single regulatory regime, the key environmental factor is competition. Greater competition usually brings more alternative bids. Evaluating more alternatives may accelerate decision speed by enhancing decision maker's cognition (Eisenhardt, 1989; Judge and Miller, 1991) but may also require more time in total while reducing the marginal time spent on evaluating each choice (Mintzberg et al., 1976; Fredrickson and Mitchell, 1984; Schweiger et al., 1986).

The link between competition and award mechanism is well-recognised in the public procurement literature. An increasing number of (potential) bidders places the principal in a more favourable position for rent extraction under both auctions and negotiations, but

[10] Bajari et al. (2014) show that costs from renegotiation are as high as 7.5–14% of the winning bid.

[11] Using a sample of 17 industrial and 15 developing countries in 1994, Jin and Zou (2002) show the national government is more than twice of sub-national government in size measured by the proportional of a nation's GDP taken up by the total expenditure at corresponding government level.

the effectiveness of auctions depends more heavily on the number of bidders and also on the distribution of bidders' valuations, which determines the degree of competition (Calzolari and Spagnolo, 2010; French and McCormick, 1984; Samuelson, 1985).[12] Other environmental factors include geographic location, economic and political regimes, economic condition in a certain year and coincidence with elections.

Decision-specific Factors. Contract complexity is the most important decision-specific factor. Complex contracts containing dimensions that are difficult or even impossible to specify may give rise to greater quality concerns. Designing complex contracts requires more effort and time input (Tadelis, 2012). As discussed earlier in this section, greater contract complexity and quality concerns favour negotiation over auction, which in turn affects award speed.

Related to contract complexity, the contract type whether a contract is primarily on constructions (i.e. works contract), public utilities (i.e. supply contract) or professional services (i.e. services contract), can affect the choice of award mechanism and the decision speed. Works contracts are usually more complex and require more inputs. The organisation literature also identifies decision urgency as a decision-specific factor (Rajagopalan et al., 1993).

Our literature search uncovers only four empirical studies on decision speed in public procurement and no studies on the delays of the decisions . Decarolis (2014) compares two different auction designs but not negotiation-based award mechanisms. Reeves et al. (2015, 2017) and Palcic et al. (2022) examine only PPP projects that account for a small number of public contracts. Reeves et al. (2017) compare the two negotiation-based award mechanisms (i.e. the negotiated procedure and competitive dialogue) by employing a time dummy, which may not accurately reflect the difference between the two award mechanisms. These studies include few or no variables representing organisational or environmental factors in their analyses.

3. Data and methods

This section describes the institutional arrangements used in public procurement (Section 3.1), an initial descriptive summary of our data (Section 3.2), and our regression models and variables (Section 3.3).

3.1. Institutional background: Award mechanism types and award process

The general award mechanism forms for public procurement are similar in many countries. The UK and EU has followed the World Trade Organisation (WTO) Agreement on Government Procurement adopted by 94 WTO members. The UK has retained, regardless of Brexit, EU Public Procurement Directives[13] that prescribe four benchmark award mechanisms: two, the open procedure and the restricted procedure, are auction-based; the remaining two, the negotiated procedure and the competitive dialogue, are negotiation-based. Procurement rules favour the choice of open and restricted procedures, because these relative simple procedures promote competition and avoid favouritism (Bajari et al., 2008; Bulow and Klemperer, 1996). The negotiated procedure and competitive dialogue are allowed under specific circumstances, e.g. when complex technology is required.[14]

The four award mechanisms are distinguished by their permission for prequalification and negotiation (see Table 1). The open procedure allows any interested firms to submit a tender and does not include prequalification. The restricted procedure may preselect bidders who submit a request to participate and only the prequalified bidders are allowed to submit a tender. The competitive dialogue and negotiated procedure allow preselection. The competitive dialogue permits negotiations only before final bids are submitted and concludes with a competitive bidding stage after the last round of negotiation. Under the negotiated procedure, negotiation continues until a winner is selected.

The four different award mechanisms can all be represented by the same timeline shown in Fig. 2, which represents the standard lifecycle of public procurement under EU Public Procurement Directives. The timeline starts from the initiation of a contracting opportunity when a contract notice (CN) is dispatched, t_{CN}. A CN specifies items such as the target to be purchased, estimated value, award mechanism, requirements, and end date of application. Some CNs also provide the planned contract start (t_{PS}) and end dates. The release of a CN initiates the procurement process (also known as award process/period, or tendering process/period).[15]

Fig. 2 illustrates the three consecutive stages of contract award: the response period, screening period and standstill period. The type of award mechanism determines activities taking place in the first two stages. The response period lasts until the end date of application, t_{EA}. During this period, complete tenders are submitted under the open procedure, and requests to participates are submitted under the restricted procedure, competitive dialogue and negotiated procedure. Immediately following the response period, the screening period is for contracting authority to evaluate the qualification and bids of interested bidders under the open procedure and bids from prequalified bidders under the restricted procedure, negotiated procedure and competitive dialogue. An award decision notice is issued to all bidders at the end of the screening period and an at-least-10-day standstill period for challenging the winning bid is required before a contract is formally awarded and signed, t_{CA}. Later, a contract award notice (CAN) is published to announce the outcome of the award.

The EU public procurement directives also allow for two accelerated procedures, which may be used for urgent procurement requests. The accelerated restricted procedure shrinks the length of the procurement process but is otherwise the same as the restricted procedure. The accelerated negotiated procedure is a similarly contracted version of the negotiated procedure.

3.2. Award mechanisms and decision speed: Descriptive analysis

Our data cover all UK public procurement contracts for the period of 2009–2015 published in the Tenders Electronic Daily (TED).[16] TED is the digital version of the Official Journal of the European Union, where public procurement contracts above the EU thresholds must be advertised. It is advocated to publish under-threshold contracts on the TED. The data consist of two parts, CN and CAN, which are linked by

[12] With increasing number of bidders, the magnitudes of the highest- and second-highest valuations tend to increase and converge. The threat of losing forces the bidder with the highest valuation to bid closer to its true valuation and transfer more surplus to the principal (Holt, 1979; Harris and Raviv, 1981). A large number of bidders is one of the conditions for auctions to be more effective than negotiation in extracting surplus (Bulow and Klemperer, 2009, 1996). Other conditions are low communication cost and well-specified contracts (Myerson, 1981; Riley and Samuelson, 1981; McAfee and McMillan, 1987a; Tadelis, 2012).

[13] The EU public procurement directives, currently Directives 2014/23/EU, 2014/24/EU and 2014/25/EU and formerly Directives 2004/17/EC and 2004/18/EC, govern public procurement contracts with a value above the EU procurement thresholds, which are reset annually. These EU laws are accessible from EUR-Lex.

[14] EU public procurement Directive 2014/24/EU Article 26 describes the specific circumstances when the negotiated procedure and competitive dialogue are applicable.

[15] These terminologies are used interchangeably in practice and in the literature.

[16] The data are accessible from the European Union Open Data Portal: https://data.europa.eu/data/datasets/ted-csv?locale=en. Our data are the 2nd February 2017 version. A data information file is available on this website.

Table 1
Features of EU award mechanisms.

Award mechanism	Prequalification	Minimum No. of participants after prequalification	Discussion before final bids are submitted	Discussion after final bids are submitted
Open procedure	No	N.A.	No	No
Restricted procedure	Yes	5	No	No
Competitive dialogue	Yes	3	Yes	No
Negotiated procedure	Yes	3	Yes	Yes

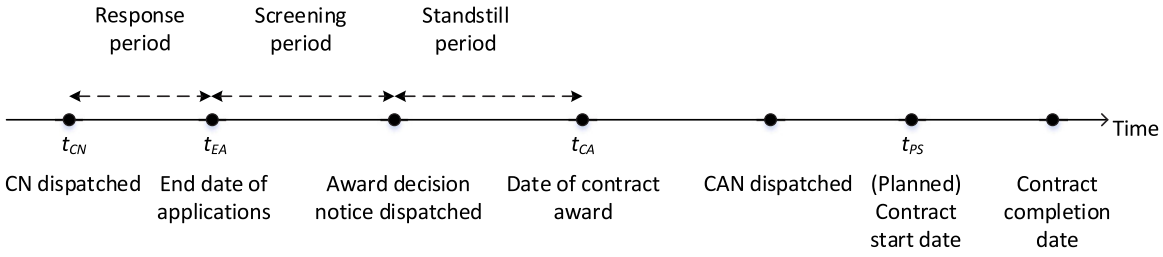

Fig. 2. Life-cycle of EU Public Procurement.
Notes. 1. Response period: for submitting requests to participate under the (accelerated) restricted, (accelerated) negotiated, and competitive dialogue procedures; for submitting tenders under the open procedures. 2. Screening period: for preselection and bid evaluation under the (accelerated) restricted, (accelerated) negotiated, and competitive dialogue procedures; for bid evaluation under the open procedure. 3. Standstill period: a publicity period for challenging the winning bid. 4. CN stands for contract notice that announces a procurement opportunity; CAN stands for contract award notice that publishes the outcome of award.

Table 2
Causes of sample size changes.

	Sample size	Trimmed by 1%	Availability of t_{PS}	$t_{CA} \geq t_{PS}$	Availability of other variables	Benchmark award mechanism
Table 3	28,482	✓				
Table 4	7,869	✓	✓			
Table 5	3,921	✓	✓	✓		
Table 7	5,093	✓	✓		✓	✓
Table 8 (columns (1) and (2))	5,093	✓	✓		✓	✓
Table 8 (column (3))	2,432	✓	✓	✓	✓	✓
Fig. 3	7,452	✓	✓			✓
Fig. 4	3,675	✓	✓	✓		✓

Notes. A tick under each factor indicates that the factor is a cause of the change of sample size in the corresponding table or figure.

a common reference variable CAN ID. We use data only for contracts that were successfully awarded.[17]

The initial dataset contains 29,042 observations. The sample size varies in our tables and figures for five reasons: (1) data trimmed by 1% to exclude extreme values; (2) the availability of t_{PS}; (3) the condition that t_{CA} coincides with or is after the t_{PS}; (4) the availability of other variables; and (5) discussing only the four benchmark award mechanisms. In Table 2, a tick indicates that the factor affects the sample size in a table or figure.

Table 3 summarises the duration of award process (which is the aggregation of the response period, screening period and standstill period) by award mechanisms. The duration of an award process is calculated as the difference between the dispatch date of contract notice (t_{CN}) and the contract award date (t_{CA}). Among the four benchmark award mechanisms, the open procedure on average has the shortest award process (125.67 days), followed by the negotiated procedure (213.88 days), restricted procedure (229.32 days) and competitive dialogue (346.65 days). The accelerated negotiated procedure (149.66 days) tends to be longer than the accelerated restricted procedure (109.89 days).

We take a contract as having experienced late award if its award date (t_{CA}) coincided with or took place after its planned contract start date (t_{PS}). Table 4 shows that half of the contracts in the sample were not awarded on time. Among the benchmark award mechanisms, the proportion of delayed contract is the lowest for the open procedure (46%) and the highest for the competitive dialogue (59%). There is no great difference in the proportions of delayed contract between the restricted procedure (53%) and the negotiated procedure (54%).

Table 5 shows the statistics of the duration of delay disaggregated by award mechanisms. The duration of delay is computed as the difference between t_{CA} and t_{PS} when t_{CA} coincides with or is after t_{PS}. On average, the negotiated procedure is the benchmark award mechanism with the shortest duration of delay (40.28 days), followed by the open procedure (49.85 days) and the restricted procedure (95.96 days).

The above preliminary descriptive statistics of award process and delay show that the negotiated procedure is no worse (and sometimes even better) than the restricted procedure regarding the decision speed. These results are at odds with the claim that negotiation is responsible for delay in a procurement process.

We plot the Kaplan–Meier Curve, which is a non-parametric technique used in duration analysis, to further describe the data. Fig. 3 presents the Kaplan–Meier curves for the 7,452 contracts where we have data on t_{PS} and thus can identify whether delays have occurred.

[17] Although we are unable to estimate the number of awards that failed during the period from 2009 to 2015, the European Commission estimates that 10% of contracts were not awarded in 2016 (see "TED advanced notes" on the webpage provided in footnote 16). Public buyers deal with failed awards by not publishing anything, advertising a cancellation notice or releasing a CAN with no winner and no value. The data fed into our regression model do not contain any unsuccessful contracts, excluding observations with no contract value.

Table 3
Duration of award process (in days).

Award mechanism	Obs.	Mean	CI (lower)	CI (upper)	S.D.	Min.	25th	50th	75th	Max.
Open	13,018	125.67	124.52	126.81	66.44	42	84	110	146	665
Restricted	12,087	229.32	227.44	231.20	105.35	42	153	204	278	671
Negotiated	1,408	213.88	207.21	220.54	127.48	42	123	175	268.25	663
Competitive dialogue	541	346.65	334.71	358.59	141.41	58	235	333	445	671
Accelerated restricted	1,213	149.66	144.24	155.08	96.21	42	82	123	187	640
Accelerated negotiated	99	109.89	95.75	124.03	70.89	42	63	80	142	444
Others	116	230.38	204.62	256.14	140.06	45	124	181.5	325.75	664
All	28,482	179.60	178.36	180.85	106.92	42	104	150	224	671

Notes. 1. The duration of award process is calculated as the difference between the dispatch date of contract notice (t_{CN}) and the date of contract award (t_{CA}).
2. "CI (lower)" and "CI (upper)" refer to the lower and upper bounds of the 95% confidence interval.
3. "Others" refers to a procedure without prior publication of a CN or a call for competition.
4. The sample is trimmed by 1% to exclude outliers.

Table 4
Proportion of delayed contracts (in days).

Award mechanism	Obs.	No. of delay	Proportion of delay
Open	3,887	1,783	0.46
Restricted	3,089	1,629	0.53
Negotiated	376	204	0.54
Competitive dialogue	100	59	0.59
Accelerated restricted	341	197	0.58
Accelerated negotiated	45	26	0.58
Others	31	23	0.74
All	7,869	3,921	0.50

Notes. The award of a contract is regarded as delayed if the date of contract award (t_{CA}) is on or after the planned contract start date (t_{PS}). This measure tends to underestimate the proportion of delayed contracts. A more precise way to decide whether a contract is delayed is to compare t_{CA} with the *planned* date of contract award, which is prior to t_{PS} but is not available in our dataset.

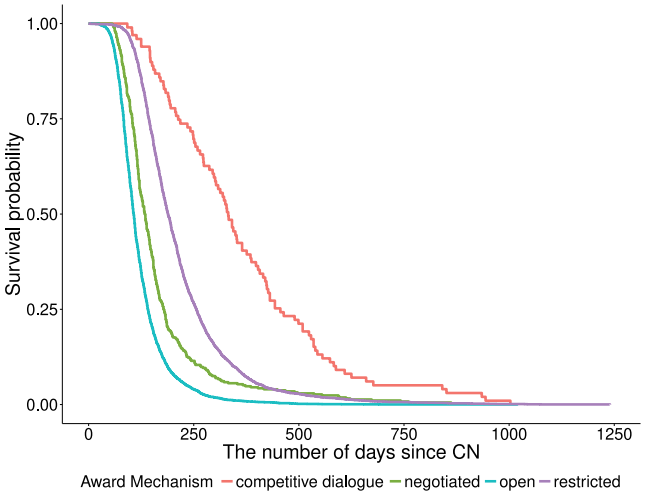

Fig. 3. Kaplan–Meier Curve for Contracts with Benchmark Award Mechanism.
Notes. This figure presents the Kaplan–Meier curves for the 7,452 contracts that are with the benchmark award mechanism and have data on the planned contract start date (t_{PS}). The dispatch date of contract notice (t_{CN}) is taken as the starting time. A lower survival probability means that a higher proportion of contracts have been awarded, and accordingly a shorter overall duration of the award process. At any given time, the open procedure has the lowest survival probability, which corresponds to the shortest overall duration. The negotiated procedure has a lower survival probability than the restricted procedure and the competitive dialogue until after 400 days of procurement initiation when the curves for the negotiated and restricted procedures converge. The median life time, i.e. when half of the contracts have been awarded, is the shortest for the open procedure (100 days), second shortest for the negotiated procedure (137 days), 190 days for the restricted procedure and 330 days for the competitive dialogue.

t_{CN} is taken as the starting time.[18] The survival probability stands for the proportion of contracts that are not awarded, so the average overall duration of the award process can be inferred accordingly. The instant survival probability and median life time (i.e. when half of the contracts have been awarded) suggest that the overall durations of the open procedure and negotiated procedure are shorter than the restricted procedure and competitive dialogue.

Fig. 4 plots the Kaplan–Meier curves for the 3,675 contracts with delayed award and takes t_{PS} as the starting time. This figure reflects the duration of delay. The survival probability of the negotiated procedure stays relatively low with a distinct sharp decline to 40% not long after t_{PS}. It intersects with the survival probability of the open procedure at 17% after 100 days of delay when the survival rates for the restricted procedure and the competitive dialogue are just below 40%. This suggests that a greater proportion of contracts with the negotiated or open procedure (83%) were awarded within 100 days after the planned contract start date than with the restricted or the competitive dialogue (60%).

3.3. Models and variables

We use two measures of award speed – the hazard of award and probability of delay – as dependent variables. Table 6 summarises variables used in our models. Table 7 describes the explanatory variables that enter into the main regressions. The distribution of the key explanatory variable – award mechanism – in the main regressions is similar to that in the full dataset.

We apply the split-population duration model (Schmidt and Witte, 1989; Wooldridge, 2010), which combines the logit model and the Cox Proportional Hazard model (Cox PH model), to address our research questions. Gori et al. (2017) use a similar model to test delay in the delivery of public contracts.

Let T_i be a positive random variable that represents the time spent on contractor selection for procurement i. For procurement i, the hazard function at time t_j is $h(t_{ij}) = \lim_{\Delta t \to 0} \left\{ \frac{Pr[t_j \le T_i < t_j + \Delta t | T_i \ge t_j)]}{\Delta t} \right\}$. The hazard function $h(t_{ij})$ expresses the probability that a procurement contract i is awarded exactly at time t_j conditional on that the contract is not awarded earlier and, therefore, it is still at risk of being awarded at the beginning of t_j. The hazard rate is negatively related to the duration of award process (and the duration of delay).

Assuming that the same set of explanatory variables x affects the probability of delay $Pr(D = 1 \mid x)$ and the conditional hazard, h^*, that exists only when $D = 1$, the split-population duration model can be expressed as

$$h(t) = Pr(D = 1 \mid x) \times h^*(t \mid D = 1, x), \quad (1)$$

We estimate the probability of delay by the logit model, a generalised linear model with logistic distribution (Train, 2009). The logit

[18] For clarity of presentation, we include only the benchmark award mechanisms in Figs. 3 and 4. Those with the accelerated or other procedures are excluded.

Table 5
Duration of delay (in days).

Award mechanism	Obs.	Mean	CI (lower)	CI (upper)	S.D.	Min.	25th	50th	75th	Max.
Open	1,783	49.85	44.75	54.95	109.88	0	7	61	175.9	3,661
Restricted	1,629	95.96	90.03	101.89	121.95	0	18	126	341.2	1,033
Negotiated	204	40.28	27.81	52.75	90.30	0	0	31.75	207.7	568
Competitive dialogue	59	99.93	67.56	132.31	124.24	0	23	137	358.2	652
Accelerated restricted	197	71.18	58.17	84.19	92.58	0	12	95	262.6	557
Accelerated negotiated	26	15.77	−4.66	36.20	50.57	0	0	0	79.75	244
Others	23	128.13	36.02	220.25	213.02	0	4	158	380.9	979
All	3,921	70.57	66.92	74.22	116.52	0	9	34	90	3,661

Notes. 1. The duration of delay is computed as the difference between the date of contract award (t_{CA}) and the planned contract start date (t_{PS}) if t_{CA} coincides with or is after t_{PS}
2. "CI (lower)" and "CI (upper)" refer to the lower and upper bounds of the 95% confidence interval.
3. "Others" refers to a procedure without prior publication of a CN or a call for competition.

Table 6
Variable definition.

Dimension	Variable	Definition
Process outcomes	Hazard of award	The conditional probability that a contract is awarded at time t (given that the contract is not awarded before time t). The dependent variable in Cox PH regressions.
	Probability of delay	The probability of delaying a contract award, i.e. when t_{CA} coincides with or is after t_{PS}. The dependent variable in logit regressions.
Decision process characteristics	Award mechanism	Types of award mechanism. Four values (the open procedure, restricted procedure, negotiated procedure and competitive dialogue) are included in the regressions.
Environmental factors	Response period	The length of time between t_{CN} and t_{EA}. A measure of competition. A longer response period increases the probability that a procurement opportunity is observed and considered by more potential bidders.
	Lots dummy	Equals to 1 when a contract is divided into multiple lots and 0 when lots are not used. It is a measure of competition and can also be viewed as a measure of contract complexity perceived by the public authority. Dividing a large (and potentially complex) contract into lots lowers the capital investment and clarifies the work requirement of each component. A lot is more accessible to smaller suppliers than a full large contract.
	Year	The year when the CN was published.
	Region	The region where the procuring authority locates. It has six values: Greater London, England outside London, Scotland, Wales, Northern Ireland and others.
Organisational factors	Buyer's experience	Measured as cumulative sum of CNs issued by a public buyer. Bajari et al. (2008), Chong et al. (2014) and Gori et al. (2017) adopt the same measure.
	Central purchase dummy	Equals to 1 if the procurement is conducted by a central purchasing body or by several buyers buying together, and 0 if not.
	Authority type	Type of the contracting authority.
Decision-specific factors	Log contract value	The natural logarithm of the contract value stated in the CAN. It is used as a measure of complexity, following Bajari et al. (2008), Chong et al. (2014) and Gori et al. (2017).
	Contract duration	The estimated duration of contract stated in the CN. It is used as a measure of complexity, following Bajari et al. (2008), Chong et al. (2014) and Gori et al. (2017).
	Quality criterion dummy	Equals to 1 for "most economically advantageous tender" (i.e. indicating a higher level of quality concerns) and 0 for "lowest price" (i.e. indicating a lower level of quality concerns).
	Contract type	Type of contract. Contains three values (works, supply and services contracts) that reveal basic contract attributes
	CPV code	Common Procurement Vocabulary. A 9-digit code developed by the EU to further classify what is to be purchased.
	Planned award period	The difference between t_{CN} and t_{PS}. A variable that captures the urgency of procurement, as determined by the public procurer.

model is expressed as

$$log_e\left[\frac{Pr(D=1\mid x)}{1-Pr(D=1\mid x)}\right]=\beta_0+\beta x, \tag{2}$$

where β is a vector of coefficients, which is estimated by the maximum likelihood method. Each coefficient measures the effect of one unit change in the related explanatory variable on the log odds ratio of delay (or shows the difference from the baseline category if the explanatory variable is binary or categorical), when holding other explanatory variable constant. Rearrange Eq. (2) arrives at the probability of delay

$$Pr(D=1\mid x)=\frac{exp(\beta_0+\beta x)}{1+exp(\beta_0+\beta x)}. \tag{3}$$

The conditional hazard of award h^* is estimated by the standard duration model, the Cox PH model. The logarithm of the hazard of award is treated as the dependent variable. The model consists of a baseline function, $log\ h_0(t)$, which is the baseline log hazard at instant j when all predictors are 0, and a weighted linear combination of predictors, x:

$$log\ h^*(t)=log\ h_0^*(t)+\beta^* x, \tag{4}$$

where β^* is a coefficient vector. The antilog form of the model is

$$h^*(t)=h_0^*(t)exp(\beta^* x). \tag{5}$$

The Cox PH model makes no assumption about the distribution of the baseline hazard, so it cannot be used to estimate the hazard function. However, the beauty of the model is that it can assess the impacts of changes in the explanatory variables, while avoiding making unrealistic assumption about hazard distribution. This is one advantage over the OLS regression.

The coefficient measures the effect of one unit change in the corresponding explanatory variable on the hazard ratio, while holding other explanatory variables constant. When c is a constant, the hazard ratio associated with explanatory variable x_1 is

$$Hazard\ ratio_{x_1}=\frac{h^*(t)_{x_1=c+1}}{h^*(t)_{x_1=c}}=exp(\beta_1^*), \tag{6}$$

Table 7
Descriptive statistics of explanatory variables in the main regressions.

Panel A: Award Mechanism

	Sample		*Full Dataset*	
	Obs.	%	Obs.	%
Open	2776	54.51	13018	48.12
Restricted	2110	41.43	12087	44.68
Negotiated	130	2.55	1408	5.20
Competitive dialogue	77	1.51	541	2.00
Total[a]	5093	100	27054	100

Panel B: Other Categorical Variables (in the Sample)

	Obs.	%
Lots dummy (=1)	1300	25.53
Central purchase dummy (=1)	1319	25.90
Quality dummy (=1)	4706	92.40
Authority type		
Central government	301	5.91
Local authorities	2645	51.93
Water, energy, transport and telecommunications sectors	47	0.92
Body governed by public law	1540	30.24
National or federal Agency/Office	61	1.20
Regional or local Agency/Office	91	1.79
Other	408	8.01
Contract type		
Works	512	10.05
Services	3080	60.48
Supply	1501	29.47
Region		
England outside London	2920	57.33
Greater London	432	8.48
Northern Ireland	197	3.87
Scotland	1199	23.54
Wales	345	6.77

Panel C: Continuous Variables (in the Sample)

	Mean	CI (lower)	CI (upper)	S.D.
Planned award period	160.35	157.89	162.81	89.55
Experience	114.09	109.29	118.90	174.84
Contract value	17,157,573	13,407,912	20,907,234	136,498,376
Contract duration	1,171.92	1,150.39	1,193.45	783.81

[a]Not including the award mechanisms of "accelerated restricted procedure", "accelerated negotiated procedure" and "others".

which is a constant (i.e. proportional hazard).[19] A positive (negative) β_1 suggests that a rise in x_1 is associated with a higher (lower) hazard.

Hazard estimates are reliable only when the assumption of noninformative censoring holds. In our case, it requires that the censoring mechanism should have no indication of the occurrence of contract award. Our data is right-censored, i.e. not all CNs have their corresponding CANs and therefore dates of award recorded in the study time window. One reason of censoring is that some CANs were published after 2015, which is outside of our observing time. It is also likely that some public buyers of below threshold contracts do not publish CANs because they are not legally bound to do so. None of these two reasons implies that the right-censored observations differ significantly from our sample in the hazard of award.

4. Results

Section 4.1 reports results on the relationship between the four benchmark award mechanisms and award decision speed. Section 4.2 reports our further findings on the how decision speed is related to organisational factors, decision environment and contract features.

4.1. Award mechanism and decision speed

Table 8 presents the estimates for the hazard of award during the award process using a Cox PH model (column (1)) and the estimates for the two parts of the split-population duration model (columns (2) and (3)). The negotiated procedure is the baseline category. Estimates for the remaining award mechanisms reflect their difference from the negotiated procedure.[20]

Column (1) shows that compared with the negotiated procedure, the open procedure has a higher hazard of award and the restricted procedure and competitive dialogue have a lower hazard of award.[21] This means that compared with the negotiated procedure, the open procedure is associated with a shorter overall award process, while the restricted procedure and competitive dialogue correspond to a longer overall award process.

According to column (2), the open procedure tends to have a lower probability of delay, while the restricted procedure and competitive dialogue are associated with a higher probability of delay than the negotiated procedure. The insignificant estimates for the restricted procedure indicate that the probabilities of delay for the restricted procedure and the negotiated procedure do not differ greatly.

[19] Schoenfeld residual tests show that the proportional hazard assumption is valid for our data. This enables the application of the CoX PH model.

[20] We have run regressions using the award mechanism as the only explanatory variable and adding different combinations of the environmental, organisational and decision-specific factors as the control variables. The vast majority of estimates are consistent and similar in sign and significance across these regressions. The regressions in Table 8 are the preferred specifications, taking into account the number of variables, the sample size, and the fitness or the explanatory power shown by the test statistics.

[21] The comparison between the negotiated procedure and competitive dialogue is similar to the results in Reeves et al. (2017).

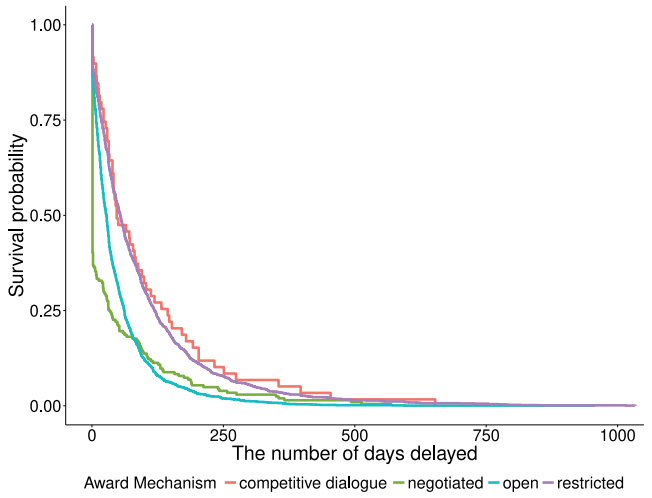

Fig. 4. Kaplan–Meier Curve for Contracts with Benchmark Award Mechanism and Delayed Award.
Notes. This figure shows the Kaplan–Meier curves for the 3,675 contracts with the benchmark award mechanism and with delayed award and takes the planned contract start date (t_{PS}) as the starting time. A lower survival probability means that a higher proportion of contracts have been awarded, and accordingly a shorter duration of delay. Plunging to 40%, the survival probability of the negotiated procedure remains the lowest during the very early stage of delay. This suggests that for the negotiated procedure 60% of contracts that were not awarded before the planned contract start date were awarded shortly after this date. The survival curves for the negotiated and open procedure intersect at around 17% at the 100th days of delay when the survival rates for the restricted procedure and the competitive dialogue are just below 40%. This suggests that 83% of contracts with the negotiated or open procedure were awarded within 100 days of delay and the figure is 60% for contracts with the restricted or the competitive dialogue.

The Cox PH model in columns (3) evaluates hazard when the award process is operated with time-overruns. The duration of delay can be inferred because the starting time is the date when delay started. Compared with contracts using the negotiated procedure, contracts with the restricted procedure and competitive dialogue have a lower probability of being awarded at any instant, which indicates a longer duration of delay on average. These two estimates are statistically significant. The difference between the open procedure and the negotiated procedure is not significant.

To facilitate comparison between the negotiated procedure with other three benchmark award mechanisms, Table 9 presents the hazard ratio of each award mechanism to the negotiated procedure and the corresponding 95% confidence intervals, using the estimates from columns (1) and (3) from Table 8. For example, during the entire award process, the estimated hazard of award for the restricted procedure is on average 33% ($= 100\% \times (1 - 0.67)$) lower than that for the negotiated procedure; after delays have occurred, the estimated hazard of award for the restricted procedure is on average 31% ($= 100\% \times (1 - 0.69)$) lower than that for the negotiated procedure. The upper boundaries of the 0.95 confidence intervals are lower than one. This indicates that the hazards of award for the restricted procedure are unlikely to be higher than for the negotiated procedure. The two hazards of award for the open procedure are estimated to be 1.62 times and 1.15 times those for the negotiated procedure. However, once delay occurs, the hazard of award for the open procedure may not necessarily be higher than for the negotiated procedure, because the lower boundary of the 95% interval (0.83) is less than one.

The results indicate benefits of time-efficiency from using the negotiated procedure instead of the restricted procedure or competitive dialogue. Such improvement is more relevant for potentially complex contracts, when using the negotiated procedure also offers direct economic benefits over the open procedure. A large number of disqualified bidders in the open procedure can dilute competition while leading to the selection of a bidder who cannot deliver what it has promised in the contract (Decarolis, 2014). This makes a prequalification process in the negotiated procedure to restore competition necessary (Tadelis and Bajari, 2006). For simpler contracts, replacing the restricted procedure with the open procedure would be a more time-effective choice.

Our results in robustness analysis are consistent with the results presented above.[22] Specifically, our robustness analysis includes (1) OLS regressions that use the logarithm of the duration of award process and duration of delay as the dependent variables to compare the benchmark award mechanisms, and (2) regressions similar to the main regressions to compare the accelerated procedures.

4.2. Other factors affecting decision speed

Our data includes measures of several other factors, i.e. the organisational factors, environmental factors and decision-specific factors, illustrated by Fig. 1 in Section 2, in addition to award mechanisms. The rest of this subsection highlights key findings on these factors, referring to results from Table 8.

The first organisational finding is in line with Wally and Baum (1994) that formalisation poses an adverse impact on efficient decision making. Buyer's experience (measured by the cumulative sum of contracts) is significant in all regressions but the findings are somewhat counterintuitive: more experience corresponds to a longer award process, a higher probability of delay and a longer duration of delay.[23] It is possible that a public entity having dealt with more procurement projects adopts a more complex organisation structure and rigid decision making process, which in turn reduce decision speed. Central government's more cumbersome processes seem to dominate its informational advantage in procurement efficiency. This is suggested by the results that local public procurers, i.e. the local authorities and regional or local agency and office, tend to make faster decisions than the central government.

The second organisational finding is the opportunities of specialisation in promoting public sector productivity. Compared to public authorities that initiate the procurement requests, central purchasing bodies on average award contracts quicker and with less delay. A central purchasing body is specialised in public procurement affairs, responsible for one-off collective purchasing or framework agreements (i.e. arrangements for purchases of similar products or services over a certain period) on behalf of several public authorities.

Our third organisational finding is a positive role that appropriate time incentives may have in improving public sector efficiency (Burgess and Ratto, 2003; Kocher and Sutter, 2006). A longer planned award period predicts a longer overall award process, a lower probability of delay and lower duration of delay. An award decision schedule is a function of the urgency of procurement and public procurer's arbitrary choice that reflects the procurer's motivation to conclude the contract award quickly. Introducing explicit incentives that include the duration of decision making may lead to quicker contract award decisions.

With respect to the environmental factors, estimates for the response period and lots dummy imply a negative relationship between the number of bidders and decision speed, which may be caused by the greater amount of total information to be processed.

The results for measures of contract complexity, as a crucial decision-specific dimension, are consistent with our expectation. Estimates for the log contract value, contract duration and quality criterion dummy suggest that complex contracts and higher concerns about quality are significantly associated with a longer overall award process,

[22] He (2018) Section 5.5 presents the results from robustness tests.
[23] Gori et al. (2017) find that the lack of experience causes higher delay probability and longer delay durations in contract execution for works contracts in Italy.

Table 8
Estimates of decision speed.

	Hazard of award Cox prop. hazards (all contracts) (1)	Prob. of delay logistic (all contracts) (2)	Hazard of award Cox prop. hazards (contracts with delayed award only) (3)
Award mechanism (Benchmark: Negotiated)			
Open	0.482***	−0.907***	0.141
	(0.111)	(0.258)	(0.169)
Restricted	−0.404***	0.271	−0.367*
	(0.110)	(0.260)	(0.162)
Competitive dialogue	−0.404*	1.832***	−0.404+
	(0.160)	(0.403)	(0.223)
Response period	−0.007***	0.002	−0.002
	(0.001)	(0.002)	(0.002)
Lots dummy	−0.119***	0.285***	−0.030
	(0.034)	(0.077)	(0.049)
Region (Benchmark: England outside London)			
Greater London	−0.215***	0.184	−0.096
	(0.054)	(0.124)	(0.081)
Northern Ireland	−0.041	0.417*	0.020
	(0.078)	(0.172)	(0.111)
Scotland	−0.161***	0.266**	−0.040
	(0.037)	(0.083)	(0.054)
Wales	−0.213***	0.738***	−0.016
	(0.060)	(0.135)	(0.081)
Buyer's experience	−0.0004***	0.001***	−0.001***
	(0.0001)	(0.0002)	(0.0001)
Central purchase dummy	0.092*	0.033	0.245***
	(0.036)	(0.083)	(0.052)
Authority type (Benchmark: Central gov.)			
Local authorities	0.125+	−0.153	0.151
	(0.064)	(0.145)	(0.093)
Water, energy, transport and telecommunications sectors	−0.627**	1.168*	−0.373
	(0.190)	(0.475)	(0.247)
Body governed by public law	0.072	−0.231	0.073
	(0.065)	(0.147)	(0.096)
National or federal agency/office	0.147	0.008	0.059
	(0.143)	(0.341)	(0.206)
Regional or local agency/office	0.381**	−1.185***	0.331
	(0.122)	(0.287)	(0.212)
Other	0.082	−0.372*	0.018
	(0.079)	(0.177)	(0.116)
Log contract value	−0.038***	0.054**	−0.025*
	(0.007)	(0.018)	(0.010)
Contract duration	−0.0001*	0.0002**	−0.0001+
	(0.00002)	(0.0001)	(0.00003)
Quality criteria dummy	−0.226***	0.262*	−0.252**
	(0.056)	(0.128)	(0.087)
Contract type (Benchmark: Services)			
Supplies	0.117+	0.076	0.189*
	(0.061)	(0.134)	(0.085)
Works	−0.231**	0.950***	−0.040
	(0.086)	(0.194)	(0.115)
Planned award period	−0.004***	−0.014***	0.001**
	(0.0002)	(0.001)	(0.0004)
Constant		1.397*	
		(0.645)	
CPV code	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Observations	5,093	5,093	2,432
R^2	0.428		0.162
Log Likelihood	−36,960.550	−2,861.349	−16,319.110
Akaike Inf. Crit.		5,870.698	

*p<0.05.
**p<0.01.
***p<0.001.
+p<0.1.

Table 9
Hazard ratios of alternative award mechanisms to the negotiated procedure.

	Cox model for duration of award process			Cox model for duration of delay		
	Exp (coef)	Lower 0.95	Upper 0.95	Exp (coef)	Lower 0.95	Upper 0.95
Open	1.62	1.30	2.01	1.15	0.83	1.60
Restricted	0.67	0.54	0.83	0.69	0.50	0.95
Competitive dialogue	0.67	0.49	0.91	0.67	0.43	1.03

a higher probability of delay and a longer duration of delay.[24] The data also show that works projects tend to have longer award process and a higher probability of delay than supplies or services contracts.

It is possible that these findings are affected by endogeneity bias. Such bias may arise if there is corruption in the award of some contracts. Corrupt relationships may be associated more closely with a choice of negotiation-based award mechanism than an auction-based mechanism (Bulow and Klemperer, 1996; Tadelis and Bajari, 2006; Huang and Li, 2015). This may also result in a cursory and therefore relatively short award process.

Our inclusion of dummies for region and type of authority dummies may partially eliminate such bias, though we cannot claim to have fully controlled for it. A more complete control could be possible with cross-country data, as in Palcic et al. (2022), allowing for cultural, legislation and other factors that might influence the extent of such relationships. Palcic et al. (2022) find no significant correlation between corruption and procurement decision speed for PPP contracts. This, to some extent, alleviates the concern of endogeneity bias in our model specification.

Correction for this particular endogeneity bias may strengthen, rather than weaken, some of our findings on the impact of organisational factors. We find, for example, that central procurement, which can be expected to reduce such close connections between bidder and procurer and hence the scope for corruption, is associated with quicker decision speeds. Correcting for any bias resulting from corruption should therefore increase, not reduce, the estimated impact of central procurement. Similar reasoning applies to buyer's experience, which may well increase such close connections, is associated with greater delay.

5. Conclusions

This study examines factors that could explain variations in the delays in awarding public procurement contracts. A novelty in our analysis is our use of the organisation literature. This literature offers both theoretical reasons and empirical evidence that organisational, environmental, and decision-specific factors affect both process and economic outcomes in the context of corporate decision making. Drawing on this literature, we present a framework (illustrated by Fig. 1) for understanding how different factors impact on decision making in public procurement.

To investigate empirically the factors affect procurement decision speed, we use a large sample of on UK public procurement contract, covering all UK public procurement contracts during 2009–2015 and providing data on many dimensions of the contract and the award process. We use several measures of award decision speed, i.e. the duration of award process, the probability of delay and the duration of delay, and adopt the logit model and duration analysis, two complementary methods for event analysis.

Our results challenge the widely held but somewhat oversimplified view that negotiations slow down decision speed, which is not always practically true (as illustrated in Figs. 3 and 4). We also find a clear role for organisational factors as well as environmental factors such as competition and decision specific factors such as contract complexity.

Our data distinguishes four main award processes determined by the EU legal framework. Among the two negotiation-based procedures in this data, the competitive dialogue allows negotiation only in early stage and ends up with a competitive bidding process while the negotiated procedure allows full negotiation. The two auction-based procedures do not allow negotiation. Of these, the restricted procedure requires pre-qualification of bidder while the open procedure does not.

Controlling for other factors, the negotiated procedure is associated with faster decision making in terms of the duration of award process, the probability of delay and the duration of delay, compared to the competitive dialogue. The duration of the overall award process is 38% lower, equivalent to about 130 days (see Table 3), and the duration of delay more than halve, a reduction of about 50 days (see Table 5). The negotiated procedure also dominates the restricted procedure, on average saving 4% of time (about 10 days) in the overall award process (see Table 3) and more than halving the duration of delay, a reduction of 45 days (see Table 5).

Competitive dialogue is associated with the slowest decision making, outperformed by the restricted procedure. The open procedure is the most effective at reducing decision time and preventing award delays. The literature though makes clear that auction-based procurement is inefficient for complex contracts, because of contractual incompleteness. An auction gives the successful bidder the opportunity to extract economic rent from unavoidable post-contract renegotiations. Our analysis, therefore, suggests that the negotiated procedure is likely to be both an cost- and time-efficient award mechanism choice for complex projects. This is in accordance with the wider use of the negotiated procedure prescribed by EU Directive 2014/24/EU, in contrast to the more limited use possible under the earlier EU Directive 2004/18/EC which favoured competitive dialogue for complex contracts. While the UK may develop its own procurement regime as it is outside the EU, our results suggest that it should still retain something similar to the EU "negotiated procedure" in any new regime.

However, it is important to note that our analysis does not take into account the potential relationship between delay in award and post-contract economic outcomes. It is possible that a longer or delayed award process leads to some positive economic outcomes, for example, better specified contracts that reduce post-contract renegotiation and quicker and more cost-effective project execution. Further research, incorporating additional data on post-award outcomes, is warranted to investigate this issue.

Our analysis is relevant to public policy because it suggests that the simpler versions of auction and negotiation, i.e. the open and negotiated procedures, are better at saving time than their more complicated counterparts, i.e. the restricted procedure and competitive dialogue, when controlling for other factors including contract complexity. This suggests that organisational factors, notably bureaucracy in administrating and coordinating different stages of more complicated award processes rather than the negotiation mechanism itself, may better account for slow decision making in public procurement. Thus, our results also show that organisational factors at the institutional level of the public procurer may play an important role that has not received sufficient attention in the literature.

[24] Reeves et al. (2015) find that capital value is positively related to the award period for PPP projects in Ireland. Reeves et al. (2017) have similar findings for PPP projects in the UK.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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