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Public procurement design: Lessons from the private sector ☆

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ABSTRACT

Public procurement regulations put constraints on the contracts and award mechanisms that public procurement agencies can use. These constraints are not present in the private sector, and recent studies suggest that the added flexibility in private sector procurement offers efficiency advantages. This paper offers a short progress report of these recent studies, and argues for the need to enhance the tools that are currently at the disposal of public sector procurement offices.

1. Introduction

Public and private sector institutions alike engage in procurement for similar goods and services. These can be standardized goods, such as office supplies, computers, or standard software packages, all of which are mass produced and are typically purchased either at list price or using some form of competitive tendering like an auction. Custom made goods, such as new buildings, custom software or legal services are different in that they are tailor-made to fit the procurer's specific and often unique needs. Public and private sector institutions often differ dramatically in the way that these custom goods and services are procured. In the U.S., for example, the public sector buyer is usually forced by regulation to use fixed-price (or unit-price) open auctions to procure custom made goods and services, while the private buyer is far less constrained. This paper offers a short progress report of the rationale behind these differences, and argues for the need to enhance the tools that are currently at the disposal of public sector procurement offices.

The tight restrictions on public sector procurement agencies are not without merit as competitive bidding is widely advocated for well known reasons, most notably for promoting competition. Open (free entry) auctions invite potential suppliers from many venues, resulting in fair market price discovery. These popular award mechanisms are also known for their transparency, making it easier to prevent corruption in the public sector where procurement agents may have incentives to rig the system in return for bribes and other benefits.[1] These features, as well as arguments for equal opportunity, provide a justification for statutes such as the U.S. Federal Acquisition Regulations (FARs) that strongly favor the use of auctions. Other countries, including those of the European Union, are also subject to similar restrictions.[2]

In contrast, the private sector makes widespread use of other procurement arrangements, and in particular, the use of cost-plus contracts that are negotiated with one potential supplier is ubiquitous. For example, Bajari et al. (2009) show that from 1995 to 2000, forty-four percent of private sector non-residential building construction projects in Northern California were procured using negotiations,

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[1] It is surprising, though, that this concern is not mentioned for private sector procurement. After all, procurement agents who work for large firms may also be prone to take bribes from potential suppliers, and given the lower level of public scrutiny, one might wonder whether this may be an even larger problem for private sector firms.

[2] Throughout the paper I make references to institutions that are prevalent in the U.S., which is not always representative of public sector regulations in other countries.

while only eighteen percent was procured using open auctions. Such procurement arrangements are also common in high tech procurement contracts and in software, yet these are seldom used in the public sector, with the exception of some defense procurement contracts.[3] This paper highlights some of the advantages offered by a richer set of procurement arrangements, and uses insights from the private sector to inform public policy debates.

Economists have studied procurement for decades. Throughout the late 1980's and 1990's, formal economic analysis described procurement as a mechanism design, or agency problem with the following characteristics. The supplier has information about production costs that the buyer does not have. The buyer must design a mechanism (or contract) to infer the supplier's costs, such as offering the supplier several potential projects to choose from, each with an associated price. The supplier then selects the one that will be produced, thus revealing his costs. For an excellent summary of this literature see Laffont and Tirole (1993).

In practice, however, the procurement problem seems to involve more challenges than just revealing a supplier's cost function. First, the buyer has to choose what exactly should be procured, and how to convey its needs to potential suppliers. Second, a contract must be laid out that includes contractual obligations and methods of compensation. Third, an award mechanism through which the procurement contract is allocated to one of the potential suppliers must be chosen. Finally, as adaptations are needed throughout the progress of production, the buyer and contractor must find ways to implement productive changes in a cost-effective way.

A series of papers beginning with Bajari and Tadelis (2001) follows an approach that blends agency theory with transaction cost economics as advocated by Williamson (1975, 1985). This approach focuses attention on adaptation costs when contractual specifications are incomplete, echoing the concerns of scholars and practitioners of engineering and construction management. They argue that the central problem in procurement is not that suppliers know so much more than buyers at the onset of the project, but that instead, both buyers and suppliers share uncertainty about many important design changes that occur after the contract is signed and production begins. These changes are usually a consequence of design failures, unanticipated conditions, and changes in regulatory requirements.[4]

This paper outlines a simple reduced-form framework that builds heavily on Bajari and Tadelis (2001). The theoretical framework for the design of contracts is laid out in Section 2, and in Section 3 I argue that the form of contracts calls for the use of matching award mechanisms such as auctions or negotiations. The upshot is that simple projects, which are defined as easy to design with little uncertainty about what needs to be produced, should be (1) procured with fixed-price contracts, (2) accompanied by high levels of design completeness, and (3) awarded through competitive bidding. In contrast, complex projects, which are defined as hard to design with large scope for surprises in the final configuration, should be (1) procured with cost-plus contracts, (2) accompanied by low levels of design completeness, and (3) awarded through a negotiation with a reputable and qualified supplier.

The intuition for these prescriptions follows from a simple and fundamental tension between providing incentives to lower costs and avoiding costly and wasteful renegotiation that accompany adaptation. The strong incentives to reduce costs that are offered by fixed-price contracts will lead the parties to dissipate valuable surplus when adaptations need to be renegotiated. These inefficiencies will often result from haggling over prices when there is lock-in (relationship specificity) of the current supplier who will use the need for adaptation to his advantage. Cost-plus contracts ease these tensions and facilitate adaptation to the contract's original requirements but discourage cost-saving efforts by the supplier.[5]

This suggests that the typical regulations that constrain public procurement agencies cause the procurement of complex projects to suffer from efficiency losses and increased costs (see, e.g., Chong et al. (2006)). Orders of magnitude of these losses are quite high based on recent work of Bajari et al. (forthcoming) These findings suggest that there is room for improvements in public sector procurement, as argued for in the conclusions of this paper.

2. The contracting framework

2.1. Contractual components: Design and incentives

Consider a buyer who wishes to procure a project (good or service) that if built according to the buyer's needs will generate a value of $\overline{v}$. A supplier must receive plans and specifications in advance that describe the project. Hence, one contractual choice the buyer faces is how much to invest in design and specification before awarding the contract. It is often impossible, or very expensive, to draft a complete design that fully describes how the project should evolve as uncertain contingencies arise ex post, resulting in contractual incompleteness. A project's contractual incompleteness will generally depend on whether the type of project is susceptible to unforeseen changes. To capture project heterogeneity, I define a project's complexity as how expensive it is to provide a more complete set of plans and contingencies. The more complex a project is, the more expensive it will be to try and prevent contractual incompleteness.

Formally, consider a complete design as a list of instructions that fully describe the project. Let $\tau \in [0, 1]$ represent the fraction of instructions that are actually written down by the buyer, and interpret τ as the probability that ex post adaptations are not needed, or as the design completeness of the project's specification. With probability $1-\tau$, a contingency will arise for which there are no specifications, implying that the prespecified plan will not result in obtaining the value $\overline{v}$. When this happens, the buyer will only obtain a value of $v<\overline{v}$.

Let $T \geq 0$ represent the project's complexity, where a higher value of T means that the project is more complex. (A natural interpretation of T is the number of instructions required to completely specify the project.) Costly engineering and drafting efforts go into producing the set of design blueprints for a given project. Providing a level of design completeness $\tau \in [0, 1]$ for a project of complexity T costs the buyer $d(\tau, T)$, which satisfies three intuitive properties.[6] First, fixing project complexity T, the costs of design are increasing in design completeness τ. Second, fixing design completeness τ, the costs of design are increasing in project complexity T. Finally, the more complex a project is, the higher is the marginal cost of design, so that $\frac{\partial^2 d(\tau,T)}{\partial \tau \partial T} > 0$ (that is, τ and T are complementary in the cost of design).

Aside from design, the buyer chooses a compensation scheme. Most procurement contracts are variants of simple fixed-price or cost-plus contracts, with unit-price contracts offering some form of hybrid between these extremes (more on this is Section 4). A fixed price contract guarantees the supplier a pre-specified price for completing the project as specified, while any adaptations are negotiated separately. A cost plus contract, instead, reimburses the

[3] Indeed, Bajari et al. (2009) show that from 1995 to 2000, ninety-seven percent of public sector building construction projects in Northern California were procured using competitive bidding.

[4] See Bartholomew (1998), Clough and Sears (1994), Hinze (1993) and Sweet (1994).

[5] In fact, Williamson expresses the idea that "low powered" incentives are good to accommodate adaptations and writes that "low powered incentives have well known adaptability advantages. That, after all, is what commends cost plus contracting. But, such advantages are not had without cost—which explains why cost plus contracting is embraced reluctantly." (1985 p.140). It turns out that in many cases cost plus contracting is indeed embraced.

[6] A more basic state space model is developed by Bajari and Tadelis (2001) that results in the reduced form function that is used here, for which these three properties are endogenously derived.

contractor for costs (labor and material) with an additional stipulated fee. Hence, the costs of any adaptations are automatically compensated for by the original contract.[7]

Let $y \in \{0, 1\}$ represent the compensation scheme, where $y = 0$ denotes cost plus and $y = 1$ denotes fixed price. Fixed price contracts generate high powered incentives because they promote cost savings (the contractor pockets every dollar saved on production costs), as opposed to the low-powered incentives generated by cost-plus contracts. Williamson (1985) argues that cost plus contracts allow for ex post adaptation, while renegotiating a fixed price contract generally involves more haggling and friction. This idea can be captured by assuming that the value of the project when adaptation is required, $v(y)$, will depend on the incentive scheme that is used. Assume that $v(0) > v(1)$ implying that if adaptation is needed then the buyer's ex post surplus is lower with a fixed price contract than it is with a cost plus contract.[8]

The following sequence of events summarizes the procurement agency's contracting problem: Given a project with complexity T, it chooses a design $\tau \in [0, 1]$ and a compensation scheme $y \in \{0, 1\}$ to maximize its expected net surplus (value less design costs, production costs and expected adaptation costs). If adaptation is not required then the project ends successfully, while if it is required then adaptation costs are incurred.

2.2. High versus low powered incentives

To compare fixed-price versus cost-plus contracts, first assume that no adaptations to the original design are needed. If a fixed-price contract is used then the supplier has strong incentives to lower the cost of production. The buyer will benefit from this if competitive pressures cause some of these cost-savings to pass on to the buyer. In contrast, with a cost-plus contract the supplier has no incentive to reduce production costs, and no cost savings can therefore be transferred to the buyer. This well known intuition suggests that the buyer's cost of a project, $c(y)$, satisfies $c(0) > c(1)$.[9]

As argued above, cost-plus contracts have the appealing feature that they facilitate adaptation. To see why, imagine that at some advanced stage of the project's production it turns out that the plans and specifications are defective, or lacking some directive for an unforeseen contingency that arises. The buyer will ask the contractor to adapt the design and implement some changes to the original plans. A fixed price contract binds the supplier to the original plans and does not oblige him to agree to the changes proposed by the buyer. Thus, the supplier must agree to the changes and to any compensation that goes with them, with the objective of making as high a profit as he can, resulting in "hold up." A cost plus contract, however, effectively offers a built in mechanism to compensate the supplier for any changes that are required—any additional costs that the supplier incurs are compensated for through the cost-plus structure.[10] This suggests that low powered incentives allow for a more cooperative implementation of adaptations when contractual incompleteness requires changes. This simple intuition is formally derived from the model above as follows[11]:

Proposition 1. More complex projects will result in less design completeness, are more likely to be renegotiated and are better procured with cost-plus incentives. Simpler projects are more likely to have more complete specifications and are better procured using fixed-price contracts.

It may seem that complex projects would result in extra effort to provide more details into the design because these projects need more design to be complete. However, the complexity of such projects implies that many changes are expected even if design efforts are high. Because complexity and design are complementary in the cost of design, then the "bang-for-your-buck" of design is actually smaller for complex projects. Thus, if a cost-plus contract is used to deal with adaptations, the added benefits of extra design efforts are smaller than the extra costs.

3. Competitive auctions versus negotiations

Since auctions promote competition and offer transparency that helps mitigate corruption, what may support the use of less competitive award mechanisms such as negotiations? This section uses the insights from the simple model described above to argue that the choice of a contract's incentive scheme will be tied to the choice of the award mechanism. Imagine that a simple project is being considered where the buyer produces a rather complete design using a fixed-price contract. To procure the design at the lowest possible price, a competitive auction will provide the buyer with the desired outcome. Suppliers will compete their surplus away, and the buyer is getting exactly what he wants: a well defined project at the lowest possible price.

Now imagine that a complex project is being procured with a fairly incomplete design, for which the buyer plans to use a cost-plus contract. Implementing any form of an auction for a cost-plus contract is quite challenging, because the costs are unknown in advance. Indeed, in the U.S. construction industry it is often argued that "[a] cost-plus contract does not lend itself well to competitive bidding" (Hinze, 1993 p.144). Furthermore, the observation has been made that in the private sector, "[m]ost negotiated contracts are of the cost-plus-fee type" (Clough and Sears, 1994 p.10.) These observations beg the question: how should a buyer award a cost plus contract effectively?

Perhaps an open auction can be conducted in which suppliers bid over the "plus" portion of the compensation. That is, a bidder i will be "you pay me the ex post measured costs, plus some profit margin equal to p_i." This would allow the buyer to choose the supplier who requests the lowest compensation, $min_i\{p_i\}$, for his management, and the costs of labor and material will be automatically paid for through the cost plus structure of the contract.

In practice, the "plus" portion of a contract is often only a small fraction of the production costs (for example, profit margins in construction and public works are in the single or low double-digits of percentage points over costs). The question then is, what type of contractor will demand the lowest compensation p_i? When bidding for a contract, a supplier will not wish to settle for less profits than it could obtain in some alternative job. It will be no surprise, therefore, that the more sought after suppliers, who have a reputation for completing projects in a cost-effective and timely manner, should have better alternative opportunities. As a consequence, their bids for the fee p_i in a cost-plus contract will be higher than the bids of less reputable, and less cost efficient suppliers.

[7] Other intermediate types of contracts that are not often used can lie between fixed-price and cost-plus contracts (see, e.g., the discussion in Section 2 of Bajari and Tadelis, 2001). These reimburse only a fraction of the total cost to the supplier and can sometimes include quality performance incentives.

[8] This inequality is derived rather than assumed in Bajari and Tadelis (2001).

[9] In Bajari and Tadelis (2001) this is endogenously derived using a standard moral hazard model (hidden cost-savings effort).

[10] With a percentage fee, any costly changes include a small increase that may effectively compensate the contractor for any opportunity costs of extra time and potential overhead. This means that the contractor has incentives to increase costs and get a higher fee, which favors fixed-fees instead of percentage fees. With fixed fees the buyer and supplier may need to bargain over a fair fee for the opportunity costs of time.

[11] The proof of this proposition is omitted, yet it follows immediately from the complementarities between complexity, design and the strength of incentives. For a close reduced form model see Tadelis (2002). Bajari and Tadelis (2001) derive this reduced form from basic principles of ex post renegotiation with asymmetric information.

The argument laid out above implies a severe form of adverse selection in that the highest cost and least able supplier will win a competitive auction for a cost-plus fee contract.[12] Furthermore, if complex projects procured with cost-plus contracts require suppliers that have more expertise, then hiring the least able supplier can be devastating. As a consequence, the observation made by construction management scholars that cost-plus contracts are ill suited for auctions has a strong economic rationale behind them. This, together with the contracting framework outlined in Section 2 implies that when projects are complex, the buyer should opt for a cost-plus contract and should find a reputable seller with whom to negotiate the final terms.[13]

There is another important merit of negotiating a contract with one reputable seller that has been recognized in a seminal article by Goldberg (1977). In the process of such negotiations, the buyer and supplier spend time discussing the project and have opportunities to consider possible pitfalls before work begins. This kind of communication is absent when auctions are used because the only piece of information that bidders need to communicate to the buyer is the price. Goldberg writes that "in competitive bidding for complex contracts, conveyance of information at the pre-contract stage is likely to be a substantial problem" (1977, p. 254). It is widely believed by experts in the construction management industry that bidders strategically read the plans and specifications to determine where they will fail. A contractor who sees a flaw in the plans can use this information to submit a low bid, and recover significant profits when necessary changes are implemented. Thus, competitive auctions lead to another form of adverse selection, which is more problematic when projects are complex. In conclusion,

Corollary 1. Complex and incompletely specified projects should be procured using a cost-plus contract to be awarded using a negotiation with a reputable supplier, while simple and mostly specified projects should be procured with fixed-price contracts and awarded by competitive bidding.

The reduced form model in Section 2, that builds on Bajari and Tadelis (2001), results in a monotonic relationship between complexity (τ) and the choice of contract, and as we argued, the choice of contract is tightly tied to the choice of the award mechanism. For intermediate levels of complexity, however, the relative benefits of one kind of contract or another will be small. As a consequence, competitive market conditions will play an important role in favoring auctions or negotiations for intermediate levels of complexity. In particular, it is well known that the benefits from a competitive auction will generally depend on the number of qualified bidders who can participate in the auction, where more potential bidders result in higher benefits from using an auction. It therefore follows:

Corollary 2. For moderately complex projects more potential competition will favor a more complete design and a fixed-price contract to be awarded using a competitive bidding. If potential suppliers are scarce then less design will be favored with a cost-plus contract that is negotiated with a reputable supplier.

On a final note, open auctions and negotiations are not the only award mechanisms that are used in public and private procurement. It is quite common, especially in the private sector, to administer "invited bidders" auctions in which only a handful of suppliers are invited to participate.[14] An important difference between open and restricted auctions concerns the participation of qualified bidders for relatively complex, but somewhat well specified projects. Preparing bids for such projects is challenging and costly. If qualified suppliers expect that less qualified suppliers may try to compete and offer low bids, then this may deter the qualified suppliers from exerting the costly time and efforts needed to prepare the bids. As a consequence, the buyer may benefit from preventing less qualified suppliers from bidding, which is obtained by restricting competition to guarantee a reasonable rate of return to the participating qualified bidders.[15]

4. Adaptation costs

The arguments above show that fixed price contracts provide incentives to reduce production costs, but hamper efficient adaptation, while cost-plus contracts do the opposite. An important next step is to measure the inefficiencies imposed by fixed price contracts when adaptation is needed. The challenge is to compare similar projects that are procured with different incentives and award mechanisms, and then measure the total costs of completion, as well as the resulting quality.

A recent paper by Bajari et al. (forthcoming) (henceforth, BHT) makes progress along these lines and finds that adaptation costs are indeed quite high, especially in comparison to profit margins. They analyze public highway construction contracts from Northern California with a total value of $2.2B. The contracts are an interesting hybrid between fixed price and cost plus contracts called "unit price" contracts. Civil engineers that work for California's Department of Transportation (Caltrans) first prepare a list of items that describe the tasks and materials required for the job. These include items such as laying asphalt, installing new sidewalks and striping the highway. For each listed item, the engineer provides an estimate of the anticipated quantity that will be needed to complete the job. For example, the estimates may be for 25,000 tons of asphalt, 10,000 square yards of sidewalk and 50 rumble strips. The list of estimates is publicly advertised along with a detailed set of plans and specifications that describe how the project is to be completed.

Each participating bidder will then propose per unit prices for each of the listed items. This bid is a vector of unit prices that specifies the supplier's price for each listed item. Table 1 shows an example of a completed bid, which must be sealed and submitted prior to a set bid date. The contract is then awarded to the contractor with the lowest estimated total bid, defined as the sum of the estimated individual line item bids (calculated by multiplying the estimated quantities of each item by the unit prices in the bid).

Unit price contracts are an interesting hybrid of fixed price and cost-plus contracts. On one hand, the contract is easily set up to allow for competitive bidding using the estimated final bid. On the other hand, if some adaptations are needed, the contract has a built-in "cost-plus" mechanism using the item's per-unit bid. Using the example in Table 1, if 26,752 tons of asphalt were actually used instead of the estimated 25,000 tons, costly haggling is not required because the final payment made to the contractor will just multiply the new quantity by the $25 per-unit bid, effectively granting the contractor an increase in payment of $(26,752-25,000)\times 25 = \$43,800$. Indeed, actual quantities are almost never equal to the original bid, yet this built-in "cost plus" part of unit price contract allows for an automatic way to compensate the supplier for ex post adaptations.

[12] Note that this adverse selection problem is not akin to that in Laffont and Tirole (1993). Unlike their setting, it is not assumed that the seller knows more about the cost of the particular project, but just that more able sellers have higher outside options, regardless of the projects actual costs.

[13] Banerjee and Duflo (2000) show evidence from the Indian software industry that cost plus contracts are awarded to more reputable sellers, while fixed price contracts are awarded to less reputable sellers. The mechanism they explore is different, and is based on contacts chosen by the suppliers. In reality, however, it is typically the buyer who chooses both contracts and award mechanisms.

[14] Bajari et al. (2009) show that from 1995 to 2000, thirty-seven percent of private sector non-residential building construction projects in Northern California were procured using restricted auctions with invited bidders.

[15] Ye (2007) investigates the problem of costly bidding, and how restricting the number of bidders may help the buyer.

Table 1
Unit price contract—an example.

Item	Description	Estimated quantity	Per unit bid	Estimated item bid
1.	Asphalt (tons)	25,000	$25.00	$625,000.00
2.	Sidewalk (square yards)	10,000	$9.00	$90,000.00
3.	Rumble strips	50	$5.00	$250.00
			Final bid:	$715,250.00

Not all issues that arise from a need for adaptation ex post are addressed by unit prices. The Standard Specifications and Construction Manual of California's Department of Transportation discuss the determination of the final payment at length. To a first approximation, there are three primary reasons that account for large enough adaptations that merit not following the simple vector product of unit prices and actual quantities, which then requires the buyer and supplier to negotiate payment changes.

First, if the difference between the estimated and actual quantities is small, then the unit prices times the actual quantities will determine final payments. If the difference is larger, however, or if it is thought to be due to negligence by one party, both sides can propose to renegotiate an adjustment of compensation.

Second, above and beyond changes in the estimated quantities, the project may require a change in scope, which is a change in the overall description and design of the project. A change order that modifies the scope of the contract and the final payment will then be negotiated, and a breakdown of negotiations, which sometimes occurs, often leads to arbitration or a lawsuit. When these change orders are agreed upon, extra payments may reflect the use of unanticipated materials or other adjustment costs, and they are recorded as extra work.

Finally, if work is not completed on time or if it fails to meet specifications, Caltrans may impose deductions in the form of liquidated damages. Such deductions are often a source of heated disputes between Caltrans and the contractor, who may argue that the source of the delay is poor planning or inadequate specifications provided by Caltrans. Caltrans instead will argue that the contractor's negligence is the source of the problem. The final deductions imposed will be the outcome of negotiations or even lawsuits and arbitrations between contractors and Caltrans.

Using a comprehensive data set of 819 completed contracts, BHT estimate the adaptation costs and conclude that they are substantial. The implied adaptation costs on the different changes to final payment range from sixteen cents to over two dollars for every dollar of change, which are significant by any standard. These numbers might be surprising in the context of the existing economics literature that has emphasized private information and moral hazard as the main sources of departures from efficiency in procurement. However, these findings are consistent with concerns raised in Construction and Engineering Project Management.[16]

BHT calculate that the average ratio of the adaptation costs to the winning bid is between eight and fifteen percent. Even half of this number would be substantial, especially because profit margins in this industry are around three percent. Since contractors factor these costs into their bids, the government, and hence the taxpayer, is ultimately responsible for expected adaptation costs on the project as they are directly passed on from the bidders.

5. Lessons for public sector procurement

In the public sector, statutes such as the U.S. FARs (and the many statutes that are modeled after the FARs) strongly favor the use of open competitive bidding. As explained earlier, complex projects that have incomplete designs and specifications are ill suited for fixed-price contracts awarded through competitive bidding. Instead, negotiating a more flexible cost-plus contract with a reputable supplier may be the preferred course of action. The deficiency of open auctions is a consequence of several aspects that are shared by complex projects. First, expectations are that ex post haggling and frictions might occur when changes are needed. Second, due to strategic reasons there will be a lack of input by qualified and knowledgeable contractors at the design stage. Third, the need to proceed quickly without the ability to complete detailed plans and specifications will also cause contractual incompleteness and a need for ex post renegotiation.

Bajari et al. (2009) study the award mechanisms used by the private sector for non-residential building construction contracts that were awarded in Northern California between 1995 and 2000. Unlike the public sector, private sector buyers can more easily use mechanisms other than auctions to select a contractor. Open competitive bidding is only used in eighteen percent of private sector contracts while forty-four percent of these contracts are negotiated. Public sector procurement agencies may benefit from following some pages in the private sector's playbook.

Negotiated contracts may be less effective in selecting the lowest cost bidder compared to open auctions. However, the problems discussed in this paper suggest that economizing on ex post transaction costs is an important potential source of cost savings and this may outweigh the benefits of competitive bidding. An important policy implication is, therefore, to allow the public procurement buyer to identify projects that stand out in their level of complexity, and then treat these projects differently from the more standard and simple projects. Once identified, using some form of cost plus compensation for these projects is needed, together with a set of clear guidelines to select an appropriate supplier.

Selecting a supplier without a competitive bidding mechanism should raise concerns regarding transparency and more importantly, avoiding favoritism and outright corruption. This concern means that the public sector buyer must find a way to use information about the past performance of potential suppliers as a selection criteria (Kelman, 1990), while at the same time have a transparent way through which past performance is evaluated. For example, a centralized system may be set up through which performance evaluations of private sector firms are aggregated at a regional and national level. These may be based on independent customer satisfaction surveys, as well as some monitoring and control by an unbiased agency. See Spagnolo (2012) for a short summary along this line.

Another policy implication that results from the conclusions of this paper relates to the design of plans and specifications. Adaptation costs result from incompleteness of project design and specifications, which may have been avoided if contract specifications were more complete. It is therefore important to ask whether increasing the costs and efforts put into estimating and specifying projects before they are let out for bidding may be beneficial. Since the magnitude of adaptation costs estimated in BHT is sizeable, there may be room to consider some experimentation with more careful and costly design efforts, and to carefully examine the results of any such added effort. Several public sector agencies can share a specialized high quality design center, or form a public–private partnership by outsourcing extra design and design verification to third party engineering firms that can supplement the design efforts done by the agency's own engineering staff.

In summary, current conventional wisdom suggests that the use of negotiated contracts in the public sector is problematic.[17] Allowing for greater discretion in contractor selection increases the possibility for favoritism, kick backs and political corruption. The competitive bidding system is less prone to corruption since it allows for free

[16] See Bartholomew (1998), Clough and Sears (1994), Hinze (1993) and Sweet (1994). Also see Bajari and Tadelis (2001) for a more complete set of references and discussion of the literature.

[17] Of course, if the procured service is one that lasts over time, one way to control adaptation with cost-plus incentives is by procuring the service in government internally with its own employees. See Levin and Tadelis (2010) for a transaction-cost incentive approach to this problem of privatization versus government provision of services.

entry by qualified bidders and there is an objective criteria for selecting the winning bidder. An important policy issue is whether it is possible to construct a mechanism that minimizes the ex post cost of making changes and the potential for corruption. To date, this question has not been explored seriously in the existing literature. The research described above suggests that developing such a mechanism could improve efficiency in public sector procurement.

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