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Procurement contracts: Theory vs. practice☆

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ABSTRACT

Laffont and Tirole's [Laffont, J., Tirole, J., 1986. Using cost observation to regulate firms. Journal of Political Economy 94, 614–641.] classic model of procurement under asymmetric information predicts that optimal contracts will always entail some cost sharing and that payments will be a convex function of realized cost. In contrast, pure cost-reimbursement contracts are common in practice, as are contracts in which payments are a concave function of realized cost. We consider a straightforward extension of Laffont and Tirole's model that admits optimal contracts of the forms that prevail in practice. The extension simply allows the supplier to be able to reduce production costs more easily when costs are initially high than when they are initially low.

1. Introduction

Real-world procurement contracts take on a variety of forms. Rogerson (1992) describes four distinct types of contracts commonly employed by the U.S. Department of Defense: (1) pure fixed price (PFP) contracts, in which the supplier receives a single, fixed payment for the procured item, regardless of the supplier's realized cost; (2) pure cost reimbursement (PCR) contracts, in which the payment made to the supplier is precisely the supplier's realized cost of producing the item; (3) incentive fixed price (IFP) contracts, in which payment to the supplier increases with realized cost up to a threshold cost level, and is capped at this threshold level; and (4) incentive cost reimbursement (ICR) contracts, in which payment to the supplier again increases with realized cost up to a threshold, and then reflects realized cost exactly above the threshold.[1]

These four types of contracts are illustrated in Figs. 1–4. Notice from Figs. 3 and 4 that payment is a concave function of realized cost under an IFP contract, while payment is a convex function of realized cost under an ICR contract.

Under the procurement contract illustrated in Fig. 5, payment is a concave function of realized cost in some regions and a convex function of cost in other regions. This structure parallels the reward structure regulated utilities commonly face when they operate under "incentive regulation." Extremely high profit (corresponding to unit cost below c_1) and extremely low profit (corresponding to unit cost above c_2) typically are not politically acceptable in regulated industries. Consequently, allowed profit is bounded above and below, corresponding to payments (revenues) that vary dollar for dollar with costs as costs decline below c_1 and as costs increase above c_2 in Fig. 5. In contrast, to motivate the firm to reduce its operating costs, incentive regulation implements profit sharing for intermediate profit realizations (corresponding to cost realizations $c \in (c_1, c_2)$ in Fig. 5). By allowing the firm to retain some, but not all, of the cost reduction it implements in the form of higher profit, incentive regulation can secure benefits for the regulated firm and consumers alike.[2]

Despite the rich variety of procurement and regulatory contracts that are observed in practice, the classic (and still the standard) economic model of procurement under asymmetric information admits only convex contracts like the ICR contracts illustrated in Fig. 4. Except in trivial cases of limited interest, Laffont and Tirole (LT)'s (1986) classic model of procurement does not admit PFP or PCR contracts. The primary model on which LT focus their analysis also does not admit concave contracts like the IFP contract illustrated in Fig. 3. This model also does not produce contracts with both concave and convex regions, like the contract depicted in Fig. 5.

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[1] The Department of Defense (DOD) assigns different names to these four types of contracts. As Rogerson (1992, p. 11) reports, the DOD refers to: (1) PFP contracts as firm fixed price (FFP) contracts; (2) PCR contracts at cost plus fixed fee (CPFF) contracts; (3) IFP contracts as cost plus incentive fee (CPIF) contracts that revert to FFP contracts above a threshold cost level; and (4) ICR contracts as CPIF contracts that revert to CPFF contracts above a threshold cost level.

[2] Different incentive regulation plans incorporate different forms of profit sharing for intermediate profit realizations. See Sappington (2002), for example, for a discussion of the different types of incentive regulation plans that have been implemented in the telecommunications industry.

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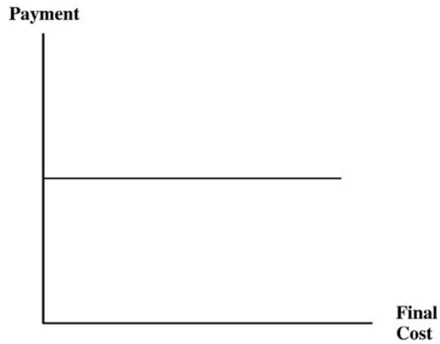

Fig. 1. A pure fixed price contract.

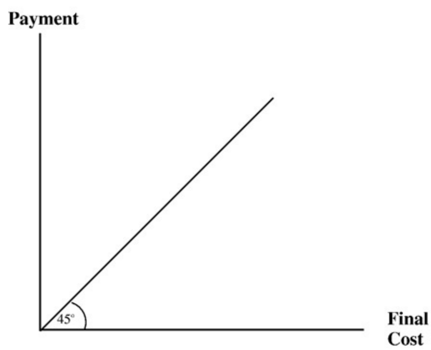

Fig. 2. A pure cost-reimbursement contract.

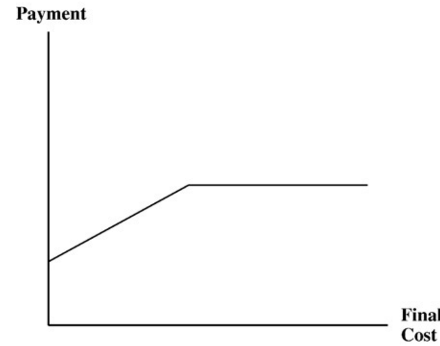

Fig. 3. A concave procurement contract.

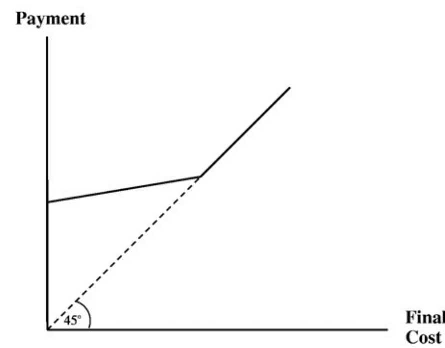

Fig. 4. A convex procurement contract.

The purpose of this research is to consider a simple generalization of LT's classic procurement model that admits a broader class of contract forms, including those commonly observed in practice.[3] The generalization has an intuitive interpretation: the supplier can reduce production costs more easily when initial cost (the component of cost beyond the supplier's control) is high than when it is low. In this sense, we allow initial cost and the supplier's cost-reducing effort to be substitutes in reducing final production costs. Intuitively, one might envision a feasible range of final cost realizations. If costs are initially close to the lower bound of this range, further cost reductions are relatively difficult to achieve. In contrast, if costs are initially quite high, some cost reduction is not difficult to achieve. Chalkley and Malcomson (CM) (2002) analyze a model of this type in a health care setting. The effort that a health care provider devotes to reducing treatment costs in CM's model is more effective at reducing these costs the more severely ill the patient is (and thus the more costly the patient would be to care for in the absence of cost-reducing effort).

CM focus on the welfare gains that an optimal contract can secure relative to the simple payment structures that are commonly employed in the health care industry. In contrast, we focus on the different contract structures that can be optimal in settings where high initial costs are associated with increased potential for cost reduction. We find that this simple – and arguably reasonable and intuitive – generalization of LT's model admits optimal contracts that are concave (like IFP contracts) and that have both concave and convex regions (as in Fig. 5). The generalization also allows PCR contracts (which induce no cost-reducing effort from the supplier) to be optimal, even in settings where cost-reducing effort is efficient, and so would always be secured absent asymmetric information about innate cost.[4]

Our presentation of these findings proceeds as follows. Section 2 describes the key features of the formal model we analyze. Section 3 reviews the key technical details of our analysis. Section 4 illustrates the variety of contracts that can arise in our model, and identifies the factors that influence the shape of optimal procurement contracts. Section 5 provides a concluding discussion. The proofs of our formal conclusions are outlined in the Appendix. A more detailed technical appendix is available upon request.

2. The Model

A buyer seeks to minimize the expected cost of procuring a single unit of a commodity from a monopoly supplier. The supplier will only deliver the commodity if he derives non-negative utility from doing so. The supplier is privately informed about his innate cost of production (β) from the outset of his interaction with the buyer. The buyer's beliefs about β are captured by the density function $f(\beta)$, which has support on the interval $[\underline{\beta}, \overline{\beta}]$. For expositional ease, we assume $1 - F(\beta) > 0$ for all $\beta \in [\underline{\beta}, \overline{\beta})$, where $F(\beta)$ is the corresponding

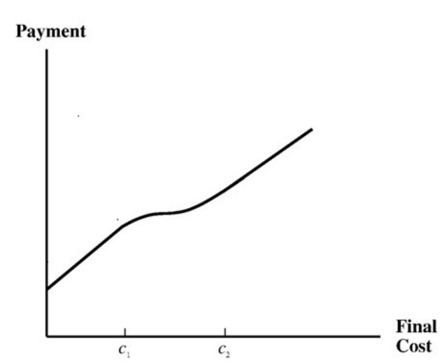

Fig. 5. A procurement contract with concave and convex regions.

[3] More fundamental modifications of LT's model also can admit optimal contracts that include those commonly observed in practice. These modifications include the introduction of transactions costs and renegotiation costs (e.g., Bajari and Tadelis, 2001) and preferences for simple contracts (e.g., Rogerson, 2003; Chu and Sappington, 2007a,).

[4] In both our model and LT's model, a PFP contract is optimal only if the buyer shares the supplier's knowledge of initial production cost.