Procurement negotiation with two-sided private information

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Short abstract
We consider a procurement negotiation process where a buyer and a supplier negotiate on the price and quality of an object simultaneously. Only the supplier makes offers, and the buyer decides whether to accept or reject. Two-sided private information is modelled: the supplier has private cost information; the buyer has private information about 1) the value of an offer to the buyer, or 2) how important quality is to the buyer. The equilibrium behaviour is characterized and compared, and the optimal amount of information the buyer should reveal is analyzed.

Keywords: Procurement negotiation, Two-sided uncertainty, Information revelation

Topics: Outsourcing and procurement.

Methodology: Quantitative modelling or optimisation.

Background and Model
Negotiations are widely used in the supplier selection process which is characterized by information asymmetry. On the one hand, the buyer may have private information about his preference on product/service attributes. On the other hand, the supplier may have private information about the costs associated with various attributes.

In the literature, negotiations are analyzed as bargaining games. The majority of bargaining models in the literature are one-dimensional where two players bargain over the partition of a fixed-size pie, or over the transaction price of an object (see Kennan and Wilson 1993 for a review). However, real-world negotiations are usually multidimensional. Recently researchers have developed multidimensional bargaining models in the context of procurement (Sen 2000, Inderst 2003, Yao 2012). Most of them assume that the private information has a two-point support.

In this paper, we consider a procurement negotiation where a buyer (he) and a supplier (she) negotiate over the price and quality of an object within at most two periods. Only the supplier makes offers. At the beginning of the first period, the supplier makes an offer of price and quality. Acceptance of the offer terminates the negotiation and trade occurs according to the offer. Should the buyer reject the offer, the supplier has one opportunity to improve the offer at the second period. If the second offer is also rejected, the negotiation ends and both players obtain zero payoffs. Both players have some cost associated with delay from the first to the second period.

We model two-sided incomplete information. The buyer has uncertainty on the supplier's cost associated with quality, while the supplier is uncertain about how the offer would be evaluated. From the supplier's perspective, we distinguish and model
two types of uncertainty about how the offer would be evaluated by the buyer. The first type of uncertainty we consider (in Model 1) occurs when the supplier has incomplete information about the exact value of the offer to the buyer. For example, when a scoring system is used, even though the evaluation criteria (the weight of quality relative to price) are public information, the score given for a particular quality level is unknown. The second type of uncertainty we consider (in Model 2) relates to the utility function of the buyer as reflected in the weighting on quality relative to price.

Summary of results
For each model, we characterize the equilibrium behaviour in two steps. Firstly, we characterize the equilibrium for the one-sided uncertainty situation where the uncertainty on the supplier's cost is removed. Then for the two-sided uncertainty situation, we characterize a separating equilibrium in which the supplier reveals his cost information at equilibrium.

We find that at the equilibrium under one-sided uncertainty, the supplier tends to choose the quality at the first-best level when he has uncertainty on the exact value of his offer to the buyer (Model 1), whilst choosing a quality lower than the first-best level when he has uncertainty in the weight of quality (Model 2). For both models, we show that the buyer can choose an optimal level of uncertainty to maximize her equilibrium profit.

Under two-sided uncertainty, we find that for both Model 1 and Model 2, if the supplier's cost parameter is continuous or the distance between possible types (of cost parameters) is not large enough, both the supplier and buyer obtain less profit than they would get under one-sided uncertainty. However, if the distance between possible types (of cost parameters) is large enough, the separating equilibrium under two-sided uncertainty matches the equilibrium result under one-sided uncertainty. In addition, under two-sided uncertainty, we find that the supply chain efficiency can be restored if the supplier commits to an additional dissipative payment to the buyer.

In addition, we show that equilibrium decisions under two-sided uncertainty are different between Model 1 and Model 2, for both the supplier and the buyer. For example, in Model 1, the probability of the buyer accepting the offer at the first period is lower under two-sided uncertainty than under one-sided uncertainty. However, the opposite result is observed in Model 2. Managerial implications are provided for the findings.

References