Contractual solutions to hold-up problems with quality uncertainty and unobservable investments

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ABSTRACT

Consider a seller and a buyer who write a contract. After that, the seller produces a good. She can influence the expected quality of the good by making unobservable investments. Only the seller learns the realized quality. Finally, trade can occur. It is always ex post efficient to trade. Yet, it may be impossible to achieve the first best, even though the risk-neutral parties are symmetrically informed at the contracting stage and complete contracts can be written. The second best is characterized by distortions that are reminiscent of adverse selection models (i.e., models with precontractual private information but without hidden actions).

1. Introduction

The so-called hold-up problem, according to which parties may have insufficient incentives to make relationship-specific investments in the absence of contractual safeguards, is a central ingredient of the property rights approach to the theory of the firm.[1] Several authors have investigated whether hold-up problems can be solved by writing suitable ex ante contracts.[2] The present paper adds to this literature by considering a novel variant of a hold-up problem in which the investing party has private information about a quality parameter that directly enters its trading partner's utility (i.e., there are common values).

Specifically, consider two risk-neutral parties, a (potential) buyer and a (potential) seller. When the parties first meet, they are still symmetrically informed, and there are no relevant wealth constraints. The parties can write a complete contract regarding the terms of trade of a good that the seller produces after the contract is written. While producing the good, the

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[1] See the seminal contributions of Grossman and Hart (1986) and Hart and Moore (1990); see also Hart (1995) for a comprehensive exposition. While the property rights approach was developed to discuss vertical integration in the context of private firms, in the meantime it has also been fruitfully applied to analyze the pros and cons of privatization, see e.g. Hart et al. (1997) and Hoppe and Schmitz (2010a).

[2] See e.g. Hart and Moore (1988, 1999), Rogerson (1992), Maskin and Tirole (1999), Tirole (1999), and Hart (1995, Chapter 4). See also Hoppe and Schmitz (2009) for the first study that investigates experimentally whether contracts can solve the hold-up problem.

seller can make unobservable relationship-specific investments that stochastically influence the quality of the good. Only the seller learns the realized quality. Finally, the good can be exchanged and payments can be made according to the contract. While it is always ex post efficient to trade, the seller can consume the good herself when no trade occurs, and both parties prefer to consume a good that has a high quality.

Can the parties implement first-best effort and trade levels by writing an appropriate contract? If not, what does the second best look like? At first sight, one might suspect that the answers to these questions should be well known, because the problem seems to be one of the most basic settings a contract theorist could imagine. However, to the best of my knowledge, this simple problem has not yet been analyzed in the literature. It turns out that the model has some interesting properties that might make it a useful building block in future contract-theoretic research.

Specifically, the first best could clearly be achieved if effort were verifiable (the parties would agree to always trade and contractually prescribe the ex ante efficient effort level). Moreover, if effort were hidden but quality were verifiable, the first best could also be achieved (the parties would make the seller a residual claimant). Yet, we will see that it is impossible to simultaneously achieve ex post efficiency (i.e., always trade) and to implement high effort when effort is a hidden action and quality is private information of the seller. The impossibility result is very simple to prove but novel.

One of the most famous impossibility results in the contract-theoretic literature is due to Myerson and Satterthwaite (1983).[3] They show that in general it is impossible to achieve ex post efficient voluntary trade when the buyer and the seller have independently distributed private information about their types, provided that it is ex ante uncertain whether or not the good should be traded.[4] However, their impossibility result does not hold if the parties can write a contract ex ante (i.e., before they learn their types), as has been shown by d'Aspremont and Gérard-Varet (1979), Arrow (1979), and Crémer and Riordan (1985). Another celebrated impossibility result is Akerlof's (1970) "lemons" problem (see also Samuelson, 1984; Myerson, 1985). In this problem, there are common values; i.e., the seller has private information about the quality of the good, which determines both the seller's and the buyer's valuation. Even though it is common knowledge that the buyer's valuation is always larger than the seller's valuation, it may be impossible to achieve ex post efficient voluntary trade. Yet, this impossibility result also does not hold when the contract is written before the quality is realized (the parties would then simply agree to always trade).

Another impossibility result that is related to the one presented here is due to Schmitz (2002b). In that model, only the buyer learns his valuation after the seller has invested unobservable effort. Hence, the impossibility result obtained there does not involve any common values. Moreover, it is weaker than the one in the present paper, because it crucially relies on the assumption that there is no third party who could act as a budget breaker.[5] This assumption may be difficult to justify in a setting that otherwise assumes complete contracting.[6]

An important advantage of the impossibility result in the present paper in comparison to impossibility results that rely on precontractual private information is the fact that here it clearly makes sense to look for the second best. As has been discussed in Fudenberg and Tirole (1991, p. 289), the second-best (i.e., ex ante optimal) contract in a model with precontractual private information such as Myerson and Satterthwaite (1983) is difficult to interpret, because it is unclear why the parties should be interested in maximizing their ex ante expected total surplus when they meet after they have already learned their types.[7] In these models, the bargaining protocol of the contract negotiation stage will determine not only the division of the cake, but also the size of the cake.

In contrast, in the present model the parties are still symmetrically informed when the contract is written. Hence, regardless of the bargaining protocol, they will agree on a contract the maximizes the expected total surplus. The parties' bargaining powers determine only the division of the cake, but not its size. Therefore, the second-best analysis is easier to justify in the present setting.

Interestingly, it will turn out that the second best is characterized by distortions that are reminiscent of models with precontractual private information (i.e., adverse selection). In particular, while trade is always ex post efficient when the quality is low, there is a downward distortion of the trade level when the quality (and thus the seller's opportunity cost) is high, provided that high effort is implemented. In contrast, if the seller's effort costs are sufficiently large, then low effort is implemented but ex post efficiency is achieved.

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[3] See also the two-type version in Matsuo (1989), that captures the economic essence of the impossibility result in an accessible way. For generalizations of the impossibility result, see Krishna and Perry (1998) and Williams (1999). Moreover, see Klibanoff and Morduch (1995) for a related impossibility result where only one party has private information.

[4] On possibility and impossibility results in frameworks with precontractual private information, see also Cramton et al. (1987) and the more recent work by Schmitz (2002a), Schweizer (2006), Grüner (2008) and Segal and Whinston (2010).

[5] Another well-known impossibility result that relies on the assumption that there is no third party is Holmström's (1982) moral-hazard-in-teams problem. In the deterministic version of his model, the first best could even be achieved in the absence of a budget breaker, if the parties could commit to burn money off the equilibrium path.

[6] Other reasons why the first best might be impossible to achieve that have been discussed in the complete contracting literature include risk aversion and wealth constraints, on which the present model does *not* rely. See Laffont and Martimort (2002) for an excellent textbook exposition of the traditional principal-agent theory.

[7] Recall that they would implement the first best if they met already before they learned their types.