Renegotiation-Proof Contracts with Moral Hazard and Persistent Private Information

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Extended Abstract

This paper analyzes a principal-agent model where the agent must report (and transfer) to the principal a privately observed cash-flow process that is persistent and affected by the agent's effort process (the pure cash-flow diversion problem obtains as a special case). In exchange, the agent receives a consumption flow process providing some promised expected utility. Precisely, the cash-flow process is a mean-reverting (Ornstein-Uhlenbeck) process, whose drift also depends linearly on the current effort of the agent. The agent is assumed to have exponential flow utility and flow cost functions, which implies a group symmetry across initial conditions (cash flow and promised utility levels) for the set of incentive compatible contracts. That is, to any contract that is incentive compatible and delivers a given promised utility w_1 given initial cash-flow y_1, one can associate, for any other promised utility w_2 and cash-flow level y_2, another contract that is incentive compatible and delivers promised utility w_2 given initial y_2, and vice versa. In that context, a contract is said to be renegotiation-proof if it satisfies some time and symmetry consistency. This concept generalizes the notion of "internal consistency" and "weak renegotiation-proofness" of Bernheim and Ray (1989) and, respectively, Farrell and Maskin (1989).

The paper characterizes the set of all renegotiation-proof (and incentive compatible) contracts, and the optimal contract among those. Any renegotiation-proof contract is characterized by a single sensitivity parameter, which determines both the agent's incentive to truthfully report cash flows and his incentive to make the contractually specified effort. For any such contract, all contractual variables have exact formulas as a function of the sensitivity parameter. The optimal sensitivity parameter is the solution of a simple one-dimensional maximization problem. The set of sensitivity parameters characterizing the set of renegotiation-proof, incentive compatible contracts only de-

pends on one exogenous parameter of the model, the risk-aversion coefficient of the agent, and is unaffected by the presence of moral hazard, compared to a pure cash-flow diversion problem.

All renegotiation-proof contracts are such that *the agent wants to report cash-flows truthfully, not only on the equilibrium path, but also after any possible deviation.* Thus, even if, at time zero, the principal has a wrong belief about the initial cash-flow, a renegotiation-proof contract of the type above will induce the agent to immediately reveal the true cash-flow level.

As a consequence of risk-aversion, the agent's continuation utility under the *optimal* renegotiation-proof contract exhibits immizerisation: almost surely, it becomes arbitrarily negative as time elapses. Immiserization arises for all parameter values of the model. Intuitively, it is less costly to provide the right incentives to the agent when his continuation utility is low, because he is more sensitive to small changes in the consumption flow. Other things equal, this makes the principal prefer to provide more utility flow today and let continuation utility drift downwards, compared to the constant promised utility and utility flow arising in the first-best contract.

Because the agent's information is persistent, the combined presence of moral hazard and adverse selection cannot be reduced to a pure moral hazard or to a pure adverse selection problem (in contrast to what earlier literature has pointed out for the iid case). In particular, *while reducing the agent's cost of effort always improves the principal's first-best payoff, it can arbitrarily reduce the principal's second-best payoff.*

Reporting incentives are linear for any arbitrary contract, which implies that the agent is either indifferent between telling the truth and lying, or wishes to lie at maximal (infinite) rate, either upwards or downwards. This makes it necessary to model jumps in the agent's reports. As a result, a contract must specify the jump in promised utility resulting from a jump in the agent's reports. For the class of renegotiation-proof contracts studied here, the contractual relation between such report jumps and promised utility jumps is completely pinned down by the sensitivity parameter characterizing each of these contracts. The agent's incentives are characterized by a Hamilton-Jacobi-Bellman equation with an impulse response component, which provides a new and simple way to deal with the possibility of unbounded drift of the reporting process. Using this technique, it is possible to derive the agent's value function not only on the equilibrium path, but also after any possible deviation. This value is a very simple function of the agent's promised utility, of the current gap between reported and actual cash flows, and of the sensitivity parameter.