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Optimal delegation with multi-dimensional decisions

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Abstract

This paper investigates optimal mechanisms in a principal–agent framework with a two-dimensional decision space, quadratic payoffs and no monetary transfers. If the conflicts of interest between the principal and the agent are different on each dimension, then delegation is always strictly valuable. The principal can better extract information from the agent by using the spread between the two decisions as a costly screening device. Delegation sets no longer trade off pooling intervals and intervals of full discretion but instead take more complex shapes. We use advanced results from the calculus of variations to ensure existence of a solution and derive sufficient and necessary conditions for optimality. The optimal mechanism is continuous and deterministic. The agent's informational rent, the average decision and its spread are strictly monotonic in the agent's type. The comparison of the optimal mechanism with standard one-dimensional mechanisms shows how cooperation between different principals controlling various dimensions of the agent's activities facilitates information revelation.

JEL classification: D82; D86

Keywords: Mechanism; Delegation; Mechanism design; Multi-dimensional decision

1. Introduction

Consider a principal who contracts with an agent who is privately informed. When the principal's and the agent's interests are conflicting, the principal may want to exert some ex ante control on the agent by restricting the decision set from which the agent picks actions. Examples

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of such constrained delegation abound across all fields of economics and political science. CEOs control division managers by designing capital budgeting rules and allocating decision rights among unit managers [26,2]. Many different aspects of corporate decisions involving product design and quality, prices, or polluting emissions are scrutinized by regulators who may impose various limits on those variables. Lastly, Congress Committees exert ex ante control on better informed regulatory agencies by designing various administrative procedures and rules that limit bureaucratic drift and constrain the agencies' discretion [41,29,19].

These examples share the common feature that principals make little use of monetary transfers to control their agents. Following the seminal works of Holmström [27,28] and Melumad and Shibano [42], these settings are fruitfully analyzed as mechanism design problems in which the principal commits to a decision rule but cannot use monetary transfers to implement that rule.[1] With no transfers and when actions lie in a one-dimensional set, optimal mechanisms look rather simple. Quite intuitively, the principal finds it hard to induce information revelation and align conflicting objectives when he controls only a single action of the agent. In a one-dimensional setting, an optimal mechanism balances the flexibility gains of letting the agent freely choose this action according to his own private information and the agency cost deriving from the fact that the principal and the agent might have conflicting objectives.

The first major result provided by the existing literature highlights the trade-off between "*rules and discretion*" that arises in such contexts. Inflexible rules allow the principal to choose his most preferred policy from an ex ante viewpoint, i.e., in the absence of any information. This is so because those rules make no use of the agent's private information. Leaving full discretion to the agent, on the other hand, allows to implement state-dependent actions, but these choices now reflect only the agent's preferences and not those of the principal. The second important result advanced by the literature is that the optimal mechanism (when continuous) can be implemented by means of interval delegation sets which set bounds on the agent's action. This is an important theoretical insight because it reduces the design of the mechanism to a simple exercise consisting in finding those bounds. This simplification is also of great value when it comes to implementing the optimal mechanism, and it clearly echoes contractual arrangements found in practice.

The objective of this paper is to study how optimal mechanisms are modified when several of the agent's activities can be controlled by a principal or, equivalently, when several principals, each being endowed with the same bargaining power and each controlling a single decision of the agent, can cooperate in designing a common mechanism. First, one may wonder how the trade-off between rules and discretion is modified. Clearly, screening possibilities are now improved and pooling certainly seems less attractive. Second, in a multi-dimensional context, the agency problem between the principal and his agent may not only be related to their average conflict of interest over all dimensions but also to the distribution of conflicts across the different dimensions. The extent to which this is the case must also be clarified. These are highly relevant issues not only from a pure theoretical viewpoint but also because many real-world problems are multi-dimensional. For instance, when designing vertical restraints with his retailers, a manufacturer may not only leave them discretion on how to fix retail prices but also on some other dimensions like after-sales services. An economic regulator may put a stringent cap on prices charged by regulated firms while leaving more discretion in choosing environmental quality. In these contexts, it is important to understand whether and how treating each dimension separately excludes important screening possibilities.

[1] See [7,11,39,3,24,32], and [6], among others.