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Adverse selection problems without the Spence–Mirrlees condition ☆

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Abstract

This paper studies a class of one-dimensional screening problems where the agent's utility function does not satisfy the Spence–Mirrlees condition (SMC). The strength of the SMC for hidden information problems is to provide a full characterization of implementable contracts using only the local incentive compatibility (IC) constraints. These constraints are equivalent to the monotonicity of the decision variable with respect to the agent's unobservable one-dimensional parameter. When the SMC is violated the local IC constraints are no longer sufficient for implementability and additional (global) IC constraints have to be taken into account. In particular, implementable decisions may not be monotonic and discretely pooled types must have the same marginal utility of the decision (or equivalently, get the same marginal tariff). Moreover, at the optimal decision, the principal must preserve the same trade-off between rent extraction and allocative distortion measured in the agent's marginal rent unit. In a specific setting where non-monotone contracts may be optimal we fully characterize the solution.
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1. Introduction

The Spence–Mirrlees condition (SMC) has been until now the main assumption that allows us to fully characterize the solution of one-dimensional adverse selection or hidden information models. Specifically, implementable contracts (and *a fortiori* optimal contracts) of standard principal–agent models and separating equilibria of signaling games can be easily characterized under this condition.[1]

We say that the SMC holds when the privately informed part has preferences that have increasing marginal rates of substitution between a decision variable and money with respect to a one-dimensional parameter or type (asymmetric information).[2] From the Revelation Principle, implementable contracts are mechanisms (i.e., maps from types to decision and money) that induce the agent to truthfully reveal her type, i.e., they must satisfy the agent's incentive compatibility (IC) constraints. Under the SMC, these constraints are equivalent to their local first- and second-order conditions and hence implementable decisions are non-decreasing in types. For principal–agent models, this is enough to provide an algorithm for computing the optimal contract (see [12], for instance). Therefore, the SMC transforms a two-level (complex) maximization problem into a much simpler optimal control program. The monotonicity of implementable (and optimal) contracts is a robust property in such models.

Our main goal is to study a class of one-dimensional screening problems where the agent's utility function does not satisfy the SMC. For a quite general framework we obtain necessary conditions for incentive compatibility which are now much more complex since they involve both the traditional local and some new global conditions. Next, we derive the necessary conditions for optimality. Finally, for a more special case we also obtain sufficient conditions for an optimum. Furthermore, for the reader not interested in going throughout all the mathematics of the paper we provide a practical algorithm for computing solutions which has an analogy with the SMC case described in the previous paragraph.

Assuming quasi-linearity, the SMC is equivalent to the constant sign of the cross derivative of the utility function with respect to decision and type. Our class of problems is characterized by the existence of a decreasing limit curve that separates two regions in the type versus decision plane where the sign of the cross derivative changes: the positive (above the limit curve) and negative (below the limit curve) single-crossing regions. The necessary local IC constraints imply that implementable decisions preserve monotonicity in each region, crossing or not the limit curve. In particular, when they cross, they must have a U-shaped form and a new necessary global IC condition emerges. Two types taking the same decision must get the same marginal tariff which leads to the same marginal utility of decision (Theorem 1). We will refer to it as the *U-shaped*

[1] Mirrlees [20] is the pioneering reference and Guesnerie and Laffont [12] give the most complete treatment for the principal–agent problem under adverse selection with one-dimensional parameter. Spence [28] is the classical reference for signaling games.

[2] In the literature of monotone methods for comparative statics there are some subtle differences among the various concepts of single-crossing. Milgrom and Shannon [18] define the order-theoretic single-crossing property for general lattice spaces. Edlin and Shannon [9] extend the analysis to strict monotone comparative statics (the strict SMC) by imposing a stronger differential restriction.

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