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Modelling countervailing incentives in adverse selection models: A synthesis☆

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ABSTRACT

This paper is concerned with countervailing incentives in the adverse selection problems that typically arise in principal-agent relationships when the agent has private information. These incentives are present when the agent is tempted to either overstate or understate his private information depending upon the specific realization of his type. These problems were first analyzed by Lewis and Sappington (1989) and have been characterized and extended by Maggi and Rodríguez-Clare (1995a) and Jullien (2000). In this paper we propose a simple method of characterizing countervailing incentives in which the key element is the analysis of the properties of the full information problem. Our method for solving the principal problem, once identified the presence of countervailing incentives, follows closely the Baron's (1989) approach, which does not require using optimal control theory. The methodology we present can be easily applied to many different economic settings. For example, in health economics, an insurer (or a hospital manager) might act as a principal and a physician as an agent. In labor settings, an employer may play the role of principal and a worker may act as the agent. In regulated industries, the regulatory agency might act as a principal designing incentive schemes for firms (the agents). In environmental regulation or resource exploitation, the principal might be an international agency dealing with national governments or firms.

1. Introduction

This paper is concerned with countervailing incentives in the adverse selection problems that typically arise in principal-agent relationships when the agent has private information. We propose a simple method of characterizing countervailing incentives in adverse selection problems. The key element in our proposal is to analyze the properties of the full information problem. One relevant advantage of our methodology is that it allows the resolution of the principal problem without using optimal control theory. This paper may be seen as a step-by-step guide to apply adverse selection models, characterized by countervailing incentives, to models of health economics, monopoly regulation, environmental regulation and others.

Most of the existing principal-agent models under adverse selection concern settings where the agent (he) has a systematic incentive to always overstate or to always understate his private information. The results are well known in the literature: the principal (she) deviates from the full information contract (either below or above the full information levels) in order to reduce informational rents. This incentive to exaggerate private information may, in certain circumstances, be tempered by a countervailing incentive to understate private information. That is, the agent might be tempted either to overstate or to understate his private information depending upon the specific realization of his type. When countervailing incentives arise, performance is distorted both above and below the levels under full information, and the agent's informational rents typically increase with the realization of his private information over some ranges, and decrease over other ranges.

Much research has analyzed the way countervailing incentives affect some specific agency problems, including Lewis and Sappington (1989), Maggi and Rodriguez-Clare (1995a, 1995b) and Jullien (2000). However, to the best of our knowledge, there are no general results in the literature characterizing the presence of countervailing incentives in a general framework. This is the contribution of this paper. We characterize the existence of countervailing incentives under adverse selection through the analysis of necessary and sufficient conditions. This new modelling of the principal-agent problem with countervailing incentives allows us to solve this problem without the

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need to use optimal control, as well as to identify ex ante whether the contract is pooling for some types. As a result, the usual method followed in adverse selection models can be used to analyze a number of related issues that have attracted considerable attention in recent years such as partially altruistic agents in health economics, labor contracts, limited liability, environmental regulation and others.

The paper is organized as follows. Section II presents the general model. In Section III, we characterize the full information case. In Section IV we analyze the general contract under private information and state the main result of the paper. In Theorem 1 we identify the exact conditions under which general incentive problems are characterized by the existence of countervailing incentives. We also state a general and very simple method to obtain the optimal contract under private information. Then we illustrate how different economic problems analyzed in literature may be seen as particular cases of our general benchmark. Finally, Section V presents some concluding remarks.

2. The model

We consider that the relationship between the principal and the agent involves an action variable, denoted as l, which is observable to both, and a monetary transfer, denoted as t, from the principal to the agent. Moreover, there is a one-dimensional parameter, denoted as θ, which is known to the agent but unobservable to the principal. The principal's uncertainty about the parameter θ is represented by a probability distribution $F(\theta)$ with associated density function $f(\theta)$ strictly positive on the support $[\underline{\theta}, \overline{\theta}]$. This function is assumed to be common knowledge.

The agent's welfare is represented by a utility function $U(l, t, \theta)$ which depends upon the action variable l, the transfer t, and the unknown parameter θ. In particular, we assume that the agent's utility depends linearly on transfers:

$$U(l, t, \theta) = u(l, \theta)+t. \tag{1}$$

We consider a principal's welfare function that incorporates a linear cost of transfers:

$$W(l, t, \theta) = w(l, \theta)-\mu t, \tag{2}$$

where μ is a parameter that may incorporate both the shadow cost of public funds and distributive considerations. For example, if the principal is a regulatory agency which takes into account distributive concerns (through a coefficient $\alpha \in [0,1]$) [1] and public funds are costly ($\lambda > 0$), [2] then the principal's function can be represented as:

$$W(l, t, \theta) = CS(l)+\alpha U(l, t, \theta)-(1 + \lambda)t = CS(l)+\alpha u(l, \theta)+\alpha t-(1 + \lambda)t,$$

where $CS(.)$ denotes the consumer surplus. So in that case $\mu=1 + \lambda - \alpha$ (Laffont and Tirole, 1990a, 1990b, consider $\alpha=1$ and $\lambda>0$, and Baron and Myerson, 1982, $0 < \alpha<1$ and $\lambda=0$). If the principal does not take into account the agent's utility and public funds are not costly then $\mu=1$.

Finally, we assume that the principal is endowed with the power to set both l and t.

3. The full information case: a benchmark

Consider the benchmark case in which the regulator knows the parameter θ. The problem of the principal under full information is then given by:

$$\max_{l,t} W(l, t, \theta)$$

subject to $U(l, t, \theta)\geq 0$.

Solving (1) for t and substituting t in (2), the problem is equivalent to:

$$\max_{l,U} W(l, U, \theta)$$

subject to $U\geq 0$.

That is,

$$\max_{l,U} w(l, \theta)+\mu u(l, \theta)-\mu U \text{ subject to } U\geq 0. \tag{3}$$

The first order conditions (where subscripts denote partial derivatives) are given by:

$$W_l(l^*, U^*, \theta) = w_l(l^*, \theta)+\mu u_l(l^*, \theta) = 0, \tag{4}$$

$$U^* = 0. \tag{5}$$

Given that transfers are costly to the principal, the full information policy consists of $l^*(\theta)$ determined by (4) and payment transfers such that the agent obtains no utility, $t^*(\theta)=-u(l^*(\theta),\theta)$. Note that,

$$\frac{dl^*(\theta)}{d\theta} = -\frac{W_{l\theta}}{W_{ll}},$$

where $W_{l\theta}(l^*, U^*, \theta)=w_{l\theta}(l^*, \theta)+\mu u_{l\theta}(l^*, \theta)$. As a consequence, the sign of $\frac{dl^*(\theta)}{d\theta}$ is the same as the sign of $W_{l\theta}$.

4. Characterization of optimal contracts under private information

We now analyze the optimal policy when the agent has private information concerning the parameter θ. The parameter θ is continuously distributed on the support $\Theta=[\underline{\theta}, \overline{\theta}]$ according to the cumulative distribution function $F(\theta)$ and the strictly positive density $f(\theta)$. We assume that $F(\theta)$ satisfies the monotone hazard rate condition; that is, the ratios $\frac{f(\theta)}{1-F(\theta)}$ and $\frac{F(\theta)}{f(\theta)}$ are non-decreasing functions of θ.[3]

The single-crossing property, which states that the greater the parameter θ, the more systematically willing an agent is to forego transfer payments to obtain a higher value for l, holds if the firm's marginal rate of substitution (MRS) of the action variable for transfer payment grows with θ.[4] Given the agent's utility defined by (1), the marginal rate of substitution is $MRS_{lt}=-\frac{U_l}{U_t}=-u_l$. Without loss of generality we assume $\frac{\partial |MRS_{lt}|}{\partial\theta}=u_{\theta l}>0$.

To characterize the optimal regulatory policy under private information we first determine the class of feasible policies and then select the optimal policy from that class.[5] At the first stage, we restrict the analysis to direct revelation mechanisms by the revelation principle.[6] A direct revelation mechanism is composed of transfer functions and associated action variable levels given by $\{l(\theta),t(\theta)\}_{\theta\in\Theta}$. Therefore, we may be restricted to regulatory policies which require the agent to report his private information parameter truthfully, that is, incentive compatible policies, to determine the class of feasible policies. The principal maximizes the expected social welfare subject to the following incentive compatibility and individual rationality constraints:

Incentive compatibility constraints (*IC*): the agent reports θ

[1] For example, if the agent is a monopoly the parameter α may be such that it weighs more consumer surplus than firm profits.

[2] Raising and transferring \$1 through public channels costs society \$(1+λ). Transfers between a firm and either consumers or the state may involve administrative costs, tax distortions or inefficiencies that can be taken into account in the design of the regulatory mechanism. See, for example, Laffont and Tirole (1986, 1993) and Caillaud et al. (1988).

[3] These properties require the density function not to increase too rapidly. They are satisfied by distribution functions frequently used in the literature (for example, Uniform, Normal and Exponential).

[4] Araujo and Moreira (2010) study a class of adverse selection problems where the agent's utility function does not satisfy the Spence-Mirrlees Condition or, also named, the single-crossing property.

[5] We adopt the approach of Baron and Myerson (1982) and Guesnerie and Laffont (1984). In this paper, we follow closely the approach by Baron (1989) that is very intuitive from an economic viewpoint.

[6] The revelation principle was established by Myerson (1979) and Dasgupta, Hammond and Maskin (1979).