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Analysis

Agri-environmental schemes: Adverse selection, information structure and delegation

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ABSTRACT

This work analyzes alternative designs of agri-environmental schemes and how different incentive mechanisms impact on their overall efficiency. It focuses on spatial targeting and delegation in an asymmetric information context. First, the optimal contract under adverse selection is modeled. This model underlines the trade-off between information rents and allocative efficiency. The impact of spatial targeting is then addressed. Disaggregated information structures increase the optimal efforts asked of the farmers. It may also involve higher information rents and may reduce the net contributions of some farmers. Finally, the consequences of delegating authority within the principal–agent relationship are investigated. The results illustrate that spatial targeting and delegation, when combined, have asymmetric impacts on farmers' payoffs.

1. Introduction

The balance of objectives of the Common Agricultural Policy (CAP) has considerably shifted over the past two decades. The importance of the support to farmers' income—although still a cornerstone of the CAP—has been fading away through the successive reforms, whereas rural development and environmental protection have been increasingly emphasized. Agri-environmental schemes (AES) have become the dominant instrument of EU agri-environmental policy (Latacz-Lohmann and Hodge, 2003), with EU expenditure on agri-environmental measures amounting to EUR 2.2 billion in 2005 and agri-environmental contracts covering more than a quarter of the EU-25 utilized agricultural area (European Commission, 2008). Through AES contracts, farmers voluntarily commit themselves to adopting practices that go beyond the minimal "Good Farming Practices". In return, they are entitled to payments meant to compensate incurred costs and foregone income.

Asymmetric information often prevails in the design of agri-environmental contracts. Opportunity costs associated with alternative practices depend on variables that are known to the farmer, but not readily known to the regulator. Another important characteristic of AES is that the scale at which they are designed, implemented and/or monitored varies greatly. Some of the agri-environmental measures in place in the EU are restricted to farmers located in narrowly-delineated zones, whereas others are available to all farmers regardless of their geographic location. Likewise, implementation and monitoring may be the responsibility of a national agency or delegated to subnational authorities (Oréade-Brèche, 2005, p. 12).

Indeed, spatial dimensions and environmental performances are not independent. In this respect, the trade-off between 'wide-and-shallow' versus more targeted schemes provides a good illustration. In recent years, there has been no clear trend favoring one type of instrument over the other. The 'Environmental Stewardship' scheme, introduced in the UK in 2005, is an example of the 'wide-and-shallow' approach. It has replaced the more targeted schemes that were in place since the mid eighties (Dobbs and Pretty, 2008; DEFRA, 2008). In the meantime in France, the introduction of '*Contrats Agriculture Durable*' marked the opposite trend toward more geographically differentiated measures.

One possible explanation of the great diversity in geographic coverage and scale of implementation of actual AES lies in the spatial heterogeneity of environmental impacts. Spatial targeting of agri-environmental measures may then be justified by cost-effectiveness arguments (Wu and Babcock, 2001; Wünscher et al., 2008) and the need to tailor AES to the specific conditions prevailing in a given area (OECD, 2003). Another explanation may lie in the (dis)economies of size characterizing the administrative and transaction costs involved by agri-environmental schemes (Falconer et al., 2001).

In this paper, we explore a third possible determinant of the degree of spatial differentiation prevailing in actual AES. We consider that spatial targeting can be used by the regulator to reduce the effects of asymmetric information. A direct consequence is that information and spatial dimensions cannot be studied separately. This is a novel aspect of this paper to tackle both dimensions together. Delegation of the

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implementation of AES to sub-national authorities can then be seen as a means of improving the regulator's ex-ante information. This leads us to address two interrelated questions in this paper: ‘How does a more geographically disaggregated design affect asymmetric information and the overall efficiency of AES?’ and ‘What are the distributional effects of delegation?’

In a recent paper, Ferraro (2008) identifies three approaches to reduce information rents: acquire information on observable attributes, offer landowners a menu of screening contracts, and allocate contracts through procurement auctions. The first approach consists in identifying observable attributes correlated with the unknown variable. The other two approaches rely on direct revelation mechanisms. While Ferraro (2008) focuses on the latter approach, we study the consequences of the combination of the first two.

Our contribution builds on three strands of the literature. First, the implications of asymmetric information for the design of agricultural and environmental policies have been extensively investigated (Bourgeon et al., 1995; Fraser, 2004; Gren, 2004; Bontems and Bourgeon, 2005). See for instance Chambers (2002) for a survey. In contexts characterized by hidden information, scholars have studied truthful direct revelation mechanisms and highlighted the trade-off between information rents and social efficiency. We underline this trade-off in the specific context of AES.

The second related strand of literature considers endogenous acquisition of *ex-ante* information. Lewis and Sappington (1991), Cremer and Khalil (1992) and Cremer et al. (1998) study the welfare implications if agents could acquire additional information before contracting. In Nosal (2006), the principal can choose to acquire additional information about the state of the world before he contracts with an agent. To the best of our knowledge, our contribution is the first to specifically model information acquisition by the principal through a disaggregated information structure, with perfect knowledge from agents.

Third, we build on the extensive literature that has analyzed the effects of delegation on the social costs of transfers (Melumad et al., 1992; Poitevin, 2000; Faure-Grimaud and Martimort, 2001; Mookherjee and Reichelstein, 2001). As delegation introduces an intermediate layer in the principal–agent relationship, it is likely to affect the social costs of transfers. We use results from this literature to address the trade-offs between the costs and benefits of delegation on allocative efficiency. We show in this context that delegation may have contrasted distributional impacts.

We develop a framework that allows us to analyze a one-stage screening situation where agents are offered a menu of contracts involving an environmental effort and a transfer in a context of asymmetric information. We consider the possibility of a *finer* information structure, which, as defined by Laffont and Tirole (1993, p. 123), “corresponds to a finer partition of the set of states of nature”. In other words, the regulator can segment the population of farmers and adapt the menus of contracts offered to agents depending on their respective position in the new partition. In order to disentangle the effects of asymmetric information and delegation costs, we proceed in two steps. We first assume that the regulator has access to the disaggregated information structure at no cost. We then relax this assumption and consider that finer information structure requires delegation, which involves specific costs.

Our contribution is twofold. First, we show that under a disaggregated information structure the regulator can impose higher environmental efforts on all farmers. The impact on information rent is less straightforward. Although a disaggregated information structure tends to limit the potential for imitative behavior, the greater level of effort involves larger transfers, which in turn tends to increase the information rents. Depending on the relative strength of these two effects, the information rent may increase for some farmers and it may reduce some farmers' net contribution to the policy. Second, we stress the role of delegation as a means of acquiring information. The conjunction of a disaggregated information structure and delegation implies asymmetric consequences for spatial targeting. For the same cost of delegation, the consequences are much more important in the areas with the most efficient farmers. This calls for a better control from the principal over the most sensitive areas.

The remainder of the article is organized as follows. Section 2 presents the analytical model, from which optimal contracts are derived under asymmetric (and exogenous) information. Section 3 focuses on the effect of a disaggregated information structure and highlights the role of spatial targeting as a means of improving the ex-ante regulator's information. Section 4 is devoted to the analysis of the asymmetric impact of delegation on the efficiency of spatial targeting. Section 5 concludes.

2. Benchmark model under asymmetric information

Consider a set of heterogeneous farmers. Each farmer may have a beneficial (or less damaging) impact on the environment if certain changes in producing activities are undertaken, e.g. through the adoption of environmentally friendly practices. The environmental benefit, $B(a)$, depends on the level of effort undertaken, a, which represents for example the amount of land enrolled in the program. The cost incurred to undertake the effort a is denoted by $V(a,\theta)$, where $\theta \in \Theta = [\underline{\theta};\overline{\theta}]$ is a parameter representing the farmer's private information (the farmer's type). The cumulative distribution function $G(\theta)$, with density $g(\theta)$, summarizes the existing heterogeneities in the conditions of production. In the subsequent analysis, the following assumptions are made:

(1) $B(.)$ is continuously differentiable and satisfies $B'(a)>0$ and $B''(a)\leq 0$;
(2) $V(a,\theta)$ is thrice differentiable, increasing in both arguments, and it satisfies:

$$\frac{\partial^2 V}{\partial a \partial \theta}(a,\theta) > 0, \frac{\partial}{\partial a}\left[\frac{\partial^2 V}{\partial a \partial \theta}(a,\theta)\right] \geq 0 \text{ and } \frac{\partial}{\partial \theta}\left[\frac{\partial^2 V}{\partial a \partial \theta}(a,\theta)\right] \geq 0 \text{ for all } \theta \in \Theta;$$

(3) $\frac{G(\theta)}{g(\theta)}$ is increasing in θ.

The environmental benefit is assumed to be increasing and concave with respect to the effort.[1] Costs are assumed to be monotonously increasing with respect to both the effort and the type index. For the same level of effort a, farmers characterized by a lower θ face lower costs. The first part of assumption 2 ensures that the standard “single-crossing” property is fulfilled. This assumption implies that the indifference curves of any two different types only cross once and that agents with a lower θ are willing to receive less for a given increase in a than agents with higher θ (Salanié, 2005). The remaining parts of assumption 2 ensure that the problem is concave. Assumption 3 is also common in adverse selection models. For most unimodal distributions, the hazard rate, as defined in Laffont and Martimort (2002), is monotone increasing with respect to θ (see Bagnoli and Bergstrom, 2005, for a comprehensive discussion of the properties of such distributions). This condition ensures that the incentive distortions are increasing with the agent's type.

As is often the case in asymmetric information problems, we assume that the regulator—hereafter referred to as the principal—knows the overall distribution of farmers' types, i.e. knows $\underline{\theta}$, $\overline{\theta}$, and $g(\theta)$, which are common knowledge. Individual opportunity costs remain private information, and are therefore unknown to the principal prior to contracting.

Note that, in our setting, the only source of heterogeneity among farmers lies in the costs of undertaking effort a, as the environmental benefit for the same level of effort is equal across farmers. This assumption is admittedly restrictive for at least two reasons. First, it might not be possible to summarize the heterogeneity among farmers into one single parameter. Second, environmental benefits may also be a source of heterogeneity among farmers. Nevertheless, this simplifying assumption will prove useful in obtaining tractable results. Taking into

[1] Two sufficient continuity conditions ensure that all farmers contract: $B'(0)=+\infty$ and $\lim_{a\rightarrow 0}B'(a)a=0$ (Laffont and Martimort, 2002).