Agri-Environmental Instruments for an Integrated Rural Policy: An Economic Analysis

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Abstract
The new Rural Development Regulation of the EU reflects the shift of attention within rural areas from agricultural production towards rural development and embraces both, farmers and non-farm residents. While agricultural production is required to comply with environmental standards, rural areas also have to fulfil the growing demand for landscape, outdoor recreation and wildlife conservation. This paper develops a model of a rural area where farmers and non-farm residents live together. A central government uses a combination of two-policy instruments--direct compensation payments and public services -- aimed at encouraging farmers to adopt environmentally beneficial practices and at the same time to increase the provision of country-side amenities and the sustained vitality of the rural area. The optimal mix of the policy instruments is evaluated under various governmental objectives. The analysis suggests that a combination of direct payments to farmers with the supply of local public services is a promising tool for rural policy development initiatives in the EU.

Keywords:
Rural development policy, farmers and non-farmers, integrated rural policy, landscape and recreation

1. Introduction

In the European Union (EU), rural areas are confronted with various changes, affecting economic activity, landscape and the environment. At different policy levels, forces can be observed that entail a shift from agricultural production towards the environment and rural development. Considering these forces, there seems to be a need for an integrated rural policy development.

Since agricultural activity covers 50.5 % of the total territory of the EU (Brouwer and Lowe, 2000), changes in the EU Common Agricultural Policy (CAP) will entail important implications for rural areas. The MacSharry reform of the CAP in 1992, including the agri-environmental policy Regulation 2078/92, implies a reduction of support prices to balance the markets while compensating income losses caused by reductions in output and/or increases in costs related to environmental beneficial farming. In recent years, agri-environmental policy has been placed at the forefront of a far wider debate concerning the future of rural, and not just agricultural, Europe. The Cork Declaration of 1996 gave particular emphasis to the role of environmental friendly forms of agriculture in contributing to sustainable rural economic development (Buller, 2000).

Measures to promote agricultural and rural development and the management of the countryside are further consolidated and made subject to a new decentralised programming procedure under the new Rural Development Regulation 1257/99 which forms the basis for a rural development policy (the "second pillar" of the CAP). This new rural development policy embraces both farm and non-farm developments as well as agri-environmental measures and forestry. An important feature of Regulation 1257/99 is that considerable discretion is left to the individual member states, which allows taking into account the diversity of rural conditions and circumstances. Moreover, while being co-financed from the CAP Guarantee Fund[1], the rural development policy is horizontal (covering all rural areas) and allows the integration of agri-environmental measures with both farming and non-farming activities (article 33 of the Regulation).

In the run-up to new trade negotiations within the World Trade Organisation (WTO), the changing role of agriculture is often indicated by multi-functionality. In the EU, multi-functionality highlights various non-trade concerns acknowledging that agriculture, in addition to the marketable production of food and fibre, generates other goods and services to which society attaches a value (Burrell, 2001). Since it can be expected that within the framework of WTO negotiations, to an

[1] Regulation 1257/99 also supersedes agri-environmental regulation 2078/92 that allows for environmental cross-compliance conditions for direct payments.

increasing extent agricultural (rural) support measures will be de-coupled from agricultural production, the scope for support of non-agricultural activities increases.

In addition to the changing international and EU policy environment, also at a regional level the attention for rural areas increases. While agricultural production methods are required to be in accordance with environmental standards, rural areas also have to fulfil the growing demand by non-farmer residents, both at a national and regional level, concerning outdoor recreation and tourism, nature and wildlife conservation, and landscape. The demand for these goods tends to increase with income, mobility and leisure time and also depends on attitudes and fashion.[2] Although some of these goods are provided by rural entrepreneurs, others have obvious public good characteristics which requires public intervention (Curry, 1994).

Given the above described shift of attention within rural areas from agricultural production towards the environment and rural development, there is a need for a new pallet of agri-environmental instruments to achieve an integrated rural policy. Despite increased interest for rural development policies, until recently there has been little economic analysis of rural policy issues (Freshwater, 1997).[3] In this paper we develop a model of a rural area where farmers and non-farm residents live together, while a central government initiates a voluntary agri-environmental program for the provision of a minimum required area of low intensity farming. The government provides incentives to participating farmers, to compensate the reduced profits associated with the shift to low intensity farming. Under different governmental objectives, we evaluate the optimal mix of two different policy instruments: a compensation payment per hectare and government services to develop activities based on low intensity farming like recreation and landscape activities or the production of regional and "environmentally friendly" products. Explicit attention is paid to the fact that also non-farm residents may benefit from such an integrated rural policy.

The remainder of this paper is organised as follows. Section 2 introduces the conceptual framework of the model and elaborates on comparative statics with respect to relevant parameters. Section 3 defines the target participation level of the program and derives the cost minimising choice of policy instruments. Section 4 considers the optimal set of policy instruments under three alternative governmental objective functions: a farmer oriented objective, a non-farm residents oriented objective and an integrated rural policy objective. Finally, Section 5 summarises the results and draws conclusions.

2. Conceptual Framework

Consider a rural area (hereafter, a region), H hectares (ha) of which are environmentally sensitive farmland. The rest of the area is populated by N identical non-farm residents (NFRs). Agricultural production is profitable but associated with environmental damage that can be reduced via the adoption of conservation practices (like conversion of arable land to extensive grassland, reducing application of fertilisers and pesticides) and/or removal of land from agricultural production (set-aside). To simplify the analysis we will not distinguish between these two alternatives and refer to land used for "low intensity farming" (LIF). Farmers would commonly not apply low intensity practices voluntarily, because it will decrease profits.[4]

Some (but not all) of the reduction in profits can be recovered by the production of environment dependent products which are related to the LIF area (hereafter defined as LIF

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[2] The recent outbreak of the foot and mouth disease in some European countries also caused considerable damage in the tourism and recreation industry which demonstrates the existing interdependencies between recreation, tourism and rural areas.

[3] Exceptions are Brunstad et al. (1999), Weaver (1998) and Latacz-Lohmann (1998) who pay attention to the provision of public goods by farmers. These contributions, however, do not take into account the integrated development of rural areas which include both farmers and NFRs. Studies from other disciplines, like sociology, seem to be less scarce (e.g. Falconer, 2000; Lowe and Ward, 1998; Slee et al., 1997; and Gasson, 1988).

[4] Typical current examples of LIF are the German market release and landscape conservation programs and the Dutch environmental management agreements (e.g. Kazenwadel et al.,1998).

activities). Examples of such LIF activities are farm-based recreation and landscape activities (like farm parks and shops, farm trails, rooms for rent, camping and increased bio-diversity) or the production of regional and "environmentally friendly" products which can be indicated through labelling, certification and place of origin (Legg, 2000). The provision of LIF activities contributes to the welfare of the region's NFRs as well as to the welfare of tourists who choose to visit the area or consumers who spend money on LIF activities (e.g. labelled products). However, we assume that in the absence of public intervention, intensive agriculture is more profitable than LIF and therefore, the latter will not be adopted. Moreover, we assume that it is not profitable to develop LIF activities on land that is fully utilised for intensive arable agriculture.

Policy Instruments

To encourage farmers to adopt LIF practices, the government offers them to participate in an environmental-friendly regulation program (ERP) under which a per-hectare direct compensation payment of s Euros is paid for each hectare enrolled in the program. In the current analysis, the direct payment s addresses both the positive and the negative externalities farmers generate upon society. Namely, it may be viewed as a compensation payment for the use of less-profitable environmentally beneficial farming practices and at the same time as a subsidy for the provision of countryside amenities.

In addition to a direct payment, the government may encourage participation in the ERP and provision of LIF activities by providing services denoted by g.[5] All farmers enrolling the ERP have access to these services. Unlike direct payments, supply of government services may also have direct positive spillover effects on the welfare of non-farmers who reside in the rural area. Examples of government services relevant for our analysis include investment in basic infrastructure like roads, information gathering and disseminating, help in legal privatisation of access rights for recreation activities at the regional and farm-level, co-ordination between farmers aimed at increasing the overall attraction of the region for farm-based tourism (Ilbery et al., 1998), lowering the transaction costs to participate in the ERP, labelling, advertising and marketing plans and more (see Curry, 1994 and Legg, 2000). Also government services may be required to deal with institutional issues like charging for public goods (Curry, 1994, ch. 9) or transforming environmental/public goods into market goods (Merlo et al., 2000).

Obviously, the government should choose s and g jointly, taking into account the interactions between the impacts of the two policy instruments on the welfare of farmers and non-farmers residing in the rural area under consideration. In the absence of an explicit spatially-variable pollution production function, the negative environmental externalities associated with agricultural production are taken care of via a rural-level participation restriction in the ERP. Specifically, the governmental choice of g and s should ensure the participation of a minimum predetermined aggregate land area, say $\overline{H}^r$ ha, in the ERP. The determination of $\overline{H}^r$ is based on country-level environmental considerations that are exogenous to our analysis.

Farmers' Behaviour

We start the formal analysis with farmer's decisions under the voluntary ERP. The agricultural land is owned by a large number of farmers, say M, with farmer m owning h_m hectares, $H = \sum_{m=1}^{M} h_m$. Farmers in the region possess identical production skills and technologies, but they vary with respect to their land endowment, land productivity and environmental characteristics. Let r_m be the number of LIF ha participating in the ERP and used for LIF activities by the m^{th} farmer ($r_m \leq h_m$). Thus, the farm-level land area left for agricultural production is $(h_m - r_m)$ ha. In addition to land, LIF and the provision of LIF activities extract labour resources from agricultural

[5] Based on a study in Greece, Dimara and Skuras (1999) conclude that farmers value government services (assistance in marketing, provision of extension services and formal agricultural training, and information concerning quality standards) as a very important instrument.

production. Let e_m and $\tilde{e}_m$ represent labour unit per ha devoted for LIF and agricultural activities, respectively. For the sake of simplicity we assume that each of these two labour units is predetermined at the level required for best management practice. The per unit cost of farmer labour is denoted by *w* (the off-farm reservation wage for example).

Due to spillover effects, the benefits from LIF activities on each farm are positively affected by the total area of LIF farming in the region, represented in our analysis by $\sum_m r_m \equiv H^r$. Higher levels of H^r are not expected to affect the production technology of LIF at the farm level. They make the rural area more attractive as a whole, however, and as a result increase consumers' demand for LIF activities like recreation and landscape activities (for empirical examples of such spillover effects see Merlo et al., 2000, Hackl and Pruckner, 1997). Explicit analysis of consumers' demand for LIF activities is out of the scope of the current paper.

Formally, benefits B_m (excluding labour costs) on farm *m* from LIF activities can be described by the following additive separable function:

$$(1) \quad B_m(r_m) = V_m(r_m) + [f(g, H^r) + s]r_m$$

where V_m is monotonically increasing, twice differentiable and concave – $V_m^{'} = \frac{\partial V_m}{\partial r_m} \equiv v_m > 0; V_m^{''} = \frac{\partial^2 V_m}{\partial r_m{}^2} = \frac{\partial v_m}{\partial r_m} \equiv v_m^{'} < 0.$ The sign of the third derivative of $V_m(r_m)$ is dependent on the specific assumed functional form. Here we assume that a good approximation of V_m can be obtained by employing a second order Taylor expansion about r_m, which implies $V_m^{'''} = v_m^{''} \approx 0, \forall \text{m}.$

Hence, the assumptions on (1) imply that the marginal benefit of LIF activities is a positive, monotonically decreasing function of r_m, while an increase in *g* and/or H^r imply a parallel upward shift of this function. The shift function *f* is monotonically increasing, twice differentiable and concave in both arguments, which are assumed to be complements, for any $g > 0$ and any H^r which exceeds some lower bound of, say, $\underline{H}$ hectares. Formally,

$$f_x^{'} = \frac{\partial f(\cdot)}{\partial x} > 0, f_x^{''} = \frac{\partial^2 f(\cdot)}{\partial x^2} < 0; \; x = g(>0), H^r(>\underline{H}), f_{gH^r}^{''} = \frac{\partial^2 f}{\partial g \partial H^r} > 0 .$$

If $g = 0$ and $H^r \leq \underline{H}$ then $f(0, H^r) = 0$.

For simplicity and without loss of generality, the marginal benefit (excluding labour costs) of land devoted to intensive agricultural production is assumed to be fixed at a level of $\tilde{v}_m$ Euros/ha.[6] In the absence of governmental intervention (*g*=*s*=*0*) LIF activities are less profitable than intensive agricultural activities-- $v_m(r_m) < \tilde{v}_m$, $\forall m$ -- and as a result $r_m = 0\ (m = 1,...,M), H^r = 0$ and $f(0,0) = 0.$ For the analysis below it is useful to define $H_{-m}^r = \sum_{\substack{j=1 \\ j \neq m}}^{M} r_j = H^r - r_m.$

Farmers are rule-takers and treat the policy parameters g and *s* as given. Under the voluntary

[6] In principal, some governmental services, like infrastructure, might also positively affect agricultural activities. Likewise, a negative spill-over effect of H^r, e.g. in case of tourism, may be valid for agricultural activities (Vail and Hultkrantz, 2000). Here we assume both effects to be negligible and hence it can be omitted from the analysis without loss of generality.

program, the problem of the m^{th} farm is to choose the level of r_m $\{0 \le r_m \le h_m\}$ that will maximise total farm-level profits from agricultural and LIF activities:

$$(2) \quad \Pi^m(r_m) = V_m(r_m) + [f(g, H^r) + s]r_m + (h_m - r_m)\tilde{v}_m - w[r_m e_m + (h_m - r_m)\tilde{e}_m].$$

While choosing r_m, the m^{th} farmer is assumed to ignore the impact of his or her own choice on the behaviour of the other (*M-1*) farmers and regards H^r_{-m} to be fixed. Moreover, since *M* is large, the impact of any specific r_m on the value of H^r is negligible. In other words, H^r is treated as a fixed parameter in the farm-level optimisation problem.[7] Assuming for simplicity that at the optimum $r_m < h_m, \forall m$, the first order condition is:

$$(3) \quad \frac{\partial \Pi^m}{\partial r_m} = \Pi^{m'} = v_m(r_m) + f(g, H^r) + s - \tilde{v}_m - w(e_m - \tilde{e}_m) \le 0 \quad (= 0 \text{ if } r_m > 0).$$

The second order condition is $\Pi^{m''} = v'_m < 0.$

Note that $v_m(r_m) + f(g, H^r) + s - we_m$ are the marginal benefits of an additional hectare in the ERP accompanied by LIF activities and $\tilde{v}_m - w\tilde{e}_m$ are the opportunity costs. Hence, equation (3) suggest that farmers will enrol land in the ERP until the marginal net benefit of an additional hectare is zero. This also implies that all hectares of a given farm that participate in the program but the last marginal one, receives a surplus. Hence, the ERP entails positive profits for participating farmers. Note also from (3) that farmers for whom $v_m(r_m) + f(g, H^r) + s < \tilde{v}_m + w(e_m - \tilde{e}_m)$, will choose not to participate in the ERP. This may happen if (i) the marginal benefit per ha devoted for LIF activities v_m, is relatively low; and/or (ii) e_m is much larger than $\tilde{e}_m$. Since we assume that all farmers have identical skills, most likely this should be related to variation of spatial productivity among farmers (farms too remote from tourists/consumers, farms located in an unattractive environment, etc.).

Assuming an internal solution and conducting comparative statics with (3) gives the impact of the different parameters on r_m.

$$(4a) \quad \frac{\partial \mathrm{r_m}}{\partial \tilde{v}_\mathrm{m}} = -\frac{-1}{v'_m} < 0, \ \frac{\partial \mathrm{r_m}}{\partial \tilde{e}_m} = -\frac{w}{v'_m} > 0, \frac{\partial \mathrm{r_m}}{\partial e_m} = \frac{w}{v'_m} < 0,$$

$$\frac{\partial \mathrm{r_m}}{\partial w} = -\frac{\tilde{e}_m - e_m}{v'_m}, \frac{\partial r_m}{\partial H^r} = -\frac{f'_{H^r}}{v'_m} > 0,$$

$$(4b) \quad \frac{\partial \mathrm{r_m}}{\partial g} = -\frac{f'_g}{v'_m} > 0;$$

$$(4c) \quad \frac{\partial \mathrm{r_m}}{\partial s} = -\frac{1}{v'_m} > 0.$$

[7] This can be formally introduced by assuming that the area participating in the ERP on any single farm is very small relative to the lower bound: $r_m << \underline{H}, m = 1,...,M$.

It can easily be verified that

(5) $$\frac{\partial^2 r_m}{\partial g^2} = -\frac{f''_g}{v'_m} < 0; \quad \frac{\partial^2 r_m}{\partial g \partial H^r} = -\frac{f''_{gH^r}}{v'_m} > 0; \quad \frac{\partial^2 r_m}{\partial s^2} = \frac{\partial^2 r_m}{\partial s \partial g} = \frac{\partial^2 r_m}{\partial s \partial H^r} = 0.$$

The comparative-statics results in (4a)-(4c) clearly show that if the m^{th} farm chooses to participate in the ERP, the area enrolled in the program increases in (i) both policy instruments *g* (4b) and *s* (4c); (ii) the aggregate level of land enrolled in the program, H^r (4a), the impact of which is similar to the one of *g*; and (iii) the per unit labour required for intensive agricultural activities, $\tilde{e}_m$ (4a) and (iv) if $\tilde{e}_m > e_m$: the reservation wage w (4a). The economic intuition of these results is obvious. The marginal net benefits of land enrolled in the program (excluding labour costs), $\frac{\partial B_m}{\partial r_m} = v_m + f(g, H^r) + s,$ increases in *g*, *s* and H^r, and the higher is $\tilde{e}_m$ the less profitable is the alternative of intensive agricultural cultivation. Similar arguments may be used to explain why r_m decreases in $\tilde{v}_m, e_m$ and w if $\tilde{e}_m < e_m$. The results in (5) will be utilised in the next section.

Non-farm Residents
Recall that in addition to farmers, the rural area is assumed to be populated by *N* identical NFRs. The utility (*U)* of a representative NFR is positively affected by the level of her income flow(*I*), by the immediate access to farm-based LIF activities, the level of which is measured by H^r and by the level of government services (like infrastructure and information centres), *g*. The income of a representative household is $I = W + P(g, H^r)$, where *W* is exogenous income (e.g. an annual wage) and $P(g, H^r)$ is the value of property services (e.g., an annual reservation rent) which is monotonically increasing and concave in both *g* and H^r. For the latter, see for example Tyrväinen and Miettinen (2000) who use data from dwellings in Finland and estimate a positive effect of amenity benefits on property prices applying a hedonic pricing method. In a different example, Hackl and Pruckner (1997) use data from Austrian tourism communities to show that benefits may be relatively large for the NFRs who indirectly generate extra money due to the environmental/landscape conditions created by farmers.

Direct utility from regional LIF activities is given by a money metric utility function, $u(g, H^r)$ which is monotonically increasing and concave in *g* and H^r (see Drake, 1992, who shows that existing agricultural landscape contributes to the utility of NFRs) for values of the latter which exceeds some critical threshold of say, $\breve{H}^r$ (when environmental amenities are too small, their effect becomes negligible; see Mitsch and Gosselink, 2000).

Household's utility may be written as

(6) $$U = W + Z(g, H^r),$$

where $Z(g, H^r) = P(g, H^r) + u(g, H^r)$. In the absence of governmental intervention, $H^r = g = 0$ implying that the utility of a representative household is $U^* = W + Z(0,0)$. The application of ERP (assuming $H^r > \breve{H}^r$) entails a positive surplus *Q* for each of the NFRs:

(7) $$Q(g, H^r) = Z(g, H^r) - Z(0,0) > 0.$$

Obviously, this surplus increases the viability of the rural area and keeps NFRs from leaving. Note that in principal, the government may use the NFRs as a vehicle to reduce public expenditure required to finance *g* by levying on each of them a per-capita tax, up to a maximum level of $Q(g, H^r)$. The shape of the functions *P* and *u* implies that *Q* is monotonically increasing and strictly concave in both arguments. We additionally assume that $\frac{\partial^2 Z}{\partial g \partial H^r} > 0$ which implies, for example, that the value of natural amenities for NFRs increases when access to these amenities increases (through infrastructure, extension services, access laws).

3. Participation Target and Cost-Minimising Policy Instruments

The ERP is aimed at the reduction of environmental pollution associated with intensive agricultural production. To satisfy this environmental goal, while choosing the policy instruments *g* and *s*, the government wishes to guarantee that at least $\overline{H}^r$ hectares of farm land in the region will participate in the ERP (and consequently, being utilised for LIF activities), $\sum_m r_m \geq \overline{H}^r$. This formulation may be viewed as the first of a two-stage policy making procedure (Cropper and Oates, 1992, Wu and Babcock, 1999). At the first stage, the government set standards or targets and then, at the second stage, policy instruments are designed to achieve these targets. Here we focus on the second stage of policy making by assuming that the number of hectares targeted for the ERP has been identified already. The background for such a target area size may be related to ecological reasons (see Mitsch and Gosselink, 2000) or the result of a political process[8] which is exogenous to our analysis. It is implicitly assumed that the ERP is socially beneficial at the country level.

Since it is costly to raise governmental expenditure, the constraint must be binding at the optimal solution, i.e.,

(8) $$\sum_m r_m(s, g, \overline{H}^r) - \overline{H}^r = 0.$$

The participation restriction in (8) allows us to express the direct payment, *s*, as a function of the governmental services *g*:

(8*a*) $$s = s(g; \overline{H}^r).$$

Complete differentiation of (8) yields (see (4b) and (4c)):

(9*a*) $$\frac{\partial s}{\partial g} = s_g^{'} = -\frac{\sum_m \partial r_m / \partial g}{\sum_m \partial r_m / \partial s} = -\frac{f_g^{'} \sum_m [\frac{1}{v_m^{'}}]}{\sum_m [\frac{1}{v_m^{'}}]} = -f_g^{'} < 0 \text{ and therefore}$$

(9b) $$\frac{\partial^2 s}{\partial g^2} = s_g^{''} = -f_g^{''} > 0 \text{ and,}$$

(9c) $$\frac{\partial^2 s}{\partial g \partial H^r} = -f_{gH^r}^{''} < 0.$$

[8] An example is the Ecological Main Structure in the Netherlands, for which the government explicitly set a goal of 100000 hectares to be managed by farmers (Oskam and Slangen, 1998).

A graphical presentation of all (g,s) combinations that satisfy the participation restriction in (8) (hereafter, the participation restriction curve), for two levels of land area targeted for the ERP ($\overline{H}^r$ and $\hat{H}^r$), is depicted in Figure 1.

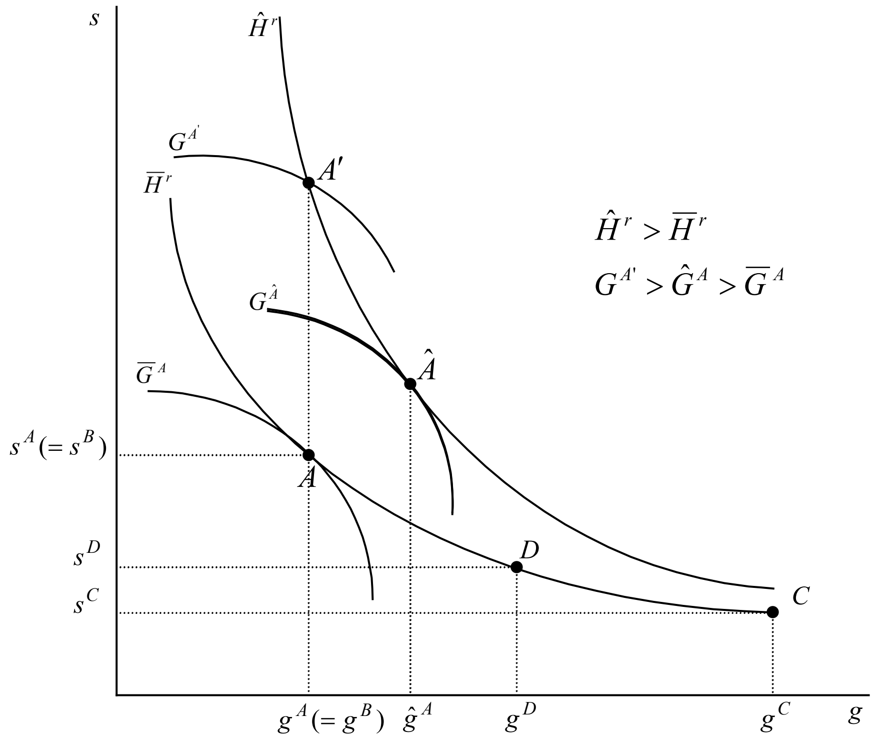

Figure 1: Participation restriction curves ($\overline{H}^r, \hat{H}^r$), iso-cost curves ($\overline{G}^A, \hat{G}^A, G^{A'}$) and the choice of policy instruments

For the sake of simplicity, we assume that all government services are purely non-rival and thus the cost of supplying them, c(g), is independent of the number of farmers. The cost function c(g) is assumed to be monotonically increasing and strictly convex, i.e., $c'(g) > 0, c''(g) > 0$. The implementation costs of the voluntary ERP depends on the number of hectares of land targeted for the program, $\overline{H}^r$.[9] Since $\overline{H}^r$ is predetermined, these costs do not affect the qualitative results of the analysis and can therefore be suppressed for convenience. The total social costs of governmental expenditure are $E = (1+\rho)[s\overline{H}^r + c(g)]$ where ρ is the marginal deadweight loss from distortionary taxes.

The objective of a *cost minimising government* (hereafter Objective A) is to satisfy the participation restriction in (8a) at minimum public expenditure

$$(10) \quad \underset{g}{\text{Min}}\{G^A = (1+\rho)[\overline{H}^r\, s(g,\overline{H}^r) + c(g)\}.$$

Assuming an internal solution, the first order condition is

[9] Implementation costs may be due to asymmetric information (e.g., Latacz-Lohmann, 1998; Burton, 1996) or monitoring and enforcement costs (Wu and Babcock, 1999). The impact of implementation costs on the relative efficiency of voluntary versus mandatory environmental regulations is analyzed in Wu and Babcock (1999). Because voluntary programs (as the ERP here considered) provide more flexibility and reduce conflicts and formal legal procedures, they assume that the implementation costs of a voluntary program is lower than that of a mandatory program.

(11) $$\frac{\partial G^A}{\partial g} = G^{'A}(g) = \overline{H}^r s_g^{'}(g,\overline{H}^r) + c^{'}(g) = 0$$
$$\rightarrow g = g^A(\overline{H}^r); s = s^A(g^A,\overline{H}^r).$$

It can be easily verified that the second order condition for a minimum is also satisfied ($\frac{\partial^2 G^A}{\partial g^2} = \overline{H}^r s_g^{''} + c^{''} > 0$). Noting that $s_g^{'} = -f_g^{'}$ (9a), the first order condition in (11) indicates that services should be provided by a cost minimising government at a level where their marginal costs, $c^{'}(g)$, equal their marginal benefits, $\overline{H}^r f_g^{'}$.

A graphical illustration of this result is also presented in Figure 1. The curves labelled $\overline{G}^A$ and $\hat{G}^A (> \overline{G}^A)$ are iso-cost curves which represent the locus of all (g,s) combinations under which $G^A = (1+\rho)[H^r s + c(g)]$ is constant. It can be easily verified that an iso-cost curve is negatively sloped and concave: $\left.\frac{\partial s}{\partial g}\right|_{G^A=\text{constant}} = -\frac{c_g^{'}}{H^r} < 0,\quad \left.\frac{\partial^2 s}{\partial g^2}\right|_{G^A=\text{constant}} = -\frac{c_g^{''}}{H^r} < 0.$ The minimum cost solution -- (g^A,s^A) -- is obtained at point A of Figure 1, where the iso-cost curve $\overline{G}^A$ is just tangent to the participation restriction curve $\overline{H}^r$. At this point,

(11a) $$\left.s_g^{'}\right|_{H^R=\overline{H}^R} = -f_g^{'} = -\frac{c_g^{'}}{\overline{H}^r} = \left.\frac{\partial s}{\partial g}\right|_{G^A=\text{constant}}$$
$$\rightarrow f_g^{'}(g^A,\overline{H}^r) = \frac{c_g^{'}(g^A)}{\overline{H}^r}.$$

To investigate the impact of changes in the target level of agricultural land enrolled in the ERP, consider it is increased from $\overline{H}^r$ to $\hat{H}^r$ (see Figure 1). Recall that since *g* and H^r are assumed to be complements in the shift function *f*, $f_{gH^r}^{''}(g,H^r) > 0$, it follows from (11a) that

(11a)' $$f_g^{'}(g^A,\hat{H}^r) > \frac{c_g^{'}(g^A)}{\hat{H}^r}.$$

With $g = g^A$ and $H^r = \hat{H}^r (> \overline{H}^r)$ the participation restriction curve ($\hat{H}^r$) is steeper than the iso-cost curve ($G^{A'}$) and crosses it from above, (see point A', Figure 1). At point A', the slopes (in absolute value) of the former and the latter curves are given by the left hand side and the right hand side of (11a)', respectively. Note that the left hand side of (11a) decreases in *g* whereas the right hand side increases in *g*. Therefore, with $H^r = \hat{H}^r$ the first order condition in (11) (or (11a)) can be satisfied only when services are provided at a level that exceeds g^A, like $\hat{g}^A$ (Figure 1). In other words, more governmental services should be provided when the target level $\overline{H}^r$ is increased, $\frac{\partial g^A}{\partial \overline{H}^r} > 0.$ The impact of a change in $\overline{H}^r$ on the optimal per hectare direct payment *s* is generally ambiguous. To see that, note from (8a) that $\frac{ds^A}{d\overline{H}^r} = \left.\frac{\partial s^A}{\partial \overline{H}^r}\right|_{g=\text{constant}} + s_g^{'}(g,\overline{H}^r)\cdot\frac{\partial g^A}{\partial \overline{H}^r}$. The first term on the right hand side is positive while the second term is negative ($s_g^{'} < 0$). Obviously, if s^A increases in $\overline{H}^r$, so does the total of direct payments, $\overline{H}^r s^A$. The opposite, however, is not necessarily true. It may well be that while $\frac{ds^A}{d\overline{H}^r}$ is negative, the total direct payments will increase. It can be shown that this will be the case only if the absolute value of the elasticity $\left(\frac{ds^A}{d\overline{H}^r}\frac{\overline{H}^r}{s^A}\right)$ is less than 1.

4. Alternative Rural Objectives in Government Decision Making

Recall that both, farmers participating in the ERP and NFRs of the rural area under consideration, receive a surplus from the program. Thus, the ERP contributes not only to the goal of environmental protection, but also to the sustained vitality of the rural area under consideration. In this section we investigate the impacts of local, rural-level concerns in government decision making. Specifically, we consider three alternative governmental objective functions: a farmer oriented objective (G^B), a NFRs oriented objective (G^C) and an integrated rural policy objective (G^D).

Farmers oriented objective

Originally, in the EU policy context (CAP), most attention with respect to (income) support in rural areas is given to farmers. A farmers' oriented objective of the ERP may therefore be associated with the 1992 CAP reform including the agri-environmental policy Regulation 2078/92, which aimed for farm income support while for the first time explicitly taking into account environmental concerns in the rural area. Under the farmers' oriented objective G^B, the government wishes to achieve the target level $\overline{H}^r$ at a (g,s) combination that will maximise aggregate farmers' welfare, ignoring the social costs of public expenditure, *E*. Formally,

$$(12)\quad \max_g\{G^B = \sum_{m=1}^{M}\Pi^m = \sum_m \{V_m(r_m) + [s(g,\overline{H}^r) + f(g,\overline{H}^r)]r_m + (h_m - r_m)\tilde{v}_m - w[r_m e_m + (h_m - r_m)\tilde{e}_m]\}\},$$

where $s(g,\overline{H}^r)$ is determined by (8) or (8a). The optimal farm-level choices $r_m(s,g)$ should also be taken into account via the Envelope Theorem, which implies $\frac{d\Pi^m}{dg} = \frac{\partial \Pi^m}{\partial g}$.

Assuming an internal solution, the first order condition is

$$(13)\quad \frac{\partial G^B}{\partial g} = \sum_{m=1}^{M}\{f_g' + s_g'\}r_m = \overline{H}^r(f_g' + s_g') = 0,$$

$$\rightarrow g = g^B(\overline{H}^r);\ s = s^B(g^B,\overline{H}^r),$$

Recall from (9a) that $s_g' = -f_g'$. So, the first order condition in (13) is satisfied for *all* (g,s) combination that satisfy the program constraint in (8). In other words, *the farmers will be indifferent between all the combinations of direct payment and services that satisfy (8), including the pair* (g^A,s^A). In a graphical illustration (not presented here), the highest attainable iso-profit curve

$G^B =$ constant, the slope of which in the (g,s) axis is $-f_g^{'}$, would completely overlap the participation restriction curve in Figure 1. Thus, for example, a government which maximises the weighted welfare of tax payers and farmers will choose the cost minimising solution, i.e., $g^B = g^A$ and $s^B = s^A$.

Non-farmer residents oriented objective

In many western countries, farmers maintain political power that is disproportionate to both their number and their importance to the economy. In contrast, rural NFRs are commonly not organised as an interest group and their political power does not reflect their number and economic contribution (Freshwater, 1997). To an increasing extent, however, it becomes evident that for keeping the rural area viable, attention should be paid to NFRs. When NFRs start to leave rural areas, there will be less scope for other economic activities like shops and accommodation facilities within rural areas and villages. This will lower utility for the NFRs that are not in the position to leave but might also deteriorate the historical rural landscape and heritage, feasibility for tourism, etc. Under the NFRs oriented objective, G^C, the government wishes to satisfy the participation constraint in (8) at a (g,s) combination that will maximise aggregate NFRs' welfare, ignoring *E*:

$$(15)\quad \max_{g}\{G^C = NQ(g,\overline{H}^r)\},$$

$$\rightarrow g = g^C(\overline{H}^r); s = s^C(g^C,\overline{H}^r),$$

where $Q(g,\overline{H}^r)$ is given by (7).

Since G^C is independent of the direct payment *s* and *Q* is monotonically increasing in *g*, the optimal solution, (g^C,s^C), is a corner solution under which the constraint in (8) is satisfied with the highest possible level of *g* and the lowest possible level of *s* (point C, Figure 1). This conclusion holds even if some (but not all) of the per-household induced welfare increase, *Q*, is taxed in order to help financing governmental services *g*. In the extreme case, where *Q* is fully taxed and each NFR is tied up to his or her reservation utility, U^*, and is used only as a vehicle to reduce governmental expenditure, NFRs will be indifferent among all (g,s) combinations that satisfy the participation constraint. Obviously, $g^C \geq g^A(=g^B)$ and $s^C \leq s^A(=s^B)$.

Integrated Rural Development oriented objective

Through the introduction of the new Rural Development Regulation 1257/99 and the expected efforts in the near future, the EU embraces both farm and non-farm developments as well as agri-environmental measures. Although the regulation is co-financed from the CAP Guarantee Fund, considerable discretion but also financial burden is left to the individual member states and therefore, taxpayers. Also, due to the increasing urban society, urban support for rural programs may be required. "In Europe, urban people see rural areas as a part of their cultural and environmental heritage that they are willing to support" (Freshwater, 1997). Hence, we consider an integrated rural development oriented objective, G^D, which maximises the weighted additive welfare of farmers, NFRs and the country's taxpayers[10]. But since farmers are indifferent among all (g,s) combinations that satisfy (8), their welfare should not be explicitly included in the objective function G^D. Formally,

[10] The governmental expenditure is net of guaranteed EU funds aimed at supporting the specific program.

(16) $\max_{g}\{G^{D} = \alpha NQ(g,\overline{H}^{r}) - (1-\alpha)(1+\rho)[\overline{H}^{r}s(g,\overline{H}^{r}) + c(g)]\}$

where $0 < \alpha < 1$ is the weight given to the NFRs' welfare.[11] The first order condition for an interior solution is

$$(17)\quad \frac{\partial G^{D}}{\partial g} = G^{'D}(g) = NQ_{g}^{'}(g,\overline{H}^{r})R(\alpha,\rho) - \overline{H}^{r}s_{g}^{'}(g,\overline{H}^{r}) - c^{'}(g) = 0$$
$$\rightarrow g = g^{D}(\overline{H}^{r}); s = s^{D}(g^{D},\overline{H}^{r})$$

where $R(\alpha,\rho) = \frac{\alpha}{(1-\alpha)(1+\rho)}$. It can easily be verified that the second order condition for a maximum, $\frac{\partial^{2}G^{D}}{\partial g^{2}} > 0,$ holds. Noting that $s_{g}^{'} = -f_{g}^{'}$, the first order condition in (17) indicates that under Objective D, services should be provided at a level where their marginal costs, $c^{'}(g)$, equal the weighted sum of their marginal benefits accruing to both, the farmers participating in the program ($\overline{H}^{r}f_{g}^{'}$) and the NFRs ($NRQ_{g}^{'}$).

To compare between g^{D} and g^{A} it is useful to calculate the value of the first order condition in (17) at point $g = g^{A}$ determined by (11):

$$(18)\quad G^{'D}(g^{A}) = NQ_{g}^{'}(g^{A},\overline{H}^{r})R(\alpha,\rho) - \overline{H}^{r}s_{g}^{'}(g^{A},\overline{H}^{r}) - c^{'}(g^{A})$$
$$= NQ_{g}^{'}(g^{A},\overline{H}^{r})R(\alpha,\rho) > 0$$
$$\rightarrow g^{D} > g^{A};\quad s^{D} < s^{A}.$$

This finding is expected since the positive weight assigned to the welfare of NFRs in the government objective function G^{D}, as compared to G^{A} in (10), shifts the optimal (g,s) combination from (g^{A},s^{A}) towards (g^{C},s^{C}) along the participation restriction curve, (e.g., point D, Figure 1). Comparative statics with (17) gives the impacts of several parameters on the level of government services. Since, $\frac{\partial^{2}G^{D}}{\partial g^{2}} < 0,$ by the second order condition, $sign\{\frac{\partial g^{D}}{\partial \xi}\} = sign\{\frac{\partial G^{'D}}{\partial \xi}\}$ where ξ represents the parameter under consideration. Specifically,

$$(19a)\quad sign\{\frac{\partial g^{D}}{\partial \alpha}\} = sign\{\frac{NQ_{g}^{'}}{(1-\alpha)^{2}(1+\rho)}\} > 0; sign\{\frac{\partial g^{D}}{\partial \rho}\} = sign\{-\frac{NQ_{g}^{'}\alpha}{(1-\alpha)(1+\rho)^{2}}\} < 0;$$

$$(19b)\quad sign\{\frac{\partial g^{D}}{\partial N}\} = sign\{Q_{g}^{'}R\} > 0;$$

$$(19c)\quad sign\{\frac{\partial g^{D}}{\partial \overline{H}^{r}}\} = sign\{NQ_{g\overline{H}^{r}}^{''}R - s_{g}^{'} - \overline{H}^{r}\frac{\partial s_{g}^{'}}{\partial \overline{H}^{r}}\}.$$

The economic intuition behind the results in (19a)-(19c) is straightforward.

[11] Welfare weights are commonly determined in the political arena (e.g. Finkelshtain and Kislev, 1997). Discussion of this issue, however, is out of the scope of this paper.

Since NFRs prefer the highest attainable level of g, increase in the weight α assigned to their welfare implies an increase in g^D. Inspection of the objective function in (16) shows that an increase in ρ might be viewed as a decrease in α, implying $\frac{\partial g^D}{\partial \rho} < 0$. Similarly, increase in the number of NFRs is equivalent to an increase in α, implying $\frac{\partial g^D}{\partial N} > 0$. Since $s_g^{'} < 0\,(9a), \frac{\partial s_g^{'}}{\partial' \overline{H}^r} < 0$ (9c) and $Q_{g\overline{H}^r}^{''} > 0$, the sign of $\frac{\partial g^D}{\partial \overline{H}^r}$ in (19c) is positive. Given this result, note that $sign\{\frac{ds^D}{d\overline{H}^r}\} = sign\{\left.\frac{\partial s^D}{\partial \overline{H}^r}\right|_{g=g^D} + s_g^{'} \cdot \frac{\partial g^D}{\partial \overline{H}^r}\}$ is indeterminate. Namely, as is the case under Objective A, the impact of a change in $\overline{H}^r$ on the optimal per hectare direct payment is generally ambiguous.

5. Implications and Concluding Remarks

The new Rural Development Regulation of the EU reflects the shift of attention within rural areas from agricultural production towards rural development. While agricultural production methods are required to be in accordance with environmental standards, rural areas also have to satisfy the growing demand by non-farm residents, both at a national and regional level, concerning outdoor recreation and tourism, nature and wildlife conservation, and landscape. This paper investigates the combined use of two policy instruments aimed at encouraging farmers to adopt environmentally beneficial practices and at increasing the provision of country-side amenities - - direct payments, (s), and public services, (g).

Due to within-region spillover effects, the total agricultural area enrolled in the environmental-friendly regulation program (ERP) has positive impacts on the welfare of both, farmers and non-farmer residents (NFRs) of the rural area. The two policy instruments are not perfect substitutes: while direct payments affect only the total agricultural area enrolled in the ERP, the supply of government services also has direct positive spill-over effects on the welfare of the NFRs. Obviously, the government should choose s and g jointly, taking into account the interactions between the impacts of the two policy instruments on the welfare of farmers and non-farmers residing in the rural area under consideration.

These instruments may be viewed as compensation given to farmers for the use of less-profitable environmentally beneficial farming practices and at the same time as incentives to expand the provision of countryside amenities. Indeed, the analysis suggests that all hectares of a specific farm that participate in the program but the last marginal one, receives a surplus. The benefits from land enrolled in the ERP increases in the level of both policy instruments, in the target land area $\overline{H}^r$ and in the per unit labour devoted for intensive agricultural activities

In addition to farmers, NFRs receive a surplus from the application of these instruments (especially g) too, which increases the viability of the rural area and keeps NFRs from leaving. In any case, governmental objectives will be served better if it has two policy instruments in its disposal instead of a single one. One implication of our analysis is that a combination of direct payments to farmers with the supply of local public services, is promising for rural policy development initiatives. By facilitating the demand and provision of LIF activities, local public services expand the economic pie of the rural area and may prove to be an important additional policy tool without the distortionary effects of conventional agricultural policy instruments like price support.

The specific choice of g and s is dependent on the target participation constraint and on the governmental objective. We found that more governmental services (g) should be provided when

$\overline{H}^r$ is increased, whereas the impact of such an increase on the optimal per hectare direct payment (*s)* is generally ambiguous. We also found that farmers are indifferent among all (*g,s*) pairs that satisfy a predetermined participation constraint and therefore farmers have no incentive to form a political lobby aiming at a specific combination of instruments. This result has an important policy implication. Being free from farmers' political pressure, the government has more flexibility to address national environmental goals and the concerns of the region's NFRs.

It is also shown that as long as the welfare gains of NFRs from the program is not fully taxed, they will prefer a combination of instruments under which the participation constraint is satisfied with the highest attainable level of governmental services and the lowest possible direct compensation payment per unit of land. Given the target participation level, substitution of *s* by *g* increases both, the value of the NFRs properties and the level of utility they draw from LIF activities at the region. Such a substitution is also likely to increase the welfare of consumers and tourists who reside out of the region (and are not explicitly considered in the current analysis) from the consumption of LIF activities supplied within the region. When the governmental objective addresses the social concerns of both, taxpayers and NFRs, the optimal level of public services will be lower than its highest attainable level, but higher than the cost minimising level.

The recognition that both farmers and NFRs play an important role in rural development issues has other implications that may deserve further study. For example, the demand for LIF activities (like farm-based recreation and landscape activities or the production of regional and "environmentally friendly" products indicated through labelling) by NFRs from within the region as well as from outside the region has not been dealt with explicitly. The same holds for the possible sources of asymmetric information and transaction costs that are related to initiatives such as the ERP suggested in this paper. The current analysis may serve as a starting point for such a more extended approach.

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