Distortions in a Multi-Level Co-Financing System: The Case of the Agri-Environmental Program of Saxony-Anhalt

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1. Introduction

Within the European Union (EU), a multi-level co-financing system for structural, agricultural, and rural development policies has been developed, sharing decision-making and financial responsibilities at different political levels (e.g. EU, Germany, and German federal states 'Länder') (Mehl and Plankl, 2001 p. 173). From a regional perspective, this system certainly provides incentives for a higher allocation of funds to specific policy areas. On the other hand regional policy-making may be distorted due to co-financing incentives.

The EU co-financing system has been criticized, in particular, based on the economic theory of federalism (Mehl and Plankl, 2001 p. 174; Postlep and Döring, 1996 p. 27). The criticism is mainly related to the violation of the principle of fiscal equivalence. This principle postulates that there has to be a congruence between those who benefit from measures and those who have to take the financial responsibility (Olson, 1969 p. 483; Laaser and Stehn, 1996 p. 63). A violation of this principle can lead to oversupply as well as undersupply of goods or special services (Rudloff, 2002 p. 242; Olson, 1986 p. 123). According to Urfei (1999 p. 237) and Rudloff (2002 p. 246), most of the agri-environmental programs violate the principle of fiscal equivalence.

In this paper, we discuss the implications of the EU multi-level co-financing system taking the financing of the agri-environmental program in Saxony-Anhalt as a case study. We show how the volume and the allocation of funds for different agri-environmental measures is influenced by this system as compared to an undistorted lump-sum transfer scenario. The paper uses an interactive linear programming approach, which has originally been developed for the case-study in Saxony-Anhalt.

2. Regional policy-making in a multi-level system

2.1 The institutional framework

The current institutional framework of the agri-environmental programs is defined by the 'Council Regulation (EC) No 1257/1999 of 17 May 1999'. As a consequence of the mid-term review of the AGENDA 2000, some adaptations were realized with the Luxembourg decisions (Council Regulation (EC) No 1783/2003 of 29 September 2003).

The EU contribution covers 75 % of the expenditures for agri-environmental measures in 'objective 1 regions' and 50 % in the other regions. According to the Luxembourg decisions, the financial contribution to agri-environmental measures will be raised to 85 % in 'objective 1 regions' and to 60 % in other regions

In the federal system in Germany, the institutional framework for rural development additionally is subject to the 'Joint Action for Improvement of Agrarian Structures and for Coast Preservation (Gemeinschaftsaufgabe Verbesserung der Agrarstruktur und des Küstenschutzes, GAK)'. Within the framework of the GAK, federal grants are provided for measures which are based on the 'Principles of market-oriented and locally adapted land cultivation (Markt- und standortangepasste Landbewirtschaftung, MSL)'. Federation and federal states share the funding of such measures at the ratio of 60 % (federation) and 40 % (federal state).

Under the conditions of Saxony-Anhalt, which is an 'objective 1' region, the EU covers 75 %, the federation covers 15 %, and Saxony-Anhalt covers 10 % of the expenditures on MSL-measures. Other measures, which are not part of the GAK, do not receive federal grants. For these measures, the EU and the federal states share the expenditures at the ratio of 75 % and 25 %. The structure of co-financing and the intergovernmental grants are of no direct importance for farmers taking part in agri-environmental programs. However, there are important implications for the regional budget and regional policy-making as will be shown in the following chapters.

2.2 The linear programming approach

Kirschke and Jechlitschka (2002, 2003) report how to implement a linear programming approach in MS-Excel$^{©}$ for its application to the design of structural and agri-environmental programs.

Under the assumption of constant marginal and average coefficients the following linear objective function can be defined:

$$Z_1 = \sum_{i=1}^{n} z_{1i} \cdot B_i \tag{1}$$

with: Z_1 1st objective

B_i budgetary expenses for a measure i

i = 1, ..., n   index of agri-environmental measures considered

z_{1i} constant marginal and average coefficient of the objective function describing the impact of the budgetary expenses for measure i on the 1st objective.

For considering two objectives, an aggregated objective function can be formulated as follows:

$$Z = (1-a) \cdot Z_1 + a \cdot Z_2$$

(2)

with $(1-\alpha)$ and α being weighting factors.

Hence, the programming approach can be formulated as follows:

$$\max_{B_1,...,B_n} Z = (1-a) \cdot \sum_{i=1}^{n} z_{1i} B_i + a \cdot \sum_{i=1}^{n} z_{2i} B_i$$

(3)

subject to:
$$\sum_{i=1}^{n} a_{ri} \cdot B_i \begin{Bmatrix} \leq \\ = \\ \geq \end{Bmatrix} b_r \qquad \text{for } r = 1, ..., m \text{ and } B_i \geq 0 \text{ for } i = 1, ..., n$$

where: $r = 1, ..., m$ is the index of restrictions (equations or inequations)

a_{ri} is the coefficient of restriction r for measure i

b_r is the right hand side of restriction r.

In order to apply the approach to a specific problem setting, relevant political measures need to be chosen, consensus about the most important objectives needs to be reached amongst stakeholders, the coefficients of the objective function need to be assessed, and relevant restrictions have to be formulated. This demanding task can be tackled step by step in discussions with stakeholders and decision makers. On the basis of the jointly formulated model, subsequent calculations and scenarios can be analyzed interactively.

The modeling approach, used for the calculations in this article, was applied to design the agri-environmental program of Saxony-Anhalt for the financial period from 2004 to 2008. In the following, a brief outline of the specific model structure is given, which is also illustrated in Table 1.

Nine groups of measures have been used as activities in the modeling approach which consist of several single measures each. Thus, the modeling approach has been used to consider the strategic situation on an aggregated level. The measures have been defined as follows:

— General extensive grassland use (including all grassland of the farm) (M1)

— Specific extensive grassland use (single grassland areas and sheep grazing) (M2)

— Specific extensive grassland use (single grassland areas and cattle grazing) (M3)

— Organic farming (M4).

These measures belong to the group called 'Market-oriented and locally adapted land management' (MSL) . Another measure is:

— Environmental protective cultivation of special cultures (vegetables, medicinal and spice herbs, pip, and stone fruit as well as vine and hop) (M5).

And finally, special nature conservation measures (VNS – 'Vertragsnaturschutz') are considered:

— Management of grassland (M6)

— Management of ancient orchards (M7)

— Management of crop land (M8)

— Management of set aside land (M9).

---------------Table 1.----------------

Two objectives have been defined as 'Environmental Quality' and 'Preservation of Agricultural Labor' each having the same weight of 0.5 in the aggregated objective function. In order to assess the coefficients of the objective function a Delphi type procedure has been used: stakeholders have been asked by questionnaires to give their estimates on a scale between one (very low impact) and nine (very high impact). The results have been subject to discussion after which the slightly adjusted means of the estimates have been used as coefficients.

The following restrictions have been defined:

— Budget restrictions, like upper and lower bounds for the total budget volumes for single measures (Table 1, row 6 and 7). The upper bounds for M2 to M5 and M7 are oriented at the maximum possible budget for each measure, as they have been chosen by stakeholders. For M1, M6, M8, and M9 upper bounds have been set arbitrarily at a high level in order to demonstrate possible trade-offs between measures.

— A restriction for the available regional budget of Saxony-Anhalt (Table 1, row 8). The coefficients of this restriction vary according to the different levels of co-financing. It is assumed that the amount of external co-financing is not limited and thus not binding in the model (Table 1, row 3).

— An upper and lower bound for the area of grassland being included in measures which are based on the existing amount of grassland in Saxony-Anhalt (Table 1, row 9 and 10).

Table 1 shows the input matrix of the reference situation. The budget allocation of the last financial period is displayed in row 2. The optimal allocation resulting from the programming approach in the depicted basic situation is displayed in row 3. Four absolute upper bounds are binding (M2, M4, M5, and M7), according to the restrictions in Saxony-Anhalt. Furthermore, M3 receives 10.57 mio. €, M6 receives 15.51 mio. €, and the measures M1, M8 and M9 are not financed at all. The upper bound for the regional budget of Saxony-Anhalt is set at 7.73 mio. €, which is binding, as well as the upper bound for grassland.

3. Multi-level co-financing distortions

3.1 Parameterization of EU co-financing levels

In order to examine the relationship between the co-financing level and the budget allocation more closely, a parameterization of the EU co-financing level is carried out comparing the results with the budget allocations of a respective lump-sum scenario with the same total budget volume. This comparison allows to assess the distortions of the current multi-level co-financing system. For this purpose, we parameterize the level of EU co-financing between 0% and 100 %. We proceed by gradually changing the coefficients of the regional budget (Table 1, row 8) in steps between 0 and 1 for M5 and VNS measures. Respectively, the coefficients are changed between 0 and 0,4 for MSL measures, corresponding to a co-financing level from the EU between 0 % and 100 %. For each level of EU co-financing a lump-sum scenario is calculated with an equivalent overall budget. In the lump-sum scenarios the coefficients of the regional budget are set to 1.

Figure 1 displays the resulting budgets at every EU co-financing level and for the respective lump-sum scenario. The figure shows that there is no difference in the budget volumes for the measures M2, M4, M8, and M9 between the co-financing and the lump-sum scenario. M2 receives the budget volume of the upper bound (6 mio. €) at any level of EU co-financing and the respective lump-sum. M4 does not reach the upper bound at lower levels of EU co-financing and the lump-sum scenario, due to the lower bound for grassland use of 20,000 ha. Above a 20 % EU co-financing level and the respective lump-sum financial volume, M4 is fully financed at the upper bound. The reasons for the high priority of M2 and M4 in both scenarios are the high objective coefficients.

Despite the lowest objective coefficients, M8 and M9 are financed at high levels of EU co-financing and the respective lump-sum scenario. These measures are the only ones not using any grassland; hence, above about 80 % of EU co-financing and the respective lump-sum volume they receive the additional financial volume, as the upper bound for grassland is binding.

------------Figure 1.------------

For the measures M1, M3, M5, M6, and M7 there is a difference in funding between the co-financing and the lump-sum scenarios. M5 and M7 are not financed for lower budget volumes in both scenarios. They switch to the upper bound above about 50% EU co-financing level, whereas the same switch occurs under the lump-sum scenario only at higher financial volumes. The figure shows a similar picture for M6, but in contrast, the switch occurs at lower financial volumes under the lump-sum scenario. Therefore, for M5 and M7 the multi-level co-financing system increases the incentives at lower financial volumes, whereas it decreases incentives for M6. With respect to M1 and M3, these measures would not be financed at all (M1) or at lower levels (M3) under the lump-sum scenarios, whereas they receive a considerable priority under the co-financing scenarios for specific co-financing levels. M1, thus, receives a budget between about 40 % and 70 % of EU co-financing. For M3, from a EU co-financing level from about 20 % to 80 %, the budget is raised to the upper bound of 15 mio. €.

3.2 Trade-off between measures

In order to analyze the interrelations between the measures more closely, Figure 2 illustrates the parameterization of the EU co-financing level and of the lump-sum scenario of selected measures within one diagram. M2, M4, M8, and M9 are not displayed in this figure, as there

is no difference in the budgets between the co-financing and the lump-sum. The budgets of the remaining five measures are represented in per cent of the respective upper bounds.

----------------Figure 2.------------

For the co-financing scenario, the figure shows a clear trade-off between the VNS measure M6 on the one hand and the MSL measures M1 and M3 on the other hand in the range of about 55 % to 80 % of EU co-financing level. Starting from a 55 % EU co-financing level, with increasing external funding M3 is substituted by M6. For M5 and M7 there is no trade-off with respect to the other measures and between the measures themselves and the picture is more simple. As discussed for Figure 1, these measures switch from zero to a 100 % financing level at around 50 % EU co-financing.

The results of the lump-sum parameterization also show a clear trade-off between M6 and M3, but this trade-off already occurs at lower financial volumes. M6 starts to be financed with a total financial budget of about 22 mio. € and above. When the measure reaches its upper bound at a total financial volume of about 45 mio. €, M3 starts to be financed again and M5 and M7 are financed as well.

3.3 Objective 1 status and Luxembourg decisions

Following the EU enlargement Saxony-Anhalt may loose its 'objective 1' status with a high EU co-financing level, but according to the Luxembourg decisions the EU co-financing level will generally be increased for agri-environmental programs by 10 percent points. If we consider the two possible future scenarios for Saxony-Anhalt, 'Loss of Objective 1 status' (A) or 'Retaining objective 1' status (B), by looking at the respective EU co-financing levels of 85 % (A) and 60 % (B), we find that Saxony-Anhalt is faced with two different strategic options. If the federal state retains 'objective 1' status, VNS measures would gain priority. If

the 'objective 1' status is lost, MSL measures would be strengthened diminishing the decline of external EU co-financing.

At the higher level of EU co-financing after the Luxembourg decisions under scenario A, the losses of external grants for each regional Euro going into other measures than to MSL measures, which are additionally financed by the federation, are reduced. Hence, the opportunity costs for shifting money to VNS measures decrease.

At the lower level of EU co-financing in scenario B, the importance of MSL measures rises, as the federation is co-financing 60 % of the regional share for MSL measures. The previously financed M6 becomes too costly and is substituted by MSL measures, even though these measures have lower objective coefficients (Table 1, row 4 and 5).

The two different strategic options for Saxony-Anhalt according to its 'objective 1' status are reflected in Figure 1 for a co-financing level of 85% (A) and 60 % (B), respectively. The figure shows the divergent incentive for funding specific measures in those cases.

3.4 Distortion levels

In order to analyze to what extent the multi-level co-financing system distorts the financing of measures as compared to an equivalent lump-sum scenario, Figure 3 displays the values of the objective function for both scenarios at different co-financing levels and lump-sum financial volumes, respectively.

-------------Figure 3.-----------

As can be seen in Figure 3, the values of the objective function are lower under the co-financing scenario than under the lump-sum scenario in the interval between about 20 % and 80 % of EU co-financing. At low and at high levels of external grants there is no difference in the budget allocation between the lump-sum and the co-financing scenarios. At high EU co-financing levels the difference in co-financing between MSL and VNS measures becomes so

small, that there is no distortion under the co-financing scenario. At low financial volumes, the lower bound for grassland causes the same choice of measures for both scenarios and there is no distortion in the multi-level co-financing system.

The findings show that budget allocation and priority setting for the agri-environmental program in Saxony-Anhalt would be different and would lead to higher 'objective achievement', if Saxony-Anhalt received federal and EU grants as a lump-sum. In the case study considered, the difference in the values of the objective function between the EU co-financing system and the lump-sum scenarios would amount to up to 6 % for a EU co-financing level of 60 %. Hence, the objective achievement could be increased by this amount in an undistorted financing system. This is considerable, but not as high as might have been expected. This is mainly due to the specific restrictions in the case-study, like the upper bounds and grassland restrictions.

4. Conclusions

The influence of different mixed co-financing schemes on regional policy-making has been considered exemplarily using the results of an interactive programming approach for the case of designing the agri-environmental program of Saxony-Anhalt. The implications of co-financing have been discussed for several policy scenarios.

First, the current EU co-financing system for agri-environmental programs certainly provides an extended financial budget for these programs.

Second, the mixed co-financing system changes priority setting and the allocation of funds between measures. It is obvious that a region can maximize benefits from external grants by shifting money into measures with higher external co-financing levels. Furthermore, the results draw a more detailed picture showing that the impact of mixed co-financing in the German system on regional policy-making will decline when the EU co-financing level is

increased, due to a reduced difference of the external co-financing level between measures. Respectively, the impact rises when the EU co-financing level is reduced. For the case of Saxony-Anhalt there are two opposite strategic options arising. If the 'objective 1' status is lost after the decisions of Luxembourg, MSL measures would gain a higher priority. If, on the other hand, Saxony-Anhalt retains 'objective 1' status, VNS measures would gain a higher priority, due to an increased co-financing level.

Third, if Saxony-Anhalt receives EU and federal grants as a lump-sum, giving the chance of undistorted policy decision-making, the values of the objective function are higher in all scenarios than with co-financing.

It can be assumed, that local actors have a good knowledge about the impact of agri-environmental measures in a region and also better represent local preferences for the provision of public goods than upper political levels. Therefore, the lump-sum scenario shows a best and undistorted allocation of funds from a regional point of view. The results are congruent with the principle of 'fiscal equivalence' and the demand for extended and unbiased local responsibility (Osterburg and Stratmann, 2002 p. 276). The case study of the agri-environmental program of Saxony-Anhalt underlines the general problem of decision-making and co-financing in a multi-level political system (Oates, 1999 p. 1122).

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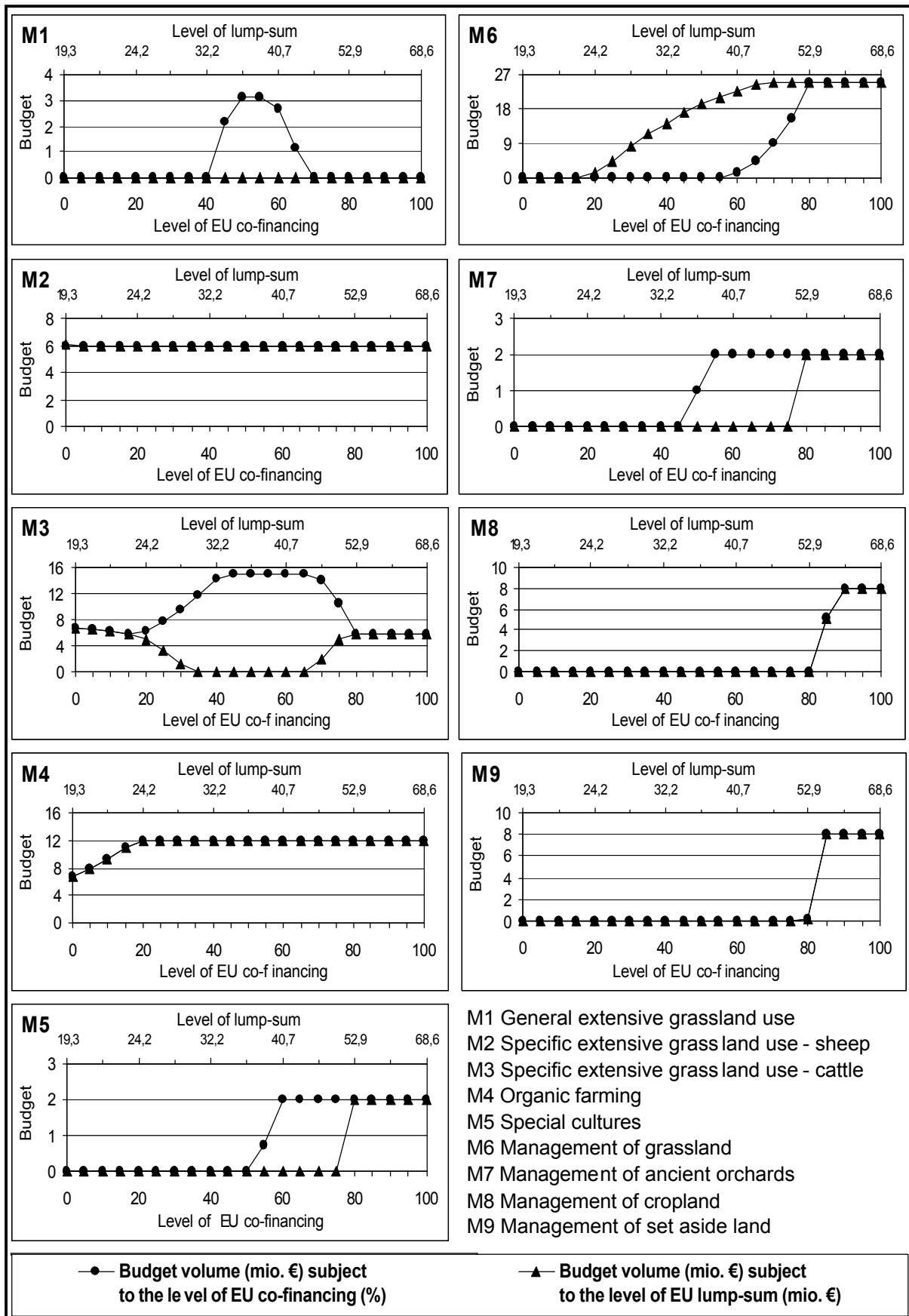
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Table 1. Input matrix of reference situation.

1.		Ext.grassl. whole farm (M1)	Ext. grassl. sheep (M2)	Ext. grassl. cattle (M3)	Organic farming (M4)	Spec. crop cultivation (M5)	Environm. manag. grassl. (M6)	Manag. ancient orchards (M7)	Environm. manag. cropland (M8)	Set aside land (M9)	Sum	
2.	Current allocation	23.0 mio. €				1.736 mio. €	20.0 mio. €				44.736	Current allocation for 2004-2008 (mio. €)
3.	Optimal allocation	0.000	6.000	10.573	12.000	2.000	15.507	2.000	0.000	0.000	100.0	Upper bound for overall budget (mio. €)
4.	Objective: Agr. labour	6.0	6.5	6.0	7.0	5.0	6.0	4.0	3.0	2.9		Objective coefficients for obj. 1 (weight: 0.5)
5.	Objective: Environm. quality	5.0	6.9	6.0	7.0	5.5	7.1	7.0	5.0	5.3		Objective coefficients for obj. 2 (weight: 0.5)
6.	Upper bounds	25.0	6.0	15.0	12.0	2.0	25.0	2.0	8.0	8.0	103.0	Absolute upper bounds for measures (mio. €)
7.	Lower bounds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Absolute lower bounds for measures (mio. €)
8.	Regional budget	0.10	0.10	0.10	0.10	0.25	0.25	0.25	0.25	0.25	7.734	Upper bound for regional budget (mio. €)
9.	Grassland upper bound	1785.7	1282.1	1538.5	303.0	0.0	800.0	0.0	0.0	0.0	40000	Upper bound for grassland (ha)
10.	Grassland lower bound	1785.7	1282.1	1538.5	303.0	0.0	800.0	0.0	0.0	0.0	20000	Lower bound for grassland (ha)

Source: Own illustration and calculations.

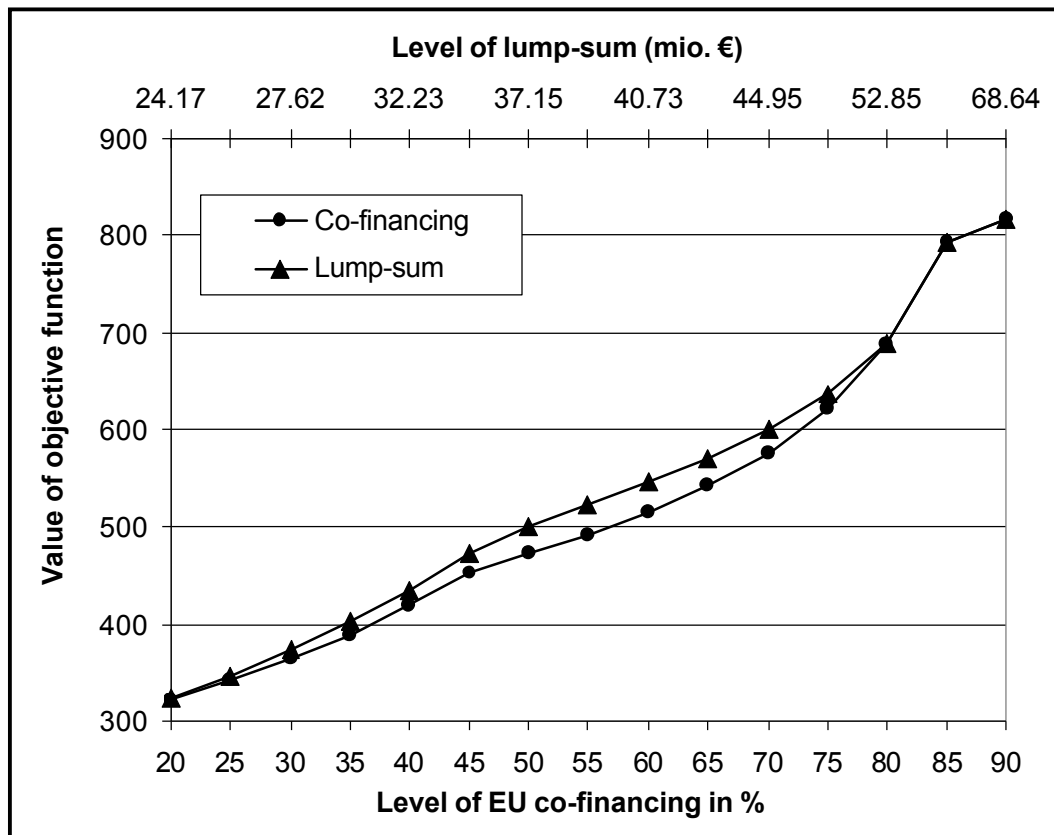**Figure 1. Parameterization of EU co-financing and lump-sum levels.**

M1 General extensive grassland use
M2 Specific extensive grass land use - sheep
M3 Specific extensive grass land use - cattle
M4 Organic farming
M5 Special cultures
M6 Management of grassland
M7 Management of ancient orchards
M8 Management of cropland
M9 Management of set aside land

— ● — **Budget volume (mio. €) subject to the le vel of EU co-financing (%)**

— ▲ — **Budget volume (mio. €) subject to the level of EU lump-sum (mio. €)**

Source: Own calculations.

Figure 2. Trade-off between measures.
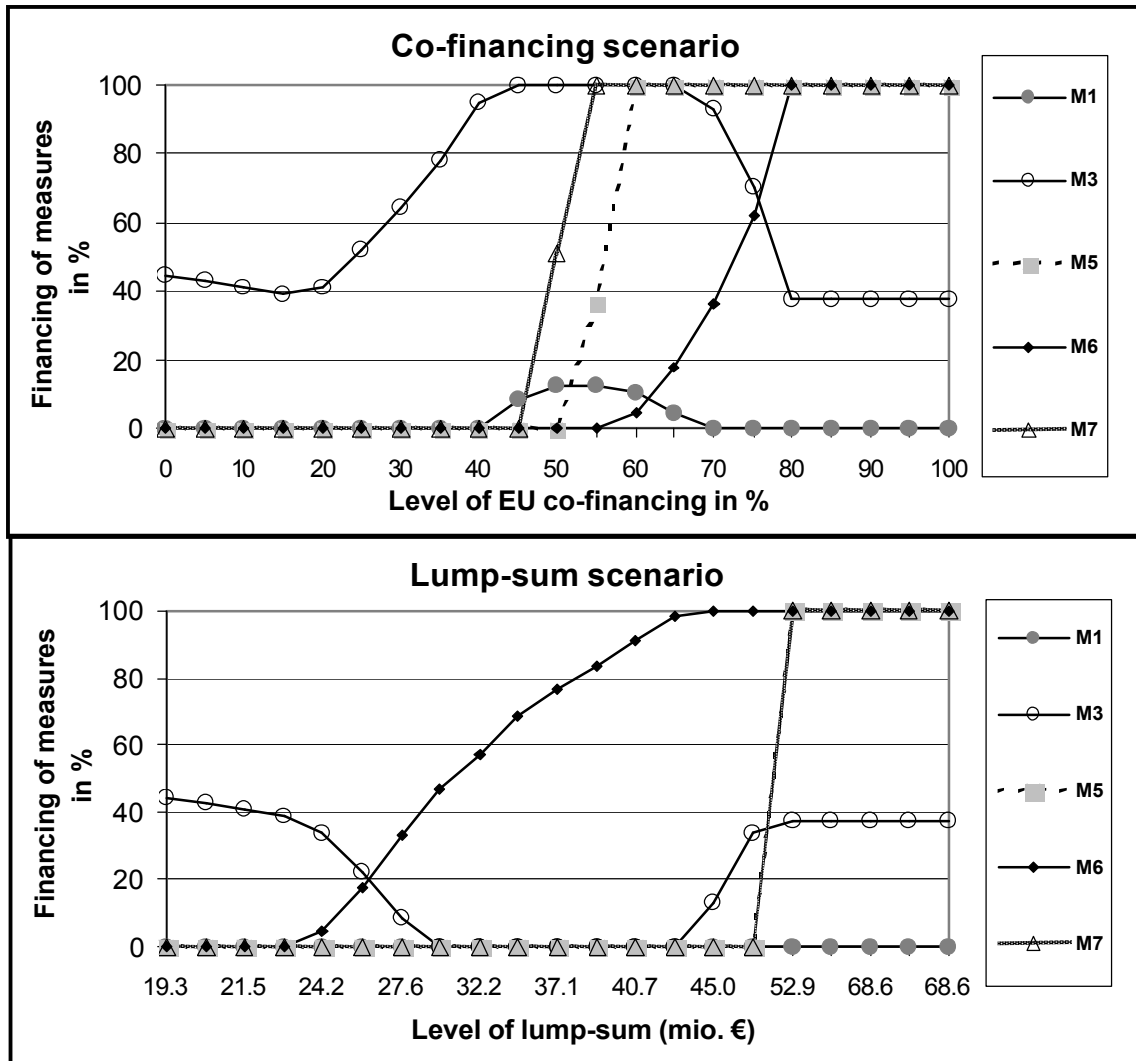
Figure 3. Values of the objective function.

Source: Own calculations.