European Farms' Participation in Agri-environmental Measures

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Abstract
Due to their diversity and voluntariness, agri-environmental measures (AEMs) are among the Common Agricultural Policy instruments that are most difficult to assess. We provide an EU-wide analysis of AEM adoption and AEM support received per hectare using a Heckman sample selection approach and single farm data. Our analysis covers 23 Member States over the 2000-2008 period, assesses the entire portfolio of AEMs and focuses on the relationship between AEM participation and farming system. Results show that participation in AEMs is more likely in less intensive production systems, where, however, per hectare premiums tend to be lower. Member States group into three categories: high/low intensity farming systems with low/high AEM enrollment rates, respectively, and large high diversity countries with medium AEM enrollment rates.

Keywords: Agri-environmental; CAP; farm; EU; estimation.

1 Introduction

A core question in the debate on how to promote public goods provision by the Common Agricultural Policy (CAP) in the new programming period 2014 to 2020 concerned agri-environmental measures (AEMs): should we deepen cross-compliance by a small set of mandatory, uniform measures across the EU as found in the 'greening' approach or rather strengthen the current approach where a rich variety of AEMs is programmed more site specific by the Member States? The compromise adopted by the Council of EU Agriculture Ministers on 16 December 2013 now foresees both compulsory new 'green direct payments' which make up 30 percent of national direct payments in Pillar I as well as the continuation of AEM under Pillar II. The continuation of AEMs along with the flexibility of countries to shift funds between the two pillars once more raises the question on how these measures can be assessed both in economic and ecological terms.

AEMs provide area-based compensation payments for farmers who in turn carry out agri-environmental services that go beyond the application of usual good farming practice.[1] In practice, farmers voluntarily enter a 5-year commitment for cultivating a certain amount of area under specific agri-environmental (AE) guidelines. In fact and in spite of about 20 years of research on AEMs, their impact on agricultural production, farm incomes and environment is still difficult to assess. Due to their large diversity – they are programmed at Member State or even regional level - and their character as voluntary opt-in instruments, they can hardly be assessed and modelled uniformly across EU Member States. The number of AE programmes as well as the share of agricultural land enrolled varies significantly across EU Member States (cf. section 4).

Therefore, AEM impact assessments are usually rather narrow, both in terms of measures and regional scope considered and in terms of width of implications analysed. Available empirical AEM studies usually focus on specific measures in single regions or countries, providing either economically or ecologically focused assessments (Uthes and Matzdorf, 2013 provide a recent and comprehensive review of the AEM literature). Economically focused analyses are for instance provided by Bamière et al. (2011), Claassen et al. (2008), Matzdorf and Lorenz (2010), Peerlings and Polman (2008), Sattler and Nagel (2010), Uthes, Matzdorf, et al. (2010), Uthes, Sattler, et al. (2010), Wätzold et al. (2008), Wilson et al. (1999). Ecologically focused assessments are for example provided by Casey and Holden, (2006), Critchley et al. (2004) and Feehan et al. (2005). Additionally, also sociological in-depth studies of farmers'

[1] The majority of agri-environmental (AE) programmes in the EU comprise measures targeting management of grass and semi-natural forage, input management, management plans and record keeping, soil cover, soil management, buffer strips, crop management and landscape feature management (Keenleyside et al., 2011).

sociological and cultural reasons for participating in AEMs are available, for example Emery and Franks (2012), Burton et al. (2008), Falconer (2000).

In order to be able to quantify past and future economic and ecological impacts at a larger regional scale, one first needs to know whether AEM participation and AEM support received across measures and countries can be attributed to certain groups of farms. This means, one needs to identify whether farmers' participation in AEMs is correlated with certain common characteristics *across* measures and regions and, if so, what these characteristics are. We therefore aim at analysing farmers' AEM uptake and the AEM support received per ha of the total Utilised Agricultural Area (UAA) across measures and countries at EU-27 level.

Though a vast amount of general AEM literature exists (cf. Uthes and Matzdorf, 2013), the literature on farmers' uptake of AEMs in the EU is rather limited (a literature review on the adoption of conservation agriculture focusing on North and South America and Africa is provided by Knowler and Bradshaw, 2007). In the European literature, farmers' participation in AEMs has usually been analysed by means of econometric discrete choice models[2]. In the empirical part of their paper, Vanslembrouck et al. (2002) apply a probit model to the analysis of farmers' uptake of two different AEMs (farm beautification and buffer strips) in the Belgium Flemish and Walloon regions, respectively. Their sample comprises 390 farms. Dupraz et al. (2003), again using a probit model, analyse the participation of 248 farmers in an AEM to protect the nesting of endangered birds in the Walloon region, Belgium. Defrancesco et al. (2008) distinguish between non-participation and participation in one of three specific AEMs (low-input measures and grassland conservation in two different geographical zones) in Veneto, Italy by means of a multinomial logit model. Their analysis applies to 139 farms surveyed in 2005/06. Hynes and Garvey (2009) use panel data (about 1,100 farms per year in the period 1995-2005) from the Farm Accountancy Data Network (FADN) to model Irish farmers' participation in AEMs based on a logit model. Pufahl and Weiss (2009) evaluate the effects of AEMs in general (across measures) on input use and farm outputs in Germany by means of a propensity score matching. These propensity scores for participating in AEMs of 32,000 farms in the time period 2000 to 2005 are derived using a logit model. Giovanopoulou et al. (2011) analyze the participation and the extent of participation in terms of hectares enrolled of 125 farmers in a nitrate reduction programme in Larisa, Greece using a Heckman sample selection model. Since not only AEMs participation itself, but also the extent of participation in terms of enrolled farming area is voluntary, we follow a similar approach as Giovanopoulou et al. (2011) by applying a two-step Heckman sample selection model where in the first step the farm characteristics driving farmers' participation in AEMs and in the second step the characteristics affecting the support received per ha of the total UAA are identified. Our analysis is based on data from 157,862 sample farms across 23 EU Member States[3] surveyed in the time period 2000 to 2008.[4]

With respect to explanatory variables, studies based on questionnaires – naturally - put emphasis on characteristics and attitudes of the farmer herself (e.g. environmental awareness, education, age; Vanslembrouck et al., 2002, Dupraz et al., 2003, Defrancesco et al., 2008, Giovanopoulou, 2011), not available for large-scale samples. Another focus in the literature is on different measures characterizing the production portfolio of farms (e.g. farm type measures, livestock densities, cropping shares; Dupraz et al., 2003, Defrancesco et al., 2008, Pufahl and Weiss, 2009, Hynes and Garvey, 2009, Giovanopoulou et al., 2011). Finally, farm characteristics are often considered (e.g. farm size, share of rented land; Vanslembrouck et al.,

[2] We focus on quantitative assessments here since other methods are not applicable in a EU-wide context.
[3] Bulgaria, Romania, Cyprus and Lithuania are not considered since no counts on AE programme participation were available from the database.
[4] A similar approach based on a probit model representing the decision on considering AEM participation and a tobit model representing participation and extent of participation in terms of acreage is applied by Ma et al. (2012) for a sample of 1,700 farms and some hypothetical AEMs in Michigan, USA.

2002, Defrancesco et al., 2008, Pufahl and Weiss, 2011). Most of the studies mentioned above (especially Hynes and Garvey, 2009, whose analysis is based on similar data as ours), but also descriptive studies relying on surveys on farmers' participation in AEMs repeatedly state the importance of how well the measures fit into the actual production programme (e.g. Wilson and Hart, 2000, Sattler and Nagel, 2010, Keenleyside et al., 2011). This observation fits with our aim of attributing participation and support levels to certain groups of farms. We therefore focus on identifying the relationship between different *production activities* and AEM adoption and support received by considering eight different cropping shares and four different animal activities. Additionally, farm size, location in a less favoured area and a trend are taken into account.

The paper contributes to the literature on farms' participation in AEMs by providing the first EU-wide empirical analysis (a very detailed descriptive analysis of AEMs in the EU is provided by Keenleyside et al., 2011). Additionally, it is one of very few studies analysing AEM participation across measures (another one being provided by Pufahl and Weiss, 2009 for Germany) and clearly focusing on the relationship between AEM participation and a wide range of production activities (another one being provided by Hynes and Garvey, 2009 for Ireland).

The paper is organized as follows. Section 2 gives an overview of AEMs in the EU, describes the database and compares the AEM participation rate and monetary extent of AEM support across the EU Member States. Section 3 describes the estimation method applied, followed by the introduction of the explanatory variables in section 4. Section 5 presents the results at EU level and section 7 sets them into regional and political context. Section 7 concludes.

2 Agri-environmental measures in the EU

This section provides a brief overview of the agri-environmental policy in the EU (section 2.1), describes the database used in our empirical analysis and compares AEM participation rates and the extent of AEM support received per UAA across the EU Member States based on the FADN database (section 2.2).

2.1 Agri-environmental policy in the EU

While few Member States started experiencing with agri-environmental contracting in the 1980s, optional AEMs became part of European Community law in Council Regulation (EEC) 797/85 in 1985. As part of the 1992 MacSharry reforms, Council Regulation (EEC) 2078/92 prescribed the mandatory implementation of an agri-environmental programme for all Member States. In 1999, AEMs were continued by transferring the legislation to the Rural Development Regulation (EEC 1257/99) as part of the the Agenda 2000 CAP reform (European Commission, 2005, Latacz-Lohmann and Hodge, 2003).

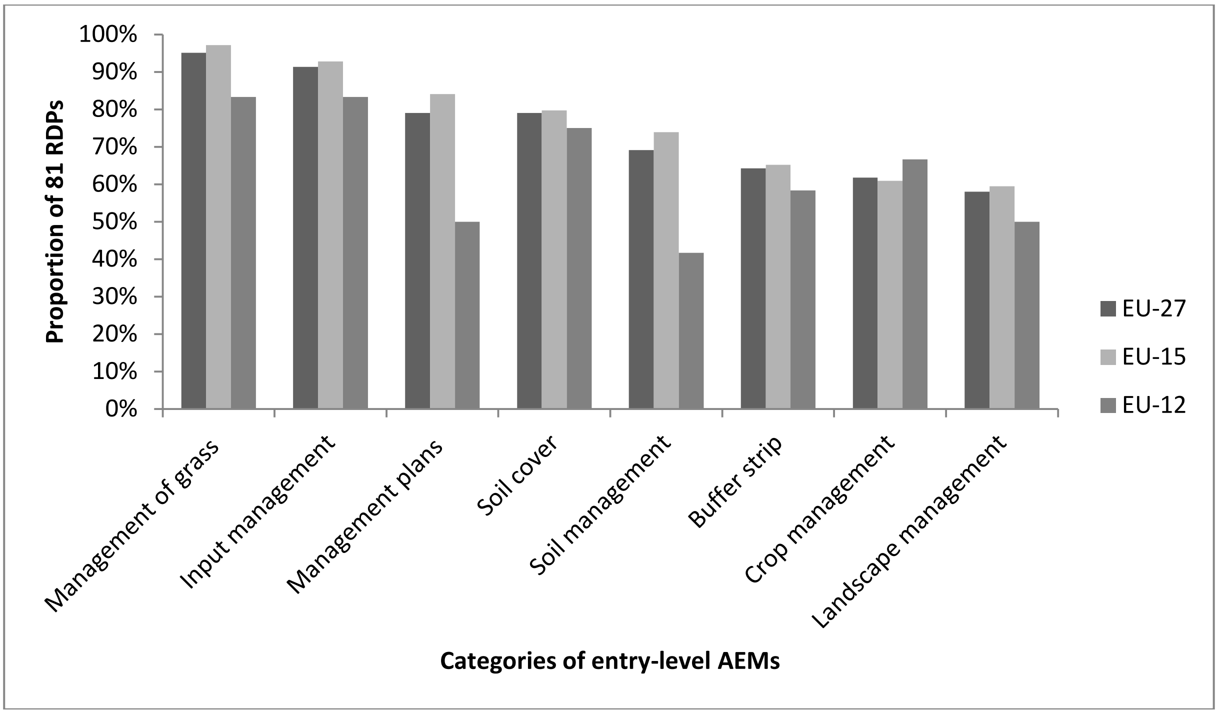
In the programming period 2007-2013, AEMs accounted for a large share of expenditure (23 percent) of the European Agricultural Fund for Rural Development (EARDF), the so-called second pillar of the CAP, which in turn accounted for 20 percent of the fund dedicated to the CAP. Second pillar instruments are co-financed by the Member States, so that, in terms of total expenditure, they are even more important.

A recent Institute for European Environmental Policy (IEEP) report systematically reviews so-called 'entry level' AE schemes in the 2007-2013 Rural Development Programmes (RDPs) of the EU (Keenleyside et al., 2011).[5] Though more demanding and less frequent

[5] The exact definition of 'entry level' reads: 1) management requirements that are close to the reference level; 2) not requiring significant changes to the system or farming and achievable by most of the target farms by: adjusting certain farming practices or continuing existing management that maintains environmental resources which might otherwise be under threat; 3) targeted at the majority of land and farms within a defined area, or of a specified type; 4) flat rate payments and few asso-

‘higher-level’ AE schemes are excluded from their analysis, the systematic typology developed by them will be briefly repeated here as it provides an excellent overview of the existing schemes. Keenleyside et al. (2011) review 81 RDPs in continental Europe (69 RDPs in the EU-15 and 12 RDPs in the EU-12) and classify the AEMs into 63 different types of management actions, which again are grouped into 15 broader categories. Figure 1 below reports the eight most important AEM categories found by them, i.e. those which are represented in at least 50 percent of the RDPs reviewed at EU-27 level.

Figure 1. AEM categories and their prevalence across the EU



Source: Adapted from Keenleyside et al. (2011).

AEMs targeted to the management of grassland and semi-natural forage are represented in most of the RDPs, followed by input management programmes on the second and management plans on the third place. From the fourth to the eighth place, soil cover, soil management, buffer strip, crop management, and landscape feature management can be found in decreasing frequency. Apart from crop management programmes, measures of these eight categories are relatively more frequently represented in Western than in Eastern European Member States. The remaining seven AEM categories are less frequent and most of them are also difficult to capture by the production variables applied by us (e.g. ‘wildlife management’, ‘irrigation management’, ‘training’).

2.2 Farms’ participation in agri-environmental measures

Our analysis is based on sample data from the Farm Accountancy Data Network (FADN) for the years 2000 to 2008[6]. The FADN data are derived from a rotating panel and include information on the amount of AE payments each farm received[7]. According to Hynes and Garvey

ciated non-productive investments; 5) a relatively simple, non-competitive application process and desk-based approval process (Keenleyside et al. 2011, p. 2).

[6] FADN comprises only ‘professional farms’ (country-specific size thresholds apply).

[7] FADN variable JC800: Agri-environment and animal welfare payments. Animal welfare measures were implemented in the 2000-2006 programming period only in Germany and Scotland (AGRIGRID, 2008). In the 2007-2013 programming period, 21 programmes include animal welfare measures. In detail, animal welfare measures are implemented in Austria, Estonia, Finland, Germany, Hungary, eight regions in Italy, Slovakia, four regions in Spain and Scotland. However, on average across the Member States only 1.56 percent of the total Rural Development (RD) budget is allocated to animal welfare measures.

(2009) and our own descriptive analysis, considerable path dependency prevails in the system. If a farm received AEM payments at one point in time during the observation period, it is almost sure that it participates in AEMs for the whole period. Each farm was therefore picked only once in the time period 2000 to 2008. If a farm was observed in more than one year, only the latest observation is considered. In most Member States, the lower threshold for receiving AEM payments is set at 100 Euro in total per farm (i.e. a farm theoretically eligible for AEM payments of less than 100 Euro in total per year does not receive any AEM payment) and the upper threshold for AEM payments is 1000 Euro per hectare. Thus, farms receiving less than 100 Euro in total and farms receiving more than 1000 Euro per hectare were excluded as outliers from the sample (on average across the countries 0.43 percent of the farms are dropped as outliers). Table 1 displays descriptive statistics on the adoption rate and AEM support per ha per Member State. Bulgaria, Cyprus, Lithuania and Romania are not considered as no or not enough (less than 1 percent of the observed farms) data on the receipt of AE payments is available.

Table 1. Descriptive statistics of AE-payment recipience.

Country	Number of observations	Percentage of farms receiving AE-payments [%]	Average AE-payment per ha UAA [€/ha]	Standard deviation of AE-payments per ha UAA
AT	3029	96.4	260.0	139.9
BE	2936	46.8	48.6	75.9
CZ	2196	62.2	52.3	66.3
DE	13310	40.6	82.3	92.4
DK	7091	30.6	77.5	85.7
EE	640	76.5	40.8	23.9
ES	16966	8.3	91.5	97.5
FI	1423	92.9	161.6	79.2
FR	14217	22.8	55.2	53.7
GR	5946	4.5	265.6	80.6
HU	2494	39.6	107.1	76.3
IE	2183	46.0	157.2	71.3
IT	46561	15.2	279.1	195.1
LU	671	97.3	122.9	108.5
LV	1737	57.7	55.4	59.4
MT	376	4.9	146.7	122.3
NL	2791	15.2	133.9	130.9
PL	15723	20.9	84.1	81.8
PT	5991	23.4	161.2	154.9
SE	1693	88.9	92.2	71.1
SI	1023	80.1	170.7	114.1
SK	817	38.2	71.2	47.6
UK	8048	41.4	65.7	67.7

Source: Based on FADN 2000-2008.

Among the remaining 23 countries, the highest proportion of farms receiving AE payments in the FADN sample was observed in Luxembourg, Austria and Finland (97.3, 96.4 and 92.9 percent, respectively), the lowest proportion in Greece, Malta, and Spain (4.5, 4.9 and 8.3 percent, respectively). On average across the 23 countries, 45.7 percent of the farms received AE payments in the time period 2000-2008. As FADN reports only the total amount of money transferred, but not the area committed, the payments received are divided by the total UAA per farm. On average, farms participating in AEMs received 121 Euro per hectare UAA as AEM compensation. The lowest values can be found in Estonia, Belgium and the Czech Re-

The highest share of total RD budget devoted to animal welfare measures is 7.02 percent in the Italian region Valle d'Aosta. In the other regions the share varies from 0.06 percent in Galicia, Spain to 3.18 percent in Slovakia (Eurogroup for Animals, 2010).

public (40.8, 48.6 and 52.3 Euro per hectare, respectively). The highest values are observed in Italy, Greece and Austria (279.1, 265.6 and 260.0 Euro per hectare, respectively).

3 Method

This section describes the econometric setup of the analysis. Following Giovanopoulou et al. (2011), we apply a two-step (Heckman) sample selection estimation procedure. In its first step, a probit estimation is applied in order to represent farmers' decision on participation in AEMs. The second step then describes the AEM payments received per ha of farm land, conditioned on the participation decision.

3.1 First step: Adoption of AEM

The first step depicts the farmer's decision whether to join an AEM scheme or not. The binary variable Y_i represents this yes-no decision (Mittelhammer et al., 2000):

$$y_i = \begin{Bmatrix} 1 \\ 0 \end{Bmatrix} \text{ if } Y_i^* = x_i\beta + \varepsilon_i \begin{Bmatrix} > \\ \leq \end{Bmatrix} 0, \tag{1}$$

with the parameters β to be estimated, the explanatory variables x_i and the error term ε_i with $\mathrm{E}[\varepsilon_i] = 0$. Y_i^* is an unobservable latent variable. Assuming farmer i receives a utility U_{ij} when alternative j (=0 or 1) is chosen and further assuming utility maximizing behavior, farmer i chooses alternative $Y_i = 1$, if $U_{i1} > U_{i0}$, i.e. if $Y_i^* = U_{i1} - U_{i0}$ is such that $y_i^* > 0$ (Mittelhammer et al., 2000). For the observable binary variable Y_i (adoption or non-adoption of the AEM) follows:

$$y_i = \begin{Bmatrix} 1 \text{ if } y_i^* > 0 \text{ or } u_{i1} > u_{i0} \\ 0 \text{ if } y_i^* \leq 0 \text{ or } u_{i1} \leq u_{i0} \end{Bmatrix}, \tag{2}$$

leading to the linear regression model

$$Y_i^* = x_i\beta + \varepsilon_i. \tag{3}$$

The probability that $y_i = 1$, i.e. of enrolling in AEMs, can be represented by (choosing a Probability Density Function for ε_i that is symmetric around a mean of zero):

$$p_i = P(y_i = 1) = P(y_i^* > 0) = P(\varepsilon_i > -x_i\beta) = P(\varepsilon_i < x_i\beta) = F(x_i\beta). \tag{4}$$

In our case, a standard normal distribution is used:

$$p_i = F_{NORM}(x_i\beta) = \int_{-\infty}^{x_i\beta} (2\pi)^{-1/2} \exp\left(-\frac{z^2}{2}\right) dz. \tag{5}$$

The problem is then estimated using the log-likelihood function (Mittelhammer et al., 2000, Greene, 2002):

$$\ln\left[L(\beta;y)\right]=\sum_{i=1}^{n}\left[y_i\ln\left(1-F_{NORM}\left(-x_i\beta\right)\right)+\left(1-y_i\right)\ln\left(F_{NORM}\left(-x_i\beta\right)\right)\right] \tag{6}$$

where $F_{NORM}(\cdot)$ is the Cumulative Distribution Function (CDF) of the standard normal distribution.

Due to the non-linearity of expression (6), only marginal effects are meaningful for the results interpretation. Marginal effects are calculated as (Mittelhammer et al., 2000):

$$\frac{\partial p_i}{\partial x_i}=(2\pi)^{-1/2}\exp\left[-\frac{1}{2}\left(x_i\beta\right)^2\right]\beta_j\,. \tag{7}$$

The marginal effects are evaluated at their means. Significances of the marginal effects are derived using simulated results.

3.2 Second step: Amount of AE support received per hectare

The second step determines the impact of explanatory variables on the AEM support received per ha of total UAA, i.e. at the left hand side only participating farms are considered. For consistent estimation, the inverse Mill's ratio from the first step enters the second step as additional regressor (e.g. Mittelhammer et al., 2000, Greene, 2002):

$$Y_i=x_i\beta+\sigma\left[\frac{f_{NORM}\left(x_i\beta/\sigma\right)}{F_{NORM}\left(x_i\beta/\sigma\right)}\right]+V_i\,,\quad i=1,\ldots,n\,, \tag{8}$$

where now Y_i are the (positive) AEM payments per farm per hectare of total UAA. Please note that not the whole area necessarily needs to be enrolled in AEMs. However, the dataset does not comprise the number of hectares enrolled in AEMs per farm. Our approach thus measures the combined impact of the explanatory variables on the share of hectares enrolled and the 'intensity' of the program in terms of amount of support paid per hectare. It also fits to our aim to allocate AEM budgets to different farm types across Europe. Equation (8) is estimated via ordinary least squares (OLS) with σ being set to 1 (Mittelhammer et al., 2000). Significances of the coefficients and the marginal effects[8] are derived using a bootstrap procedure.

4 Determinants of farms' participation in agri-environmental measures

The explanatory variables used in the analysis refer to three categories: 1) shares of cropping areas (in percent) for eight crops respectively crop categories, 2) livestock intensities (Livestock Units per hectare) and 3) other variables (economic size and a dummy variable for the participation in the Less Favoured Area scheme). They are displayed in Table 2 (constant and trend not listed).[9] Most of them are chosen to represent the production scheme of the farms, which is largely conceived as being one of the most important drivers for the uptake of AEMs (e.g. Wilson and Hart, 2000, Hynes and Garvey, 2009, Keenleyside et al., 2011). In order to avoid perfect collinearity of the cropping shares, we excluded the areas for potatoes, sugar

[8] Marginal effects in the second step estimation are calculated to ease results interpretation due to nonlinear terms in the explanatory variables.
[9] Country-wise descriptive statistics of the explanatory variables can be provided upon request.

beet, hops, tobacco, other industrial crops, mushrooms and seeds. On average 91.4 percent of the total UAA are covered by the included cropping shares.[10] We estimate each country independently, acknowledging that programs and farm conditions differ considerably across the EU Member States.

Countries where the AE participation was very low or very high (below 7 percent - Greece and Malta - or above 93 percent - Austria and Luxembourg) are not considered in the first step estimations as there is too little variation in the dependent variable. However, the second step estimations are applied to them as well in order to identify the characteristics steering the extent of AE support received.

Table 2. Definition and summary descriptive statistics of the explanatory variables.

Abbr.	Variable	Unit	FADN code	Mean across countries	Std. dev. across countries
			Cropping shares		
CERE	Share of cereals area	%	SE035 / SE025	30.06	26.59
GRASS	Share of grassland area	%	(K150AA + K151AA) / SE025	26.44	27.21
OILS	Share of oilseed crops area	%	K132AA / SE025	3.96	7.39
VEGET	Share of vegetable area	%	SE046 / SE025	6.73	17.44
PERMCROP	Share of permanent crops area	%	SE054 / SE025	5.85	16.01
WINE	Share of vineyards area	%	SE050 / SE025	4.91	14.85
OFOD	Share of other fodder crops area	%	(K144AA + K145AA + K147AA) / SE025	16.83	22.30
PULSES	Share of pulses area	%	K129AA / SE025	0.57	2.91
			Stocking density of livestock activities		
DAIRY	Dairy cows (in LU) per ha	LU/ha	SE085 / SE025	0.62	11.42
SUCKLER	Suckler cows (in LU) per ha	LU/ha	D32AV*0.8 / SE025	0.07	0.35
SUCKLERroot	Root of suckler cows (in LU) per ha		D32AV*0.8 / SE025	0.10	0.21
SHEEP	Sheep and goats (in LU) per ha	LU/ha	SE095 / SE025	0.29	9.58
PIPO	Pigs and poultry (in LU) per ha	LU/ha	(SE100 + SE105) / SE025	3.94	46.81
			Farm size and LFA location		
ESU	Economic size	European Size Units (ESU)	SE005	94.97	159.62
LFApart	Participation in LFA scheme	0 = no, 1 = yes	JC820	0.42	0.40

Source: Based on FADN 2000-2008.

5 Results

Country-wise estimated coefficients and marginal effects for first and second step estimations are given in the appendix. The fractions of correct predictions of the first step are given in the last column of Table A 1. On average across the countries, 79 percent of the outcomes are correctly predicted by the explanatory variables chosen. The lowest fraction of correct predictions is attained in Ireland (64 percent), the highest in Finland (96 percent). The last column of Table A 3 displays the R^2s of the second step (AE payments received per ha). On average across the Member States the R^2 is 0.35, a normal value for panel data analyses. The smallest R^2 is found in the UK (0.08), the highest in the Czech Republic (0.80). In the tables below a summary of the marginal effects of step 1 (Table 1) and step 2 (Table 2) across the countries is given. The results analysis mainly draws on these two tables and is structured according to the types of explanatory variables (cropping shares, stocking densities, and other farm characteristics).

[10] Initially, also fertilizer and plant protection input were considered as explanatory variables. However, both were highly correlated with each other and finally left out due to endogeneity with the dependent variables.

Table 1. Summary of marginal effects of the AEM adoption equation (first step).

Explanatory variable	Applied in # countries	Significant in # countries	Significant in % of cases	Positive in # of significant cases	Positive in % of significant cases	Negative in # of significant cases	Negative in % of significant cases
Cropping shares							
CERE	18	10	55.6	8	80.0	2	20.0
GRASS	18	15	83.3	14	93.3	1	6.7
OILS	14	10	71.4	8	80.0	2	20.0
VEGET	17	14	82.4	0	0.0	14	100.0
PERMCROP	14	8	57.1	3	37.5	5	62.5
WINE	8	5	62.5	3	60.0	2	40.0
OFOD	18	15	83.3	11	73.3	4	26.7
PULSES	10	9	90.0	9	100.0	0	0.0
Stocking densities of livestock activities							
DAIRY	18	10	55.6	1	10.0	9	90.0
SUCKLER	18	15	83.3	14	93.3	1	6.7
SHEEP	13	2	15.4	1	50.0	1	50.0
PIPO	17	6	35.3	0	0.0	6	100.0
Farm size and LFA location							
ESU	18	16	88.9	15	93.8	1	6.3
LFAPART	15	13	86.7	13	100.0	0	0.0
General							
TREND	18	16	88.9	14	87.5	2	12.5

Source: Estimation based on FADN 2000-2008.

Table 2. Summary of marginal effects of the premiums per ha received equation (second step).

Explanatory variable	Applied in # countries	Significant in # countries	Significant in % of cases	Positive in # of significant cases	Positive in % of significant cases	Negative in # of significant cases	Negative in % of significant cases
Cropping shares							
CERE	22	13	59.1	5	38.5	8	61.5
GRASS	21	14	66.7	10	71.4	4	28.6
OILS	17	6	35.3	2	33.3	4	66.7
VEGET	21	12	57.1	8	66.7	4	33.3
PERMCROP	18	15	83.3	13	86.7	2	13.3
WINE	13	12	92.3	11	91.7	1	8.3
OFOD	23	11	47.8	6	54.5	5	45.5
PULSES	12	6	50.0	6	100.0	0	0.0
Stocking densities of livestock activities							
DAIRY	22	15	68.2	4	26.7	11	73.3
SUCKLER	21	12	57.1	9	75.0	3	25.0
SHEEP	17	9	52.9	9	100.0	0	0.0
PIPO	22	11	50.0	7	63.6	4	36.4
Farm size and LFA location							
ESU	23	15	65.2	2	13.3	13	86.7
LFAPART	20	11	55.0	9	81.8	2	18.2
General							
TREND	23	12	52.2	8	66.7	4	33.3
MillRa	18	9	50.0	8	88.9	1	11.1

Source: Estimation based on FADN 2000-2008.

5.1 Cropping shares

In general, AEM participation appears to be triggered by less intensive cropping activities and hampered by the more intensive ones, a finding that is supported by Hynes and Garvey (2009) for Ireland in general and by others with respect to more specific crops and regions. In detail, cropping shares of cereals, grassland[11], oilseeds[12], and pulses[13] are clearly positively correlat-

[11] Grassland is usually associated with a high environmental value and supported by AEMs in most Member States (Keenleyside et al., 2011). This effect is also supported by findings of Pufahl and Weiss (2009).

ed with the participation in AEMs (80-100 percent of the significant marginal effects across countries are positive[14]), whereas vegetables cropping shares are clearly negatively correlated with AEM adoption (100 percent). Cropping shares of permanent crops tend to be negatively correlated (62.5 percent), which could be motivated by the often high production intensity such that AEM do not fit well with current farming practices, whereas vineyards and other fodder cropping shares tend to be positively correlated with AEM participation (60 and 73.3 percent, respectively).

The picture is less clear regarding the impact of cropping shares of different crops on the support received per ha. Once farms with high cropping shares of permanent crops and vineyards participate in AEM, the support received per ha is rather high (86.7 and 91.7 percent significant positive marginal effects), probably reflecting high AEM payments provided for these crops to compensate for high opportunity costs compared to not apply AEM practices (e.g. extensive olive groves). For pulses, again, the cropping shares are clearly positively correlated with the support per ha received (100 percent). Cropping shares of grassland, vegetables and other fodder crops tend to be positively correlated (in 54.5 to 71.4 percent of significant cases), whereas cropping shares of cereals and oilseeds tend to be negatively correlated with the support per ha received (61.5 and 66.7 percent respectively).

5.2 Stocking densities of livestock activities

Similar to cropping activity results, AEM participation appears to be triggered by low-intensity livestock activities and hampered by the others. Stocking densities of dairy cows and pigs and poultry[15] are clearly negatively associated with the participation in AEMs (90 and 100 percent of the significant cross-country marginal effects are negative). Stocking densities of suckler cows, a usually very low-intensity activity, on the contrary, are clearly positively correlated with the uptake of AEM (93.3 percent)[16]. With respect to sheep and goat stocking densities only two significant cases are observed, one of them displaying a positive (Ireland) and the other one a negative relationship (United Kingdom), which might reflect different AE policies targeted to sheep farming in the countries.

However, with respect to the amount of AEM support received per hectare, nine of nine significant marginal effects are positive for sheep and goat keeping. For dairy cows, a higher stocking density tends to decrease the support per hectare received (73.3 percent of the significant cross-country marginal effects are negative), whereas higher suckler cow and pig stocking densities tend to increase the financial support received (75 and 63.6 percent, respectively).

5.3 Farm size, less favoured area (LFA) and trend

Farm size (measured in economic terms[17]), less favoured area (LFA) location and trend are positively correlated with the probability of participating in AEM (93.8, 100.0 and 87.5 percent, respectively). Pufahl and Weiss (2009) also observe a positive relationship between AEM adoption and farm size in terms of area. In their review on 'farmers' adoption of conservation agriculture' in the Americas and Africa, Knowler and Bradshaw (2007) state that a

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[12] That fits with the observation that some Member States promoted oilseeds in the crop rotation by AEMs after CAP reforms have equalized per ha payments across Grandes Cultures. Equally, organic farming systems could show higher than average oilseed shares.

[13] This might be explained by the fact that organic farms typically show high cropping shares of nitrogen binding pulses, and that AE programmes either directly support cropping of pulses or indirectly by promoting lower mineral nitrogen fertilizer use.

[14] Only significant values are considered throughout the analysis.

[15] A negative effect of pig and poultry farming on the uptake of AEM is also supported by Pufahl and Weiss (2009).

[16] Similar results are found by Pufahl and Weiss (2009). In particular, they find that the cattle livestock density itself is negatively connected with AEM participation (though not significantly). However, restricting the analysis to farms with a positive, but relatively low density of cattle, a positive effect turns out in their analysis (Pufahl and Weiss, 2009).

[17] The unit of measurement is ESU (European Size Unit). One ESU relates to a standard gross margin of 1,200 Euro.

majority of studies observe a positive relationship between adoption of conservation techniques and farm size, a finding that might be explained by economies of scale to enroll in AEMs. LFA location is also often named among the factors being very closely related with AEM adoption (e.g. Pufahl and Weiss, 2009, Keenleyside et al., 2011).

With respect to support per hectare received, farm size has the opposite effect. The higher the farm size, the lower the payments per hectare received This relationship holds in 86.7 percent of the significant cases and might reflect the fact that farms specialized in intensive production system, such as fruits and vegetables where payment rates might be higher, tend to be smaller. However, for LFA location, again, a positive correlation with the support per hectare received is estimated in 81.8 percent of the significant cases. That might be explained by the fact with lower costs of extensification under less favorable production conditions.

With increasing time, the support per hectare tends to increase (66.7 percent of significant marginal effects).

Our findings thus support the often raised critique that AEMs are not able to reach high intensity farming systems, which have a higher probability of generating negative externalities. This can be followed from both the effect of LFA location (more marginal areas) and the impact of more extensive activities on participation rates. In cases where almost any farm in a country seems to be enrolled, one might also assume that programs provide a kind of flat rate support to common farming practices.

6 A Member State and policy perspective

It is interesting to put our findings in the context of the general discussion about the CAP. A first interesting observation is that four Mediterranean Member States (Greece, Spain, Malta and Italy) have the lowest enrollment rates (between 5 and 15%). Portugal with 23% is also well below the average of all Member States. That might be partly explained by the importance of fruits, vegetables, olive groves and vineyards in these countries, which are typically intensively managed, and also by a farm structure dominated by small scale farms. These countries might hence disfavor reforms which shift funds towards AEMs. They might also lobby for exemptions of small scale farms from compliance measures as now implemented for the 'Greening package'.

The opposite might be found in the Northern Member States (Sweden and Finland) with enrollment rates around 90% and countries dominated by mountainous conditions (Austria with the highest enrollment rates of 97%, Slovenia with 80% and the Czech Republic with 62%). These countries might have an interest in maintaining the available agricultural land where more marginal production conditions are found e.g. to foster bio- and landscape diversity. At least Sweden is also often mentioned as being in favor of more radical reforms of the CAP. Probably, the governments in these countries might assume that any negative impact of lower Pillar I payments could be mitigated by higher support to AEMs which already now covers almost their total farm population. Supporting our results, Glebe and Salhofer (2007) found that EU countries with a bigger tourism industry, regions where the productivity of agricultural land is lower and countries with a smaller percentage of agricultural population compared to the total population, hence, countries where more political weight is given to farmers' income tend to implement agri-environmental programs to a relatively larger extent. The low enrollment rates in the Netherlands (around 15%) can be clearly explained by the intensively managed production system dominating Dutch agriculture. The remaining countries show less clear tendencies. Poland (~21%) and France (~23%) as countries which are in favor of maintaining Pillar I support show relatively low rates of enrollments in AEM. For countries opposing shifts towards Pillar II, it might be politically wise to keep Pillar II programs limited. But clearly, similar to other larger Member States such as the UK and Germany, there are also considerable differences in natural conditions found in France and Poland, such that enrollment for instance in more mountainous regions might reach the high participation rates observed in the Northern Member States.

7 Conclusions

Our study provides the first EU-wide quantitative analysis of AEM participation. We focus on assessing AEM participation and monetary support received across measures and in relationship to farm production activities. The analysis is based on a Heckman sample selection approach modeling the decision on AEM adoption in a first and the amount of AEM support received per hectare in a second step. It is based on FADN single farm data from 2000 to 2008 and estimated separately for 23 EU countries.

The analysis shows that production characteristics play a significant role in the uptake of AEMs and AE payments received per ha. As a general rule, less intensive production activities (e.g. grassland, suckler cow husbandry) trigger AEM adoption of farmers both because they fit better with AEM requirements and AEM might also often be specifically targeted to them. Also comparably larger farm sizes and location in a less favoured area are usually associated with a higher probability of AEM adoption. Overall, our results support the often raised critique that AEM are not able to reduce negative externalities in intensive farming systems, but are rather used to keep low intensity farming systems in production.

The impact of the same explanatory variable on the AEM support per hectare UAA received might be different than in the adoption equation, which can sometimes be explained by the fact that though high intensity production systems are less likely to participate in AEM, once they do so, higher compensation payments are provided per hectare, and, probably also more hectares are enrolled in the programme. This reverse relationship holds for example for vegetable and permanent crop cultivation and pig and poultry husbandry. Whereas a higher farm size increases the likelihood of AEM participation it decreases the amount of per hectare support received. However, some farming activities and characteristics (grassland, pulses, suckler cows, LFA location) clearly foster AEM participation and also the amount of support received per hectare.

Setting our results into Member State and policy context, broadly, three country categories can be identified. First, countries with a majority of high intensive production systems like the Netherlands and Mediterranean Member States feature the lowest AEM enrollment rates and are thus more likely to disfavor reforms shifting funds towards AEMs. Second, Northern Member States (Sweden and Finland) and mountainous regions (Austria, Slovenia, and the Czech Republic) with bigger tourism industries, a lower land productivity and a relatively small agricultural population have the highest AEM enrollment rates probably reflecting their interest in maintaining a high bio- and landscape diversity. The third category of countries is mainly constituted of bigger Member States with a higher diversity of natural conditions and production systems and consequently shows less clear tendencies in AEM enrollment.

Our results can be further used in follow-up quantitative studies on economic and ecological effects of policies across Europe as for example demanded by Uthes and Matzdorf (2013).

References

AGRIGRID (2008). Methodological grids for payments in animal welfare measures (215) in the EU. Deliverable 8, Methodological grids for payment calculations in rural development measures in the EU, EU 6th Framework Programme, Project Reference: SSPE-CT-2006-044403.

Bamière, L., Havlík, P., Jacquet, F., Lherm, M., Millet, G. and Bretagnolle, V. (2011). Farming system modelling for agri-environmental policy design: The case of a spatially non-aggregated allocation of conservation measures. *Ecological Economics* 70: 891–899.

Burton, R.J.F., Kuczera, C. and Schwarz, G. (2008). Exploring Farmers' Cultural Resistance to Voluntary Agri-environmental Schemes. *Sociologia Ruralis* 48: 16–37.

Casey, J.W. and Holden, N.M. (2006). Greenhouse Gas Emissions from Conventional, Agri-Environmental Scheme, and Organic Irish Suckler-Beef Units. *Journal of Environment Quality* 35: 231.

Claassen, R., Cattaneo, A. and Johansson, R. (2008). Cost-effective design of agri-environmental payment programs: U.S. experience in theory and practice. *Ecological Economics*, Payments for Environmental Services in Developing and Developed Countries 65: 737–752.

Critchley, C.N.R., Burke, M.J.W. and Stevens, D.P. (2004). Conservation of lowland semi-natural grasslands in the UK: a review of botanical monitoring results from agri-environment schemes. *Biological Conservation* 115: 263–278.

Defrancesco, E., Gatto, P., Runge, F. and Trestini, S. (2008). Factors Affecting Farmers' Participation in Agri-environmental Measures: A Northern Italian Perspective. *Journal of Agricultural Economics* 59 (1): 114-131.

Dupraz, P., Vermersch, D., Henry de Frahan, B. and Delvaux, L. (2003). The Environmental Supply of Farm Households. A Flexible Willingness to Accept Model. *Environmental and Resource Economics* 25: 171-189.

Emery, S.B. and Franks, J.R. (2012). The potential for collaborative agri-environment schemes in England: Can a well-designed collaborative approach address farmers' concerns with current schemes? *Journal of Rural Studies* 28: 218–231.

European Commission (2005). Agri-environment Measures: Overview on General Principles, Types of Measures, and Application. Directorate General for Agriculture and Rural Development, http://ec.europa.eu/agriculture/publi/reports/agrienv/rep_en.pdf.

Eurogroup for Animals (2010). Overview of the animal welfare payment measure in EU Member States rural development programmes 2007-2013. Brussels, Belgium.

Falconer, K. (2000). Farm-level constraints on agri-environmental scheme participation: a transactional perspective. *Journal of Rural Studies* 16: 379–394.

Feehan, J., Gillmor, D.A. and Culleton, N. (2005). Effects of an agri-environment scheme on farmland biodiversity in Ireland. *Agriculture, Ecosystems & Environment* 107: 275–286.Giovanopoulou, E., Nastis, S.A. and Papanagiotou, E. (2011). Modeling farmer participation in agri-environmental nitrate pollution reducing schemes. *Ecological Economics* 70: 2175-2180.

Glebe, T. and Salhofer, K. (2007). EU agri-environmental programs and the "restaurant table effect". *Agricultural Economics* 37: 211–218.

Greene, W.H. (2002). *Econometric Analysis*, 5th ed. Prentice Hall, Upper Saddle River, N.J.

Hynes, S. and Garvey, E. (2009). Modelling Farmers' Participation in an Agri-environmental Scheme using Panel Data: An Application to the Rural Environment Protection Scheme in Ireland. *Journal of Agricultural Economics* 60: 546–562.

Keenleyside, C., Allen, B., Hart, K., Menadue, H., Stefanova, V., Prazan, J., Herzon, I., Clement, T., Povellato, A., Maciejczak, M. and Boatman, N. (2011). Delivering environmental benefits through entry-level agri-environment schemes in the EU. Report prepared for DG Environment, Project ENV.B.1/ETU/2010/0035.

Knowler, D. and Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food Policy* 32: 25-48.

Latacz-Lohmann, U. and Hodge, I. (2003). European agri-environmental policy for the 21st century. *Australian Journal of Agricultural and Resource Economics* 47: 123–139.

Ma, S., Swinton, S.M., Lupi, F. and Jolejole-Foreman, C. (2012). Farmers' Willingness to Participate in Payment-for-Environmental-Services Programmes. *Journal of Agricultural Economics* 63 (3): 604-626.

Matzdorf, B. and Lorenz, J. (2010). How cost-effective are result-oriented agri-environmental measures?—An empirical analysis in Germany. *Land Use Policy*, Forest transitions Wind power planning, landscapes and publics 27: 535–544.

Mittelhammer, R.C., Judge, G.G. and Miller, D.J. (2000). *Econometric Foundations*. UK: Cambridge University Press.

Peerlings, J. and Polman, N. (2008). Agri-environmental contracting of Dutch dairy farms: the role of manure policies and the occurrence of lock-in. *European Review of Agricultural Economics* 35: 167–191.

Pufahl, A. and Weiss, C.R. (2009). Evaluating the effects of farm programmes: results from propensity score matching. *European Review of Agricultural Economics* 36 (1): 79-101.

Sattler, C. and Nagel, U.J. (2010). Factors affecting farmers' acceptance of conservation measures—A case study from north-eastern Germany. *Land Use Policy*, Soil and Water Conservation Measures in Europe 27: 70–77.

Uthes, S. and Matzdorf, B. (2013). Studies on Agri-environmental Measures: A Survey of the Literature. *Environmental Management* 51: 251-266.

Uthes, S., Matzdorf, B., Müller, K. and Kaechele, H. (2010). Spatial Targeting of Agri-Environmental Measures: Cost-Effectiveness and Distributional Consequences. *Environmental Management* 46: 494–509.

Uthes, S., Sattler, C., Zander, P., Piorr, A., Matzdorf, B., Damgaard, M., Sahrbacher, A., Schuler, J., Kjeldsen, C., Heinrich, U. and Fischer, H. (2010). Modeling a farm population to estimate on-farm compliance costs and environmental effects of a grassland extensification scheme at the regional scale. *Agricultural Systems* 103: 282–293.

Vanslembrouck, I., Van Huylenbroeck, G. and Verbeke, W. (2002). Determinants of the Willingness of Belgian Farmers to Participate in Agri-environmental Measures. *Journal of Agricultural Economics* 53: 489–511.

Wätzold, F., Lienhoop, N., Drechsler, M. and Settele, J. (2008). Estimating optimal conservation in the context of agri-environmental schemes. *Ecological Economics* 68: 295–305.

Wilson, G.A. and Hart, K. (2000). Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. *Environment and Planning* A 32: 2161-2185.

Appendix

Table A 1. AEM adoption (first step), estimated coefficients.

	CONST	TREND	CERE	GRASS	OILS	VEGET	PERMCROP	WINE	OFOD	PULSES	DAIRY	SUCKLER	SUCKLERr	SHEEP	PIPO	ESU	LFAPART	Fraction of correct predictions
BE	-66.34 ***	19.78 ***	-0.90 ***	-1.08 ***		-2.47 ***	-2.23 ***		-1.14 ***		21.11 ***	-126.89 ***	148.66 ***		-0.13	0.12 ***	72.11 ***	0.75
CZ	-434.53 ***	41.20 ***	0.75 *	1.73 ***	1.33 ***	-0.41	0.46	1.26 ***	1.56 ***	2.61 *	-60.56 **	-334.24 ***	150.81 **	31.95	-0.03	0.11 ***	81.69 ***	0.79
DE	-26.29 ***	-1.62 ***	0.02	0.36 ***	-0.48 ***	-1.43 ***	-0.19	-0.32 ***	-0.31 **	4.76 ***	-39.07 ***	-197.10 ***	138.26 ***		-4.83 ***	0.03 ***	71.51 ***	0.69
DK	-49.20 ***	5.73 ***	-0.81 ***	0.35 **	-1.33 ***	-1.87 ***	-1.21 ***		0.28 **	3.61 ***	-0.17	-108.25 ***	70.62 ***		-0.06 *	0.03 ***		0.73
EE	-169.61 ***	13.43 ***	0.57 *	1.12 ***	1.25 *	-1.95	0.44		2.04 ***	11.86 ***	-95.58 *	-839.01	479.46 **	58.99	-9.68	0.19 **	49.18 ***	0.78
FI	-298.29 ***	1.77	0.19	-0.65	4.09 **	-0.19			1.30 ***		-76.99 *	5561.61	-1493.54		-3.40	0.44 **	403.95 ***	0.96
FR	-156.33 ***	0.29	-0.22	1.41 ***	1.22 ***	-0.83 ***	-0.46 **	-0.43 **	0.66 ***	2.02 ***	-1.82	-94.99 ***	60.48 ***	-0.13	-0.08	0.09 ***	85.85 ***	0.84
HU	-342.84 ***	36.75 ***	0.05	0.73 **	0.03	-0.93 **	0.69 **	0.48	0.71 *		0.48	-239.55 **	212.31 ***	8.48	-0.23	0.10 ***		0.71
IE	-5.71	7.85 ***	-0.49	-0.59					-0.91		-7.43	-41.26	26.21	51.10 ***		-0.75 ***	19.87 ***	0.64
IT	-118.06 ***	-6.29 ***	-0.07	0.75 ***	0.65 ***	-1.19 ***	0.40 ***	0.80 ***	0.37 ***	1.08 ***	0.00	-0.05	-21.05 ***	-1.29	-0.04	0.01 **	86.95 ***	0.86
LV	-256.49 ***	25.49 ***	0.61 ***	0.78 ***	2.52 ***	-1.56 ***	-0.77 *		1.47 ***		-8.90	-182.78	289.66 **	52.11	-0.23	0.02	7.56	0.68
NL	-156.56 ***	3.96 ***	0.62 **	0.89 ***		-0.74 ***	-0.57 **		-0.50 **		4.16	-133.47 ***	207.89 ***	-0.04	-0.06 *	0.00		0.85
PL	-405.39 ***	32.29 ***	0.58 ***	0.42 ***	1.09 ***	-0.33 *	-0.11		0.24	4.24 ***	-16.17 ***	-49.94	95.35 **		-0.07	0.01	34.46 ***	0.84
PT	-181.67 ***	2.08 ***	0.56 ***	0.31 ***		-0.42 **	0.88 ***	1.03 ***	-0.03		-4.85 *	-26.50 **	117.46 ***	-0.06	-0.03	0.14 ***	77.11 ***	0.79
SE	-44.59 **	3.44 *	0.64 ***	2.67 ***	0.95	-2.15 ***			2.74 ***	2.88	-49.10 **	-525.81 ***	371.79 ***	-2.67	-4.45 ***	0.32 ***	31.06 **	0.89
SI	43.63	11.98 ***	-0.27	-0.16	1.91	-1.93 *	0.07	-0.87	-2.56 ***		-54.42 ***	39.82	-4.18	-3.41	-39.35 ***	0.59 **	34.65 ***	0.81
SK	-428.10 ***	41.32 ***	-0.47	1.42 ***	-0.25	-0.47	0.61	0.29	2.14 ***	3.25 *	-53.73	-136.94	164.75	-62.13	-0.24	0.05 ***	24.58	0.86
UK	-225.41 ***	21.66 ***	1.16 ***	1.00 ***	2.32 ***	-0.84 ***			1.16 ***	1.62 ***	-27.59 ***	-105.44 ***	79.55 ***	-12.15 ***	-0.04	0.02 **	33.00 ***	0.77

Source: Estimation based on FADN 2000-2008. Significance levels: ***1 percent, **5 percent, *10 percent.

Table A 2. AEM adoption (first step), marginal effects.

	CONST	TREND	CERE	GRASS	OILS	VEGET	PERMCROP	WINE	OFOD	PULSES	DAIRY	SUCKLER	SHEEP	PIPO	ESU	LFAPART
BE	-24.19 ***	7.21 ***	-0.33 ***	-0.39 ***		-0.90 ***	-0.81 ***		-0.42 ***		7.70 ***	465.41 ***		-0.05	0.04 ***	0.28 ***
CZ	-173.30 ***	16.43 ***	0.30 *	0.69 ***	0.53 **	-0.16	0.18	0.50 ***	0.62 ***	1.04 *	-24.15 **	932.26 *	12.74	-0.01	0.04 ***	0.31 ***
DE	-10.12 ***	-0.63 ***	0.01	0.14 ***	-0.19 ***	-0.55 ***	-0.07	-0.12 ***	-0.12 **	1.83 ***	-15.04 ***	1265.99 ***		-1.86 ***	0.01 ***	0.28 ***
DK	-15.82 ***	1.84 ***	-0.26 ***	0.11 **	-0.43 ***	-0.60 ***	-0.39 ***		0.09 **	1.16 ***	-0.05	415.53 ***		-0.02 *	0.01 ***	
EE	-53.15 ***	4.21 ***	0.18 *	0.35 ***	0.39 *	-0.61 *	0.14		0.64 ***	3.72 ***	-29.95 *	3514.33 **	18.48	-3.03	0.06 **	0.15 ***
FI	-12.93 ***	0.08	0.01	-0.03	0.18 **	-0.01			0.06 **		-3.34 **	-1582.48		-0.15	0.02 **	0.94 ***
FR	-40.25 ***	0.08	-0.06	0.36 ***	0.32 ***	-0.21 ***	-0.12 **	-0.11 ***	0.17 ***	0.52 ***	-0.47	176.10 ***	-0.03	-0.02	0.02 ***	0.26 ***
HU	-119.45 ***	12.81 ***	0.02	0.25 **	0.01	-0.32 ***	0.24 **	0.17	0.25 *		0.17	2262.13 ***	2.96	-0.08	0.03 ***	
IE	-2.18	3.00 ***	-0.19	-0.22					-0.35		-2.84	69.89	19.54 ***		-0.29 ***	0.08 ***
IT	-23.22 ***	-1.24 ***	-0.01	0.15 ***	0.13 ***	-0.23 ***	0.08 ***	0.16 ***	0.07 ***	0.21 ***	0.00	-80.87 ***	-0.25	-0.01	0.00 **	0.24 ***
LV	-102.28 ***	10.16 ***	0.24 ***	0.31 ***	1.00 ***	-0.62 **	-0.31 *		0.59 ***		-3.55	3568.66 **	20.78	-0.09	0.01	0.03
NL	-27.82 ***	0.70 ***	0.11 **	0.16 ***		-0.13 ***	-0.10 **		-0.09 **		0.74	874.53 ***	-0.01	-0.01 *	0.00	
PL	-87.89 ***	7.00 ***	0.13 ***	0.09 ***	0.24 ***	-0.07 *	-0.02		0.05	0.92 ***	-3.51 ***	820.75 ***		-0.01	0.00 *	0.08 ***
PT	-47.24 ***	0.54 **	0.15 ***	0.08 ***		-0.11 ***	0.23 ***	0.27 ***	-0.01		-1.26 *	449.76 ***	-0.02	-0.01	0.04 ***	0.21 ***
SE	-4.58 **	0.35 *	0.07 ***	0.27 ***	0.10	-0.22 ***			0.28 ***	0.30	-5.05 **	545.06 ***	-0.27	-0.46 ***	0.03 ***	0.03 **
SI	11.67	3.20 ***	-0.07	-0.04	0.51	-0.52 **	0.02	-0.23	-0.69 ***		-14.55 ***	-2.53	-0.91	-10.52 ***	0.16 **	0.10 ***
SK	-110.93 ***	10.71 ***	-0.12	0.37 ***	-0.07	-0.12	0.16	0.07	0.56 ***	0.84 **	-13.92	918.57 *	-16.10	-0.06	0.01 ***	0.06
UK	-84.06 ***	8.08 ***	0.43 ***	0.37 ***	0.86 ***	-0.31 ***			0.43 ***	0.60 ***	-10.29 ***	292.01 ***	-4.53 ***	-0.02 *	0.01 **	0.13 ***

Source: Estimation based on FADN 2000-2008. Significance levels: ***1 percent, **5 percent, *10 percent. Negative values are shaded.

Table A 3. Premiums per ha received (second step), estimated coefficients.

	CONST	TREND	CERE	GRASS	OILS	VEGET	PERMCROP	WINE	OFOD	PULSES	DAIRY	SUCKLER	SUCKLERr	SHEEP	PIPO	ESU	LFAPART	MillRa	R^2
AT	4.39 ***	-0.03 ***	-0.03 ***	-0.02 ***	0.00	0.02 **	0.01 ***	0.02 ***	-0.03 ***	0.03 ***	0.91 ***	0.78	0.86 **	1.02 ***	-0.09 ***	0.00 **	0.02		0.35
BE	-256.46 ***	26.29 ***	-0.31	-0.31		0.98	-0.74		-0.23		-8.72	-149.43 ***	120.30 **		-1.40 **	0.09 *	69.08 ***	2.03 ***	0.24
CZ	-109.15 **	12.07 ***	0.21	1.76 ***	0.09	3.24 ***	3.18 ***	4.58 ***	0.98 ***	-0.15	-92.97 ***	-66.87	32.79	25.30	2.71	0.00	-3.06	0.24	0.80
DE	-6.99	-1.55 ***	0.09	1.17 ***	-1.21 ***	1.85 ***	1.82 ***	1.70 ***	0.08	4.70 ***	-46.43 ***	51.20	-8.12		-2.26 *	0.00	37.07 **	0.54	0.29
DK	106.83	-3.63	0.43	0.85 ***	-0.74	4.39 ***	1.73 **		0.82 ***	0.84	-15.25 **	28.45	-19.79		0.93 *	-0.05 ***		-0.51	0.23
EE	8.21	2.25	0.20	0.37 **	-0.01	-0.60	1.34 ***		0.33 *	0.07	-49.94 ***	-167.17	87.32 *	51.72 ***	-1.23	-0.01	1.31	-0.03	0.24
ES	2.19 ***	-0.03	-0.01 ***	-0.01 ***	-0.01 **	0.01	0.00	-0.01 **	-0.02 ***		0.04	1.49 ***	-1.30 ***	0.12 ***	0.08 ***	0.00 ***	-0.51 ***		0.19
FI	-271.95	2.40 ***	-0.77 ***	2.69 ***	0.52	3.10 ***			0.12		-39.12 ***	-277.63 ***	294.65 ***		0.30	0.09	431.27 *	1.53 **	0.24
FR	7.75	0.99 ***	-0.46 ***	0.17	-0.09	1.82 ***	1.43 ***	1.86 ***	-0.11	1.82 ***	22.06 ***	28.58	-5.13	32.50 ***	0.52 **	-0.08 ***	10.16	0.31	0.32
GR	3.30 ***	0.14	-0.02 ***			-0.04 *	0.01 ***	0.02 ***	0.00					0.06	-0.35	-0.01 ***	-0.01		0.37
HU	50.96	2.04	-0.23	-0.43	0.38	0.59	1.89 ***	2.41 ***	-0.03		-6.92	110.11	-61.54	16.59	23.10 ***	0.01		0.11	0.56
IE	-302.84 **	42.82 ***	-3.14 ***	-3.82 ***					-5.03 ***		25.90 ***	-82.14 *	36.36	252.02 ***		-5.44 ***	95.80 ***	6.75 ***	0.26
IT	-934.94 ***	-38.27 ***	-0.35 *	3.74 ***	3.81 ***	-4.19 ***	5.53 ***	8.64 ***	2.32 ***	6.42 ***	25.69 ***	65.99 **	-177.71 ***	5.87	0.95	-0.02 *	428.11 ***	6.50 ***	0.57
LU	1.40 **	0.01	-0.01 *	-0.01	-0.02 ***			0.05 ***	-0.01	0.05 ***	-0.42 ***	-0.52	0.02		0.05 *	0.00 ***	0.67 **		0.77
LV	-72.96	4.84	0.14	0.53 **	0.61	-1.68 **	2.86 ***		0.67 *		-30.84 ***	-11.73	112.07 *	108.86 ***	0.71	-0.02 *	9.32 ***	0.57	0.26
MT	-19.26 ***	2.31 ***				0.04	-0.01	0.09 **	0.04		0.04			0.46	-0.01	0.00	2.64 *		0.39
NL	-2293.53 ***	37.53 ***	6.43 ***	9.60 ***		-4.88 **	-5.25 ***		-4.73 ***		3.60	-1212.40 ***	1888.82 ***	-14.83	0.88 *	-0.17 ***		11.93 ***	0.20
PL	452.84 *	-26.35	-0.40	0.27	-1.41 ***	1.77 ***	3.20 ***		0.33	-0.55	-6.55	156.12 **	-105.61 **		-0.36	-0.06 ***	-20.16	-0.95	0.30
PT	-141.13	0.27	2.15 ***	1.58 ***		4.19 ***	2.52 **	3.20 ***	0.53 **		14.79	176.18 ***	-64.82	13.95 ***	54.36 ***	-0.46 *	13.41	0.80	0.33
SE	-84.41 ***	-0.13	0.60 ***	1.83 ***	0.33	-0.62			2.50 ***	4.02 ***	-51.53 ***	-217.15 ***	147.26 ***	2.87	-2.29 ***	0.10 ***	15.60 ***	1.29 ***	0.40
SI	-18.90	19.28 ***	0.70	-1.10 **	6.29 ***	-3.66 ***	1.10 **	0.01	-5.69 ***		-85.85 ***	288.49 ***	-58.43	133.83 ***	-58.19 ***	0.96 ***	46.20 ***	3.89 ***	0.40
SK	226.61	-5.46	-1.51 ***	-0.76	-0.71	-0.54	-4.12 ***	7.74 ***	0.18	0.57	-88.28 *	-172.12	27.22	-19.41	-8.98	-0.05 *	4.72	-0.05	0.22
UK	45.80	3.27	-0.58 ***	-0.15	-0.35	0.08			-0.17	0.22	-12.10 ***	-56.86 ***	56.57 ***	16.91 ***	2.67 ***	-0.02 ***	-21.60 ***	0.32	0.08

Source: Estimation based on FADN 2000-2008. Significance levels: ***1 percent, **5 percent, *10 percent. Negative values are shaded.

Table A 4. Premiums per ha received (second step), marginal effects.

	CONST	TREND	CERE	GRASS	OILS	VEGET	PERMCROP	WINE	OFOD	PULSES	DAIRY	SUCKLER	SHEEP	PIPO	ESU	LFAPART	MillRatio
AT	4.39 ***	-0.03 ***	-0.03 ***	-0.02 ***	0.00	0.02 *	0.01 ***	0.02 ***	-0.03 ***	0.03 ***	0.91 ***	0.94 *	1.02 ***	-0.09 ***	0.00 *	0.02	
BE	-256.46 ***	26.29 ***	-0.31	-0.31		0.98	-0.74		-0.23		-8.72	-52.66 ***		-1.40 ***	0.09	69.08 **	2.03 ***
CZ	-109.15 **	12.07 ***	0.21	1.76 ***	0.09	3.24 ***	3.18 ***	4.58 ***	0.98 ***	-0.15	-92.97 ***	-18.25	25.30	2.71	0.00	-3.06	0.24 *
DE	-6.99	-1.55 ***	0.09	1.17 ***	-1.21 ***	1.85 ***	1.82 ***	1.70 ***	0.08	4.70 ***	-46.43 ***	34.31 *		-2.26	0.00	37.07 **	0.54
DK	106.83	-3.63	0.43	0.85 ***	-0.74	4.39 ***	1.73 **		0.82 ***	0.84	-15.25 ***	-8.16		0.93	-0.05 **		-0.51
EE	8.21	2.25	0.20	0.37 **	-0.01	-0.60	1.34 ***		0.33	0.07	-49.94 ***	25.71	51.72 ***	-1.23	-0.01	1.31	-0.03
ES	2.19 ***	-0.03	-0.01 ***	-0.01 ***	-0.01 ***	0.01	0.00	-0.01 ***	-0.02 ***		0.04	1.25 ***	0.12 **	0.08 ***	0.00 ***	-0.51 ***	
FI	-271.95	2.40 **	-0.77 ***	2.69 ***	0.52	3.10 ***			0.12		-39.12 ***	503.13		0.30	0.09	431.27 **	1.53 *
FR	7.75	0.99 ***	-0.46 **	0.17	-0.09	1.82 ***	1.43 ***	1.86 ***	-0.11	1.82 ***	22.06 ***	23.84 **	32.50 ***	0.52 *	-0.08 ***	10.16	0.31
GR	3.30 ***	0.14	-0.02 ***			-0.04	0.01 ***	0.02 ***	0.00				0.06	-0.35	-0.01 **	-0.01	
HU	50.96	2.04	-0.23	-0.43	0.38	0.59	1.89 ***	2.41 ***	-0.03		-6.92	-47.89	16.59	23.10 ***	0.01		0.11
IE	-302.84 **	42.82 ***	-3.14 ***	-3.82 ***					-5.03 ***		25.90 **	-52.07 **	252.02 ***		-5.44 ***	95.80 ***	6.75 ***
IT	-934.94 ***	-38.27 ***	-0.35 *	3.74 ***	3.81 ***	-4.19 ***	5.53 ***	8.64 ***	2.32 ***	6.42 ***	25.69 ***	-274.83 ***	5.87	0.95	-0.02 *	428.11 ***	6.50 ***
LU	1.40 **	0.01	-0.01 *	-0.01	-0.02 **			0.05 ***	-0.01	0.05 ***	-0.42 ***	-0.51		0.05 **	0.00 ***	0.67 ***	
LV	-72.96	4.84	0.14	0.53 ***	0.61	-1.68 **	2.86 ***		0.67 **		-30.84 ***	267.94 **	108.86 ***	0.71	-0.02	9.32 **	0.57
MT	-19.26 **	2.31 **				0.04	-0.01	0.09 **	0.04		0.04		0.46	-0.01	0.00	2.64	
NL	-2293.53 ***	37.53 ***	6.43 ***	9.60 ***		-4.88 **	-5.25 ***		-4.73 ***		3.60	1650.50 ***	-14.83	0.88 *	-0.17 ***		11.93 ***
PL	452.84 **	-26.35 *	-0.40	0.27	-1.41 ***	1.77 ***	3.20 ***		0.33	-0.55	-6.55	-166.92		-0.36	-0.06 ***	-20.16	-0.95 *
PT	-141.13	0.27	2.15 ***	1.58 ***		4.19 ***	2.52 **	3.20 **	0.53 **		14.79	106.28 **	13.95 ***	54.36 ***	-0.46 **	13.41	0.80
SE	-84.41 ***	-0.13	0.60 ***	1.83 ***	0.33	-0.62			2.50 ***	4.02 ***	-51.53 ***	1.34 ***	2.87	-2.29 ***	0.10 ***	15.60 ***	1.29 ***
SI	-18.90	19.28 ***	0.70	-1.10 ***	6.29 ***	-3.66 ***	1.10 ***	0.01	-5.69 ***		-85.85 ***	224.16 ***	133.83 ***	-58.19 ***	0.96 ***	46.20 ***	3.89 ***
SK	226.61	-5.46	-1.51 ***	-0.76	-0.71	-0.54	-4.12 ***	7.74 ***	0.18	0.57	-88.28 *	-129.36	-19.41	-8.98	-0.05 *	4.72	-0.05
UK	45.80	3.27	-0.58 ***	-0.15	-0.35	0.08			-0.17	0.22	-12.10 *	0.30	16.91 ***	2.67 ***	-0.02 ***	-21.60 ***	0.32

Source: Estimation based on FADN 2000-2008. Significance levels: ***1 percent, **5 percent, *10 percent. Negative values are shaded.