Output Effects of Agri-environmental Programs of the EU:[a)]

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ABSTRACT:

By definition agri-environmental programs of the EU aim not only at improving environmental quality, but also at reducing overproduction while supporting farm income. The aim of the study is to empirically measure the success of agri-environmental programs in regard to the objective of reducing or stabilizing production levels.

Keywords: agri-environmental programs, de-coupling, output effects

1. Introduction

Pressed by GATT (WTO) negotiations and budgetary pressure the principal objective of the 1992 CAP Reform as well as of the AGENDA 2000 Reform of the EU was to reduce overproduction and expensive exports of certain agricultural products. To meet this goal price supports were partly replaced by direct payments. Beside this major shift in the support practice a number of measures to accompany output reduction were launched. The most prominent of these "Accompanying Measures" are agri-environmental programs introduced under Council Regulation 2078/92 and now regulated under Council Regulation 1257/99. The stated goals of these agri-environmental programs are threefold (Council Regulation 2078/92): i) reducing or stabilizing production levels, ii) safeguarding farm income, and iii) improving environmental quality. Therefore, by definition agri-environmental programs of the EU aimed not only at improving environmental quality, but also at accompanying the overall goals of the two reforms, i.e. reducing overproduction while maintaining (supporting) farm income. In the context of the GATT-Uruguay agreement agri-environmental programs are policies under the Green box, i.e. are supposed to 'have no, or at least minimal trade distorting effects or effects on production' (Annex 2 of the Agreement of Agriculture, signed in Marrakech). Many agri-environmental programs attempt to decrease output and increase environmental quality by banning or restricting the use of specific inputs (e.g. easily soluble commercial fertilizers or growth regulators) while at the same time compensating participants by direct payments. While restrictions on inputs clearly have a negative effect on production, direct payments if not fully decoupled (e.g. farmers may spent at least part of the direct payments the get for restricting specific inputs to buy more of not restricted inputs) may have a positive impact, leaving the overall effect of the program an open empirical question.

The aim of the study in hand is to empirically measure the success of agri-environmental programs in regard to the objective of reducing or stabilizing production levels. In particular, we investigate the impact of ten agri-environmental programmes in Austria, the EU country where agri-environmental programs played the most important role (e.g. about 75% of agricultural land participated at least in one agri-environmental measure; around 17% of total EU agri-environmental budget is transferred to Austrian farmers), on grain yields, utilizing farm accounting data and Monte Carlo simulation procedures.

The reminder of this study is organized as follows: The next section describes the agri-environmental program analyzed. Section 3 discusses estimation procedures. Section 4 presents estimation results. Section 4 discusses the results.

2. Austrian Agri-environmental program

The Austrian agri-environmental programme OEPUL (Austrian programme for the promotion of extensive farming methods compatible with requirements of environmental protection and the maintenance of the countryside) was introduced in 1995, the year after EU-accession consisting of about different measures (Groier and Loibl, 2000). Ten programs are relevant for grain producers.

1.) Elementary support
2.) Organic farming
3.) Non-application of agro-chemicals, whole farm
4.) Crop rotation measures
5.) Extensive cereal cultivation
6.) Non-application of growth regulators
7.) Non-application of easily soluble commercial fertilizers and growth regulators
8.) Non-application of easily soluble commercial fertilizers and synthetic chemical crop protection agents
9.) Non-application of fungicides
10.) Non-application of synthetic chemical crop protection agents

The first four programmes require the farm as a whole to participate, while the rest allows for partial participation (e.g., that only 15% of a farm's tilled acreage were managed according to a program's stipulations). Farmers could participate in more than one program at the same time.

Estimation Procedure

The utilized data consists of farm accounting data linked with the official agricultural support data (INVEKOS) for a sample of 2053 (approximately 1 % of all) Austrian farms. One year of data before Austria joined the EU (and hence the OEPUL program was in place) (1994) and one year of data with OEPUL being in place (1997) are available. From these 2053 farms, 1383 farms produced grain in all four years of observation.

As depicted in Table 1 participation rates were highly unequal between programs, ranging from a high of 93% for ‘elementary support’ to a low of under 1% for ‘non-application of synthetic chemical crop protection agents’.

Table 1

As illustrated in Figure 1 most farms participate in more than one program and on average in three programs:

Figure 1

In order to be able to compare yields of different kinds of grain (we looked at wheat, rye, oats, barley), we constructed a index of relative yields for every farm in the following way: relative yields of farm *i* for gain *j* (v_i^j) is given by

(1) $v_i^j = \frac{V_i^j}{\overline{V}^j}$, $i = 1, \ldots, n$ farms, and j = *wheat, rye, barley, oats*,

where V_i^j is the absolute yield of farm *i* for grain *j* and $\overline{V}^j$ is the average yield for grain *j* over all *n* farms. The relative yield of farm *i* over all *j* grains (v_i) is given by

(2) $v_i = \frac{\sum_j \left(v_i^j F_i^j\right)}{\sum_j F_i^j}$, $i = 1, \ldots, n$ farms, and j = *wheat, rye, barley, oats*,

where F_i^j is the area farm I allocates to grain j. Hence, v_i is the weighted average of the relative yields of all grains.

To estimate the effects of program participation on yields in 1997 we utilize the following method: The actual relative yields observed in 1997 ($v_{i,1997}$) can be explained by the hypothetical yields we would have observed without agri-environmental program ($h_{i,1997}$) and the actual participation in agri-environmental programs. Program participation is modelled by dummy variables (D_i). For the four programs which require the farm as a whole to participate dummies are set to 1 for participants and 0 for non-participants. For the six programs with partial participation, the dummies are equal to the share of the acreage in the program to total area under tillage (i.e., the dummy can range from 0 to 1). Hence, assuming a linear relationship the impact of program participation can be estimated by

$$(3)\ v_{i,1997} = \text{Ò}_0 + \text{Ò}_1\, h_{i,1997} + \sum_{k=1}^{10}\left(b_k D_{k,1997}\right) + \varepsilon_{\text{i}}$$

The coefficients ò_k depict the influence of program participation on relative yields. To get an estimate of $h_{i,1997}$, the yields we would have observed in 1997 without agri-environmental program participation, we utilize the data of 1994, the year before agri-environmental programs were introduced. In particular, we estimate relative yields in 1994 $v_{i,1994}$ as dependent on the 1994-values of variables designed to model farm characteristics that are thought to influence yields. Tilled area (***AREA***; as a proxy for economies of scale; expected sign: +), the ratio of tilled to total farm area (***RATIO***, a proxy for specialization; expected sign: +), unit value per hectare (***UV***, this is a variable compiled for tax purposes; it includes soil characteristics, climate etc. ; expected sign: +), and animal-units per hectare (***AUH***, to somehow account for the unrecorded amount of manure, which is typically disposed on the field; expected sign: +) are chosen as such explanatory variables. Being aware that these four variables only partly explain the differences in yields across farms we also add the ten dummies of program participation in 1997 to the regression. The purpose to include these dummies is to pick up differences in yield that eventual program participants exhibited even before the introduction of the these programs. Hence,

$$(4)\ v_{i,1994} = g_0 + g_1\, AREA_{1994} + g_2\, RATIO_{1994} + g_3\, UV_{1994} + g_4\, AUH_{1994} + \sum_{k=1}^{10} \left(d_k D_{k,1997} \right) + \varepsilon_i$$

Subsequently, we take the parameters estimated in of regression (4) and the values of $AREA_{1997}$, $RATIO_{1997}$, UV_{1997}, and AUH_{1997} to calculate the hypothetical yields we would have observed in 1997 with no agri-environmental program in place:

$$(5)\ h_{i,1997} = c_0 + c_1\, AREA_{1997} + c_2\, RATIO_{1997} + c_3\, UV_{1997} + c_4\, AUH_{199c} + \sum_{k=1}^{10} \left(d_k D_{k,1997} \right)$$

Taking into account the stochastic nature of the coefficients estimated in regression (4), we perform a Monte-Carlo simulation. In particular, we utilize the covariance matrix of regression (4) to draw a sample of 2000 coefficient vectors[1]. These 2000 coefficient vectors are used to calculate 2000 $h_{i,1997}$ and to estimate 2000 times regression (3). The results of these procedures are presented below.

[1] the coefficients of the step1 regression are multivariate normally distributed as (**b**,**COV**), with dimension 15. In order to draw the required sample from this multivariate normal distribution, we need the Cholesky-factorization A of the (15x15)-covariance matrix COV; with this matrix, we can transform a vector y of 15 independent realization of a standard normal distribution so as to conform to the distribution of the covariance matrix COV:

$\mathbf{x} = \mathbf{b} + \mathbf{Ay}$ with $\mathbf{A}$ = cholesky($\mathbf{COV}$) and $\mathbf{y} \sim N(\mathbf{0},\mathbf{1})$

Estimation Results

Equation (6) depicts the results of regression (4) (t-ratios in parentheses):

$$(6)\ v_{i,1994} = \underset{(21.7)}{0.638} + \underset{(5.1)}{0.0020}\ AREA_{1994} + \underset{(6.11)}{0.170}\ RATIO_{1994} + \underset{(8.8)}{0.106}\ UV_{1994} + \underset{(5.9)}{0.060}\ AUH_{1994} +$$

$$+ \underset{(2.7)}{0.062}\ D_{1,1997} - \underset{(7.8)}{0.169}\ D_{2,1997} - \underset{(4.7)}{0.165}\ D_{3,1997} + \underset{(1.5)}{0.023}\ D_{4,1997} - \underset{(1.3)}{0.027}\ D_{5,1997} -$$

$$- \underset{(4.3)}{0.074}\ D_{6,1997} - \underset{(1.1)}{0.053}\ D_{7,1997} - \underset{(0.0)}{0.0003}\ D_{8,1997} - \underset{(2.1)}{0.132}\ D_{9,1997}\ ?\ \underset{(1.1)}{0.129}\ D_{10,1997}$$

$R^2 = 0.37$
(the critical t-value for a regression with 1383 observations and 15 independent variables is t_{crit}=1.96)

For a panel regression, the value of R^2 is quite satisfactory; moreover, it can be seen that farms that later participated in the OEPUL-programs, even in 1994 exhibited quite diverse grain yields (e.g., farms that in 1997 were to participate in the program #9 "Non-application of fungicides" showed on average 17% lower than farms that were not to participate).

The covariance matrix derived in regression (6) is used to perform the Monte Carlo simulations described above. Table 2 presents the results of 2000 times running regression (3). Mean coefficients values and t-ratios along with the lower and upper 5%-limits of their respective distributions are presented and can be interpreted in the following way: For example, participating in the OEPUL program "organic farming" reduces yields on average (of our 2000 regressions) by 11%. In 95% of our 2000 regressions the negative impact on yields from program participation is between 7% and 14.5%. The average t-value is –4.38 and in 95% or our regressions it is between –2.65 and –6.04. Hence, organic farming a statistical negative impact on yields. Beside organic farming significant negative impacts on yields are only estimated for participation in the "extensive crop cultivation" program. Participation in the program "Non-application of agro-chemicals, whole farm" has a negative impact on average as well as for 95% of our regressions. However, the t-value is not significant on average. Five more programs have a negative impact on average, but the upper limits are positive. Two program have a positive impact on average, but also at low statistical significance level. With a range from 0.34 – 0.36, the R^2-values are quite satisfactory. The non-OEPUL yields account for about 85% of yields in 1997.

Table 2

Conclusion

By definition agri-environmental programs of the EU aim not only at improving environmental quality, but also at reducing overproduction. Beside agri-environmental programs are policies under the Green box. Hence, they are supposed to 'have no, or at least minimal trade distorting effects or effects on production' (Annex 2 of the Agreement of Agriculture, signed in Marrakech). This study empirically measure the success of agri-environmental programs in regard to the objective of reducing production levels. In particular, we investigate the impact of ten agri-environmental programmes in Austria, the EU country where agri-environmental programs played the most important role (e.g. about 75% of agricultural land participated at least in one agri-environmental measure; around 17% of total EU agri-environmental budget is transferred to Austrian farmers), on grain yields. From the ten programs analysed, only two showed a significant negative impacts on yields.

References

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Table 1: Participation rate in percent of the sample

Program	%
Elementary support	93,8
Organic farming	11,9
Non-application of agro-chemicals, whole farm	3,3
Crop rotation measures	84,6
Extensive cereal cultivation	37,1
Non-application of growth regulators	61,5
Non-application of easily soluble commercial fertilizers and growth regulators	2,8
Non-appl. of easily soluble comm.. fert. & synth. chemical crop protection agents	1,9
Non-application of fungicides	5,9
Non-application of synthetic chemical crop protection agents	0,8

Table 2: Results of Monte Carlo simulations (n=2000)

		coefficient			t-ratio		
#	OEPUL program	mean	5%-limit	95%-limit	mean	5%-limit	95%-limit
1	Elementary support	0.037	0.005	0.069	1.65	0.21	3.11
2	Organic farming	-0.110	-0.145	-0.070	-4.38	-6.04	-2.65
3	Non-application of agro-chemicals, whole farm	-0.065	-0.117	-0.011	-1.79	-3.28	-0.29
4	Crop rotation measures	0.015	-0.008	0.037	0.99	-0.47	2.41
5	Extensive cereal cultivation	-0.119	-0.148	-0.090	-6.21	-7.69	-4.69
6	Non-application of growth regulators	-0.005	-0.029	0.021	-0.30	-1.75	1.18
7	Non-appl. easily sol. com. fert. & growth regulators	-0.039	-0.104	0.032	--0.80	-2.16	0.65
8	Non-appl. easily sol. com. fert. & synth. chem. Crop prot.	-0.028	-0.161	0.113	-0.29	-1.62	1.12
9	Non-application of fungicides	-0.016	-0.102	0.068	-0.27	-1.68	1.09
10	Non-application of synthetic chemical crop protection	-0.091	-0.258	0.068	-0.80	-2.28	0.59
	$h_{i,1997}$ (no-OEPUL yields)	0.849	0.770	0.933	16.69	15.98	17.36
	R^2	0.35	0.34	0.36			

Figure 1: Number of programs farms participate