A PMP Model for Assessing the Impacts of New CAP 2014-2020 on Olive Farming Systems in Andalusia Region, Spain

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Abstract

This contribution analyzes the likely impacts of the new CAP reform on different olive farming systems in Andalusia, Spain. It uses a Positive Mathematical Programming model calibrated with the neutral procedure. The model compares the situation of the average olive farm in the base year with its position in a simulated year using two policy scenarios. Results indicate *inter alia* that the new distribution rules of aids don't incentive the adoption of integrated and organic farming. Alternatively, implementing green payment scheme would better redistribute public support from less to more environmentally-friendly olive farming practices, enhancing the CAP aids legitimacy.

 Keywords: CAP Reform 2014-2020, PMP, Olive Farming Systems, Andalusia.

1.   Introduction

The final agreement reached regarding the CAP 2014-2020 application modalities in Spain considers that all olive farming systems (irrigated and non-irrigated conventional and integrated olive productions and organic production) comply *de facto* with the greening conditions. In this investigation the impact of this new policy is assessed against the potential effect of an alternative policy considering the greening conditions fulfilled only by those farming systems *a priori* more environmentally-friendly and already benefiting from specific agro-environmental support under the previous CAP regime, i.e. organic and integrated olive farming systems.

The analysis is conducted by means of a representative farm Positive Mathematical Programming (PMP) model calibrated with the neutral procedure (Röhm and Dabbert, 2003). The model is used to compare the situation (essentially surface area of different farming systems, farm gross margin, and agricultural policy aids) of the average farm for olive production in Andalusia (by far the most important olive-growing region in Spain and in the world) in a base year, with the situation in a simulated year using scenarios entailing different assumptions concerning the new CAP. The base year in this study is 2011, the most recent year for which the whole data needed to define base situation are available.

Section 2 presents the base year data and the policy scenarios established for the simulated year, and describes the PMP model used. Results are analysed in section 3 and conclusions are drown in section 4.

2.   Materials and methods

To measure the impact of the new CAP 2014-2020 on the different olive farming systems, the results of the representative PMP farm model described below for the base year (2011) will be compared with the results obtained by simulating new agricultural policies, keeping constant other variables (in particular prices, yields and costs).

2.1   *Characteristics of the modelled farm in the base year*

Table 1 summarises the characteristics of the average olive farm in Andalusia in 2011. The total irrigated and non-irrigated areas of the average farm correspond to those of the average farm growing olive grove (table olive area is excluded) in Andalusia according to the last Spanish agricultural census of 2009. The distribution of the irrigated and non-irrigated land of the different farming systems has been estimated as equal to the proportion of these systems in the irrigated and non-irrigated total area of olive grove in Andalusia. Prices, yields

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and costs/ha in the conventional farming derive from data provided by the Ministry of Agriculture, Food and Environment (MAGRAMA, 2013). The yields of integrated and organic productions are considered the same as in the conventional production. The olive price is assumed to be for organic 1.2 times and for integrated 1.1 times the conventional, and the variable costs/ha of organic and integrated are respectively 1.1 and 1.05 times the conventional.

Table 1. Characteristics of the average farm

Farming system	Area (ha)	Yields (100 kg olives/ha)	Prices (€/100 kg olives)	Variable costs (€/ha)
Dry farming	*5.811*			
Conventional	4.288	40.16	37.72	816.66
Integrated	1.237	40.16	41.49	857.49
Organic	0.286	40.16	45.26	898.33
Irrigated farming	*1.966*			
Conventional	1.526	57.76	37.72	1189.11
Integrated	0.440	57.76	41.49	1248.57

2.2 Agricultural policy scenarios

Table 2 shows the agricultural policy measures considered to compare their impacts on the average olive growing farm in Andalusia.

Table 2. Agricultural policy measures in base year and scenarios.

Type of support	Base year (2011)	Scenario I: all systems are under green payments	Scenario II: Only organic and integrated are under green payments
Decoupled direct payments	764.78 €/ha	535.35 €/ha	535.35 €/ha
Greening suport			
Conventional production		229.43 €/ha	0.00 €/ha
Organic production		229.43 €/ha	229.43 €/ha
Integrated production		229.43 €/ha	229.43 €/ha
Agro- environmental support (coupled)			
Organic production	266.85 €/ha	266.85 €/ha	266.85 €/ha
Integrated production	49.14 €/ha	49.14 €/ha	49.14 €/ha

The basic source of the measures for the base year 2011 is Mili *et al.* (2013). For this year a reduction of 9% of the total direct payments exceeding 5000 € is applied to the farm in concept of modulation, according to the regulation in force in 2011. The suggested scenarios I and II take into account the general rule established in the new CAP reform (European Commission, 2013), where only 70% of the total decoupled direct payments existing in the base year are kept in all cases while the remaining 30% are received when greening practices are implemented. In scenario I it is considered - as approved in the new CAP for permanent crops including olive production- that all olive farming systems comply with the greening

conditions. Meanwhile in scenario II it is supposed that only organic and integrated farming obtain systematically the 30% of direct payments reserved for greening practices.

2.3   The PMP model

Let X_{ij} be the area in hectares for crop i (i=1: conventional olive, i=2: integrated olive, i=3: organic olive) on land type j (j=1: dry land, j=2: irrigated land). The model to simulate results with different agricultural policies, prices and costs can be represented as follows:

(1) $$\mathbf{max:}\ F = \sum_{j=1}^{2} \sum_{i} [p_{ij} * y_{ij} + a_{ij} - c_{ij} + (\alpha_{ij} + \beta_{ij} * X_{ij})] * X_{ij} + XP1 + mod * XP2$$

(2) $$\sum_{i} X_{ij} \leq A_j \quad (\lambda_j) \quad \forall j$$

(3) $XP1 + XP2 \leq DP$

(4) $XP1 \leq M$

(5) $X_{ij}, XP1, XP2 \geq \mathbf{0}$

where the following variables are added to X_{ij}:

$XP1$: amount, in €, of decoupled direct payments not liable to be reduced via modulation.

$XP2$: amount, in €, of decoupled payments above $XP1$, liable to modulation reductions. In the simulation scenarios $XP2 = \mathbf{0}$.

And where:

p_{ij}, y_{ij}, a_{ij}, c_{ij} : price, in €/kg of olives; yield, in kg/ha; coupled support not subject to reduction by modulation (agro-environmental aids for organic and integrated olive groves in base year to which coupled direct payments are added in simulations), in €/ha; and costs, in €/ha, of crop i on land type j.

A_j : area, in ha, of land type j.

DP : Decoupled payments received by the farm. In the base year and in simulations these payments are: $(A_1 + A_2)$ x decoupled payments/ha shown in Table 2.

mod : (1-% of reduction via modulation). This parameter is 0.91 in the base year, where the percentage of reduction is 9%, and 1 in the simulation scenarios where there is not reduction.

In the model, expression (1) to be maximized represents the farm's gross margin (including coupled subsidies) plus decoupled aids. It is made up of decreasing gross margin functions for each crop with respect to crop level, as corresponds to the neutral calibration procedure proposed by Röhm and Dabbert (2003).[1] Equation (2) is the land area constraint, for both dry and irrigated farming. Equation (3) defines decoupled payment dues to the farm before modulation: $XP1$ +$XP2$, and equation (4) limits the amount of this payment, M, free from modulation reductions. M amounts to €5,000 in the base year and is a positive real unrestricted number in the simulations when no modulation takes place. The lambda in the right of the land constraints represents its dual values.

The expressions of the base year calibration parameters α_{ij} and β_{ij} are obtained using the necessary conditions of Kuhn-Tucker, as proposed by Judez *et al.* (1998, 2001). These expressions for the model (1)-(5) are:

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[1] This calibration procedure appeared to be the most suitable after be compared with the cost average procedure and the use of exogenous elasticities (see Mili *et al.*, 2013).

$$\beta_{ij} = \frac{\left[\overline{\lambda}_j - (\overline{p}_{ij} * \overline{y}_{ij} + \overline{a}_{ij} - \overline{c}_{ij})\right]}{\overline{X}_{ij}} \qquad\qquad \alpha_{ij} = -\beta_{ij} * \overline{X}_{ij}$$

where $\overline{X}_{ij}$, $\overline{p}_{ij}$, $\overline{y}_{ij}$, $\overline{a}_{ij}$ and $\overline{c}_{ij}$ are the values of X_{ij}, p_{ij}, y_{ij}, a_{ij} and c_{ij} in the base year and where $\overline{\lambda}_j$ is the yearly rental price of the land type j that year.

3. Results

Results for different simulations with respect to the base year are presented in Table 3. Variations only capture the changes due to the implementation of agricultural policies simulated. For scenario I there is no variation in the area of different farming systems with respect to the base year. The gross-margin-without-aids does not vary. The subsidies increase slightly due to the fact that the agricultural policy for this simulation does not consider the reduction for modulation included in the base year.

Table 3 also shows that in simulation II there are increases of integrated and organic farming areas in detriment of the conventional farming. This variation in the distribution of area on the farm is associated with a decrease of total aids by nearly 20% as consequence of the 30% loss of decoupled aids (also lost in simulation I), being recovered as coupled aids in integrated and organic farming but not recovered in conventional farming, because in simulation II it is hypothesized that this system does not benefit from greening aids. The consequence of this fact is a decrease in gross margin plus aids by 9%.

Table 3. PMP model results.

	Base year 2011	Simulations (% variation with respect to base year)	
		Scenario I: All systems are under green payments	Scenario II: Only organic and integrated are under green payments
Area			
Conventional dry farming (ha)	4.29	0.00	-5.51
Integrated dry farming (ha)	1.24	0.00	16.67
Organic dry farming (ha)	0.29	0.00	10.49
Conventional irrigated farming (ha)	1.53	0.00	-4.67
Integrated irrigated farming (ha)	0.44	0.00	16.17
Subsidies			
Coupled aids (€)	158.67	1124.55	341.89
Decoupled aids before modulation (€)	5947.69	-30.00	-30.00
Modulation reduction (€)	85.29	-100.00	-100.00
Decoupled aids after modulation (€)	5862.40	-28.98	-28.98
Total aids after modulation (€)	6021. 07	1.42	-19.21
Gross margin and objective function			
Gross margin without aids (€)	6272.47	0.00	0.65
Gross margin plus aids (€)	12293.54	0.69	-9.08
Objective function (€) (1)	12293.54	0.69	-9.87
Ratios			
Total aids/ha (€)	774.22	1.42	-19.21
Gross margin plus aids/ha (€)	1580.76	0.69	-9.08
Total aids/Gross margin plus aids (%)	48.98	0.72	-11.14

(1) Gross margin plus aids with quadratic function.

4. Conclusions

The present investigation shows that with the new CAP establishing that all olive farming systems fulfill *ex-ante* the conditions to perceive the green payments, there will be virtually no changes re. the distribution of farm area for the three systems, nor in the aids received. Conversely, if the organic and integrated farming systems are under green payments while the dominant conventional farming cannot benefit from such support, the area cultivated under the integrated and organic systems could increase significantly with the ensuing decrease in the area occupied by the conventional system. This substitution between farming systems is associated with losses in the total aid received, which in turn cause a decrease in the farm benefits.

It could be asserted that the distribution rules of the green payment agreed in the new CAP do not incentivise the adoption of integrated and organic farming systems. An alternative policy advocating the implementation of the green payment scheme in the olive sector would have a further positive effect in terms of support redistribution from less (conventional) to more (integrated, organic) environmentally friendly farming practices rewarding the public goods generated (better environment and product quality) through such public aids, which in addition contributes to enhance the legitimacy of the CAP aids. The drawback of this alternative is a loss of aids and gross margin for the olive sector.

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