Greek cotton farmers' supply response to partial decoupling of subsidies

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Abstract— **A mathematical programming model based on a countrywide sample of farms is used to assess the impacts of the new C.A.P on the supply of the cotton sector in Greece. Results show a decrease in cotton cultivated area along with the introduction of a new production system called "semi-abandonment cotton". Farm income is practically unchanged, largely due to the decoupled payments. When these payments are not considered, farm income turns negative in some cases, thus leading towards abandonment of activities.**

Keywords— **Cotton, C.A.P, decoupling, mathematical programming**

I. INTRODUCTION

Common Agricultural Policy (C.A.P.) reform issued in 2003 introduces decoupling subsidies from production and cross-compliance for European farmers. A mathematical programming model quantifies, in the short run, the cotton sector response to policy changes regarding crop mix and rotation, and estimates gross margin and resource use based on data from representative farms of the Greek arable sector. Results suggest a significant decrease of area cultivated by cotton whereas alfalfa and cereal areas are increased. Average farm income remains rather constant, although it is subject to regional variation. Land left idle may increase in the medium term as some farms generate unacceptably low returns to working capital.

II. METHODOLOGY AND CASE STUDY

A model of arable agricultural supply featuring the integration of farm-level decisions with regional aggregates based on a methodology proposed by Sourie et al. [1] and is specified for the Greek cotton farming system. The model is built in a block angular form where each farm maximizes gross margin containing linear demand functions when demand is not perfectly elastic and it is detailed so that agronomic considerations as well as resource and market constraints to be taken into account. Producer and consumer welfare is maximised in a partial equilibrium framework of the arable agriculture.

The assessment of the new C.A.P. impact on the arable crop supply of cotton growing farms is based on a countrywide sample with farms reported in Farm Accounting Data Network (F.A.D.N.). According to that database, 978 farms cultivated cotton in Greece during the year 2002. The sample farms are situated into the four regions of F.A.D.N.: Region 450 which includes Macedonia and Thrace, region 460 including Western Greece, the Ionian islands and Peloponnesus, region 470 includes all of Thessaly, and region 480 that includes the Sterea Hellas, Crete and the Islands of the Aegean.

Two different optimizations (maximization of aggregate gross margin subject to the set of constraints) are run in this exercise[1]. Firstly the model is run given the C.A.P. policy in force in year 2002 (base year) for validation purposes using the following constraints: *Resource constraints* (limits to available irrigated area, possibility of cultivating non-irrigated cotton in fields with high underground water line, restriction of water consumption at the 2002 levels), *policy constraints* (quotas on tobacco, cotton cultivation limited to areas cultivated in 2000[2]), m*arket constraint* (sugar industry contracts determining sugar beet production), r*otation constraint* (bi-annual rotation for four-year alfalfa cultivation) and *calibration constraint* (only crops cultivated during the last three years are allowed on the farm).

[1] The optimization is written in GAMS code [2] and for the resolution the CPLEX and the MINOS algorithms were used.

[2] This constraint is farm specific.

The objective function contains one quadratic term since it includes demand function of alfalfa derived assumed to be linear. Parameters of the demand line are estimated using simple regression based on data provided by wholesalers on price response to quantity changes experience from recent years. Price levels of other crops are determined in markets beyond the Greek borders so that their prices are considered exogenous for Greek cotton farms.

The model validation process revealed that in many cases the model was able to perfectly reproduce the observed behaviour. However in about 30% of the farms optimal crop mix is more or less different from the observed one. Nevertheless, even if the fit at the farm level is poor, the aggregate activity levels approach satisfactorily to the actual ones approaching the observed crop mix (Figure 1).

The second optimization takes into consideration the changes of revised C.A.P. (decoupling, cross compliance) and calculates the optimal crop mix in year 2006, by adding cross compliance with intercropped vetch cropping in the 20% of eligible land decreased by alfalfa cultivated area.

III. RESULTS

Comparing the optimal crop mix for the year 2006 (after revised C.A.P. implementation) with the 2002 crop mix, a remarkable decrease of 24% in cotton cultivated area is observed amounting at 82.6 thousand ha. A new cotton production system is also introduced, called semi-abandonment cotton, taking up about 26 thousand ha. This type of cotton production is also observed in Spain [2] and uses limited inputs since the goal is not to harvest but to reach the open capsule stage so as to receive the coupled land subsidy. Provisional data provided by the Ministry of Agriculture for the cultivation period 2006-2007 confirm the above estimations, especially regarding cotton surfaces and quantities delivered. Changes concerning cotton but also the other arable crops are shown in Figure 1 and tables 1 and 2 below.

Given the optimal crop mix, resulted farm income[3] is examined and compared with observed farm income in the sample farms in year 2002. At national level, farm income remains practically stable (increased approximately 2% that is about 240 €). The part of the decoupling payment amounts to 76% so the net farm income (Farm income minus decoupling payment) is somewhat less than 2500 €. At the regional level, impacts are contrasting with less favored areas (in terms of cotton yields) getting benefit from the reform, whereas highly productive areas observe losses. This means that the decoupling payment, calculated on the basis of 2002-2002 returns, renders the income distribution more equitable.

Cotton growers in Macedonia and Thrace (region 450), are favoured by the revised C.A.P. regime, as lower yields due to soil and climatic conditions, forced them in the past to systematically receive fewer subsidies, reported per ha, than their counterparts in Thessaly (region 470) or Sterea Hellas region (480). Both decoupling payment and the area compensation for cotton have been determined by ha, based on the average yield at the national level, resulting in favouring region 450 in terms of monetary receipts. Farms in region 480, due to the large part of land cultivated by alfalfa (13% of arable land compared with 2% in the other regions) that was not subsidized, were receiving less subsidies per farm, so consequently they receive lower decoupling payment than the other regions.

Examining farm income after the new C.A.P. implementation (not counting the decoupling payment) reveals that in some cases it is negative whereas in many farms annual return to cash outflows (working capital[4]) is remarkably low. If this happens for two consecutive years, rational farmers would not keep on cultivating, given that they receive a significant amount in the form of decoupling payment

[3] Farm income is calculated as total gross margin less land rent plus interest, ownership charges (building and machinery depreciation). It includes family labour and management charges. In the case of cotton growers farm income concerns only arable agriculture activities (livestock, perennial crops and trees benefits and costs are excluded from the calculations).

[4] The profitability (return) of capital used for variable expenses is calculated as the cash left in the farm at the end of the cultivating period (not including the decoupled payment inflow), that is the Farm Family Income (minus the decoupled payment inflow) plus depreciation divided by the variable expenses.

(about 8000 € in average). Farms prone to abandonment of activity (slippage) amount at about 9% of the total number of farms, which corresponds to 6.3% of their arable land. Soft wheat and maize culture will decrease the most, reaching about 10% and 9% of the short-term optimal soft wheat and maize acreage respectively.

IV. CONCLUSIONS

As long as cotton subsidies are partially coupled to the selected levels cotton cultivation persists at about ¾ of the stabilized levels of 2000-2002 period. However the practice of semi-abandonment cotton among farmers will be alarming for cotton ginners who may see supply further shrink and be obliged to totally reorganize their raw material sources.

Impacts of the new C.A.P. to farm incomes seem to be insignificant when considering the national average but they are variable when the analysis is reported at the regional level, initiating income redistribution. It should be pointed out however that the Farm Income expected in 2006 greatly depends on the Decoupled Payment allocated to the farms. Limiting or abolishing that payment in the future will jeopardize the financial and economic viability of the majority of Greek arable farms.

Further investigation with regard to slippage or abandonment of activities should be undertaken by using long-term models in order to consider structural changes, such as dynamic models or a sequential recursive model that for the time being do not exist for Greek arable agriculture.

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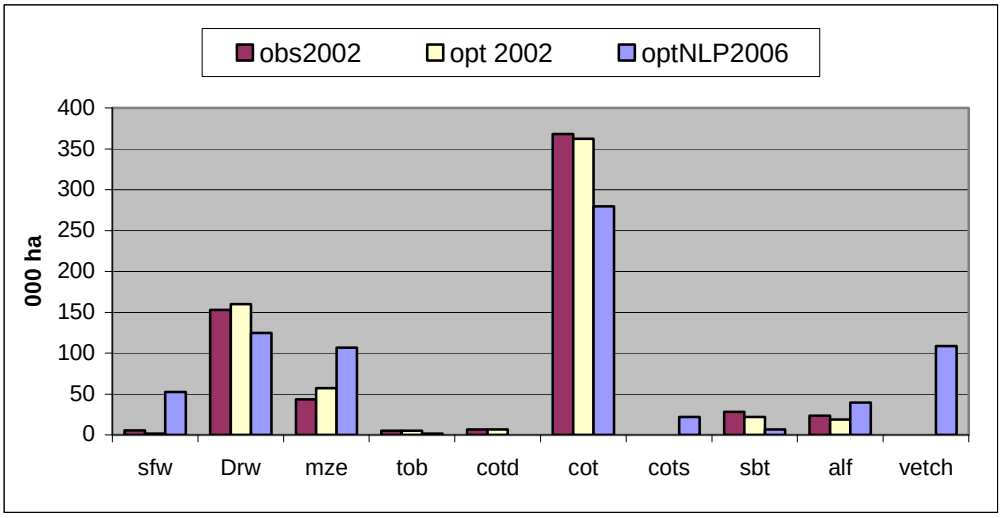
Figure 1. Observed vs. optimal crop mix[5]



[5] Sfw:soft wheat, drw: durum wheat, mze: maize, tob: tobacco, cotd: dry cotton, cot: cotton, cots: not harvested cotton, sbt:sugarbeet, alf:alfalfa

Table 1. Crop mix observed in 2002 at country and regional level.

	sfw	drw	mze	tob	cotd	cot	cots	sbt	alf
reg450	5,108	93,431	24,964	2,374	3,275	141,417	na	17538	5,831
reg460	0	0	13	0	58	1,659	na	0	9
reg470	237	45,375	13,259	1,768	3,190	163,696	na	10715	5,189
reg480	0	14,138	5,244	1,075	52	61,578	na	0	12,468
Greece	5,345	152,944	43,481	5,217	6,575	368,351	na	28253	23,497

Table 2. Optimal crop mix after the C.A.P. revision at country and regional level.

	sfw	drw	mze	tob	cotd	cot	cots	sbt	alf
reg450	45,487	57,114	43,400	1,573	0	94,243	20,036	6,847	25,983
reg460	0	0	978	0	0	0	761	0	0
reg470	7,131	55,158	52,520	0	0	114,845	577	0	13,486
reg480	0	12,494	9,736	0	0	70,640	746	0	0
Greece	52,617	124,766	106,635	1,573	0	279,728	22,120	6,847	39,469

Table 3. Impacts on farm income and regional distribution.

	Farm income 2006 (€)	Farm income 2002 (€)	Decoupled payment (€)	Net farm income 2006 (€)	Farm income 2006 (€/ha)	Farm income 2002 (€/ha)	Decoupled payment/ Farm Income 2006
reg450	10,467	9,819	8,390	1,767	902	850	80%
reg470	14,097	14,339	10,470	3,268	1,215	1,240	74%
reg480	13,346	14,549	7,938	5,351	1,151	1,250	60%
Country average	11,827	11,578	9,028	2,490	1,020	1,000	76%