Are CAP Decoupling Policies Really Production Neutral?

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Abstract — **This paper examines the effects of decoupling policies on Greek cotton production. We estimate a system of cotton supply and input derived demand functions under the hypothesis that producers face uncertainty about prices. Using our estimation results we simulate the effects on cotton production under four alternative policy scenarios: the 'Old' CAP regime (i.e. the policy practiced until 2005), the Mid Term Review regime, a fully decoupled policy regime and a free trade-no policy scenario. Our results indicate that cotton production gradually decreases as more decoupled policies are adopted. Moreover, the fully decoupled payment is found to be non-production neutral since it indirectly affects producers' decisions through the wealth effect.**

Keywords— **CAP, decoupling, uncertainty**

I. INTRODUCTION

The Common Agricultural Policy (CAP) has been reformed three times over the last fifteen years (McSharry Reform in 1992, AGENDA 2000 in 1999 and Mid Term Review (MTR) in 2003). Concerted efforts to reform the CAP, in turn, have shared a common purpose: to shift support from production and prices to direct income support measures. In particular, under the MTR all compensatory payments given in the context of the first two reform packages were replaced by a Single Farm Payment (SFP) based on historical payments while being entirely decoupled from the kind and/or the level of production [1].

According to the concept of SFP, production decisions depend only on market prices. Given that market prices will tend to approximate the actual, nowadays lower, world prices, production is expected to decline. However, this rather straightforward development is going to be the case only in a static world, undisturbed by shocks. In the presence of uncertainty over prices, nevertheless, which, in the absence of intervention mechanisms is expected to grow more intense, reality may be substantially different.

In fact it is questionable whether SFP is going to be production neutral in a potential uprise of uncertainty and risk. Simply put, it is worth considering the effects of increasing producers' wealth, assuming first that producers are risk averse, and how such rising wealth may in turn increase production by decreasing the relevant farmers' risk attitude. The 'wealth effect', first introduced by Hennessy [2] is expected to reverse a potential decline in production expected in the face of lower farm prices.

One the other hand, the degree of risk aversion may substantially differ among farmers. In particular, a link may well exist between farm size and risk aversion levels. Risk aversion in fact may be inversely related to the level of wealth, i.e. farms with lower income and wealth, are expected to be more risk averse than large farms, with substantially greater resources. Decoupled payments in turn, will increase farmers' wealth and will subsequently lead to lower levels in risk aversion. The drop in risk aversion is expectedly going to be greater for small farms in relation to what will happen in their "larger" counterparts. In this light, the wealth effect is going to be more intensive for less wealthy farmers.

The objective of this paper is to evaluate the effect of decoupling policies on Greek cotton production. We have chosen cotton, not only because of its great importance for Greek agriculture, but mainly because, especially for cotton, a mix of partial and fully decoupled measures has been adopted after 2005. Under the MTR regime, 65% of the total amount of subsidies producers' received throughout 2000-2002 (i.e. the reference period), will be paid to producers as a fixed payment independent of the level of production. The rest 35% of the total amount of subsidies will be transferred to producers as an area payment [3]. However, the total budget that is available for the area payment is fixed and this means that if the total cultivated land increases then the amount of the area payment per producer will decrease. On this ground, the area payment relates to fluctuations in world prices since the level of production and as a result cultivated land depend on them.

The above policy mix renders the evaluation as well as the comparison of the effects of various alternative policies on cotton production a significant research objective. In this context, we have decided to examine and comparatively review the effects of a) the 'Old' CAP regime (i.e. the policy practiced until 2005), b) the new MTR regime which is a combination of partially and fully decoupled measures, c) a full decoupling system which probably could be applied in the next years and d) a free trade scenario which could also be adopted especially in the period after 2013.

The rest of the paper is organized as follows. The following section presents a literature review on partial and full decoupling practices research that has been implemented in Europe or elsewhere. In section three, we outline the theoretical framework first and then delineate its empirical specification. In the ensuing fourth part we present the estimation and simulation results as well as a rounded discussion of the main results obtained by the statistical analysis. Finally, in the fifth section we put forward the main conclusions of our study.

II. LITERATURE REVIEW

Decoupling policies in the farm sector have been thoroughly examined by a significant number of researchers in Europe and elsewhere, especially in the US, over the last 15 years. Although these studies have followed different theoretical approaches they have come to a common conclusion: All different kinds of decoupling policies affect farmers' production decision. Even though this is an expected result for partly decoupled measures, it is of a special interest in the case of fully decoupled policies, since it contradicts their main property namely their neutrality towards realized production. In the remainder of this section we put forward a short presentation of the main studies on this topic.

Moro and Sckokai [4] have simulated the effects of AGENDA 2000 reform on arable crop farmers in Italy using a profit function approach. They found that this policy package has affected crop production mainly through the mechanism of land allocation. On the basis of their findings, producers are expected to increase the land allocated in wheat production. The increased supply of wheat in turn, has been estimated to negatively affect oilseeds production.

In a partly different paper, Gohin and Guyomard [5] analyzed the compensatory payments and set-aside requirements of AGENDA 2000 reform from a different point of view. They launched a comparison between this policy mix and the 'green box' criteria, using data for cereals, oilseeds and protein crops production in France throughout 1973-1997. Their findings suggest that, even if AGENDA 2000 reform had been more decoupled than McSharry reform, it would not satisfy many of the 'green-box' criteria since it would lead to production and trade distortions.

If we turn now to studies dedicated to the analysis of full decoupled policies, we see that the bulk of them has been done in the US and has been almost exclusively oriented towards the analysis of the effects of the Federal Agricultural Improvement and Reform Act (the FAIR Act) implemented in the US after 1996. There are many studies dealing with the analysis of the direct and indirect effects of the FAIR Act on American Agriculture. In the next lines, we summarize some of the most representative pieces of research that refer to the indirect effects of the FAIR Act.

A fully decoupled policy becomes coupled in the presence of uncertainty and risk. The first study that analyzed the results of a decoupled policy taking into consideration uncertainty and risk was conducted by Hennessy [2]. He suggested a framework where, under the assumption that producers are risk averse, the decoupled payments affect production through two effects: the wealth effect and the insurance effect. The first effect arises when a policy measure affects producers' total wealth: if wealth increases producers become less risk averse and as a consequence they produce more. The second effect takes place through the stabilization of farm income, when government increases payments so as to compensate producers for price reductions. Additionally, Hennessy's simulation results confirmed the existence of both effects.

In a highly interesting paper, Goodwin and Mishra [6] made an ex-post analysis of fixed payments effects on corn, soybeans and wheat cultivated land under uncertainty. In their analysis decoupled payments have three discernible effects on cultivated land: the first is the direct effect, the second one is the effect on financial leverage and the third is the wealth effect. Their study showed that decoupled payments influence farmers' decision on land allocation since the elasticity of land with respect to payment was found to be positive. As for indirect effects, they were found to be positive but smaller than direct ones.

In another paper, Serra *et.al.* [7] examined the ex-post effect of the lump-sum payments on agricultural output in Kansas under price uncertainty. They estimated production function alongside utility maximization conditions and having found that the elasticity of production with respect to lump-sum payments was positive, they came to the conclusion that the realized fully decoupled payments were not really decoupled from farm output.

As for the evaluation of the MTR of CAP, a very interesting piece of work has been made by Sckokai and Moro [8]. They have simulated the effects of MTR regime on cultivated land of arable crops in Italy under price uncertainty. Using FADN farm level data, they found that the corn and oilseeds acreage is going to be increased but the opposite holds for durum wheat and other cereals acreage. Yet, the most interesting finding is that decoupled payments are not production neutral since the positive wealth and insurance effects will compensate the negative price effect in all cases.

III. THEORETICAL FRAMEWORK

In this section we present the model which specifies farmer's risk preferences. We assume non-linear mean variance risk preferences which mean that absolute risk aversion is non-constant similar to other studies [8], [9]. Producers' risk preferences are specified through a mean-variance utility function:

$$U = U(\bar{W}, \sigma_w^2) \qquad (1)$$

where $\bar{W}$ and σ_w^2 are the mean and variance of final wealth which are uncertain due to price uncertainty that producers face. The certainty equivalent of this type of utility function is

$$U = \bar{W} - \frac{a(\bar{W}, \sigma_w^2)\sigma_w^2}{2} \qquad (2)$$

where $\bar{W}$ is the expected wealth which is the sum of initial wealth W_o and random market profits $\bar{\pi}$, σ_w^2 corresponds to wealth variance and α is the Arrow-Pratt measure of absolute risk aversion.

Additionally, in line with other studies [8], [9], we assume that preferences are specified as Constant Relative Risk Aversion (CRRA) type i.e. the coefficient of absolute risk aversion α depends on the level of wealth and can be specified as follows:

$$a = \frac{a_c}{\bar{W}} \qquad (3)$$

From the above specification it is clear that as wealth increases the degree of risk aversion decreases. According to the foregoing analysis producers will maximize the expected utility function of the form:

$$U(p^e, w, V_p, z, W_0) =$$

$$W_0 + p^e y - wx - \frac{a_c}{2(W_0 + p^e y - wx)} y^2 V_p \qquad (4)$$

where W_0 is initial wealth, y is output quantity, p^e corresponds to expected output price, w and x are prices and quantities of variable inputs respectively, z corresponds to fixed inputs and V_p is the variance of expected output price.

The expected utility function satisfies the following properties:

1. It is increasing in output price and initial wealth and decreasing in input prices and variance of expected output price.
2. Under CRRA preferences, it is homogeneous of degree one in expected output price, input prices, initial wealth and variance of expected output price.
3. It is continuous and differentiable so we obtain the supply and derived demands as follows:

$$y(p^e, w, V_p, z, W_0) = \frac{\partial U / \partial p^e}{\partial U / \partial W_0}$$

$$x_i(p^e, w, V_p, z, W_0) = -\frac{\partial U / \partial w}{\partial U / \partial W_0}$$

$$\partial U / \partial W_0 = 1 + \frac{a_c}{2(\bar{W})^2} y^2 V_P$$

4. Under DARA preferences is quasiconvex in (p^e, w, W_0).

5. The standard symmetry and reciprocity conditions hold.

In order to estimate the coefficients of the supply and derived demand functions we use the normalized quadratic form of indirect utility which takes the form:

$$\bar{U} = a_0 + \sum_{i=1}^{m-1} a_i \bar{r}_i + \frac{1}{2}\sum_{i=1}^{m-1}\sum_{j=1}^{m-1} a_{ij}\bar{r}_i \bar{r}_j \qquad (5)$$

where $\bar{U} = U / w_m$

$$\bar{r} = (p^e / w_m, w / w_m, V_p / w_m^2, W_o / w_m, z)$$

Applying the derivative property in equation (5) supply and derived demand functions are specified as follows:

$$y = (b_i + \sum_j b_{ij}\bar{r}_j)/(d_i + \sum_j d_{ij}\bar{r}_j) \qquad (6)$$

$$x_i = -(c_i + \sum_j c_{ij}\bar{r}_j)/(d_i + \sum_j d_{ij}\bar{r}_j) \qquad (7)$$

where *b, c, d* are the coefficients to be estimated.

We model price expectations using the rational expectation hypothesis i.e. each period producers expect that price will be equal to the price that they received the previous period that is:

$$E_t(P_t) = P_{t-1} \qquad (8)$$

As for the computation of expected output price variance, we used the formula that first proposed by Chavas and Holt [10]. According to their formula, variance of expected output price is equal to the weighted sum of squared differences between actual prices and their expected values:

$$Var(P_{i,t}) = \sum_{j=1}^{2} \omega_j \left[P_{i,t-j} - E_{t-j-1}(P_{i,t-j}) \right]^2 \qquad (9)$$

where weights ω_j are equal to 0.50 and 0.33 respectively[1].

Additionally, since we wanted to measure the risk attitude of farmers according to their farm size we computed the coefficient of relative risk aversion as follows:

$$a_c = a_1 d_1 + a_2 d_2 \qquad (10)$$

where d_1 and d_2 are dummy variables that distinguish two types of farm size: small-medium sized farms which own land smaller or equal to 5 hectares and large sized farms which own land more than 5 hectares.

The data we use are from Farm Accountancy Farm Accountancy Data Network (F.A.D.N.) and the National Statistical Service of Greece. The data are in a farm level during the period 1994-2002 and our dataset consists of 1342 observations. The variables are prices and quantities of cotton production and three variable inputs: land, labour and intermediate inputs. Initial wealth has been computed as the difference between total assets value and total debts value. Finally, we used quantity of capital which is considered as a quasi-fixed input of production and a time trend that captures the effects of technology on cotton production.

We estimated a system of three equations: cotton supply, intermediate inputs derived demand and land derived demand applying the Iterative Nonlinear SURE method in STATA 10 econometric software. We imposed homogeneity condition using wage as a numeraire and we also imposed the symmetry restriction. However, because of high nonlinearity in parameters of equations (6) and (7) convergence was not achieved so following Coyle's [9] suggestion, we divided all equations with the common denominator:

$$\partial U / \partial W_0 = 1 + \frac{a_c}{2(\bar{W})^2} y^2 V_P \qquad (11)$$

IV. ESTIMATION AND SIMULATION RESULTS

In this section we present the estimated supply and derived demand functions as well as the simulation results based on them for the evaluation of four alternative cotton policy regimes. As we noted in the introductory comments these regimes refer to: the 'Old' CAP regime that had been in action till 2005, the new MTR regime consisting of a combination of partial and fully decoupled measures, another fully decoupled system seen as an alternative to the MTR regime in the coming years and finally, a completely free market-no policy scenario, mainly used as a reference system.

Table 1 presents the obtained estimation results. It appears that in their vast majority the estimated coefficients are statistically significant and they have the correct sign. Moreover, the reported results

1. [1] In Chavas and Holt [10] study variance has three years time horizon but given that the weight in third year is small i.e. equal to 0.17 and because we did not want to lose observations we constructed the variance with two years time horizon.

substantiate the existence of both a positive relationship between initial wealth and cotton supply and a negative relationship between cotton price variance and cotton supply. Finally, the coefficients of risk aversion are positive, which means that farmers have decreasing absolute risk aversion (DARA) preferences. The corresponding coefficient for small-medium sized farms however, is larger and statistically significant while being very close to zero and statistically insignificant for large sized farms (i.e. equally zero). Such findings confirm that wealthier farmers are less risk averse and are in line with results obtained in earlier studies [8].

Table 1. Estimated parameters of supply and derived demands

Variables	Cotton Supply	Land Demand	Rest Intermediate Inputs Demand
Constant	0.960 (26.54)	-0.569 (-25.12)	-0.697 (-20.21)
Price of Cotton	0.223 (4.79)	-0.069 (-5.36)	-0.310 (-7.25)
Price of Land	-0.069 (-5.36)	0.228 (21.89)	-0.097 (-7.48)
Price of Rest Intermediate Inputs	-0.310 (-7.25)	-0.097 (-7.48)	0.429 (10.12)
Cotton Price Variance	-0.0012 (-1.50)	-0.001 (-2.03)	-0.001 (-1.14)
Initial Wealth	0.203 (10.76)	0.128 (10.68)	0.089 (4.91)
Quantity of Capital	0.019 (5.47)	-0.017 (-7.61)	-0.038 (-11.25)
Time trend	0.081 (3.75)	0.002 (0.14)	0.017 (0.81)
Risk Aversion Coefficient Small-Medium Farms	2.875 (9.68)	2.875 (9.68)	2.875 (9.68)
Risk Aversion Coefficient Large Farms	0.00000737 (0.18)	0.00000737 (0.18)	0.00000737 (0.18)
R^2	0.88	0.84	0.76

Note: Numbers in parenthesis are z-values, significant at 0.05 level

In Table 2, the elasticities of cotton supply are presented. All computed elasticities are consistent with economic theory, since they exhibit the correct sign. In addition, the cotton supply elasticity in relation to cotton price is higher for small-medium sized farms than for large sized farms, with a value of 0.437 and 0.168 respectively. Similar results have been reported by other studies in this field [11]. Finally, cotton supply elasticity in relation to initial wealth is higher for small-medium sized farms than for large farms.

Table 2. Elasticities of cotton supply

	Cotton	Initial Wealth	Cotton Price Variance	Land	Rest Intermediate Inputs
Small-Medium Sized Farms					
Cotton	0.437	0.162	-0.004	-0.060	-0.663
Large Sized Farms					
Cotton	0.168	0.131	-0.001	-0.032	-0.254

Note: Elasticities are computed at the corresponding mean values

We now turn to our simulation strategy. Using the above-mentioned elasticities and FAPRI [12] projections on cotton world prices until 2013, we have simulated the effects of the four alternative policy scenarios presented earlier on. In order to evaluate the 'Old' CAP regime, we increased the cotton world price by the amount of mean subsidy per kilogram that producers received during the period 2000-2002 (i.e. the reference period for MTR reform). Obviously, in this case the wealth effect on cotton production has been zero.

Furthermore, we have assessed the MTR reform through changes in prices and initial wealth. We discounted a 65% of the total subsidies producers received during the reference period and we increased initial wealth by this amount. We also, increased world price projections by the remaining 35% of total subsidies per kilogram of production. In the full decoupling policy scenario we assume that producers receive the world price and their initial wealth is increased by the full amount of subsidies that they received during the reference period. Moreover, in the free trade scenario we assume that production depends only on world prices. Finally, we recomputed the cotton price variance for all these cases in order to consider its effect on cotton production.

Table 3 presented below, report the percentage changes in cotton production under the three alternative regimes ('Old CAP regime, MTR regime, full decoupling regime) taking as a reference the free trade-no policy scenario. Elaborating on the results of each individual scenario, we come to realise that the 'Old' CAP regime distorts production more than any other alternative. Under this regime, production is on average, compared to the fourth-no policy scenario, higher by 54% and 19%, for small-medium and large farms respectively. In the case of a more decoupled policy, i.e. under the MTR regime, the corresponding increases are 23% for small-medium farms and 12% for large farms. Finally, in the presence of a fully decoupled policy regime the distortions to production are smaller than in any other case. The corresponding increases in production are 4% for small-medium sized farms and 6% for large sized farms.

Table 3. Percentage changes in cotton production in relation to free trade-no policy scenario

	Small-Medium Sized Farms		
Year	Old CAP Regime	MTR Regime	Full Decoupling Regime
2006	60%	22%	2%
2007	52%	22%	3%
2008	49%	22%	3%
2009	58%	24%	4%
2010	56%	23%	5%
2011	54%	23%	5%
2012	53%	24%	6%
2013	52%	24%	7%
	Large Sized Farms		
Year	Old CAP Regime	MTR Regime	Full Decoupling Regime
2006	22%	10%	4%
2007	18%	11%	4%
2008	16%	11%	5%
2009	21%	12%	6%
2010	20%	12%	6%
2011	19%	13%	7%
2012	19%	13%	8%
2013	19%	14%	8%

Taking into consideration the aforementioned results, we first conclude that when support to producers is connected to prices, small and medium sized farms produce more than large farms since their cotton supply elasticity is greater. Secondly, it becomes apparent that the closer we move to a more decoupled policy the smaller the distortion to production becomes. The most interesting result, nevertheless, is that even in the case of adopting a fully decoupled policy; producers' decisions are indirectly affected through the wealth effect. In particular, production appears to be higher than in the free trade scenario and this difference is exclusively attributed to the fully decoupled payments received by the farmers. This means that in real world there is no fully decoupled policy and that any type of support to producers' income affects production decisions even indirectly.

Up to now, our analysis of the four policy scenarios has been based on farm-level data derived from the F.A.D.N database and is thus representative of the corresponding sample of farmers. We wanted, however to approximate the level of overall cotton production in Greece under these four alternative policy scenarios so as to get a more complete picture. Using our previous results, we made projections on overall cotton production of small-medium sized and large farmers respectively. In order to effectuate these projections, we used the distribution of Greek cotton producers by farm size. According to this distribution, 30% of overall production is supplied by small and medium sized farmers and the remaining 70% by large sized farmers.

In Table 4 the approximation of the overall cotton production under these four policies until 2013 is presented. If we take again, the free trade-no policy scenario as a point of reference, we see that the overall cotton production under the 'Old' CAP regime is greater by 22% on average, while an increase by 13% under the MTR regime and only by 5% in case a fully decoupled policy is adopted. These differences in production trends become more obvious if we take a look in Figure 1.

Table 4. Overall cotton production in Greece under four alternative policies

Overall Cotton Production in Greece				
Year	Free Trade Scenario	Full Decoupling Regime	MTR Regime	Old CAP Regime
2006	946437	977908	1072856	1239230
2007	980958	1019441	1112244	1238087
2008	994302	1039512	1134185	1234807
2009	952965	1002497	1095014	1240616
2010	964706	1021274	1110684	1245222
2011	973336	1037130	1124100	1248067
2012	980012	1051252	1136805	1251797
2013	987112	1066176	1149833	1254657

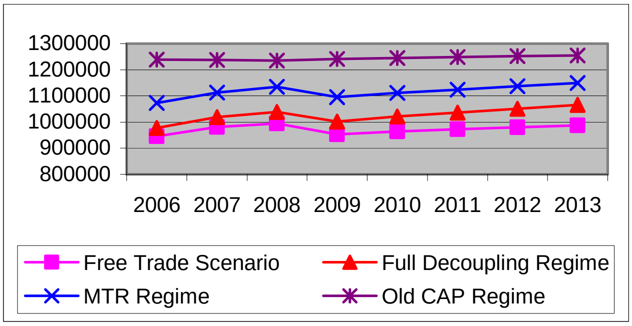

Fig. 1 Overall cotton production in Greece under four alternative policies

V. CONCLUDING REMARKS

All in all, in this study we have attempted to evaluate the effects of four alternative policy scenarios on Greek cotton production: the 'Old' CAP regime i.e. the policy in action until 2005, the new MTR regime adopted after 2005, a fully decoupled policy and a free trade-no policy scenario mainly used as a system of reference. In our analysis, we assumed that cotton producers face uncertainty over prices and we used the mean-variance utility function approach, proposed by Coyle [9].

Our estimation results indicate that cotton producers are risk averse and their risk attitude is greatly influenced by farm size. In particular, small-medium sized farmers appear to be more risk adverse than large sized farmers. We also found that the elasticities of cotton supply in relation to farmers' initial wealth and the cotton price score greater values within small-medium sized farms than within their 'larger' counterparts. This means that a proportional change of these two measures has a stronger effect on the cotton supply of small-medium farms.

According to the obtained simulation results and in line with our expectations production gradually decreases as farmers' support becomes decoupled to production. However, although the fixed payment given to producers is supposed to be production neutral this seems not to be valid in real world. On the basis of our results it becomes apparent that even decoupled payments affect the volume of production. Our analysis makes that evident by comparing the level of cotton production obtained under the free trade-no policy scenario and the one achieved after the full decoupling policy scenario. Cotton production in the second case is greater than in the first one. This practically means that so long as farmers receive an extra income through supporting measures their production behaviour is affected and the supplied quantity in turn does not unilaterally depend on market conditions.

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