The Markets of Cotton Seed and Maize in Greece: Welfare Implications of the Common Agricultural Policy

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Abstract

The model developed in this paper is applied to cotton seed and maize industries and examines the welfare implications of the Common Agricultural Policy (CAP) cotton and maize policy regimes in Greece, after its accession in the European Union (1981). The results of the quantitative analysis indicate that in both markets remarkable amounts have been transferred in favor of producers. Cotton farmers received, however, considerably higher amounts and their income protection levels rose faster than was the case for maize farmers. On the other hand, maize consumers have lost, in terms of economic welfare, during the whole period under consideration and particularly after the mid-80's. This was not the case for cotton seed consumers, since they were buying during the whole period at world market prices. Finally, and in terms of economic efficiency, it has been shown that the CAP cotton regime is by far the more efficient compared to the maize regime due to the kind of practiced policies and the differences in the elasticities of supply.

Keywords: *Common Agricultural Policy, welfare analysis, cotton and maize, Greece.*

Introduction

Greece is the largest cotton seed producer in the EU with more than 90 per cent of the EU's total production in 1995. The rapid growth in Greece's cotton production began after the country's accession into the EU. During these years production has increased from 384.7 thousand tons in 1981, to a maximum of 1,268 thousand tons in 1995. On the other hand, Greece is also among the cotton producing countries with the highest yields worldwide, with almost 3 tons of cotton seed per ha. Maize production is of relatively lower importance and accounts for almost 5 per cent of the cultivated area. Due to a new type of seed introduced in the late 70's and the expansion of irrigation facilities that took place in Greece at that time, maize yields rose sharply, and reached a level of 10 tones per ha, one among the highest in the world. However, since the late 80's, yields and production have stabilized and produced output, accounts on average, for 2 million tons annually.

Nevertheless, the irrigation facilities and the extended use of chemicals that led to remarkable yields internationally and to output increases, have also become the main factors in restricting future expansion in cotton seed and maize production. The reason is the high production costs that place farmers in an unfavorable competitive position in world markets. Therefore, the development of both industries is closely related to the (high) level of farmers' income protection. In the EU cotton regime, market intervention operates through a target price that is set annually for cotton seed. Cotton ginners are able to pay the farmer's

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target price because they receive a deficiency payment equal to the difference between the target price and the world market price. In addition, since the crop year 1986/87, a mechanism of maximum guaranteed quantities coupled with a corresponsibility levy is in use. In the case of maize, floor prices, supported through a system of export subsidies and levies, are in order. Although a market policy reform, mainly aiming at lower producer prices supplemented by direct income payments, has been introduced in 1992, EU prices are still above the world market price level.

It is worth mentioning that, in Greece, high levels of cotton seed price support have been realized mainly after the country's accession in the EU. Cotton seed prices were moving very close to their respective world market prices until 1981. However, after 1981 the prices rose sharply and finally stabilized at a level three times higher or more than that of its world market counterparts. On the other hand, maize prices received by farmers were always higher than their respective world prices, with no immediate changes after the country's accession in the EU.

The objective of this paper is to analyze the welfare effects of both policy regimes, and to examine the economic efficiency of the adopted policies. The analysis is undertaken in a partial equilibrium framework, and the relevant welfare changes are perceived in terms of changes in producers' and consumers' surpluses. Further on, the economic efficiency of both CAP regimes is measured in terms of dead weight losses per unit change in producer's surplus.

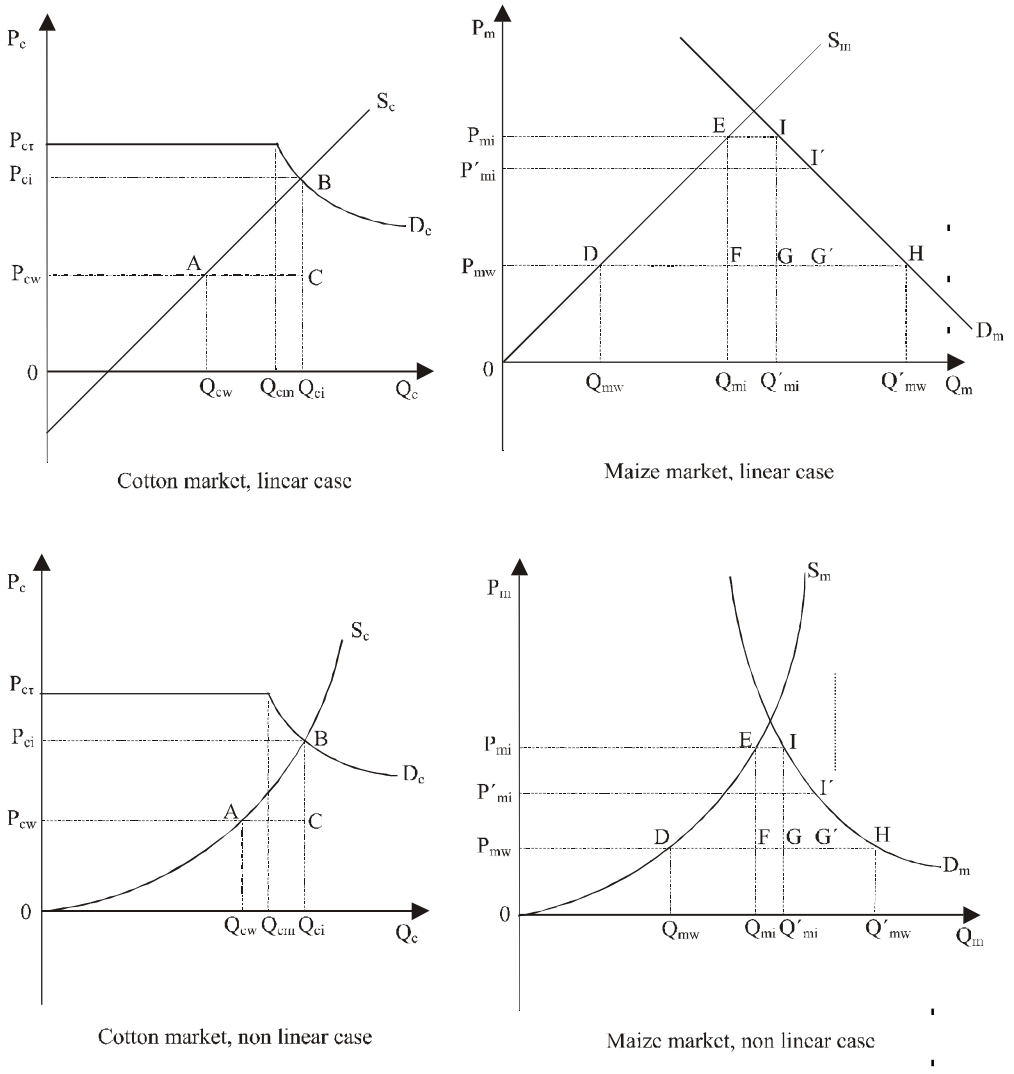
In addition to the introduction, this study includes four other sections. The second section presents the theoretical framework in which we analyze the effects of both policy regimes in terms of economic welfare. The third section presents the results of regression analysis and the obtained elasticities. The fourth section quantifies and discusses the welfare implications of the implemented policies. Finally, in the study's fifth section, the main conclusions are presented.

Theoretical Framework

The theoretical framework adopted in this paper is based on a partial equilibrium approach, a version of which is already being used in various studies aiming at analysing the welfare implications of agricultural policies (Leu, Schmitz and Knutson, 1987; Otsuka and Hayami, 1985). The model that has been developed analyzes the effects that price policy induced changes have on farmers' economic welfare and on the welfare of consumers of agricultural products.

Figure 1 describes the analytical procedure used to examine the effects of the CAP cotton regime on cotton seed and maize markets in Greece. The diagramatic exposition refers to linear and non linear supply and demand curves. The welfare analysis that follows depends on them. We present the case where the supply curve is inelastic, i.e. a positive quantity of the good under consideration is produced at a zero price in the first (linear) case, and a zero quantity is produced at a zero price in the second (non linear) case. The upper panel shows the linear demand and supply functions, while the lower one shows the non linear functions. Here, we only discuss, the linear case, although the non linear one is also presented in the lower part of Figure 1. The analysis of the non linear case is almost identical to that of the linear one, the only differences arising from the different shape of the respective supply and demand curves.

Figure 1: Cotton Seed and Maize Markets in Greece.



The cotton seed market is depicted in the upper left panel (linear case) of this figure with S_c representing farmers' cotton seed supply. The levels of the target price and the world price are depicted by $P_{c\tau}$ and P_{cw}, respectively. If maximum guaranteed quantity (MGO) is set equal to Q_{cm}, given that cotton seed is a non-storable not directly consumable good, D_c provides the demand for cotton seed when a deficiency payment and a corresponsibility levy are used. This is the case whenever the annual production exceeds MGO, provoking a proportional decrease of both deficiency payments and prices received by farmers. The latter is equal to P_{ci}, while the differences between $P_{c\tau}$ and P_{ci}, and P_{ci} and P_{cw} repre-

sent the corresponsibility levy and the actual deficiency payment received by farmers, respectively. In the case just described cotton seed production corresponds to Q_{ci}, while producers' income, in terms of producers' surplus, increases by the area $P_{cw}P_{ci}BA$, the budget effect equals $P_{cw}P_{ci}BC$ and ABC gives the dead-weight loss.

The maize market is presented in the upper right panel (linear case) of Figure 1 with S_m being the supply function for maize. D_m and P_{mw} represent the demand curve and the world price for maize, respectively. P_{mi} refers to the domestic price received by maize producers. Since there exists a domestic price support system because of the CAP regime of levies and export subsidies, the domestic price increases from P_{mw} to P_{mi} with a corresponding supply expansion from Q_{mw} to Q_{mi}. These movements result in producer gains in terms of increased producers' surplus equal to $P_{mw}P_{mi}ED$, such that they are obviously better off. The dead-weight loss is the triangle DEF. On the other hand, and on the demand side, this price increase from P_{mw} to P_{mi} leads to a demand decrease from Q'_{mw} to Q'_{mi} and to a loss in consumers' surplus equal to $P_{mw}P_{mi}IH$. The respective dead weight loss in the demand side is GIH. Only after the 1992 CAP reform the price paid by consumers is lower than the actual price received by producers, i.e. equal to P'_{mi}. In this case, and only for the period after 1992, the change in consumers' surplus and the respective dead weight loss are equal to $P_{mw}P'_{mi}I'H$ and I'G'H, respectively.

Quantitative measures of the areas $P_{cw}P_{ci}BA$ and ABC, in the upper-left panel and of $P_{mw}P_{mi}ED$ and DEF as well as of $P_{mw}P_{mi}IH$ and GIH, in the upper-right panel of Figure 1, require the estimation of the elasticity of cotton seed supply and the estimation of maize supply and demand elasticities. Based on these, we can provide a measure of the impacts of both price policies on economic welfare and get some estimates about their economic efficiency. Our results refer to the 1976-1997 period and are presented and discussed in the next sections.

Regression Analysis and Empirical Results

The model for the Greek cotton seed and maize markets consists of the following equations, presented and discussed below.

The cotton seed market

A Nerlovian type of supply function (Nerlove, 1958) for cotton seed is specified as:

$$Q^s_{c,t} = f_1\left(P_{c,t-1},\ P_{m,t-1},\ Q_{c,t-1},\ D\right) \tag{1}$$

where: $Q^s_{c,t}$ = quantity of cotton supplied in the year t

$P_{c,t-1}$ = price of cotton seed received by farmers in the previous year

$P_{m,t-1}$ = price of maize received by farmers in the previous year

$Q_{c,t-1}$ = quantity of cotton supplied lagged by one period

D = a dummy variable used to capture the potential effects of the Greek accession in the EU in 1981

Given that cotton seed is a non-storable not directly consumable good, which can only be used as a raw material for ginned cotton production, it is reasonable to assume that the demand for cotton seed is perfectly elastic at the domestic price level.

The maize market

The supply function for maize is the following:

$$Q^{s}_{m,t} = f_2\left(P_{m,t-1},\ P_{c,t-1},\ P_{s,t-1},\ Q_{m,t-1},\ D,\ T\right) \tag{2}$$

where: $Q^{s}_{m,t}$ = quantity of maize supplied in the year t
$P_{c,t-1}$ = price of cotton seed received by farmers in the previous year
$P_{m,t-1}$ = price of maize received by farmers in the previous year
$P_{s,t-1}$ = price of sugar beets received by farmers in the previous year
$Q_{m,t-1}$ = quantity of maize supplied lagged by one period
D = a dummy variable used to capture the potential effects of the Greek accession in the EU in 1981
T = a time trend

The demand for maize, the latter being mainly used as an input in animal production, is specified as:

$$Q^{D}_{m,t} = f_3\left(P^{d}_{m,t},\ P_{f,t},\ Q_{me,t}\right) \tag{3}$$

where: $Q^{D}_{m,t}$ = quantity demanded
$P^{d}_{m,t}$ = price of maize paid by farmers
$P_{f,t}$ = price of other feeds (weighted average) paid by farmers
$Q_{me,t}$ = meat quantity produced yearly

Since prices are administratively determined in the context of the CAP regime, they are stripped from their equilibrating function under the operation of market forces. Consequently, the function of equalizing quantities that are being supplied and demanded is shifted to imports. Thus the equilibrium condition is:

$$M_{m,t} = Q^{D}_{m,t} - Q^{S}_{m,t} \tag{4}$$

where: $M_{m,t}$ = net maize imports

All the above equations have been estimated by OLS due to the fact that all prices are exogenously determined. The data used in all equations are annual and cover the period 1966-1997. For cotton seed, the data was obtained from the Hellenic Cotton Board's publication Annual Cotton Report. For maize, the data was obtained from the Ministry of Agriculture and the National Statistical Service of Greece. The estimated results for a linear as well as for a log-linear specification are reported in Table 1.

Table 1: Estimated Parameters of the Supply and Demand Functions.

Variable	Linear model			Log Linear model		
	Supply of cotton	Supply of maize	Demand for maize	Supply of cotton	Supply of maize	Demand for maize
Constant	993.55 (4.55)[a]	108.03 (0.18)	-2,473.80 (-1.89)	3.25 (2.65)	2.57 (2.30)	-2.06 (-0.82)
$P_{c, t-1}$	4.20 (2.52)	-8.89 (-2.15)		0.41 (2.40)	-0.61 (-3.97)	
$P_{m, t-1}$	-73.51 (-5.19)	73.66 (1.95)		-1.14 (-3.78)	0.60 (2.12)	
$P_{s, t-1}$		-274.25 (-2.38)			-0.68 (-3.39)	
$Q_{c, t-1}$	0.75 (10.14)			0.70 (7.88)		
$Q_{m, t-1}$		0.69 (4.18)			0.81 (6.72)	
D	-158.23 (-2.73)	416.02 (2.16)		-0.13 (-1.34)	0.20 (1.73)	
T		43.06 (2.42)			0.03 (2.17)	
T2		-0.88 (-1.80)			-0.001 (-1.91)	
$P_{m, t}$			-124.02 (-2.67)			-0.92 (-2.63)
$P_{f, t}$			209.13 (2.46)			1.56 (1.86)
$Q_{me, t}$			10.16 (9.23)			1.36 (10.27)
$\bar{R}^2$	0.94	0.96	0.79	0.92	0.98	0.84
D.W.	—	—	1.70	—	—	1.63
Durbin's h	0.14	-1.89	—	-1.14	-1.23	—
UTHEIL	0.1086	0.0900	0.1223	0.1047	0.0794	0.1286

[a] Numbers in parentheses are t-statistics.

In order to evaluate the goodness of fit of the estimated equations, we consider two measures: the adjusted R^2, and the UTHEIL inequality statistic (see Greene, 1997, pp. 372-373). These statistics indicate that both the linear and log-linear specifications were adequate in fitting the data and have almost equivalent forecasting power. Therefore, in the absence of any decisive evidence in favor of either of these specifications both of them are employed. For the estimated demand equations the Durbin-Watson statistic for first order autocorrelation is reported. For the supply equations, where lagged endogenous variables are included in the relevant equations, we report the Durbin's h-statistic for first order autocorrelation.

Even though the results of the regression analysis are self-explanatory, several observations can be made. All the price coefficients are statistically significant, and exhibit the expected sign. The supply of cotton depends on its own price, but the statistical relationship between the quantity supplied and the price of maize is even stronger, as the values of t-statistic in both specifications reveal. On the other hand, the price of cotton affects highly the supply of maize in both specifications, although the statistical significance of the cotton price coefficients is almost double in the log-linear model. The supply of maize is also influenced by the price of sugar beets, something not holding in the case of cotton supply.

From the above estimates, we can derive various elasticities of supply and demand, which are presented in Table 2. Our estimates for cotton seed own price elasticities of supply are 0.42 and 0.41, depending on the functional form of the supply function. These estimates are lower than those found by Zanias (1979); Lianos and Rizopoulos (1988); and close to those estimated by Apostolou and Varelas (1987); Mergos and Stoforos (1996); Karagiannis, Katranidis and Velentzas (1997); and Lekakis (1998). The differences may be attributed to the use of maize rather than wheat as a substitute in production.

Table 2: Elasticity Estimates.

	Linear model				**Log-linear model**			
	Price of				Price of			
Function	Cotton	Maize	sugar	other feeds	cotton	maize	sugar	other feeds
Supply								
Cotton	0.42	-1.77			0.41	-1.14		
Maize	-0.37	0.73	-0.55		-0.61	0.60	-0.68	
Demand								
Maize		-0.81		1.85		-0.92		1.56

The own price elasticities of maize supply are 0.73 and 0.60, depending on the model specification. These values are close to the ones found by Baltas (1987). The cross price elasticity of maize supply w.r.t the price of cotton seed is -0.37 in the linear model and -0.61 in the log-linear specification. Finally, the estimated demand elasticities for maize indicate an almost inelastic demand for maize w.r.t to its own price. The respective values are -0.81 in the linear and -0.92 in the log-linear model. The demand, however, for maize w.r.t the price of the other feeds paid by farmers, is elastic, and the relevant values are 1.85 in the linear and 1.56 in the log-linear specification.

Welfare Implications

The welfare implications of the CAP policies implemented in the cotton seed and maize markets have been estimated in terms of producer's and consumer's surplus, and dead weight loss. Changes in producer's surplus, ΔPS_c and ΔPS_m, as well as the changes in consumer's surplus ΔCSm and in the corresponding values of the dead weight loss for cotton seed DWL_c and maize growers DWL_m respectively, have been calculated for a linear as well as a log linear specification of supply and demand (Elbasha, 1997; Voon and Edwards, 1991) as follows:

(a) Linear specification

The cotton market

Change in producer's surplus:

$$\Delta PS_c = P_{cw}P_{ci}BA = \tfrac{1}{2}(P_{ci} - P_{cw})(Q_{ci} + Q_{cw}) = [(P_{ci} - P_{cw})Q_{ci}]\left[1 - \frac{1}{2}\cdot\varepsilon^{s}_{cc}\cdot\frac{(P_{ci} - P_{cw})}{P_{ci}}\right] \quad (5)$$

where ε^{s}_{cc} represents the price elasticity of cotton seed supply. The dead-weight loss is given as:

$$DWL_c = ABC = (P_{ci} - P_{cw})Q_{ci} - \Delta PS_c \quad (6)$$

The maize market

Change in producer's surplus:

$$\Delta PS_m = P_{mw}P_{mi}ED = \tfrac{1}{2}(P_{mi} - P_{mw})(Q_{mi} + Q_{mw}) =$$

$$= \left[(P_{mi} - P_{mw})Q_{mi}\right]\left[1 - \frac{1}{2}\cdot\varepsilon^{s}_{mm}\cdot\frac{(P_{mi} - P_{mw})}{P_{mi}}\right] \quad (7)$$

where ε^{s}_{mm} refers the price elasticity of maize supply.

Change in consumer's surplus:

$$\Delta CS_m = P_{mw}P_{mi}IH = \tfrac{1}{2}(P_{mi} - P_{mw})(Q'_{mi} + Q'_{mw}) =$$

$$= \left[(P_{mi} - P_{mw})Q'_{mi}\right]\left[1 + \frac{1}{2}\cdot\varepsilon^{d}_{mm}\cdot\frac{(P_{mi} - P_{mw})}{P_{mi}}\right] \quad (8)$$

where ε^{d}_{mm} denotes the price elasticity of maize demand.

The dead-weight loss is given as:

$$DWL_m = DEF + IGH = (P_{mi} - P_{mw})Q_{mi} - \Delta PS_m + \Delta CS_m - (P_{mi} - P_{mw})Q'_{mi} =$$

$$= (P_{mi} - P_{mw})(Q_{mi} - Q'_{mi}) + \Delta CS_m - \Delta PS_m \quad (9)$$

(b) Log-linear specification

The cotton market

Change in producer's surplus:

$$\Delta CS_m = P_{cw}P_{ci}BA = (P_{ci} - P_{cw})Q_{ci} - \int_{Q_{cw}}^{Q_{ci}} S_c dQ_c + P_{cw}(Q_{ci} - Q_{cw}) =$$

$$= P_{ci} \cdot Q_{ci}\left[\frac{1}{1 + \varepsilon^s_{cc}}\right]\left[1 - \left(\frac{P_{cw}}{P_{ci}}\right)^{(\varepsilon^s_{cc}+1)}\right] \quad (10)$$

and the deadweight loss:

$$DWL_c = ABC = (P_{ci} - P_{cw})Q_{ci} - \Delta PS_c \quad (11)$$

The maize market

Change in producer's surplus:

$$\Delta PS_m = P_{mw}P_{mi}ED = (P_{mi} - P_{mw})Q_{mi} - \int_{Q_{mw}}^{Q_{mi}} S_m dQ_m + \left[P_{mw}(Q_{mi} - Q_{mw})\right] =$$

$$= P_{mi} \cdot Q_{mi}\left[\frac{1}{1 + \varepsilon^s_{mm}}\right]\left[1 - \left(\frac{P_{mw}}{P_{mi}}\right)^{(\varepsilon^s_{mm}+1)}\right] \quad (12)$$

Change in consumer's surplus:

$$\Delta CS_m = P_{mw}P_{mi}IH = (P_{mi} - P_{mw})Q'_{mi} + \int_{Q'_{mi}}^{Q'_{mw}} D_m dQ_m - P_{mw}(Q'_{mw} - Q'_{mi}) =$$

$$= P_{mi} \cdot Q'_{mi}\left[\frac{1}{1 - \varepsilon^d_{mm}}\right]\left[1 - \left(\frac{P_{mw}}{P_{mi}}\right)^{(1-\varepsilon^d_{mm})}\right] \quad (13)$$

The dead-weight loss is calculated as:

$$DWL_m = DEF + IGH = (P_{mi} - P_{mw})Q_{mi} - \Delta PS_m + \Delta CS_m - (P_{mi} - P_{mw})Q'_{mi} =$$

$$= (P_{mi} - P_{mw})(Q_{mi} - Q'_{mi}) + \Delta CS_m - \Delta PS_m \quad (14)$$

In what follows we present our results dividing the whole period under consideration (1976-1997) in four sub-periods: the period before the entry into the EU (1976-1981), the period after the entry and till the introduction of the system of Maximum Guaranteed Quantities (M.G.Q) in the cotton market (1982-1986), the following period till the 1992 CAP reform (1986-1992) and finally the period until 1997, the last year for which statistical data are available (1993-1997). The results reported in Table 3, indicate that a remarkable increase in the amounts transferred to cotton and maize farmers has taken place after the Greek accession into the European Union (1981). This development was, however, much stronger in the case of cotton than in the case of maize. Cotton farmers received in the pe-

riod 1982-1985 a total amount more than five times higher than in the period before entry. This development continued in the period after the introduction of the corresponsibility levy (1986) as well as after the 1992 CAP reform although in a more moderate form. According to our estimates, in the period 1993-1997, cotton farmers received on average 25.9 or 25.3 bil. greek drachmas p.a. and at constant 1982 prices, depending on model specification. Furthermore, the transfers to maize farmers have also increased, especially after the mid 80's, but compared to cotton with a clearly lower rate. The relevant transfers seem to have been almost stabilized after 1992. In the period 1993-1997 they received on an average year by basis 7.5 or 7.6 bil. greek drachmas depending on model specification. On the other hand, maize consumers have experienced, remarkable losses in their economic welfare, especially after 1986. This development has been halted after the 1992 reform. Their loss in the period 1993-1997 amounted to 7.1 bil. greek drachmas per annum according to the linear model or 7.9 bil. greek drachmas per annum, according to the log-linear model. The total welfare effect of both policies, measured in terms of dead weight loss, rose remarkably, directly after the entry into the EU in the case of cotton and after 1986 in that of maize. The relevant amounts on a yearly basis and for the period 1993-1997 were 3.2 and 2.3 bil. greek drachmas (linear specification) or 3.5 and 2.6 bil. greek drachmas (log-linear) specification, for cotton and maize, respectively.

Table 3: Price Policy Induced Changes in Economic Welfare of Cotton and Maize Producers, Maize Consumers and Total Welfare Effect in mil. drs. per Year[a].

	ΔPS_c	ΔPS_m	ΔCS_m	DWL_c	DWL_m
Linear model					
1976-1981	2044	3167	-1640	-113	-554
1982-1985	11900	4188	-2575	-1305	-635
1986-1992	19598	8618	-7265	-2593	-2376
1993-1997	25866	7530	-7092	-3158	-2330
Log-linear model					
1976-1981	1837	2935	-1665	-103	-511
1982-1985	11547	4148	-2470	-1412	-611
1986-1992	18849	8897	-7378	-2904	-2645
1993-1997	25326	7603	-7856	-3509	-2610

[a] ΔPS_c: change in producer's surplus of cotton producers, ΔPS_m: change in producer's surplus of maize producers, DWL_c: dead weight loss in cotton market, DWL_m: dead weight loss in maize market.

The results reported on Table 4 are showing, that a major portion of farmers' income depends on the implemented CAP policies in both markets. On average and for the period after the Greek entry into the EU (1982-1985), more than 50 per cent of the cotton growers' income could not be realized, according to both specifications, if the existing policy regime had not been used. This policy-induced income is much larger than its counterpart for the years before the entry into the EU. The calculated ratios have almost stabilized after the mid 80's at a level of 60 per cent. In the case of maize, farmers enjoyed a relatively high income protection before and after 1981. It is worth mentioning that the CAP regime did not alter the level of maize growers' income protection that much, as in the case of cotton,

Table 4: Price Policy Induced Changes in the Economic Welfare of Cotton and Maize Producers and Maize Consumers as a Percentage of their Total Economic Welfare (p.a)[a].

	$\frac{\Delta PS_c}{PS_c}$	$\frac{\Delta PS_m}{PS_m}$	
Linear model			
1976-1981	11.9	40.4	22.4
1982-1985	50.0	28.1	26.1
1986-1992	59.8	52.8	57.6
1993-1997	58.4	56.7	46.6
Log-linear model			
1976-1981	13.3	41.8	15.8
1982-1985	55.2	29.0	18.7
1986-1992	65.6	54.9	45.5
1993-1997	64.3	59.0	39.9

Note: Since the estimated demand for maize does not intersect the price axis when a log specification is used, we assumed, in order to compute the consumer surplus (CS), that the quantity demanded tends to zero at a hypothetical price (choke price) which is set at a multiple of the observed average price. We have set this choke price three times higher than observed maize prices paid by maize demanders. Such a price was also leading at zero demanded quantities in the linear model.

[a] $\Delta PS_c/PS_c$: change in cotton producers' welfare (ΔPS_c) divided by their total economic welfare (PS_c), $\Delta PS_m/PS_m$: change in maize producers' welfare (ΔPS_m) divided by their total economic welfare (PS_m), $\Delta CS_m/CS_m$: change in maize consumers' welfare (ΔCS_m) divided by their total economic welfare (CS_m).

since they were benefiting from significant income protection even in the years before 1981. According to our estimates the respective ratios of income protection reached a level of almost 60 per cent during the 90's.

On the other hand, and due to the floor price element of the maize policy regime, maize consumers were always the losers of the practiced policy, while in the case of cotton consumers, i.e. cotton ginners, were not affected by the implemented regime, since they were always buying cotton at world prices. In the period after 1981 maize consumers have experienced increased welfare losses, which in the period 1986-1992 reached a level of 57.6 and 45.5 per cent depending on model specification, compared to their total welfare under world market prices. Only for the period after 1992, i.e. after the implementation of the CAP reform, were the respective ratios lower, apparently due to the lower prices paid then by maize consumers.

The relative economic efficiency of the CAP regime has been evaluated in terms of the deadweight loss over the changes in producer's surplus. According to the estimated ratios the policy inefficiency rose, compared to the period before accession, and especially after 1981 for cotton and after the mid 80's for maize. Furthermore, and for the whole period under consideration, our estimates indicate, that the CAP cotton regime is more efficient than the CAP maize regime. This is probably due to the fact, that no deadweight loss exists on the demand side for cotton, because of the deficiency payment character of the cotton regime, while in the case of maize, beyond the dead weight loss on the supply side, there occurs a dead weight loss on the demand side as well. The calculated percentages, regard-

ing to the value of the respective dead weight losses over the value of changes in producer's welfare are presented in Table 5.

Table 5: Price Policy Efficiency Ratios for Cotton and Maize Markets (% p.a)[a].

	$\frac{DWL_c}{\Delta PS_c}$	$\frac{DWL_m}{\Delta PS_m}$	$\frac{DWL^s_m}{\Delta PS_m}$	$\frac{DWL^D_m}{\Delta PS_m}$
Linear model				
1976-1981	2.2	16.9	11.9	5.0
1982-1985	10.1	12.3	8.0	4.3
1986-1992	12.6	28.1	16.7	11.4
1993-1997	12.1	30.7	18.7	12.0
Log-linear model				
1976-1981	2.3	15.6	9.3	6.4
1982-1985	11.2	11.8	6.7	5.1
1986-1992	14.6	31.8	14.8	17.0
1993-1997	13.8	35.0	16.3	18.7

[a] $DWL_c/\Delta PS_c$: dead weight loss observed in the cotton market (DWL_c) divided by the respective change in cotton producers' welfare (ΔPS_c), $DWL_m/\Delta PS_m$: dead weight loss observed in the maize market (DWL_m) divided by the respective change in maize producers' welfare (ΔPS_m), $DWL^s_m/\Delta PS_m$: dead weight loss (supply side) observed in the maize market (DWL_m) divided by the respective change in maize producers' welfare (ΔPS_m), $DWL^D_m/\Delta PS_m$: dead weight loss (demand side) observed in the maize market (DWL_m) divided by the respective change in maize producers' welfare (ΔPS_m).

During the period 1993-1997 the total dead weight loss over the change in producer's surplus for maize was considerably higher than that for cotton. Thus, the figures calculated for this period on average and on an annual basis indicate that for each 100 greek drachmas transferred to cotton farmers there is a deadweight loss of 12.1 or 13.8 greek drachmas, depending on model specification. The values for maize farmers were 30.7 and 35 respectively. This means that the applied CAP maize regime was clearly less efficient than the one applied in the cotton market.

Conclusions

In this paper we have considered two products, namely, cotton seed and maize, and two different price policy intervention systems. The cotton seed market is organized through a system of deficiency payments, while in the case of the maize market a floor price system is used. For the purposes of this study we have estimated the necessary supply and demand functions for the period 1967-1997, and consequently we have calculated the welfare implications of the practiced policies, in terms of changes in producers' and consumers' surpluses. For the statistical estimates and the welfare analysis that followed we have used two models of different specification, namely a linear and a non linear one. Both were of almost equivalent statistical power, and according to them the estimated changes in economic welfare were very close to each other. Therefore we have left both in the study in order to make some comparisons if wanted, and to avoid the criticism that our results could be at-

tributed to an artifact of a specific model. Finally, we have estimated economic efficiency ratios for the relevant policies.

The empirical analysis has shown that the CAP cotton and maize price policy regimes, as implemented after the Greek accession into the EU (1981), have greatly affected producers' welfare. This was especially clear in the case of cotton, where farmers received significant transfers that were still increasing, albeit with a more moderate form, at least till 1997 the last date for which statistical data are available. Furthermore, after 1981 cotton farmers' income reached levels of protection, calculated as the ratio of the price policy induced income over their total income, that were many times higher than that found before 1981. On the other hand, it is only after the mid 80's that maize farmers received higher income protection than before 1981 and the amounts transferred to them grew at a much lower rate than in the case of cotton. The latter have been almost stabilized after the 1992 CAP reform.

Taking the analysis a step further, it has been shown that the relative economic efficiency of cotton price policies was constantly higher than that of maize. This is not only attributable to the deficiency payment policy applied in the cotton sector, which leaves consumers' welfare, unaffected but is also associated with the higher elasticities of supply estimated for maize production. This situation is still continuing after the 1992 CAP reform, with maize prices paid by consumers being clearly reduced.

The efficiency of both policies is expected to increase in the future, although for different reasons. If a CAP reformulation is to result in reduced expenditures on the cotton market, i.e. will reduce the level of internal support, then lower target prices for cotton seed and accordingly a higher economic efficiency for the CAP cotton regime are to be expected. In the case of maize the state of art is different. The EU, due to its WTO commitments and its enlargement to the East, has to reduce the price for cereals and among them of maize as well. The CAP reform of 1992 introduced price cuts for maize producers, giving them however, substantial income compensating payments coupled, although indirectly, to the quantities produced. In any case after 1992, maize consumers had to pay, clearly lower prices for maize than before. Renewed measures, in the same direction, will be introduced in the maize market after the year 2001. Therefore, further improvements are expected, mainly arising from the demand side.

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