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**MFA Quotas Elimination: the Case of Cotton Yarn in Greece - a Multi-Market  
vs. a Single Market Analysis**

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The objective of this article is to analyze the welfare effects of the Multifiber Agreement (MFA, 1974-1995) and the Agreement on Textiles and Clothing (ATC, 1995-2005) regime on the cotton yarn sector in Greece. We consider cotton yarn as a final product in a vertically linked market setting, consisting of a) the cotton seed market (primary production), b) the labor market for cotton yarn (intermediate market), c) the cotton lint market (intermediate market) and d) the cotton yarn market. Cotton seed producers supply mills with cotton seed where it is processed and altered to cotton lint. The cotton lint is then used by cotton yarn producers together with labor as the two main inputs to cotton yarn production<sup>1</sup>.

The price linkages that exist in vertical markets add complications to the process of measuring welfare effects. Changes in price-policy in one market affect producers of the other markets. To deal with these complications, we use a multi-market approach, which allows us to take into consideration the simultaneous nature of the price changes. This approach has been used in the past by a number of researchers (Katranidis, *et. al.*, 2005; Jeong *et. al.*, 2004; Brannlund and Kristrom, 1996) to examine welfare effects in a multi-market setting where two or more prices change simultaneously.

We call this model “the sequential approach” and extend past research by comparing the welfare results obtained from the “sequential” multi-market model to the welfare results obtained with a “single-market approach”. This approach rests on the assumption that the final market for cotton yarn is a market for a “necessary output”, which allows us to examine any welfare changes from a simultaneous change in two or more prices, in a single market, i.e. the market for the necessary output. On a theoretical level, the welfare results obtained from the “single-market approach” and

the “multi-market sequential approach” should be equal. Empirically though, the results obtained from these two approaches differ substantially.

The primary goal of this article, however, is to examine the effects of trade liberalization on the Greek market for cotton yarn and outline the methodological approach of estimating price-induced welfare effects in a multi-market setting. The single-market approach merely touches on an interesting subject that researchers need to be aware of when the availability of data restricts them to estimating welfare changes in one market. The method outlined and the empirical considerations we focus on are, especially, useful for researchers in agricultural economics, where interrelated markets are often encountered and data availability prevents the full development of a multi-market model.

### **The MFA and the Markets for Cotton, Yarn and Labor**

In 1974, a quota regime was instituted for Textile and Clothing (T&C) products by the initial MFA (in force since 1/1/1974) that provided rules for the imposition of quotas through bilateral agreements and unilateral actions. Since then, the MFA was extended several times, after initiation by developed countries, to cover a larger number of products and countries (1978, MFA II; 1982, MFA III; 1986 MFA IV; 1991 MFA IV extended). Quota impositions were applied on imports from developing countries when surges of imports occurred (Francois *et. al.* 2000). In 1987, when the Round of Uruguay began, the discussion for trade liberalization in T&C was initiated. By the end of the Uruguay Round, the ATC (1995) came into force. The ATC realized the idea of trade liberalization by requiring the gradual elimination of any quota restrictions, which were still in place from the MFA regime,

by the year 2005. Fifty one percent (51%) of quotas were to be eliminated by 12/31/2004 and the other 49% as of 1/1/2005.

The gradual elimination of existing quotas exerted negative pressure on the incomes of Greek yarn producers, who now faced lower prices for their product and a more competitive international market. Export levels decreased and imports surged. At the same time, due to other international developments, Greek producers were also faced with higher costs for labor input. We examine the welfare effects of these two simultaneous price changes during the period of the MFA regime (1974-1994), when quotas were in place, and the initial period of the ATC regime (1995-2000), when quotas were being gradually eliminated. The welfare effects during the ATC regime represent the gradual move from the MFA quota regime to the free trade scenario.

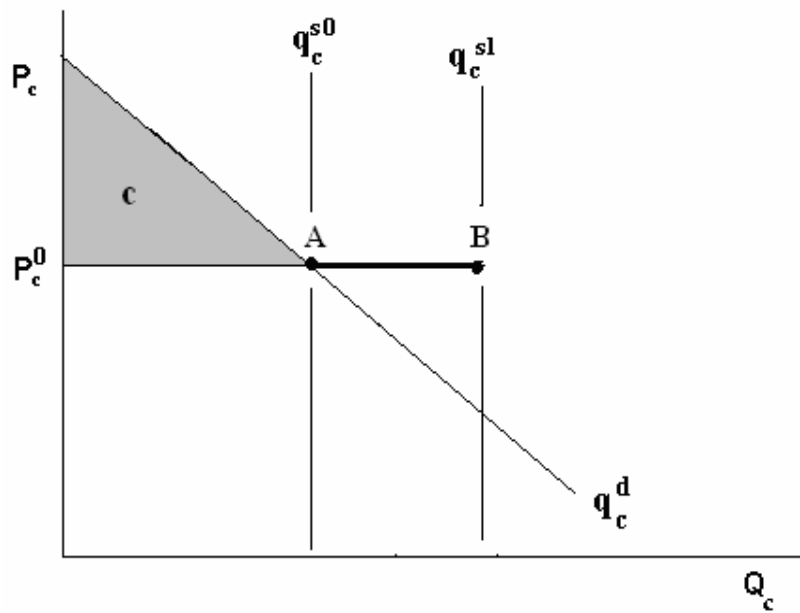
Prior to estimating these price-induced welfare effects to cotton yarn producers, we need to examine the price-policies in the markets for seed, cotton and labor, in order to determine how each market will affect yarn production and how each has to be appropriately included in the theoretical and the mathematical model.

The production of yarn rests on the primary production of seed. Producers supply mills with seed where it is deseeded and altered to cotton. In 1981, when Greece entered the EU, the Common Market Organization (CMO) called for deficiency payments to seed producers. This resulted in significant increases to production. The increased production was absorbed in whole by cotton producers, who are obligated to purchase from farmers all the quantities of seed they supply. Thus, after 1981, the production of cotton surged as well. The question arises if the surge in the production of seed and cotton affected the welfare of producers of yarn.

To answer this question we consider Greece to be a small exporting country (the price taker case) for cotton (Figure 1). In the cotton market, there is no government

intervention and domestic prices equal world prices. Producers of cotton are, however, obligated to purchase from farmers all the quantities of seed they supply at a predefined price. Thus, the supply of cotton is perfectly inelastic (Karagiannis *et. al.*, 1997). Any increase in the production of cotton ( $q_c^{s0} \rightarrow q_c^{s1}$ ) will be directed towards the export market (exports increase by AB). This will leave domestic demand (point A) and prices unaffected ( $p_c = p_c^0$ ). As prices of cotton will not change, any surge in production will leave consumers of cotton, namely, the producers of yarn, in terms of changes in their welfare, completely unaffected (area c).

**Figure 1. The market for Cotton**



Thus, the increase in the production levels of seed and cotton, after Greece entered the EU, could not have had any effect on the yarn sector. *Any change in price- policy, directed toward the seed market, will not affect the welfare of producers in the yarn market, as long as the small country assumption is valid.*

Next, we look at the labor market. Although in the past decade the immigrant population surged, the cost of labor retained a slightly increasing trend, leveling off

after 1995. Greece's labor costs stand at three times the respective cost of labor in comparison to other major yarn exporting countries in the world (8 highest-volume exporting countries). The recent trend of inflow of immigrant workers to Greece is expected to decrease the cost of labor and benefit producers.

The above theoretical considerations suggest that we have two simultaneous changes in prices that affect producers' welfare. These are the decrease in the prices of yarn, induced by the gradual liberalization of trade and the increase in prices of labor. In sum, we model the *change in cotton-yarn producers' welfare resulting from the simultaneous change in the price of one of the inputs, in an intermediate market (price of labor), combined with a change in the price of the final good (price of yarn).*

## **Methodology**

To model the effect of trade liberalization for T&C on cotton yarn producers, we start by defining two prices: a) prices observed in Greece, as determined by the intervention regime for yarn, since the MFA was instituted. We call these prices "*intervention prices*" (or initial prices). b) Prices that prevail in world markets *or* the prices that would prevail in Greece in the case of no intervention for T&C. We call these prices "*non-intervention prices*" (or final prices). *The welfare effect, of the MFA intervention regime, is the geometric area under the supply curve defined between the intervention and the non-intervention prices.* In other words, the effect of trade liberalization on producers' welfare is the change in producers' surplus, that was annually transferred to them during the MFA regime, which producers will have to forego, if trade is liberalized. Respectively, in the labor market, we define as intervention prices the prices of labor observed in Greece whereas the non-

intervention prices are those paid to labor in the 8 highest-volume yarn exporting countries in the world.

### **Sequential Approach**

We start with the representative cotton yarn producer who maximizes profits:

$$\begin{aligned} \max_q \Pi = & p_y * q_y^s \left( p_y, p_c, w_{y1}, \tilde{w}_{yj}, \tilde{R}_{yk}^s \right) - p_c * q_c^d \left( p_y, p_c, w_{y1}, \tilde{w}_{yj}, \tilde{R}_{cl}^d \right) \\ & - w_{y1} * q_{y1}^d \left( p_y, p_c, w_{y1}, \tilde{w}_{yj}, \tilde{R}_{yj}^s \right) - \sum_j \tilde{w}_{yj} * q_{yj}^d \left( p_y, p_c, w_{y1}, \tilde{w}_{yj}, \tilde{R}_{yj}^s \right) \end{aligned} \quad (1)$$

where  $q_y^s$  is the supply of cotton yarn (final good),  $p_y$  is the price of cotton yarn,  $q_c^d$  and  $p_c$  are the derived demand for cotton lint and the price of cotton lint respectively;  $w_{y1}$  is the cost of labor,  $q_{y1}^d$  is the derived demand for labor,  $\tilde{w}_{yj}$  is the price vector of the rest of the inputs to production for  $j=2\dots n$ ,  $q_{yj}^d$  is the derived demand for the respective input in the production of cotton yarn and  $\tilde{R}_i$  the vector of all the other factors and inputs assumed to be constant. From the maximization problem we deduce that profits for producers of yarn will be a function of the prices of yarn, the prices of cotton, the labor cost and the costs of the other inputs to production. Thus, profits will be expressed by a profit function of the form:

$$\Pi \left( p_y, p_c, w_{y1}, \tilde{w}_{yj}, \tilde{R} \right) \quad (2)$$



If we consider a price change for labor, cotton and yarn, then the quasi-rents to the producers of yarn are equal to:

$$\Delta\Pi = \Pi\left(p_y^i, p_c^i, w_{y1}^i, \tilde{w}_{yj}, \tilde{R}\right) - \Pi\left(p_y^w, p_c^w, w_{y1}^w, \tilde{w}_{yj}, \tilde{R}\right) \quad (3)$$

where i= the initial prices (i.e. 0 or the intervention prices ) and w= the final prices (i.e. 1 or the international prices or non-intervention prices). Equation 3 can be expressed with the following line integral (Kaplan, 1993; JHS, 1982):

$$\Delta\Pi = \int_L \left[ \frac{\partial\Pi}{\partial p_y} \left( p_y, p_c, w_{y1}, \tilde{w}_{yj}, \tilde{R} \right) dp_y + \frac{\partial\Pi}{\partial p_c} \left( p_y, p_c, w_{y1}, \tilde{w}_{yj}, \tilde{R} \right) dp_c \right. \\ \left. + \frac{\partial\Pi}{\partial w_{y1}} \left( p_y, p_c, w_{y1}, \tilde{w}_{yj}, \tilde{R} \right) dw_{y1} + \frac{\partial\Pi}{\partial \tilde{w}_{yj}} \left( p_y, p_c, w_{y1}, \tilde{w}_{yj}, \tilde{R} \right) d\tilde{w}_{yj} \right. \\ \left. + \frac{\partial\Pi}{\partial \tilde{R}} \left( p_y, p_c, w_{y1}, \tilde{w}_{yj}, \tilde{R} \right) d\tilde{R} \right] \quad (4)$$

where L is the path we follow depending on the sequence of the price changes. Given that producers maximize profits, the profit function is continuously differentiable and path independent. Thus, we can express it with the sum of the following definite integrals:

$$\Delta\Pi = \int_{p_y^1}^{p_y^0} \frac{\partial\Pi}{\partial p_y} \left( p_y, p_c^0, w_{y1}^0, \tilde{w}_{yj}, \tilde{R} \right) dp_y + \int_{p_c^1}^{p_c^0} \frac{\partial\Pi}{\partial p_c} \left( p_y^1, p_c, w_{y1}^0, \tilde{w}_{yj}, \tilde{R} \right) dp_c \\ + \sum_j \left( \int_{w_{yj}^0}^{w_{yj}^1} \frac{\partial\Pi}{\partial w_{yj}} \left( p_y^1, p_c^1, w_{y1}, \tilde{w}_{yj}, \tilde{R} \right) dw_{yj} \right) + \sum_k \left( \int_{R^0}^{R^1} \frac{\partial\Pi}{\partial R} \left( p_y^1, p_c^1, w_{y1}^1, \tilde{w}_{yj}, \tilde{R} \right) dR \right) \quad (5)$$

From Hotelling's lemma and the Envelope Theorem:

$$\frac{\partial \Pi}{\partial p_y} = q_y^s, \quad \frac{\partial \Pi}{\partial p_c} = -q_c^d, \quad \frac{\partial \Pi}{\partial w_{y1}} = -q_{yw}^d \quad (6)$$

We substitute equations 6 in equation 5. We also consider that the factors  $\tilde{R}$  and  $\tilde{w}_{yj}$   $\forall j \geq 2$  are constant so these terms are equal to zero. Furthermore, the integral for cotton integrates from  $p_c^0$  to  $p_c^1$ . However, as we argued earlier, there is no intervention in this market and, therefore, world prices equal domestic prices ( $p_c^0 = p_c^1$ ). So, this integral is also equal to zero. Consequently, the change in welfare is equal to the sum of the following integrals:

$$\Delta \Pi = \int_{p_y^1}^{p_y^0} q_y^s(p_y, p_c^0, w_{y1}^0) dp_y - \int_{w_{y1}^1}^{w_{y1}^0} q_{yw}^d(p_y^1, p_c^1, w_{y1}) dw_{y1} \quad (7)$$

Note that this is only one of the paths that we can follow. Equation 7 tells us that the change in welfare for producers of cotton yarn is equal to two geometric areas, i.e. first, the area under the supply curve for cotton yarn given initial prices of labor ( $w_{y1} = w_{y1}^0$ ) and second the area below the derived demand for labor given final prices of cotton yarn ( $p_y = p_y^1$ ). Another possible path is that of equation 8:

$$\Delta \Pi = - \int_{w_{y1}^1}^{w_{y1}^0} q_{yw}^d(p_y^0, p_c^0, w_{y1}) dw_{y1} + \int_{p_y^1}^{p_y^0} q_y^s(p_y, p_c^1, w_{y1}^1) dp_y \quad (8)$$

where the sequence of price changes is now reversed. The area below the demand curve is now estimated given  $(p_y = p_y^0)$  and the area below the supply curve is estimated given  $(w_{y1} = w_{y1}^1)$ . The reason, why these two paths produce the same welfare effect, is because second cross derivatives with respect to the prices in a profit function have to be equal. This is also known as Young's Theorem  $\left( -\frac{\partial q_{yw}^d}{\partial w_{y1}} = \frac{\partial q_y^s}{\partial p_y} \right)$ .

Since we know that for a well-behaved profit function, Young's Theorem will always hold the differential in the line integral of equation 4 will always be an exact differential. Therefore, the line integral is going to be path independent (Kaplan, 1993). Any path, we follow, will produce the same welfare effects, as long as the profit function is well-behaved.

Respectively, the change in consumers' welfare is equal to the area below the demand for yarn.

$$CS = \int_{p_y^1}^{p_y^0} q_y^d \left( p_y, p_{subs,i}, \tilde{R}_y^d \right) dp_y \quad (9)$$

Where  $p_{subs,i}$  is equal to the prices of all substitutes  $i = 1 \dots m$  to yarn consumption and

$\tilde{R}_y^d$  are other factors that affect consumption of yarn considered constant in this model.

### **Single Market Approach**

To examine the welfare effects from the price changes in one market we start by making the assumption that the output of cotton yarn is a "necessary output". If prices decrease below a certain level  $\hat{p}_y^k$ , where  $k=i,w$  for initial and final prices, then

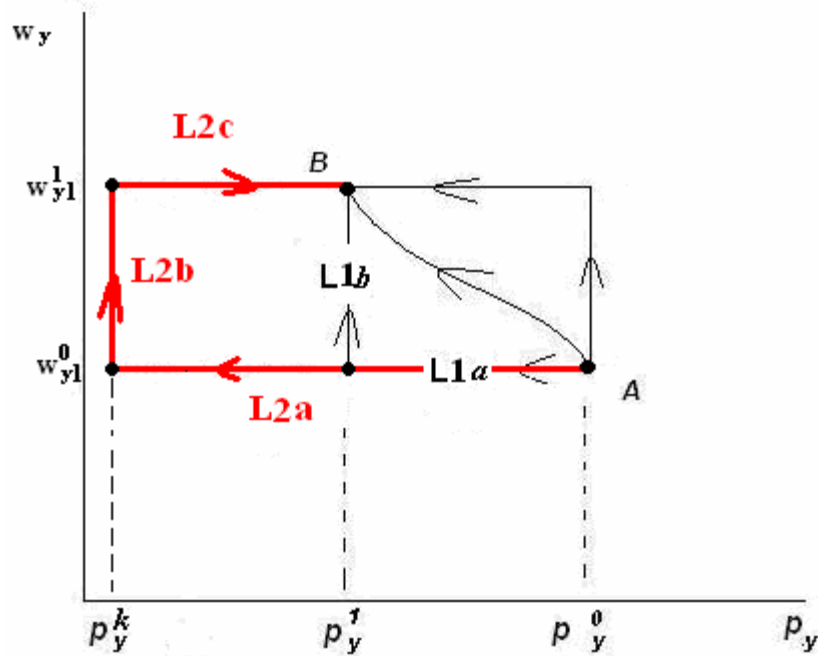
production shuts down. Thus  $\hat{p}_y^k$  is the maximum price of cotton yarn for which production is equal to zero.

$$\hat{p}_y^k = \max \left\{ p_y; q_y^s(p_y, w_{y1}^k, R_y^s) = 0 \right\} \quad k=i,w \quad (10)$$

The path we described in the previous section is that depicted by L1a-b (Figure 2). We now follow a “shutdown path”, i.e. a path that passes through the shutdown area where  $p_y = \hat{p}_y^k$ , such as path L2a-b-c. The change in quasi rents can then be split into three parts:

$$\Delta R = \Delta R(L2a) + \Delta R(L2b) + \Delta R(L2c) \quad (11)$$

**Figure 2. Two paths to estimate the welfare effect from the price changes**



By taking the line integrals we obtain the following expression for the change in quasi rents:

$$\begin{aligned}
\Delta R = & \underbrace{\left[ \int_{p_y^0}^{p_y^k} q_y^s(p_y, p_c, w_{y1}^0, R_y^s) dp_y - \int_{w_{y1}^0}^{w_{y1}^1} q_{y1}^d(p_y^k, p_c, w_{y1}, R_{y1}^d) dw_{y1} \right]}_{\Delta R(L2a)} + \\
& \underbrace{\left[ \int_{p_y^k}^{p_y^1} q_y^s(p_y, p_c, w_{y1}^0, R_y^s) dp_y - \int_{w_{y1}^0}^{w_{y1}^1} q_{y1}^d(p_y^k, p_c, w_{y1}, R_{y1}^d) dw_{y1} \right]}_{\Delta R(L2b)} + \\
& \underbrace{\left[ \int_{p_y^k}^{p_y^1} q_y^s(p_y, p_c, w_{y1}^1, R_y^s) dp_y - \int_{w_{y1}^1}^{w_{y1}^1} q_{y1}^d(p_y^k, p_c, w_{y1}, R_{y1}^d) dw_{y1} \right]}_{\Delta R(L2c)}
\end{aligned} \tag{12}$$

However, in path L2a the second integral is equal to zero as the upper and lower limits of the integral are the same. The same holds true in path L2c where the second integral is equal to zero for the same reason. In path L2b both integrals are equal to zero as we are passing through the shutdown path and quasi-rents equal zero. The remaining integrals provide us with a measure for the change in welfare, which uses data from the market for the necessary output only, i.e. the market for cotton yarn.

$$\Delta R = \int_{p_y^0}^{p_y^k} q_y^s(p_y, p_c, w_{y1}^0, R_y^s) dp_y + \int_{p_y^k}^{p_y^1} q_y^s(p_y, p_c, w_{y1}^1, R_y^s) dp_y \tag{13}$$

Theoretically, the welfare estimates from the sequential (equations 7 or 8) and the one-market approach (equation 13) provide us with the same measure of welfare effects. By using the single-market approach less data are required for the estimation of welfare changes. This approach is especially useful for researchers when data is hard to find. On the other hand, the sequential approach, although it requires more data, reduces the importance of obtaining good estimates of supply and demand outside the range of contemplated changes (Just, Hueth and Schmitz, 1982).

## Statistical Estimation Method

### Sequential Approach

The estimation of the welfare effects requires the supply function for yarn, the derived demand function for cotton, the derived demand function for labor and the derived demand function for yarn. The equations we use are the following:

$$q_y^s = \alpha_0 + \alpha_1 P_{y,t-1} + \alpha_2 P_{c,t-1} + \alpha_3 Q_{y,t-1}^s + \alpha_4 w_{y1} + \varepsilon_a \quad (14)$$

$$q_c^d = \beta_0 + \beta_1 P_{y,t} + \beta_2 P_{c,t} + \beta_3 Q_{c,t-1}^d + \beta_4 w_{y1} + \varepsilon_\beta \quad (15)$$

$$q_{yw}^d = \gamma_0 + \gamma_1 P_{y,t} + \gamma_2 P_{c,t} + \gamma_3 Q_{yw,t-1}^d + \gamma_4 w_{y1} + \varepsilon_\gamma \quad (16)$$

$$q_y^d = \delta_0 + \delta_1 P_{y,t} + \delta_2 P_{tex,t} + \delta_3 P_{synth,t} + \delta_4 P_{NC,NS,t} + \delta_5 Q_{y,t-1}^d + \varepsilon_\delta \quad (17)$$

where  $Q_{y,t-1}^s$  is the lagged production of yarn,  $Q_{c,t-1}^d$  = the lagged demand for cotton,  $Q_{yw,t-1}^d$  = the lagged demand for labor in the yarn market,  $P_{synt,t}$  = the prices of synthetic yarn,  $P_{tex,t}$  = the prices of textiles,  $P_{NC,NS,t}$  = the prices of non-cotton, non-synthetic yarn and  $\varepsilon_\alpha, \varepsilon_\beta, \varepsilon_\gamma, \varepsilon_\delta \sim N(0, \sigma_{\varepsilon_i})$ .

As the error components are correlated simultaneous estimation must be used. The used estimation method was Seemingly Unrelated Regressions (SUR) with restrictions (Iterated Zellner Efficient Estimation - IZEF). SUR is appropriate when in a system of equations none of the dependent variables shows up on the right hand side of the equations and the error components are correlated (Pyndick και Rubinfeld, 1981).

Lagged demand and supply variables enter our system of equations as explanatory variables. In the demand equation habitual consumption requires the use of past year's demand as explanatory variables. In the supply equation we used past year's quantities supplied  $Q_{i,t-1}^j$ , according to Nerlove (1958).

The following restrictions are used so that the profit function is well-defined:

$$-\frac{\partial q_y^s}{\partial p_c} = \frac{\partial q_c^d}{\partial p_y}, \quad -\frac{\partial q_{yw}^d}{\partial p_c} = -\frac{\partial q_c^d}{\partial w_{y1}} \text{ and } \frac{\partial q_{yw}^d}{\partial p_y} = -\frac{\partial q_y^s}{\partial w_{y1}} \quad (18)$$

which are equivalent to  $-\alpha_2 = \beta_1$ ,  $\gamma_2 = \beta_4$  and  $\gamma_1 = -\alpha_4$ . These restrictions are necessary in empirical work to assure that the welfare results from equations 7 and 8 are equal<sup>2</sup>.

#### One - Market Approach

For the one market approach we only need to estimate the supply and demand of cotton yarn. Thus model 2 takes the following form:

$$q_y^s = \alpha_0 + \alpha_1 P_{y,t-1} + \alpha_2 P_{c,t-1} + \alpha_3 Q_{y,t-1}^s + \alpha_4 w_{y1} + \varepsilon_a \quad (19)$$

$$q_y^d = \delta_0 + \delta_1 P_{y,t} + \delta_2 P_{tex,t} + \delta_3 P_{synth,t} + \delta_4 P_{NC,NS,t} + \delta_5 Q_{y,t-1}^d + \varepsilon_\delta \quad (20)$$

The welfare changes are then estimated with the use of equations 9 and 13 which we derived in the previous section.

The data for our statistical analysis came from the Greek Ministry of Agriculture, the World Cotton Statistics (ICAC, 2003), the World Textile Demand (ICAC, 2003), ICAP and the Annual Statistics of the Greek Industry. The CPI index<sub>(1987=1)</sub> was used as the numeraire commodity and all measures were transformed to metric. The world prices for labor and the world prices for cotton yarn are a weighted average estimated from the 8 largest volume-exporting countries in the world. The Durbin-h method was used to test for autocorrelation.

To assess the statistical reliability of our welfare estimates we use bootstrapping techniques. The importance of this procedure in agricultural economics has been stressed by Kling and Sexton (1990), Jeong, *et. al.* (2001), Bullock *et. al.*, (2002).

Bootstrapping techniques allow us to obtain confidence intervals for our welfare estimates asserting reliability to our results. Non-parametric Bootstrap was used (Efron, 1979) for data from 1975 to 2000, a total of 26 observations. The Bootstrap procedure established a random sample of 26 observations using our initial sample while drawing with replacement. The new sample data was used to estimate the regressions. The results were collected onto a table that included the beta parameters  $(\hat{\beta})$ , as well as the estimate for the welfare change  $(\hat{w})$ . This procedure was repeated  $n$  times creating a table with  $n$  estimates of the parameters  $\hat{\beta}$  and the welfare change  $\hat{w}$ . In empirical research we usually consider  $n=1000$ . The bootstrap was only performed for the welfare results from the sequential approach.

All estimations were done in 1987 Greek drachmas and the results were converted to 1987 \$ US. The SAS econometric program was used.

### **Regression Results and Comparison of the Two Models**

The Regression Results are presented in Table 1. The system of equations from the sequential approach explains 89% of the variability. In the equation for the supply of yarn all the coefficients carry the expected signs and are significant. In the equation for the derived demand for labor we observe that the price of cotton lint exhibits an insignificant coefficient. The same holds true for the price of labor in the derived demand for lint. Changes in the price of labor do not seem to affect the derived demand for lint and vice versa. The remainder of the variables, in these two equations, carry the expected coefficient and are significant. In the demand-for-yarn equation, the prices of textiles, non-cotton yarns, non-synthetic yarns show insignificant coefficients. Durbin-h tests did not show any autocorrelation problems.



None of the restrictions were statistically significant, however, their use in this model has a theoretical basis so we choose to include them in the analysis. The single market model explains 75% of the variability. Similar observations are made regarding the statistical significance of the variables in these two equations.

**Table 1. Regression Results from the Sequential and the Single Market Model**

	Model 1 (Sequential Approach)				Model 2 (Single Market Approach)	
Variable	Supply of Yarn	(derived) Demand for Labor	(derived) Demand for Lint	(derived) Demand for Yarn	Supply of Yarn	(derived) Demand for Yarn
Constant	75854*** (4.86)	7419 (1.53)	24979* (1.67)	70156*** (-2.76)	81202*** (4.06)	67468*** (2.58)
P <sub>c</sub> (Price of Cotton)	-0.067*** (-3.90)	0.006 (0.96)	-0.071** (-2.17)		-0.076*** (-2.36)	
P <sub>y</sub> (Price of Cotton Yarn)	0.053*** (3.99)	0.009* (1.84)	0.066*** (3.90)	-0.057* (-1.77)	0.055*** (3.05)	-0.058* (-1.72)
W <sub>ys</sub> (Cost of Labor)	-0.009* (-1.84)	-0.008** (-2.09)	0.006 (0.96)		-0.015 (-0.97)	
P <sub>NC,NS</sub> Price of non-cotton, non-synthetic yarn				5.86E-6 (0.66)		7.2E-6 (0.8)
P <sub>synth</sub> Price of Synthetic yarn				-8.81E-7 (-0.09)		6.18E-7 (0.06)
P <sub>tex</sub> Price of Textiles				-0.007 (-0.81)		-0.007 (-0.84)
Lag D <sub>y</sub> (Lagged Demand of yarn)				0.462*** (2.64)		0.480*** (2.68)
Lag S <sub>y</sub> (Lagged supply of yarn)	0.345*** (2.85)				0.36*** (2.62)	
Lag D <sub>c</sub> (Lagged Demand for Lint)			0.063*** (7.43)			
Lag W <sub>y</sub> (Lagged Demand for Labor)		0.688*** (6.88)				
Durbin-h (t-statistic of the lagged error term parameter in parenthesis)	0.94 (0.69)	0.49 (0.26)	1.45 (1.40)	0.19 (0.29)	1.10 (0.74)	0.16 ( 0.39)
R <sup>2</sup> (Adjusted)	0.89				0.75	
System Degrees of Freedom	81				39	
W <sub>restriction(1)</sub>	-8.924 (0.75)					
W <sub>restriction(2)</sub>	-52.286 (-0.99)					
W <sub>restriction(3)</sub>	-16.139 (-0.8)					

The values in parenthesis are t-values, \*\*\* significant at 0.01 level, \* significant at 0.1 level  
Own estimation

Using equations 7 and 9 for the sequential approach and equations 9 and 13 for the single-market approach, we estimated the changes in producers' and consumers'

surpluses for yarn, induced by the changes in yarn prices and the cost of labor input.

The results can be seen in Table 2.

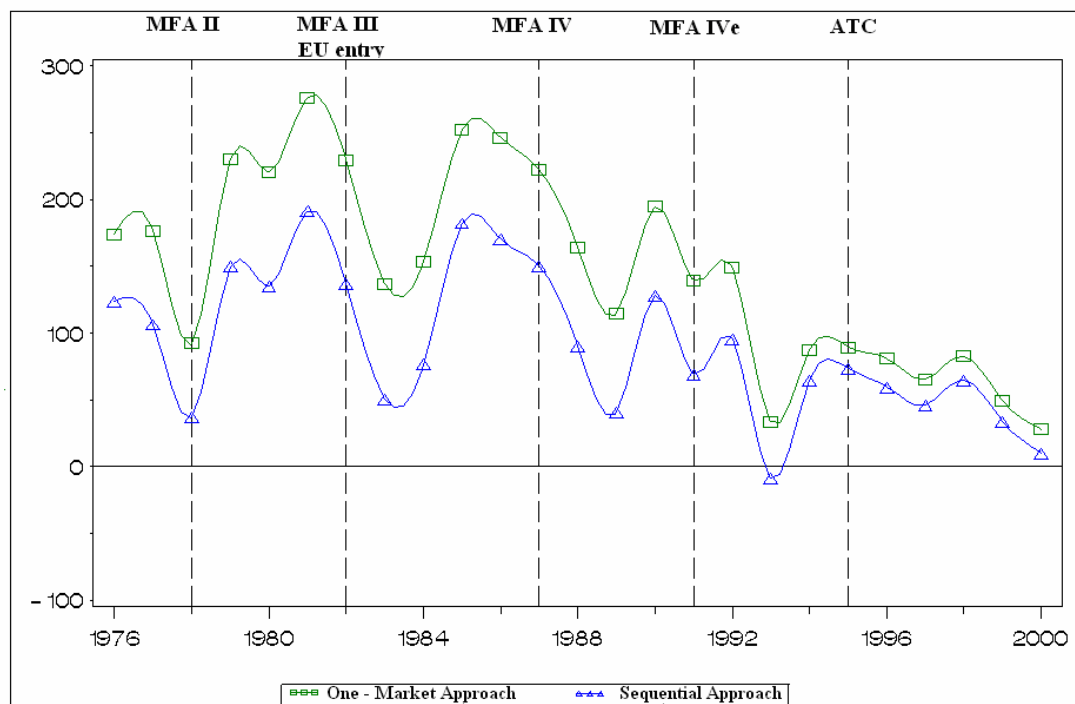
**Table 2. Annual Transfers to Producers and Consumers (mil 1987 US \$)**

Year	Model 1 (Sequential Approach)		Model 2 (One Market Approach)	
	Change in Producer Surplus $\Delta PS$	Change in Consumer Surplus $\Delta CS$	Change in Producer Surplus $\Delta PS$	Change in Consumer Surplus $\Delta CS$
1976	123,88	-125,92	174,24	-124,64
1977	106,42	-113,78	176,35	-112,98
1978	37,55	-74,13	92,38	-73,31
1979	149,69	-132,17	230,55	-131,83
1980	135,31	-146,06	220,41	-145,73
1981	191,18	-162,34	276,13	-161,94
1982	136,76	-159,70	229,73	-159,27
1983	50,77	-109,84	136,85	-109,20
1984	76,58	-113,08	153,53	-112,80
1985	182,24	-150,42	252,34	-150,33
1986	170,21	-170,38	246,49	-170,53
1987	150,32	-165,53	222,15	-166,99
1988	90,41	-132,71	164,19	-133,05
1989	41,17	-112,01	114,80	-112,62
1990	128,06	-144,41	194,63	-144,78
1991	68,95	-129,83	139,49	-130,73
1992	95,43	-118,97	148,92	-118,94
1993	-8,63	-49,44	33,70	-49,44
1994	64,50	-94,25	87,41	-94,57
1995	73,42	-97,14	89,46	-97,15
1996	59,53	-89,27	80,97	-89,56
1997	46,44	-84,43	65,48	-84,97
1998	64,96	-93,14	82,70	-93,44
1999	34,12	-62,24	49,49	-62,09
2000	10,01	-45,91	28,03	-45,52

Own Estimations

The two models show the same trends (see Figure 3), however, the welfare results for producers from the single-market model are consistently higher than the results from the sequential approach. The question remains as to which set of results are better estimates for measuring the changes in welfare in vertical and horizontal markets.

**Figure 3. Annual Transfers to Producers of Cotton Yarn (mil. 1987 US \$ ).**



Own Estimations

According to Just, Hueth and Schmitz (1982), “...when data permit, the welfare effects, associated with a multiple price change, can be calculated more accurately by estimating supply and demand in each market for which prices change and then using the sequential approach, where the welfare change associated with each price change is evaluated in its respective market...”. With the single market approach we are using the part of the supply curve for which we don’t have any observations for, i.e. we have to estimate the area under the supply curve near the axes, whereas in the sequential approach all of our observations fall in the range of the contemplated price changes. Thus the welfare effects estimated with the sequential approach are more accurate. However, a full analysis is still pending, in the literature, regarding the accuracy of welfare estimates in sequential and single-market models (Dadakas and Katranidis, 2006). With the above considerations we continue the welfare

analysis and the bootstrap procedure with the results obtained from the sequential approach.

### **Welfare Analysis**

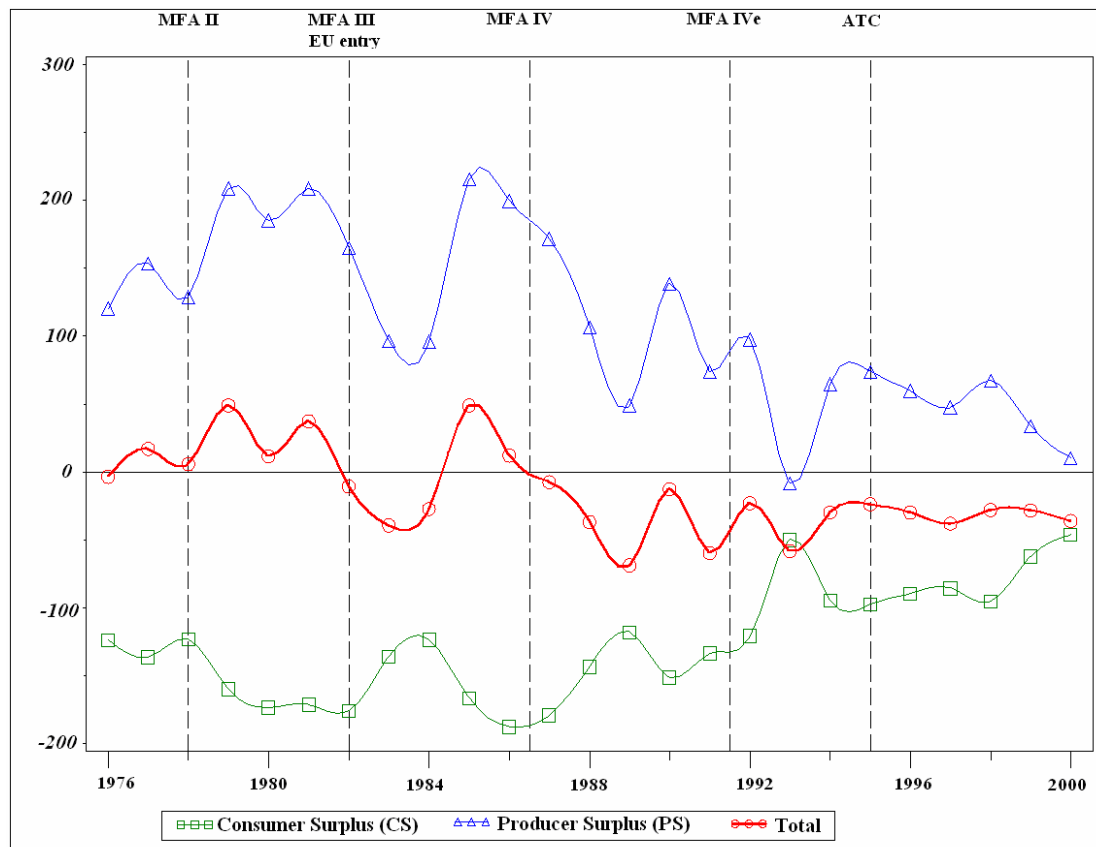
According to our results and for the period under consideration, transfers to yarn producers decreased substantially, over the last 3 decades, making Greek cotton yarn production less viable in the international markets. Until 1987, transfers remained at relatively high levels exhibiting high volatility. Downward spikes are observed on the dates the MFAs were signed (with the exception of MFA II). These spikes were followed by immediate increases in the transfers reflecting policy attempts to support producers' income.

After 1987 we observe a persistent downward trend in transfers to Greek producers. 1986 was the year, when a further extension of the MFA, namely the MFA IV, was signed. At the same time, and in the context of the Round of Uruguay, deliberations began that aimed to the elimination of all quotas for T&C. Both developments might have triggered changes in protecting the relevant markets. In 1991 (MFA IV Extended), the first official attempt was made to eliminate the quota regime. However, it was not signed until 1994. The third extension of 1993 caused transfers to drop to negative levels<sup>3</sup>. By the year 2000, and after the decision for the gradual elimination of all quotas, transfers were almost equal to zero.

We also contrasted the losses to producers' welfare with the gains to consumers' welfare (Figure 4). The top line in Figure 4 is the pattern of producers' surplus during the MFA and the ATC regime. It represents gains to producers' welfare due to the intervention regime. The bottom line is the consumers' surplus during the MFA and the ATC regime. It represents losses to consumers' welfare due to the same regime.

The middle line represents the sum of both effects, i.e. the sum of the changes in producers' plus consumers' surplus.

**Figure 4. Annual transfers to producers and consumers of cotton yarn (mil. 1987 \$ US)**



Own Estimations

After 1987 the (negative) changes in consumers' surplus exhibited an upward trend. This means that consumers' losses became less when compared to the years after the initial signing of the MFA. Therefore, losses in producers' welfare were somewhat leveled by the gains to consumers.

## Bootstrap Analysis

To add statistical meaning to our previous results we used the bootstrap method. Table 3 shows the bootstrapped mean annual income transfers to producers of cotton yarn using as separator key dates, the years various MFAs were resigned.

According to the results presented on Table 3, transfers to producers, after the MFA was instituted (1974), i.e. for the period 1975-1977, reached a three year average of 85 mil. \$ US (column 2, Table 3). With the signing of the MFA II, this amount increased to 149 mil \$ US. After 1982, we observe a persistent downward trend that led mean annual transfers to producers down to 42 mil. \$ US by 1996-2000.

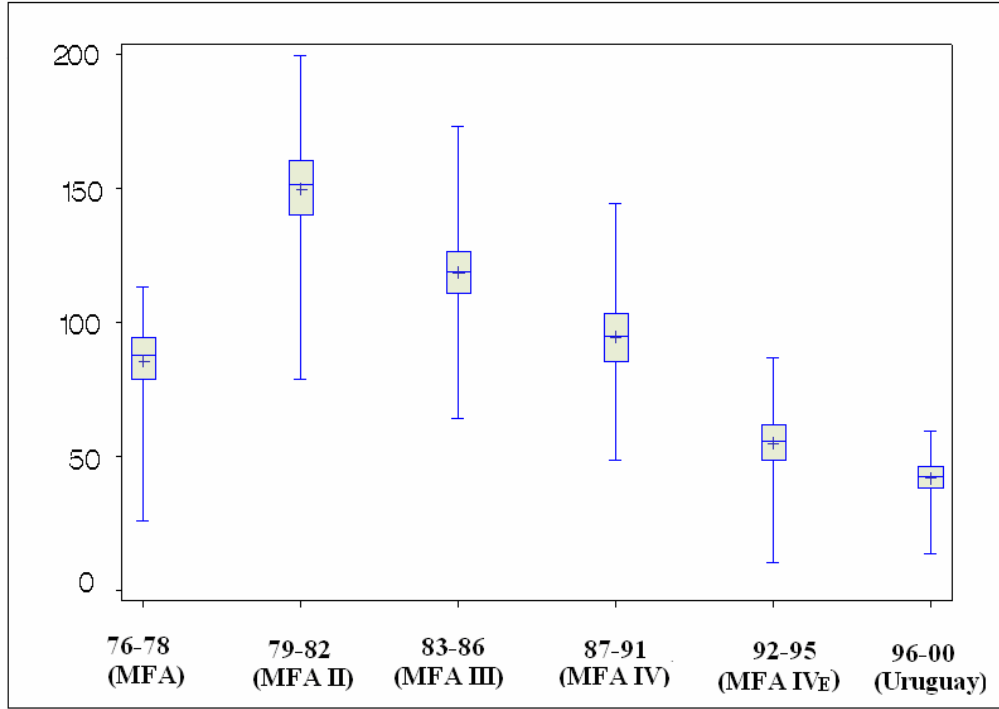
**Table 3. Transfers to the cotton yarn producers (MFA years). Bootstrapped results (mil. 1987 \$ US).**

Years	1975-1977 MFA I	1978-1982 MFA II	1983-1986 MFA III	1987-1991 MFA IV	1992-1995 MFA IV Extended	1996-2000 ATC
<b>Mean Period Income Transfers (Sequential Approach)</b>	85.45 <sup>a</sup> (12.43)	149.77 (15.59)	118.63 (12.19)	93.61 (13.40)	54.80 (10.06)	41.82 (6.15)

<sup>a</sup> The values in parenthesis is the standard deviation  
Own Estimations

Figure 5 presents these results with Box-Whiskers plots. Box –Whiskers plots allow us to visualize the entire distribution of a random variable. Each plot provides us with the corresponding 5%, 25%, 50%, 75% and 95% quantiles of the bootstrap sample. The median is represented with a cross inside the box. The plot allows us to visualize a downward trend in mean annual income transfers that prevailed in the last two decades.

**Figure 5. Box-Whiskers Plots for MFA years (mil. 1987 \$ US).**



Own estimations

We used the “shift method” (Noreen, 1989) to test for the significance of the differences. Mean annual income transfers decreased, after 1982, by 31 mil. \$ US. The drop, we observe after 1982, represents a significant change  $\left( \text{prob}\left(\frac{nge+1}{NS+1}\right)=0 \right)$  (see Table 5) and implies that producers noted, after the implementation of the MFA III a significant decrease in their incomes (the Figure of the distributions for the shift method can be seen in the Appendix). After 1986, and the beginning of the negotiations for the liberalization of trade, in the context of the Uruguay Round, mean annual transfers to producers dropped by 24 mil. \$ US. This difference also represents a significant decrease in transfers. The initiation of the discussions on trade liberalization had a profound effect on Greek producers. The same scenario, in terms of statistical significance, can be seen when we compare the period 1987-1991 (MFA IV) to 1992-1995 (MFA IVe). Transfers dropped by 39.5

mil. \$ US and, by 1995, Greek yarn producers' realized incomes equaled half those realized in the 80's. Finally, after the signing of the ATC (1995) transfers decreased by another 12 mil. \$ US, which also represents a significant reduction in transfers to producers. The signing of the ATC seemed to exercise further pressure on producers' incomes.

**Table 5. T-statistic for the difference in period mean annual transfers to producers of cotton yarn**

Years	Pre and Post MFA II	Pre and Post MFA III	Pre and Post MFA IV	Pre and Post MFA IV Extended	Pre and Post ATC
Mean Difference	62.85	-31.03	-23.63	-39.52	-12.11
Criterion	4.032	3.707	3.499	3.499	3.499
$\frac{nge+1}{NS+1}$	1	1	1	1	0.981
$prob\left(\frac{nge+1}{NS+1}\right) \leq a$	0	0	0	0	0.019

\*\*\* significant at 0.01 level, \* significant at 0.1 level,  
Own estimations

The results suggest that producers started realizing lower levels of transfers after 1982. Transfers recovered in 1985 and 1986 (see figure 2), however, the initiation and the further progress in the negotiations of the Uruguay Round sealed the fate of the MFAs, as early as 1987. Mean annual income transfers decreased after the MFA IV (1986), after the MFA IV Extensions (1991-1994) and after the signing of the ATC (1995). By 1992, most of the negotiated changes to the MFA were completed and a ten-year plan for the gradual elimination of quotas was in place. *This means that our analysis supports that although the final agreement was signed in 1995, the after-effects of the Uruguay Round were already felt by producers some years earlier, i.e. after 1987.*



Finally, we looked in a more detailed manner at the effects of EU entry on producers' welfare. Since changes in policy directed toward the seed market are not expected to have any effect on yarn producers, EU entry should not have effects on the pattern of imports protection and accordingly to the transfers realized by yarn producers. To test this hypothesis, we compared transfers prior and after EU entry, i.e. 1975-1981 and 1982-1987 respectively. Mean annual income transfers in the period prior 1981 equaled 120 mil. \$ US (Table 6). After it, the respective transfers increased to 126 mil. \$ US. This represents, however, a non-significant increase in the relevant amounts.

**Table 6. T-statistic for the difference in period mean annual transfers to producers of cotton yarn After EU entry**

Years	1975-1981 Pre-EU period	1982-1987 Post-EU period
Bootstrap Mean	120.35 (13.05) <sup>a</sup>	126.38 (13.10)
Mean Difference	6.27	
Criterion value	3.106	
$\frac{nge + 1}{NS + 1}$	0.7892	
$prob\left(\frac{nge + 1}{NS + 1}\right) \leq a$	0.2108	

<sup>a</sup> The values in parenthesis is the standard deviation  
Own estimations

These results support the argument that EU entry did not have any effect on producers' transfers. As we argued earlier, EU policies, at least those related to the agricultural sector, cannot influence yarn producers' welfare as the markets for seed and cotton are disjoint. The pattern of import protection, applied in Greece after 1981 in the yarn sector, did not significantly differ from the one applied prior to EU entry.

## **Conclusions**

We examined the transfers to producers of cotton-yarn in Greece using a multi-market setting that is appropriate when vertically or horizontally related markets are considered. We developed the model for a small exporting country using a sequential and a single-market approach. The single-market approach produced consistently higher price-induced welfare effects to producers than the sequential approach. Theory suggests that the results from the sequential approach are more likely to be accurate so we proceeded with the welfare analysis and the bootstrap sample using only the sequential method.

The results showed that transfers to Greek cotton yarn producers significantly decreased over the last two decades. An interesting finding is that the Greek accession to the European Union (1981) did not affect the magnitude of transfers to Greek yarn producers. This means that the pattern of import protection in the yarn sector did not change because of the entry. Our findings indicate that all the developments in policy-induced changes in producer's welfare are to be attributed to the relevant regulations included in the MFA (1974) as well as in its further modifications. All our results agree with the expected effects from MFA regulations.

Producers' incomes decreased over the past years making cotton yarn production less competitive and exerting negative pressure on producer's welfare. Producers started realizing lower mean annual income transfers as early as 1982. The beginning of the discussions of 1986, in the context of the Uruguay Round on trade liberalization, signaled a significant negative impact on producer's welfare. Changes in the pattern of imports protection, which were decided with the signing of MFA IV (1986/7), affected negatively the transfers to yarn producers. After the signing of the ATC, and the implementation of the plan for the gradual elimination of quotas, the

reduction in producers' transfers reached the lowest levels we observe in the period we study.

Finally, after 1987 losses in producers' welfare were partially leveled by the gains to consumers. The latter realized price decreases and significant increases in their welfare.

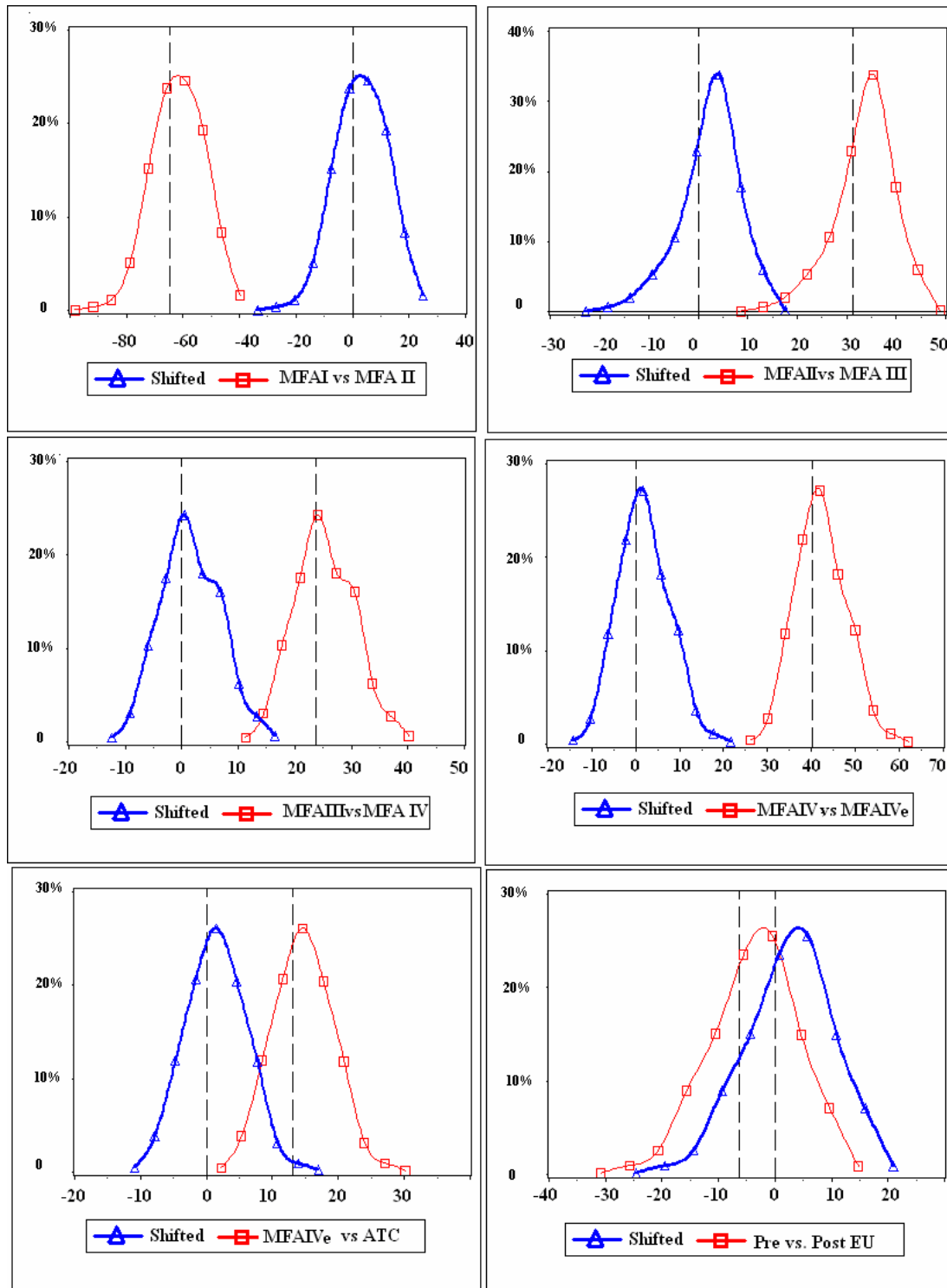
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## Appendix

**Figure A. Distributions on differences (numbers of bootstrapped observations)**



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<sup>1</sup> We refer here forth to the cotton seed market as the *seed* market, the market for cotton lint as the *cotton* market and the market for cotton yarn as the *yarn* market.

<sup>2</sup> In technical terms, these restrictions assure that the line integral of equation 4 is an “exact differential equation”, which is path independent. Although, in theory, any path we follow will provide us with the same welfare effects in econometric work, we have to impose these restrictions to assure that the profit function is well behaved.

<sup>3</sup> Negative levels of transfers show that producers would be better off in a free trade scenario.