Assessing the Impact of Environmental Policies on International Trade Flows and Competitiveness: The Case of Syrian Olive Oil Industry

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Abstract

The idea that compliance with environmental policies can be used to achieve competitive advantage in the international markets has important implications for the way we conceive trade flows and export competitiveness. This paper aims at investigating the impact of compliance with environmental policies on international trade flows and competitiveness in developing and transition economies. To fulfill this aim, a number of questions and concerns about international trade flows and competitiveness impacts of compliance with environmental policies have been addressed qualitatively and some quantitatively for the Syrian olive oil industry. The findings indicate that compliance with environmental policies in developing and transition economies has negative impacts on their international trade flows and export competitiveness. In addition, a strong support emerges to the strategic environmental policy hypothesis and its use in the international markets. Furthermore, it turns out that there is a need for more serious research by the developing and transition economies' governments to determine the most efficient methods for meeting compliance with the domestic environmental policies in order to be consistent with the presented and anticipated environmental policies in the international markets. In the end, a number of policy applications generate from this paper for Syria as well as other developing and transition economies.

Key words: *Environmental Policies, International Trade Flows, Competitiveness, Olive Oil Industry, Syria.*

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1. Introduction

It is becoming increasingly important to put the trade-environment issues in a global context. Indeed, the potential use of environmental policies to achieve competitive advantage in the international markets is a topic of growing policy concern. As the World Trade Organization (WTO) continues to tighten restrictions on traditional government export programs, environmental policies are being increasingly scrutinized as potential instruments for international trade flows and competitiveness. The WTO, the European Union (EU) Commission and other international organizations have recently given special attention for the issue of assessing possible environmental policies impacts on international trade flows and competitiveness, particularly for developing and transition economies. Thereby, the possibility that governments may compromise environmental policies to gain competitive advantage in the international markets is an issue of considerable policy importance for the way we conceive trade flows and export competitiveness. Accordingly and to put in a nutshell, five main motivations explain the importance of quantifying such a topic for developing and transition economies.

First of all, the relationship between compliance with environmental policies, international trade flows and export competitiveness is complicated and multifaceted. There are many different viewpoints on this relationship. Some of them believe that the enforcement of compliance with environmental policies is an additional burden, which increases production costs and harms the international competitiveness of key economic sectors. Others consider that the enforcement of compliance with environmental policies is a valuable mechanism for improving production efficiency, enhancing trade flows, achieving international competitiveness and reducing adverse impacts on the environmental quality where the costs of environmental damage are paid by society as a whole. Consequently, there is a need to understand whether the enforcement of compliance with environmental policies and efforts to ensure the environmental quality ultimately increase or decrease international trade flows and competitiveness for developing and transition economies.

Second, the potential use of environmental policies as the best way to promote trade flows and achieve export competitiveness in international markets is a topic of growing policy concern, particularly for developing and transition economies. Indeed, the environmental characteristics of products and production processes are increasingly becoming an influential factor in determining the quality of products and export competitiveness at the local and international levels. Producers in developing and transition economies must strive, and to the maximum extent possible to meet compliance with environmental policies adopted in foreign export markets, especially for the principal export sectors important to them, so they are able to compete successfully in the international markets. Where achieving compliance with environmental policies has become an integral part of the quality of products and export competitiveness, producers in developing and transition economies need to be able to meet such policies to achieve customary market prices, meeting such policies leads both to price premiums and to higher market shares for them. Thus, environmental policies are increasingly appearing as one of the main tools in the race to promote trade flows and achieve international competitiveness.

Third, while the impact of compliance with environmental policies on international trade flows and export competitiveness is widely discussed in the economic literature, there has been little empirical analysis of how compliance with environmental policies might affect international trade flows and export competitiveness of key economic sectors in the future, particularly in developing and transition economies. Indeed, we know that the enforcement of compliance with environmental policies which promotes the conservation of environmental quality involves additional costs which may reduce the countries' international trade flows and competitiveness, i.e., induce a reduction in both production and exports levels.

Meanwhile, the economic literature regarding the impact of environmental policies on international trade flows and export competitiveness has attracted a lot of attention over the last decades. The main focus of this literature is to assess whether the adoption of environmental policies has a negative impact on international trade flows and export competitiveness. Theoretically, although these concerns are well confirmed, unfortunately, there is no conclusive answer on this issue so far. For example, the evidence for a negative impact of the enforcement of environmental policies on international trade flows is at best mixed (see, e.g., Tobey, 1990; Van Beers & Van den Bergh, 1997; Harris et al., 2002). On the other hand, empirical studies have not provided strong support for the hypothesis that compliance with environmental policies might lead to the loss of international competitiveness of industry, and consequently a decline in the production and exports of the country (see, e.g., OECD, 1985; Ratnayake, 1998; Ederington et al., 2005). Therefore, there is an urgent need highlighted to know whether the adoption of compliance with environmental policies has a negative or a positive impact on international trade flows and export competitiveness for developing and transition economies.

Fourth, the concerns are growing in developing and transition economies about the possible misuse of environmental policies as tools of discrimination against the access of their products into the developed economies markets. These concerns coincide with the growing domestic and international pressures on developing and transition economies to develop and enforce environmental policies that are necessary for the protection and preservation of the environment, which, if successful, could lead to an increase in production costs and a decrease in exports, particularly of products where they have significant competitive advantages. In addition, these concerns are also based on the following three assumptions (UN-ESCWA, 2005:4): (a) the enforcement of compliance with environmental policies increases production costs; (b) producers in developing and transition economies are ill-informed and ill-equipped to come into compliance with environmental policies adopted in the developed economies markets, which can further increase such costs; and (c) exporters in developing and transition economies are price-takers and do not have the ability to translate increased production costs into equivalent sales at higher output market prices. These conditions could therefore result in smaller profits, less income and lower international trade flows and export competitiveness for developing and transition economies. Thus, there is an important trade-environment dimension at stake, which warrants an urgent need for further analysis to the question of assessing the impact of compliance with environmental policies on international trade flows and competitiveness of the production and exports in developing and transition economies.

Fifth and finally, for Syria, as an open-transition economy embarking the road of sustainable development and diversifying its industrial base certainly shares similar concerns and faces similar effects and tradeoffs like other developing and transition economies, particularly in the framework of the negotiations for accession to the WTO and the signing of both the Association Agreement with the EU and the International Trade and Environmental Agreements. This requires Syria to apply compliance with environmental policies adopted by the WTO, the EU and the International Trade and Environmental Agreements as a precondition for its admission, especially those involving wastewater effluent regulatory policies. Whether environmental policies will affect international competitiveness and whether they can be used as non-tariff barriers to trade flows is the issue that is likely to become more and more important for Syria. With reference to that the Barcelona Declaration set 2010 for the completion of bilateral agreements between EU and Mediterranean countries, and it is expected that by the year 2010 there will be an international commitment by the entire WTO and EU members' countries to comply with international environmental policies. Moreover, Syria will most likely be adversely affected by the implementation of measures that include trade sanctions or countervailing measures on the exports of countries that do not comply with environmental policies agreed to within the framework of the WTO Agreements, the Euro-Mediterranean Association Agreements and the International Trade and Environmental Agreements. So, we need to explore if compliance with these environmental policies could adversely affect international trade flows and competitiveness of Syrian olive oil production and exports.

This paper aimed at assisting developing and transition economies in addressing environment, trade flows and competitiveness linkages, as well as in influencing the international agenda as part of their efforts to assure development gains from trade liberalization, both domestically and internationally. This paper also aimed at contributing to increasing the awareness and knowledge in developing and transition economies on issues dealing with the relationship between environment, trade flows and competitiveness. More specifically, the objectives of this paper are (i) to shed light on the impact of compliance with environmental policies on the production and exports for the Syrian olive oil industry; (ii) to assist developing and transition economies in examining how compliance with environmental policies can help to improve economic efficiency and export competitiveness; and (iii) to explore the need for supporting the use of environmental policies as the best way to promote international trade flows and avoid environmental dumping in the region, especially before the environmental damage occurs. In a real sense, the basic objective has to be: "prevention is better than cure with respect to compliance with environmental policies in developing and transition economies".

To fulfill these objectives, we examine the relationship between environmental policies, international trade flows and competitiveness by assessing the scope and scale of international trade flows and competitiveness impacts of compliance with environmental policies. This relationship can be assessed by applying a simple, empirical and tractable economic policy model. This model calculates the percentage change in the production and exports from compliance with environmental policies, particularly when effective mechanisms are put into place to encourage innovation, improve information dissemination and promote technology transfer in a free market system based on the following three main pillars (UN-ESCWA, 2005:5): (I) while the enforcement of compliance with environmental policies can increase production costs, the size of the cost increase attributable to environmental compliance can be small relative to total production costs, thereby limiting the adverse implication for production, exports, international trade flows and competitiveness; (II) given the business instincts of entrepreneurs, higher compliance costs caused by enforcing environmental policies can be offset by seeking out lower cost alternatives, and by implementing efficiency gains and productivity improvements in order to maintain, or even reduce, the cost of production in a free market system; and (III) while competition in the international marketplace is rife, producers in developing and transition economies with strategic vision can enforce compliance with environmental policies and still reap a profit by attracting consumers, particularly in niche markets, who are willing to pay more for environmentally friendly products or specialized goods. These conditions could therefore result in larger profits, more income and higher international trade flows and competitiveness for developing and transition economies.

Thus, there are three levels of analysis arising from the application of this model. The first level called “simple case” scenario, which is calculating the impact of compliance with environmental policies on production and exports in the absence of secondary responses. The second level is based on the concept of “efficiency improvements”, which is based on the principle that the amended environmental policies could provide industries with incentives to encourage them to search for innovative ways to reduce costs and improve profitability. The third level is based on the concept of “international price adjustments”, which is based on the principle that industries by complying with environmental policies could transfer some of the additional production costs to consumers by raising the prices of their products.

The remainder of this paper is organized as follows. Section 2 provides the economic indicators by reviewing the international market for the Syrian olive oil industry. Section 3 summarizes and charts the potential regulatory scenario; achieving compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries. Section 4 introduces the economic model as a methodology used in the empirical part. Section 5 analyzes some exploratory results. Section 6 presents the conclusions and policy applications of this paper. The econometric estimation of the elasticities is relegated to Appendix.

2. The International Market for the Syrian Olive Oil Industry

Syria is considered as the homeland of olive tree before its spread to the rest of the world, where the views of researchers and relevant literature indicate that olive tree was first a native of the greater Syria nearly six thousand years ago (Mohammad, 2006:1). The olive oil industry in Syria is one of the most important industrial sectors of agro-industrial production and is considered as a major contributor to the national economy of the country.

Moreover, Syria is ranked the fourth largest producer of olive oil production in the world after Spain, Italy and Greece in 2006 (International Olive Oil Council, 2006). Production for 2006-2007 is estimated at about 1.2 million tons of olives and a quarter million tons of olive oil, which constitute 9% of world production. This in turn has led to the increase in the number of olive mills, which number about 860 mills at the country level (see Table 1), and this is what created the problem of pollution produced by the olive mills, which needs for concerted all efforts to solve it.

Table 1: Key statistics of the olive oil industry in Syria

Years	No. of olive mills (per unit)	Olives for oil (ton) (X)	Production of olive oil (ton) (Y)	Domestic consumption (ton) (B)	Exports (ton) (E)	Price (Euro/ton) (P)
1990	614	369590	85893	62000	0	1403
1991	645	160083	39032	66000	0	1403
1992	627	405602	102955	67000	0	1612
1993	655	234561	60139	69000	140	1746
1994	686	401400	99895	78000	450	1881
1995	709	331860	84852	78000	5364	1851
1996	704	537535	126613	85000	6116	2507
1997	707	290022	78141	95000	2072	2478
1998	675	615295	144820	88000	451	2493
1999	711	322758	80104	90000	3497	2090
2000	741	731211	165354	110000	1737	2060
2001	755	370500	95384	86000	2245	2090
2002	752	784926	194599	128500	4739	1806
2003	759	435800	103947	150000	30445	1806
2004	779	875342	201964	135000	22161	2045
2005	827	500840	123143	94000	44671	2701
2006	857	897248	252353	100000	56526	3545

Source: Authors' elaborated based on data from the International Olive Oil Council & Syrian Statistical Abstract 1990-2007.

Table 1 presents the key statistics of the olive oil industry in Syria for the years 1990-2006. The Table also shows an upward long run trend among production, domestic consumption and exports of olive oil from year to year. This is mainly because of (a) the fluctuated production in this period as a result of the alternative bearing phenomena; (b) the existence of olive oil imports as a result of the regional and international free trade agreements; and (c) the possibility of storage of olive oil from year to year without any negative impact on the quality in order to be used during the following year. The table also reveals that the industry consists mainly of a large number of olive mills, which have increased significantly, a rate of about 30% between 1990 and 2006. On the other hand, we note that there is a doubling in the production and domestic consumption of olive oil during the same period. Furthermore, it is also worth noting that Syria has started to export olive oil and in large quantities since 1993, and this is mainly due to the large increase in the production of olives during the same period.

Meanwhile, the main feature to note is the large jump in the volume of exports after 2002 due to the increase in the amount of olive oil production and the existence of a large surplus for export. As well, the growing importance of the EU markets as mainly outlets for the Syrian olive oil exports, where large quantities of olive oil are exported to some European countries such as Spain and Italy. This is because the production in these countries in some years isn't adequate to cover the contracts with the importing countries (Mohammad, 2006:8). The European Union, the United States of America, Eastern Asia, Australia and the Arab Gulf states are considered the most promising markets for export.

Given the growing importance of the relationship between environmental policies, international trade flows and competitiveness, it is important to analyze this relationship with a specific reference to the issues related to the olive oil industry in Syria through the following regulatory scenario.

3. The Potential Regulatory Scenario: Achieving Compliance with the Policy of Integrated Waste Management for the Olive Oil Pressing Industries

The policy of Integrated Waste Management for the Olive Oil Pressing Industries in Syria is a national project with the purpose of setting an integrated management system for olive oil wastes. The project is funded by the EU, managed by the United Nations Development Programme (UNDP) and implemented by the Ministry of Environment in Syria (Dimashki et al., 2007:5). The project will be achieved through the following phases:

1. Introducing the concepts of cleaner production options, as well as the prevention, control and treatment measures to the olive oil industry in the project area.
2. Training and technical assistance for concerned stakeholders in order to maintain principles of "green" production of olive oil.
3. Setting standards and limits relating to the olive oil industry pollutions in Syria.
4. Undertake awareness activities with regard to mitigating the environmental effects of waste resulting from the olive oil milling industries.

In general, the treatment and disposal of olive mills wastewater is currently one of the most serious environmental problems in the Mediterranean countries, such as Spain, Italy, Greece, and Syria, where the olive oil products are produced mainly. As a source of pollution, olive mill wastewater has existed for thousands of years, but their impacts on the environment are currently more noticeable due to the following reasons. First, the production of olive oil has increased remarkably over the past 10 years. Second, in the past, the olive oil mills were small and scattered throughout the country and discharged their wastewaters directly on the ground or under the land (particularly in coastal areas), but they are now much greater, and some of them are connected to sewerage. Third, the public awareness of the environmental problems is now much higher than it was in the past.

More specifically, the process of uncontrolled dumping of untreated olive mills wastewater into the watercourses in the Syrian territories constitutes a major threat to the environmental quality. The olive mills wastewater generated by the olive oil extraction industry is a great pollutant to the environment. This is mainly due to its high organic load, its high content of phytotoxic and antibacterial phenolic substances and its high content of the Biological and Chemical Oxygen Demand, which resist biological degradation. The characteristics and contents of olive mill wastewater in terms of both its quantity and quality are heavily dependent on the extraction process used (Shaheen & Abdel Karim, 2007:64-66). In Syria, the olive oil product is extracted mainly according to three methods. The first method is the traditional method of extraction based on press. This method constitutes 47.8% of the total olive mills. The second method is the continuous three phase decanting processes. This method generates a stream of olive oil and two waste streams, an aqueous waste (olive mill wastewater) and a wet solid waste (Zibar). This method constitutes 51% of the total olive mills. The third method is the tow-phase decanting method, which constitutes 1.2% of the olive mills (Syrian Statistical Abstract, 2007; Dimashki et al., 2007:11). To compare the wastewater amounts resulting from olive oil mills, Table 2 presents the comparative data for the three different olive oil extraction processes.

Table 2: Comparative data for the three different olive oil extraction processes

Production process	Input	Amount of input	Output	Amount of output
Traditional pressing process	- Olives -Washing water - Energy	1000 kg 0.1-0.12 m^3 40-63 kWh	- Oil - Solid waste (c. 25% water + 6% oil) - Wastewater (c. 88% water)	200 kg 400 kg 600 kg
Tow-phase decanter	- Olives -Washing water - Energy	1000 kg 0.1-0.12 m^3 90-117 kWh<	- Oil - Solid waste (c. 60% water + 3% oil)	200 kg 800- 950 kg
Three-phase decanter	- Olives -Washing water - Fresh water for decanter - Water to polish the impure oil - Energy	1000 kg 0.1-0.12 m^3 0.5-1 m^3 10 kg 90-117 kWh	- Oil - Solid waste (c. 60% water + 3% oil) - Wastewater (c. 94% water + 1% oil)	210 kg 500-600 kg 1000-1200 kg

Source: Roig et al., 2006:961; Shaheen & Abdel Karim, 2007:72.

As can be seen in Table 2, the wastewater amounts resulting from olive oil mills differ depending on the method of extracting oil used. In traditional mills, it is about 600 kg per ton of olives, and in full-automatic and semi-automatic mills, it is between 800-1200 kg per ton of olives. It should also be noted that the maximum amount of wastewater is not depending on the harvest, but on the maximum olive processing capacity of the installed extraction equipment, and on average, a surplus amount of wastewater of around 50% can be considered for the full-automatic oil extraction if compared to the traditional and semi-automatic processes (Shaheen & Abdel Karim, 2007:70). The amount of olive mill wastewater in Syria is estimated at about 800-944 thousand tons annually (Ministry of Agriculture and Agrarian Reform, 2007; Dimashki et al., 2007:12). In general, the weight composition of olive mill wastewater is 80-96% water, 3.5-15% organics, and 0.5-2% mineral salts (Shaheen & Abdel Karim, 2007:66). The olive mills wastewater is a great pollutant for the environment as we mentioned earlier, and this will require further efforts to address and benefit of olive mills wastewater.

From all the above it can be concluded regarding the pollution problems caused by olive oil production, a solution based on the principles of the clean technology concept could be both the reduction and the detoxification of olive mills wastewaters (Vlyssides et al., 2004:607). This could be achieved with the enforcement of compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries, through the introduction of the principles of the clean technology concept in the production process and the establishment of the central treatment plants. According to this policy, in the conventional 3-phase olive oil production process there is the addition of an olive stones removal stage before the malaxing stage. This leads to a 50% reduction of the added water and a consequent 50% reduction of the generated wastewaters with all the advantages of a 3-phase process and in part of a 2-phase process. This process proved to be effective for the reduction of wastewater pollution load and its detoxification (Vlyssides et al., 2004:608). In Figure 1, cost estimations of the proposed olive oil process modification and wastewater treatment method are presented.

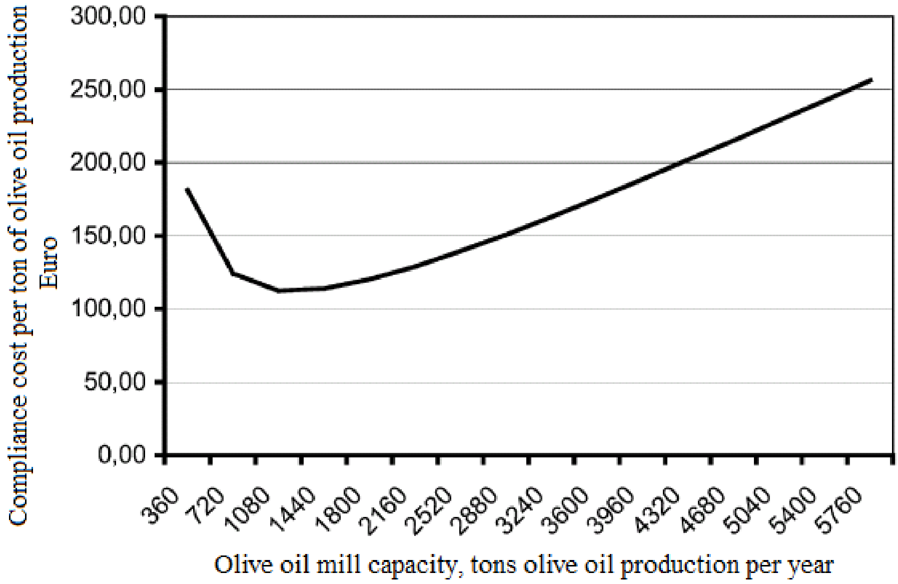

Figure 1: Cost estimation of olive oil processing modifications and wastewater treatment process (Vlyssides et al, 2004:608)

Based on the olive oil price of 2381€ per ton (the average price between 2002-2006) and the available figures reported above, the lowest cost of compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries is 120€ per ton of olive oil, and the highest cost is 250€ per ton. If these costs are passed along in the olive oil prices, the implied price increases range from about 5% (120 / 2381 = 0.05) with the low cost compliance option, and about 10% (250 / 2381 = 0.10) with the high cost option. Both the low and high costs are taken to demonstrate the possible range of impacts.

Given the preceding discussion, this scenario involves assessing or calculating the impact of the increase in the average cost of olive oil production for the producer due to compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries on the production and exports of Syrian olive oil products. In view of the available data, cost estimation of olive oil processing modifications and wastewater treatment process will lead to 5-10% increase in the average cost per ton of olive oil production.

4. The Model

This paper follows a partial equilibrium approach. The objective of this approach is to examine the impact of compliance with environmental policies on the production and exports of Syrian olive oil products. To fulfill this objective, we adopt a modified version of the Larson model (For more details about this model, see Larson, 2000; Harvard Institute of International Development, 2000; Larson et al., 2002). The model in essence is a simple profit maximizing framework used in the analysis. The basic set-up of the model assumes decreasing returns to scale production technology, as well as competition in both domestic and international markets. In this context, one type of environmental regulatory policies has been taken into account, policies on wastewater effluent or the “end of the pipe”, such as wastewater treatment and disposal regulatory policies.

Regarding the market structure facing the Syrian olive oil industry; given that there are a large number of olive oil producers and the presence of an increase in the quantity of olive oil production, the market situation revealed the presence of intense competition between producers in the domestic market, and thereby, the ability of olive oil producers to pass a part of the costs of compliance with environmental policies to the domestic consumers is somewhat limited. In addition, the introduction of efficiency improvements in the production processes is possible due to the enforcement of compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries as mentioned earlier. At the international level, the available quantities of olive oil products for export are large enough; as the share of Syrian olive oil exports has a significant proportion in the quantum of world olive oil exports, and thus a modification of the national olive oil production and consequently of the exported quantities can affect the output market prices of these products. Moreover, there is a differentiation of these products in the export markets based on country of origin; the Syrian olive oil is an example, since the Syrian olive oil products are regarded as higher quality products in comparison to products of other countries (the Syrian olive oil won the world's third place in terms of taste), and this is sufficient to give a price determination power on the Syrian olive oil exporters in the international market.

Additionally, based on the market structure situation described above, we consider three situations or possibilities in this paper: first, the basic partial equilibrium approach; second, an extension that allows for industry-level efficiency improvements to be induced by compliance with environmental policies; and third, an extension that allows for the inclusion of output market price adjustments due to domestic and export supply shifts (a large country or products differentiation based on country of origin in export markets) .i.e., where producers can pass some of the costs of compliance with environmental policies to consumers in the domestic and export markets in the form of higher output market prices.

However, the extent of the impact on the production and exports depends on the stringency of the environmental policies, the market elasticities and the production costs increase. Thus, the task at hand is how to estimate the impact on or calculate the percentage change in the production and exports of Syrian olive oil products from compliance with environmental policies and a given set of market data.

In order to estimate or calculate the likely impacts on olive oil production and exports due to compliance with environmental policies, two pieces of information are needed: (1) the increase in the production costs for the producer due to compliance with environmental policies; and (2) the impact on production and exports from the production costs increase.

Regarding the first piece of required information, note that in the case of the "end of the pipe", compliance with environmental policies acts to increase the average production costs for the producer by some constant amount, e.g., m per unit of output .i.e., m represents cost estimation of olive oil processing modifications and wastewater treatment process due to compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries.

Regarding the second piece of information, a simple partial equilibrium model of production and exports can be used as a starting point. In this case the compliance cost falls on the average production costs, i.e., the cost function for the producer can be written as:

$$C^{m}(w,r,y) = C(w,r,y) + my \tag{1}$$

Where: w and r are inputs prices, and y is the level of output. Consequently the profit function for the producer can be written as:

$$\pi(p,m,w,r) = Max_{x,k}\left[pf(x,k) - wx - rk - my\right] \tag{2}$$

Where: p is the output market price of the product, x and k are inputs used, and then the form of the profit-maximizing supply function for output Y would be:

$$Y = Y(p-m,w,r) \tag{3}$$

The percentage change in production can be computed along with the old supply function by using the price elasticity of supply as follows:

$$\eta_{Yp} = \frac{\Delta Y}{\Delta p}\frac{p}{Y} = -\frac{\Delta Y}{m}\frac{p}{Y} \quad \Rightarrow \quad \Delta Y / Y = -\frac{m}{p}\eta_{Yp} \tag{4}$$

Then, to translate the above production change into export change, the percentage change in export is given by:

$$\Delta E / E = \Delta Y / Y \frac{1}{(E/Y)} \tag{5}$$

Where: E/Y represents the exports share of total production.

One should also consider the possibility of efficiency improvements in the production processes leading to reduce the overall cost of compliance, i.e., compliance with environmental policies that effectively increases the average production costs for the producer could also alter the compliance-induced efficiency improvements in the production processes. Should if this likely possibility occurs, the adverse impact on olive oil production and exports of compliance with environmental policies would be diminished considerably (see, e.g., Porter, 1990). To calculate this effect, the profit function for the producer becomes:

$$\Pi(p,m/t,w,r) = Max_{x,k}\left[pf(x,k) - wx - rk - (m/t)y\right] \tag{6}$$

Where: t represents the efficiency parameter. Then, by applying the Hotelling's Lemma and the Quotient rule, the percentage change in production and exports are given by:

$$\Delta Y / Y = -\frac{m}{p}\eta_{Yp}(1-\eta_{tm}) \tag{7}$$

$$\Delta E / E = \Delta Y / Y \frac{1}{(E / Y)} \tag{8}$$

Where: η_{tm} represents the efficiency elasticity, i.e., the percentage reduction in the compliance costs due to efficiency improvements induced by compliance with environmental policies. If $\eta_{tm} > 1$, the percentage change in t is greater than the percentage change in m, so that the "effective" amount of the compliance costs m/t actually falls and the output price for the producer p rises. As a result, this lower effective amount of the compliance costs due to efficiency improvements induced by compliance with environmental policies causes an increase in the production and exports levels.

In addition, depending upon the size of the industry and its dominance of the world market, some of the compliance costs may be passed along to the consumers in domestic and export markets in the form of higher output market prices. For notation, let $E = E(p)$ represent foreign demand as a function of price, and let $B = B(p)$ represent domestic demand as a function of price. The starting point is the assumption that the export price (p) clears the exports market where export demand equals export supply, and where $E(p) = Y(p - m, w, r) - B(p)$ at the equilibrium price $p = p(m, w, r)$. After taking the total differential of this equilibrium condition with respect to p and m, the impact of the increase in the average production costs for the producer by m per unit of output due to compliance with environmental policies on the output market price p can be written as (see, e.g., Larson, 2000):

$$\partial p / \partial M = \eta_{Yp} / \left(\eta_{Yp} - \eta_{Bp} \frac{B}{Y} - \eta_{Ep} \frac{E}{Y} \right) \tag{9}$$

Where: η_{Ep} is the elasticity of foreign demand with respect to the output price, and η_{Bp} is the elasticity of domestic consumption with respect to the output price, and B/Y is the share of domestic consumption in total production. In fact, the relationship in equation (9) shows how much of the increase in the average production costs for the producer due to compliance with environmental policies is passed along to the consumers in both the domestic and export markets in the form of higher output market prices.

Then, given that the output market price change, with the form of the domestic supply function $Y = Y(p(m, w, r), w, r)$, the form of the export supply function $E = Y(p(m, w, r), w, r) - B(p)$, and the domestic consumption elasticity formulae, the percentage change in domestic production, domestic consumption and exports can be computed as follows:

$$\Delta Y / Y = -\frac{m}{p} \eta_{Yp} (1 - \partial p / \partial M) \tag{10}$$

$$\Delta B / B = \eta_{Bp} \frac{m}{p} (\partial p / \partial M) \tag{11}$$

$$\Delta E / E = \Delta Y / Y \frac{1}{(E/Y)} - \Delta B / B \frac{(B/Y)}{(E/Y)} \quad (12)$$

Using essentially the same process as above, the basic result of the final impact with efficiency improvements and output market price adjustments is that:

$$\Delta Y / Y = -\frac{m}{p} \eta_{Yp} (1 - \eta_{tm}) \mathrm{A}$$

$$\Delta B / B = \eta_{Bp} \frac{m}{p} (1 - \eta_{tm}) (\partial p / \partial M)$$

$$\Delta E / E = \Delta Y / Y \frac{1}{(E/Y)} - \Delta B / B \frac{(B/Y)}{(E/Y)} \quad (13)$$

Where $0 \leq \mathrm{A} \leq 1$ is the price adjustment factor showing how much of the initial change in supply from either equation (4) or (7) is mitigated through **o**utput market price adjustments, and given by:

$$\mathrm{A} = 1 + \left[\frac{\eta_{Yp}}{\eta_{Bp} \frac{B}{Y} - \eta_{Yp} + \eta_{Ep} \frac{E}{Y}} \right] \quad (14)$$

Since $\partial p / \partial M$ and A are both positive, and thus the impact on the production and exports in equations (10), (12) and (13) is smaller (absolute value) than that in equations (4) and (5) or equations (7) and (8).

Thus, the model outlined above provides three possible ways to calculate the likely impacts on olive oil production and exports due to compliance with environmental policies. In other words, the first way gives us the calculation of the direct impact of the average production costs increase on the production and export levels of the olive oil products, assuming exogenous output market prices and no efficiency improvements modification. The second way gives us the calculation of the indirect impact of the average production costs increase on choosing more efficient production techniques. This indirect impact will be combined with the direct one to define an efficient impact of the average production costs increase on the production and export levels of the olive oil products. The third way gives us the calculation of the indirect impact of the average production costs increase on the output market price. This indirect impact will be combined with the direct and indirect ones to define the final impact of the average production costs increase on the production and export levels of the olive oil products that integrates efficiency improvements modification and output market price adjustments due to compliance with environmental policies.

5. Analysis of Some Exploratory Results

The results in this section are exploratory aimed at demonstrating the usefulness of the framework developed in the previous section. In other words, our task is to calculate the underlying relationships outlined in the model described above, i.e., the calculation of the impact of the increase in the average cost of olive oil production for the producer due to compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries on the production and exports of Syrian olive oil products.

Since estimates of the elasticities for the Syrian olive oil market are not currently available, we begin our analysis by performing an econometric test, by using a double log-linear regression equation through the use of an Error Correction Model (see, e.g., Asteriou & Hall, 2007:161, 310), which enables us to directly estimate the elasticities based on the key statistics of the olive oil industry in Syria for the years 1990-2006 presented in Table 1 (see Appendix for more details).

$$Log(Y) = \beta_0 + \beta_1 Log(P) + \beta_2 Log(X) + \beta_3 Log(Y(-1)) + \beta_4 Log(P(-1)) + \beta_5 Log(X(-1))$$

$$Log(B) = \beta_0 + \beta_1 Log(P) + \beta_2 Log(Y) + \beta_3 Log(B(-1)) + \beta_4 Log(P(-1)) + \beta_5 Log(Y(-1))$$

$$Log(E) = \beta_0 + \beta_1 Log(P) + \beta_2 Log(Y) + \beta_3 Log(E(-1)) + \beta_4 Log(P(-1)) + \beta_5 Log(Y(-1))$$

Where:

Y , P , X , B , E : Notation explained in the previous section;
$Y(-1)$: Lagged value of the level of output (output in past year);
$P(-1)$: Lagged value of the output market price;
$X(-1)$: Lagged value of the quantity of the input used;
$B(-1)$: Lagged value of the level of domestic demand;
$E(-1)$: Lagged value of the level of export (foreign) demand;
$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$: Parameters (regression coefficients) to be estimated.

Through the application of (running) the econometric estimation of the elasticities, and dropping the regression coefficients that are not statistically significant. The testing results indicate that the regression equations are statistically significant with respect to the following elasticities:

$$Log(Y) = -1.77 + 0.16 Log(P) + 0.93 Log(X) \Rightarrow \eta_{Yp} = 0.16$$

$$Log(B) = 5.93 - 0.64 Log(P) + 0.51 Log(Y) + 0.39 Log(Y(-1)) \Rightarrow \eta_{Bp} = -0.64$$

Based on these equations, a price elasticity of supply η_{Yp} for the Syrian olive oil market was estimated to be 0.16. In addition, the elasticity of domestic demand with respect to output price η_{Bp} was estimated to be -0.64. On the other hand, the estimation of the elasticity of export demand with respect to output price η_{Ep} was statistically insignificant, but this elasticity was currently available in the related literature; we take it from Ayadi and Matoussi (2007:4) where it was estimated to be around -3.05 in the case study for Tunisia.

Moreover, based on the key statistics of the olive oil industry in Syria for the years 1990-2006 presented in Table 1 and experts expectations, we obtain a compute of amounts to 40% for the initial share of exports to total production E/Y, as well as we obtain a compute of amounts to 60% for the initial share of domestic consumption to total production B/Y (Dimashki & Al Rawas, 2006:12; Asfari, 2007:5).

Additionally, the average compliance cost per ton of olive oil production due to olive oil processing modifications and wastewater treatment process m, was computed to be between 120-250 €, and the percentage increase in the average cost per ton of olive oil production for the producer, i.e., the percentage decrease in the average price per ton of olive oil production for the producer m/p, was computed to be between 5-10% based on the available data reported above in Figure 1. The calculation of the impact of our potential regulatory scenario on the production and exports of Syrian olive oil products are reported below.

Table 3: The impact of the increase in the average cost of olive oil production for the producer on the production and exports of Syrian olive oil products (Equations 4 and 5)

	Small impact	Large impact
The average compliance cost per ton of olive oil m	120 €	250 €
The percentage increase in the average cost per ton of olive oil for the producer m/p	0.05	0.10
Price elasticity of supply (estimated) η_{Yp}	0.16	0.16
The percentage change in production $\Delta Y/Y$	-0.0082	-0.0163
Exports share of total production E/Y	0.40	0.40
The percentage change in exports $\Delta E/E$	-0.0204	-0.0408

Table 3 indicates that a 5% increase in the average cost per ton of olive oil production would lead to a 0.82% reduction in olive oil production, and a 2.04% reduction in olive oil exports. On the other hand, a 10% increase in the average cost per ton of olive oil production would lead to a 1.63% reduction in olive oil production, and a 4.08% reduction in olive oil exports. Therefore, given that the Syrian olive oil exports reached 202 million Euros in 2006, a best case option (a 5% increase in the average cost per ton of olive oil production) would cause a drop in export revenues of 4.12 m €, and a worst case option (a 10% increase in the average cost per ton of olive oil production) would lead to 8.24 m € drop in export revenues. In either case, the loss is significant.

The calculation of the impact of the increase in the average cost per ton of olive oil production for the producer on the production and exports of olive oil products overstate the true impact because potential efficiency improvements and output market price adjustments' effects have not yet been taken into account. We will first consider the role of including efficiency improvements.

Including efficiency improvements: Based on the available figures contained in the regulatory scenario, compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries would lead to a 50% reduction of the generated wastewaters with all the advantages of a 3-phase process and in part of a 2-phase process (noting that there are about 60% of the olive oil mills with a 3-phase process and a 2-phase process, as we mentioned previously). This can be translated into efficiency improvements of amounts to 0.30 resulting from compliance with this policy.

Table 4: Efficiency improvements due to the increase in the average cost of olive oil production (Equations 7 and 8)

	Small impact	Large impact
The average compliance cost per ton of olive oil m	120 €	250 €
The percentage increase in the average cost per ton of olive oil for the producer m/p	0.05	0.10
Price elasticity of supply (estimated) η_{Yp}	0.16	0.16
Efficiency elasticity η_{tm}	0.30	0.30
The percentage change in production $\Delta Y/Y$	-0.0057	-0.0114
Exports share of total production E/Y	0.40	0.40
The percentage change in exports $\Delta E/E$	-0.0143	-0.0286

Table 4 offers the above findings based on an efficiency elasticity of 0.30%. Under the best case option of 5% increase in the average cost per ton of olive oil production, the reduction in olive oil production would be 0.57%, and the reduction in olive oil exports would be 1.43%. On the other hand, under the worst case option of 10% increase in the average cost per ton of olive oil production, the reduction in olive oil production would be 1.14%, and the reduction in olive oil exports would be 2.86%. This is less than the calculated impact on the production and exports that we obtained in the basic model above (Table 3). In other words, the higher the efficiency improvement, the lower the result of the percentage change in production and exports of equations 7 and 8 will be, i.e., an increase in the production and exports of olive oil products will be.

Table 5: Production and exports of Syrian olive oil products in the presence of output market price adjustments (Equations 9, 10, 11, 12, 13 and 14)

	Small impact	Large impact
The average compliance cost per ton of olive oil m	120 €	250 €
The percentage increase in the average cost of olive oil m/p	0.05	0.10
Price elasticity of supply (estimated) η_{Yp}	0.16	0.16
Domestic demand elasticity wrt output price (estimated) η_{Bp}	-0.64	-0.64
Export demand elasticity wrt output price (estimated) η_{Ep}	-3.05	-3.05
Efficiency elasticity η_{tm}	0.30	0.30
Change in output price wrt the compliance cost $\partial p/\partial M$	0.09	0.09
Price adjustment factor A	0.91	0.91
The percentage change in production $\Delta Y/Y$	-0.0052	-0.0104
The percentage change in domestic demand $\Delta B/B$	-0.0021	-0.0042
Exports share of total production E/Y	0.40	0.40
Domestic consumption share of total production B/Y	0.60	0.60
The percentage change in exports $\Delta E/E$	-0.0099	-0.0197

Table 5 shows the above findings based on an output market price adjustment of 0.09%. As indicated in Table 5 above, a 5% increase in the average cost per ton of olive oil production would lead to a decrease of 0.52% in olive oil production and a decrease of 0.99% in olive oil exports. On the other hand, a 10% increase in the average cost per ton of olive oil production would lead to a decrease of 1.04% in olive oil production and a decrease of 1.97% in olive oil exports based on output market price adjustments.

This is far less than the calculated impact on the production and exports that we previously obtained because part of the increase in average cost per ton of olive oil production for the producer is passed on to consumers in the domestic and export markets in the form of higher output market prices of olive oil. In other words, an increase in the market price of olive oil in the domestic and export markets will lead to offset a part of the increase in the average cost of olive oil production for the producer due to compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries.

Therefore, given a computed efficiency improvements of 0.30%, the output market price adjustments case reflect a range of downward adjustment in production of olive oil from 0.52% to 1.04%, and in exports of olive oil from 0.99% to 1.97%, which is significantly smaller than the range demonstrated in the basic model case in Table 3 (a decrease from 0.82% to 1.63% in production of olive oil and a decrease from 2.04% to 4.08% in exports of olive oil). By including efficiency improvements and output market price adjustments our calculations of the impact of the higher average cost of olive oil products for the producer on the production and exports of olive oil products declined significantly.

Thus, the burden of the compliance costs on the industry will be reduced significantly when efficiency improvements are induced by compliance with the policy and a part of the compliance costs is passed on to the domestic and international consumers as an output market price increase. Given that the Syrian olive oil exports reached 202 million Euros in 2006, the range of reduction in export revenues in the efficiency improvements with output market price adjustments case is 2.00 m € to 3.98 m €, and the yearly loss would thus be lower than in the Basic model case by 2.12 m € to 4.26 m €. In either case, the lower loss is significant.

Hence, our best calculation of the impacts on the production and exports in the olive oil industry resulting from the enforcement of compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries is within the range of between 0.52-1.04% and 0.99-1.97% decrease in production and exports respectively. Nonetheless, in percentage terms, the range of impacts on the production and exports of olive oil products certainly indicates more future concerns and strategic thinking with regard to international trade flows and export competitiveness for the Syrian olive oil industry.

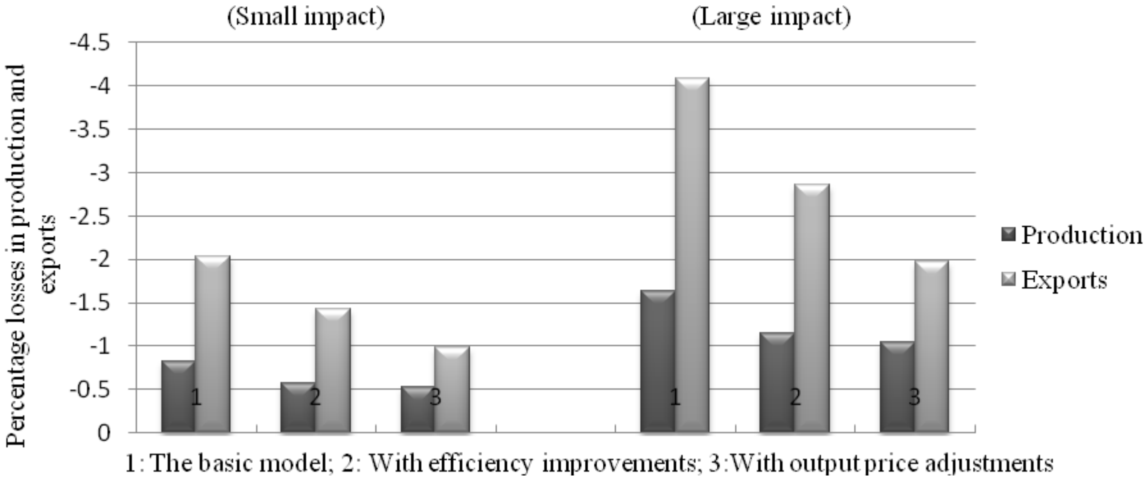

Figure 2: The impact of compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries on the Syrian olive oil production and exports

6. Conclusions and policy applications

The solution of the environmental problems caused by olive oil production is essential for the future of the olive oil industry in developing and transition economies. Accordingly, this paper raises a number of questions and concerns about the impact of compliance with environmental policies on international trade flows and export competitiveness. Are environmental policies being misused to discriminate against the access of developing and transition economies products into developed economies markets? Will the implementation of compliance with environmental policies in developing and transition economies lead to an increase in production costs and a reduction in exports, particularly of products where they have significant competitive advantages? To examine these issues, some of these questions and concerns have been addressed qualitatively and some quantitatively for the Syrian olive oil industry, e.g., the calculation of the impact of the increase in the average cost of olive oil production for the producer due to compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries on the production and exports of Syrian olive oil products.

The findings indicate that compliance with environmental policies in developing and transition economies has negative impacts on their production and exports, i.e., on their international trade flows and export competitiveness. In addition, a strong support emerges to the strategic environmental policy hypothesis, especially when it is used strategically in the international export markets and there is the possibility for the introduction of efficiency improvements in the production process and output market price adjustments in both the domestic and export markets.

For example, our exploratory analyses suggest that compliance with environmental policies would lead to a decrease in the production and exports of the Syrian olive oil products in the range of between 0.82-1.63% and 2.04-4.08% respectively, however, with efficiency improvements and output market price adjustments, the decrease in the production and exports of the Syrian olive oil products would fall to the range of between 0.52-1.04% and 0.99-1.97% respectively.

Furthermore, it turns out that there is a need for more serious research by the developing and transition economies' governments to determine the most efficient methods for meeting compliance with the domestic environmental policies in order to be consistent with the presented and anticipated environmental policies in the international markets.

Moreover, with the increasing importance of the adoption and enforcement of environmental policies and the tendency to harmonize these policies worldwide, the olive oil industry in developing and transition economies needs to become more market-oriented and behave as a profit maximizing industry in order to reap profits in the long run. It must also predict the impact of changing global conditions, such as those imposed by compliance with international environmental policies permissible under the WTO, the EU and the International Trade and Environmental Agreements, which could significantly hamper the production and exports levels, i.e., the international trade flows and export competitiveness levels.

In light of this, the relevant policy question is then how to minimize the costs of compliance with environmental policies and improve the international trade flows and competitiveness for the olive oil industry in Syria in particular and in developing and transition economies in general. To help answering this question, the following policy applications are offered for Syria as well as other developing and transition economies:

- Create an effective communication mechanism between all stakeholders and decision makers involved in this field to examine the impact of compliance with environmental policies on international trade flows and exports competitiveness.

- Provide financial support to research and development (R & D) institutions for research in the necessary environmentally sound technologies to enhance the efficiency and effectiveness of the production extraction process in the olive oil industry.

- Offer incentives to the olive oil industry for investments in cleaner technologies that increase efficiency at various stages of production process. This would reduce the "end of the pipe" compliance costs before the environmental damage occurs.

- Activate the domestic environmental regulatory policies governing the work of the olive oil industry as well as implement controls on product quality.

- Provide technical support and advanced training systems on environmental policies, as well as establish a public network with regard to the information and issues on the international environmental policies. This would help producers and exporters to know what environmental policies are and how to comply with them.

- Encourage producers and exporters to adopt international environmental regulatory policies in labeling and packaging by increasing awareness and understanding of international environmental certification systems such as the ISO 9000 and the ISO 14000, which could increase the international trade flows and competitiveness of the olive oil production and exports. At the same time helping them to achieve compliance with the local and international environmental policies.

Additionally, the Syrian government should continue to pay close attention and remain actively involved in the international negotiations on the development of international environmental policies, particularly with other developing and developed countries' governments. This is necessary to avoid the use of such policies as non-tariff barriers to trade flows in particular by developed countries, and also to ensure that developing and transition economies do not become a haven for pollution-intensive industries.

The first step to achieve this objective is to promote communication and coordination among those responsible for trade and the environment, and calling for a strategic, proactive and cooperative approach, involving exporters and importers as well as policy-setters from both developing and developed countries. This would help the Syrian government to identify a coherent policy that is viable in both areas of trade and the environment.

To sum up, achieving compliance with international environmental policies in foreign export markets, especially those that are wastewater effluent regulatory policies based can have a negative impact on the Syrian olive oil production and exports. This study is a first step toward delineating possibilities that exist now and are likely to grow in the future, particularly after Syria becomes a member of the WTO and signs the Association Agreements with the EU and the International Trade and Environmental Agreements.

As well, the importance of this study lies in the fact that it is a "first" in the case of the olive oil industry in developing and transition economies. It points to areas where the introduction of efficiency improvements in the production process and output market price adjustments in the international export markets can be made to render the industry less susceptible to the concerns of compliance with environmental policies, such as the possibility of lowering the costs of compliance with these policies and controlling production to operate at capacity. This can be secured from accessing to new environmentally sound technologies and entering into niche markets for environmentally friendly products. Also, I hope that the publication of this study will create greater awareness of the trade-environment issue in the world and that it will serve as an example for other studies covering other industrial sectors in developing and transition economies.

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Appendix

1. Cross tabulation for all linear relationships among all the variables:

Correlations

		Y	X	B	E	P
Y	Pearson Correlation	1	.984**	.571*	.578*	.609**
	Sig. (2-tailed)		.000	.017	.015	.010
	N	17	17	17	17	17
X	Pearson Correlation	.984**	1	.615**	.504*	.524*
	Sig. (2-tailed)	.000		.009	.039	.031
	N	17	17	17	17	17
B	Pearson Correlation	.571*	.615**	1	.449	.209
	Sig. (2-tailed)	.017	.009		.071	.421
	N	17	17	17	17	17
E	Pearson Correlation	.578*	.504*	.449	1	.683**
	Sig. (2-tailed)	.015	.039	.071		.003
	N	17	17	17	17	17
P	Pearson Correlation	.609**	.524*	.209	.683**	1
	Sig. (2-tailed)	.010	.031	.421	.003	
	N	17	17	17	17	17

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

2. Estimates of a price elasticity of supply η_{Yp}:

$$Log(Y) = -1.77 + 0.16Log(P) + 0.93Log(X)$$

Dependent Variable: LOG(Y)
Method: Least Squares
Date: 02/07/10 Time: 17:00
Sample: 1990 2006
Included observations: 17
LOG(Y)=C(1)+C(2)*LOG(P)+C(3)*LOG(X)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-1.771891	0.412666	-4.293770	0.0007
C(2)	0.163299	0.060237	2.710915	0.0169
C(3)	0.933055	0.030369	30.72434	0.0000

R-squared	0.990588	Mean dependent var	11.59511
Adjusted R-squared	0.989244	S.D. dependent var	0.466158
S.E. of regression	0.048346	Akaike info criterion	-3.062082
Sum squared resid	0.032723	Schwarz criterion	-2.915044
Log likelihood	29.02769	Hannan-Quinn criter.	-3.047466
F-statistic	736.7657	Durbin-Watson stat	2.094649
Prob(F-statistic)	0.000000		

The regression equation is statistically significant with respect to the relationship between Y and P because the multiple correlation coefficient is 0.99 and the multiple coefficient of determination is 0.99 (the relationship is significant), and the probability of significance (0.02) is smaller than the level of significance (0.05).

3. Estimates of the elasticity of domestic demand with respect to output price η_{Bp} :

$$Log(B) = 5.93 - 0.64Log(P) + 0.51Log(Y) + 0.39Log(Y(-1))$$

Dependent Variable: LOG(B)
Method: Least Squares
Date: 02/07/10 Time: 17:03
Sample (adjusted): 1991 2006
Included observations: 16 after adjustments
LOG(B)=C(1)+C(2)*LOG(P)+C(3)*LOG(Y)+C(4)*LOG(Y(-1))

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	5.932922	1.211244	4.898206	0.0004
C(2)	-0.644083	0.193997	-3.320071	0.0061
C(3)	0.509202	0.085519	5.954259	0.0001
C(4)	0.390586	0.082358	4.742512	0.0005

R-squared	0.803998	Mean dependent var	11.43217
Adjusted R-squared	0.754997	S.D. dependent var	0.244860
S.E. of regression	0.121200	Akaike info criterion	-1.170430
Sum squared resid	0.176274	Schwarz criterion	-0.977283
Log likelihood	13.36344	Hannan-Quinn criter.	-1.160539
F-statistic	16.40791	Durbin-Watson stat	1.780478
Prob(F-statistic)	0.000152		

The regression equation is statistically significant with respect to the relationship between B and P because the multiple correlation coefficient is 0.89 and the probability of significance (0.01) is smaller than the level of significance (0.05).

4. Estimates of the elasticity of export demand with respect to output price η_{Ep} :

Dependent Variable: LOG(E)
Method: Least Squares
Date: 02/07/10 Time: 17:06
Sample (adjusted): 1994 2006
Included observations: 13 after adjustments
LOG(E)=C(1)+C(2)*LOG(P)+C(3)*LOG(Y)+C(4)*LOG(E(-1))+C(5)
*LOG(P(-1))+C(6)*LOG(Y(-1))

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-32.13010	28.22085	-1.138523	0.2924
C(2)	2.046175	2.503898	0.817196	0.4407
C(3)	1.751334	1.243019	1.408936	0.2017
C(4)	0.106893	0.365194	0.292702	0.7782
C(5)	-4.243771	2.604124	-1.629635	0.1472
C(6)	3.089639	1.129684	2.734959	0.0291

R-squared	0.803004	Mean dependent var	8.534003
Adjusted R-squared	0.662293	S.D. dependent var	1.592980
S.E. of regression	0.925721	Akaike info criterion	2.987550
Sum squared resid	5.998717	Schwarz criterion	3.248296
Log likelihood	-13.41908	Hannan-Quinn criter.	2.933955
F-statistic	5.706755	Durbin-Watson stat	2.190080
Prob(F-statistic)	0.020532		

The regression equation is statistically insignificant with respect to the relationship between E and P because the probability of significance (0.44) is greater than the level of significance (0.05).